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# UNIVERSAL CYCLOPÆDIA AND ATLAS

VOLUME XI

# UNIVERSAL CYCLOPÆDIA AND ATLAS

A NEW EDITION UNDER DIRECTION OF

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PRESIDENT OF THE UNIVERSITY OF WISCONSIN
EDITOR-IN-CHIEF

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A NEWLY REVISED AND ENLARGED EDITION

ROSSITER JOHNSON, Ph. D., LL. D.
EDITOR OF REVISION

**ILLUSTRATED WITH COLORED PLANS, PLATES, AND ENGRAVINGS**

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*VOLUME XI*

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# MAPS IN VOL. XI.

## POLITICAL.



## PHYSICAL.



## CITY.



# 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.

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

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

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

ȝ: voiced guttural (or palatal) spirant, equivalent to Mod. Greek $\gamma$, and used in transliteration of Iranian languages and O. Eng.

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

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

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

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

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

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

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

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

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

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

ṇ: in Sanskrit the cerebral nasal.

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

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

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

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

ǫ: short open *o* in Scandinavian.

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

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

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

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

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

ṣ: voiceless cerebral spirant; used in transliterating Sanskrit.

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

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

ṭ: in Sanskrit a voiceless cerebral explosive.

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*.
ă̆a...... 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*.
ă̆y or *ā̆*.. same, but less prolonged.
ã....... as *a* in *welfare*.
aw...... as *a* in *fall*, *all*.
ee...... as in *meet*, or as *i* in *machine*.
ĕe...... same, but less prolonged, as final *i* in *Arditi*.
e....... as in *men*, *pet*.
*e*....... obscure *e*, as in *Bigelow*, and final *e* in *Heine*.
ė....... as in *her*, and *eu* in French *-eur*.
i....... as in *it*, *sin*.
ī....... as in *five*, *swine*.
ī̆....... same, but less prolonged.
ō....... as in *mole*, *sober*.
ō̆....... same, but less prolonged, as in *sobriety*.
o....... as in *on*, *not*, *pot*.
oo...... as in *fool*, or as *u* in *rule*.
ŏo...... 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*.
*k*h...... as *ch* in German *nacht*, *g* in German *tag*, *ch* in Scotch *loch*, and *j* in Spanish *Badajos*, etc.
ṅ....... nasal *n*, as in French *fin*, *Bourbon*, and nasal *m*, as in French *nom*, Portuguese *Sam*.
ñ or n-y.. Spanish *ñ*, as in *cañon*, *piñon*, French and Italian *gn*, etc., as in *Boulogne*.
*l* or y.... French *l*, liquid or mouillé, as (-i)ll- in French *Baudrillart*, and (-*i*)*l* in *Chintreuil*.
th....... as in *thin*.
*th*....... as in *though*, *them*, *mother*.
*v*....... as *w* in German *zwei*, and *b* in Spanish *Cordoba*.
sh....... as in *shine*.
zh....... as *s* in pleasure, and *j* in French *jour*.

All other letters are used with their ordinary English values.

## NOTE.

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

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

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

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

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

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

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

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

# THE
# UNIVERSAL CYCLOPÆDIA.

**Sodom** [from Heb. *Sᵉdhōm*, liter., burning, conflagration; Gr. Σόδομα]: a city memorable in the earliest records of the Hebrews for its connection with Abraham and Lot, and its miraculous destruction by a storm of brimstone and fire (Gen. xix. 24, 25). The exact situation of Sodom and its allied cities, Gomorrah, Admah, Zeboim, and Bela or Zoar, in the vale of Siddim, has long been discussed, the usual conclusion having been that the "cities of the plain" occupied the present basin of the southern bay of the Dead Sea, which was formerly supposed to have been formed at the time of the destruction of those cities. Geological examinations have shown, however, that the supposition is erroneous. The sea only underwent enlargement at that time. The shallowness of the southern end is an argument for locating the cities there. The catastrophe was not volcanic, but in consequence of the ignition by lightning of the asphalt with which the land is full, which would, of course, burn up the cities. The land sank when the asphalt had been burnt out, and then the Dead Sea overflowed the sunken ground. An earthquake may have been a contributing cause. On the southwest coast of the Dead Sea is Jebel 'Usdom (hill of Sodom), a mass of mineral salt. At the south end is a tall, isolated needle of rock, resembling a woman carrying a child. This is called Lot's wife. Josephus (*Jewish War*, iv., 8, 4) says that traces of the lost five cities could be seen under the waters of the sea, and travelers have repeated the idle tale. The catastrophe itself, outside of the Bible and Josephus, is mentioned by Strabo (*Geography*, xvi., 2) and Tacitus (*History*, v., 5). Some locate the cities at the northern end of the sea, and employ a similar argument from the presence of asphalt there; and another argument is the supposed necessity of locating Zoar at the northern end, in order to justify the language of Gen. xiii. 8–12. SAMUEL MACAULEY JACKSON.

**Sodom, Sea of**: See DEAD SEA.

**Soest**, sōst, or **Sohst**: town; Westphalia, Prussia; junction of the Berlin-Düsseldorf railway. In the Middle Ages it was one of the most flourishing cities of the Hanseatic League. It is still a handsome town surrounded by substantial walls. One of the old gates, the Osthofenthor, has been restored. The town has several important schools, a fine cathedral of the fifteenth century, and does a large trade in grain and cattle. Pop. (1895) 15,407.

**Soetbeer**, ADOLPH, Ph. D., LL. D.: political economist; b. in Hamburg, Germany, Nov. 23, 1814; educated in Hamburg, Göttingen, and Berlin; syndic of the chamber of commerce at Hamburg 1840–72; became professor in Göttingen University in 1872. He was an authority on coinage. His principal published works are *Edelmetall-Produktion und Wertverhältniss zwischen Gold und Silber seit der Entdeckung Amerikas* (Gotha, 1879) and *Literaturnachweis über Geld und Münzwesen insbesondere über den Währungsstreit, 1871–91* (Berlin, 1892). D. Oct. 23, 1892.

**Sofa'la**: a Portuguese settlement on the southeastern coast of Africa, in lat. 20° 11′ S.; also an ill-defined flat coastal area from the mouth of the Zambesi to Delagoa Bay, comprising several Portuguese settlements (see map of Africa, ref. 8–G). The city of Sofala consists of a few mud huts, situated in an unhealthful salt-swamp, but the surrounding territory is very fertile. The low coast-land swarms with wild animals. Pop. about 1,300. M. W. H.

**Sof'tas** [from Turk. *softa*, from Pers. *sōkhtah*, liter., one who burns or is zealous]: persons attached to the service of the mosques. At Constantinople the term is specially applied to the whole body of the theological students who receive instruction in the colleges (medressehs) connected with the larger mosques. From them are recruited all ranks of the Mussulman clergy. Without ordination, but according to personal aptitude or length of study, each one is appointed to his special religious functions. At various times this body of students have taken a prominent part in political affairs. Thus prior to the Russo-Turkish war (1877) they caused the deposition of an incapable grand vizier and of an obnoxious sheik-ul-Islam. Their number at the capital is probably not much below 10,000. E. A. GROSVENOR.

**Sogdia'na** (in Gr. Σογδιανή): formerly a territory of Central Asia, separated N. from Scythia by the Jaxartes, S. from Bactria by the Oxus; nearly the same regions as the present Turkestan, the city of Bokhara still bearing the name of *Sogd*. It was conquered by the Persians under Cyrus, and fell after the death of Alexander the Great to Syria; it was subsequently conquered by the Turkomans.

**Sohn**, zōn, KARL FERDINAND: painter; b. in Berlin, Germany, Dec. 10, 1805; studied painting under Schadow, whom he accompanied in 1826 to Düsseldorf, in 1830 to Italy; was appointed professor in the Academy of Düsseldorf in 1838. D. in Cologne, Nov. 25, 1867. Among his most celebrated pictures are *Rinaldo and Armida* (1827); *Diana and Actæon* (1833); *The Judgment of Paris* and *Romeo and Juliet* (1836); *Tasso and the Two Leonoras* (1838).

**Sohrāb**: See RUSTAM.

**Sohst**: See SOEST.

**Soils**: See AGRICULTURAL CHEMISTRY.

**Soissons**, swaa'sōn' (anc. *Noviodunum* and *Augusta Suessionum*): fortified town; in the department of Aisne, France; on the Aisne, 65 miles by rail N. E. of Paris (see map of France, ref. 3–F). It has manufactures of cloth and hardware, and an important trade in grain. Soissons has been many times captured in war, the last time in 1870 by the Germans. Pop. (1896) 12,373.

**Sojourner Truth**: lecturer; b. in slavery in Ulster co., N. Y., about 1775; discarded the name Isabella given by her master for that of Sojourner, claiming that the Lord had bestowed it in a vision, adding the appellation Truth because that was the substance of the message she felt impelled to deliver to men; was held in bondage even after the abolition of slavery in the State, but escaped. Although illiterate, her force of character, shrewd wit, and impressive voice made her an effective speaker, and she traveled widely in the northern parts of the U. S., advocating general emancipation, women's rights, temperance, and political reforms. D. at Battle Creek, Mich., Nov. 26, 1883. See *Narrative of Sojourner Truth* (1884).

**Sokoto'**: the largest of the HAUSA STATES (*q. v.*) in the Sudan, Africa; E. of the Niger river and S. of the Sahara Desert: separated from Lake Chad by the sultanate of Bornu. It is also known as one of the Fulbe states, because the conquering Fulbe long ago imposed their rule and the faith of Mohammed upon this and other vast regions in the Sudan. It is one of the most densely populated parts of Africa. Trade and manufactures are well developed, particularly the fabrication of leather goods, cotton cloths, and weapons, but the chief industries are agriculture and cattle-raising. To Sokoto proper belong many tributary states and districts, the largest of which is Adamawa, S. of the Benue river, besides Yakubu, Saria, Kano, Muri, Katsena, and Samfara, all of which pay annual tribute to the sultan. Here the slave-trade flourishes. A small standing army, chiefly cavalry, is maintained. The capital, Sokoto, has only about 30,000 people, and is less important in population and trade than several other towns, notably KANO (*q. v.*). C. C. ADAMS.

**Solana'ceæ**: See NIGHTSHADE FAMILY.

**Solan-goose**: See GANNET.

**So'lanine** [from Lat. *sola'num*, nightshade]: a natural organic alkaloid found in the black nightshade, potato, bittersweet, and other species of *Solanum*. The alkaloids obtained from these different sources are probably not exactly the same. Solanine is a solid crystalline substance, readily soluble in alcohol. It is very poisonous, producing paralysis of the lower extremities before death, as has been seen in cattle poisoned by eating the green shoots of potatoes, which contain solanine largely. Revised by IRA REMSEN.

**Solano**: See SIMOOM.

**Sola'num** [Lat., nightshade]: a genus of herbs and shrubs of the family *Solanaceæ*, most or all of which contain the poisonous principle solanine. The U. S. has several native species, mostly southern. There are a great many tropical species, some of them of great use in local therapeutics, though none is extensively employed in the medical practice of civilized lands except perhaps the *Solanum dulcamara*, or bittersweet. Several afford edible fruits, that of the egg-plant (*S. melongena*) being the most important. See NIGHTSHADE FAMILY. Revised by CHARLES E. BESSEY.

**Solar Cycle**: See CYCLE.

**Sola'rio**, ANDREA, da (called also *Andrea Milanese*): painter; b. at Solario, near Milan, Italy, about 1460. His method of painting indicates that he was influenced by Leonardo da Vinci, but nothing positive is known as to his teaching in art. He spent the years 1490–93 in Venice with a brother, Cristoforo, surnamed Il Gobbo (the hunchback), who was an architect and sculptor. In 1495 he had completed for S. Pietro at Murano an important altarpiece of a Holy Family with St. Jerome, now at the Brera at Milan. In 1507 he was decorating with frescoes for Charles d'Amboise the chapel of Château Gaillon in Normandy. Morelli supposes that Solario visited Flanders during the two years of his stay in Normandy, as his pictures have characteristics resembling those of the Flemish school. Andrea Solario died some time after 1515 while painting for the Certosa of Pavia an *Assumption of the Virgin*, now in the sacristy there. His best-known works are an *Ecce Homo* and a *Repose in Egypt* in the Poldi-Pezzoli Gallery at Milan, dated 1515; a *Vierge au Coussin vert*; a bust-portrait of Charles d'Amboise; a *Crucifixion* dated 1503; a *Head of John Baptist in a Charger* at the Louvre; and two portraits in the National Gallery of the London, both on panel. This painter is sometimes confounded with another Andrea di Milano, called Salai or Salaino, a pupil of Leonardo. W. J. S.

**Solar Parallax** [*solar* is from Lat. *sola'ris*, belonging or pertaining to the sun, deriv. of *sol*, sun]: the difference of the directions in which the sun is seen from the surface and center of the earth. (See PARALLAX.) The problem of determining the solar parallax is identical with that of measuring the distance of the sun, and has justly been called one of the noblest in astronomy. Attempts to estimate the distance of the sun were made even by the ancient astronomers Aristarchus and Ptolemy, but they were necessarily futile, since no observations they were able to make would measure so small a quantity as the parallax of the sun. Still they thought they measured the distance, and found it to be 1,210 radii of the earth. It is remarkable that even had the sun been as near as this, its apparent size would show its real diameter to be more than five times that of the earth. As soon as accurate observations were made with the telescope, it was found that the sun had no such parallax as it would have were its distance only 1,200 radii of the earth. At the time of Newton all that was known of the solar parallax was that it must be immeasurable with the instruments then at command.

To understand the modern solution of the problem, we must see how it presented itself to astronomers after the laws of the celestial motions were established. Imagine the sun with its retinue of eight large planets, the earth being one. As the earth revolves around the sun, astronomers see other planets in various directions, and can thus determine the annual parallax of each. In this way the ratios between the different orbits admit of very exact observation, and yet more exact determination by Kepler's third law. Thus there is no difficulty in making a map of the solar system in which all the orbits shall be laid down on the same scale. Without any knowledge of the actual distance of the sun, it can be said that if the distance of the earth be represented by unity, then that of Venus will be represented by 0·72333, that of Mars by 1·52369, that of Jupiter by 5·2028, etc. It follows from this that if any one of these distances can be determined, or even the distance of Venus or Mars from the earth at any moment, all the other distances will follow, including that of the earth from the sun, just as the knowledge of a single distance on a map will give the scale of the map. It will also be readily understood that the nearer a planet comes to the earth the greater will be its parallax, and the more easily will its distance be determined. Moreover, observations on the position of a planet can be made with much more accuracy than on the sun. Thus French astronomers of the seventeenth century saw that if the apparent position of the planet Mars among the stars could be carefully observed from two distant points of the earth's surface, its parallax, and thus its distance, and the distance of the sun, could be determined. An expedition was sent for this purpose to the colony of Cayenne in South America, to make observations of the position of Mars during the opposition of 1672. Corresponding observations were made at the Paris Observatory. By a comparison of all the observations, Cassini computed the parallax of the sun to be 9·5″. The error of this result is only about one-twelfth of its entire amount, so that this may justly be regarded as the first actual determination of the solar parallax. The corresponding distance of the sun would be 21,600 radii of the earth, or about 85,000,000 miles.

In 1849 Capt. James M. Gillis, of the U. S. navy, who was afterward superintendent of the Naval Observatory, made an expedition to Chili, for the purpose of observing the parallaxes of both Venus and Mars; but the two oppositions of Mars which occurred while he was there were not favorable, the planet being too far from the earth, and in addition to this the corresponding number of observations were not made in the northern hemisphere. No satisfactory result could therefore be reached.

Attempts to determine the parallax of Mars were not made between 1672 and 1849, because it was supposed that a much more accurate parallax could be determined by observations on transits of Venus. It occurred to Halley, the English astronomer, as far back as 1677, that the time required by the planet Venus to cross the disk of the sun in transit would be different at different parts of the earth, owing to the effect of the parallax of the planet. It was necessary, however, to wait nearly a hundred years for an opportunity of making such an observation, as no transit of Venus occurred from Halley's time until 1761. Then a transit occurred, and another in 1769. Expeditions to the southern hemisphere were sent out by various European nations, and these transits were observed wherever astronomers could see them. The results, however, were found to be much less accordant than had been anticipated, and the uncertainty of the observations thus shown was so perplexing that more than half a century elapsed before the results were definitively worked up. The German astronomer Encke, from an exhaustive discussion of all the observations, reached the conclusion that the sun's parallax was 8·5776″, a result now known to be too small by about 0·20″.

It is now found that the most accurate measures of the parallax can probably be made on the small planets between Mars and Jupiter. It is true that these bodies do not come so near the earth as either Venus or Mars, and the quantity to be measured is never so large as in the case of these planets; but this defect is more than compensated by the extreme accuracy with which the measures can be made. Dr. David Gill, astronomer at the Cape of Good Hope, has brought this method into use with great success.

Modern science has shown that there are other methods of determining the sun's distance and the dimensions of the solar system besides that of actually measuring the parallaxes of the planets. One of these consists in determining the velocity of light. The phenomena of aberration show that there is a certain ratio between the velocity of light and the velocity of the earth in its orbit. This ratio is such that the velocity of light is a little more than 10,000 times that of the earth around the sun, and from this it follows that light takes about 498 seconds to pass from the sun to the earth. It follows that if it can be determined how many miles per second light travels, the distance of the sun can be at once obtained by multiplying this number by 498. This determination has actually been made with a high degree of precision. (See LIGHT.) Unfortunately, the constant of aberration has not yet been determined with corresponding exactness, owing to the inherent difficulties in the way of measuring so small a quantity, and especially owing to the fact that measures made six months apart have to be compared to determine it.

Yet a third method of determining the sun's distance is founded on the theory of gravitation. The action of the sun in changing the motion of the moon around the earth will be slightly different, according to its distance. The difference is such that an inequality of about two minutes in the motion of the moon arises from this cause; but this inequality is very difficult to determine from observation, because the measures have to be made near the first and last quarters of the moon. Owing to the different ways in which the light of the sun falls on the moon these measures are not strictly comparable with each other, and thus arises an uncertainty which has not yet been completely eliminated.

How numerous the attempts are to determine the distance of the sun in these various ways will be seen from the following *résumé*, which gives a synopsis of some of the principal independent results so far worked out.

In 1824 Encke published his celebrated works on the transits of Venus in 1761 and 1769, in which he concluded that the sun's parallax was 8·5776″.

In 1854 Hansen found from the sun's action on the moon that Encke's parallax was too small. He did not reach a definite conclusion as to the exact amount of the increase until 1863, when he computed the parallax to be 8·916″.

In 1858 Le Verrier, from observations of the sun, found that the parallax was 8·95″.

In 1862 observations of Mars were made at several of the leading observatories in both hemispheres. From a computation of some of these, Stone found a parallax of 8·943″, and from those made at Pulkowa and the Cape of Good Hope Winnecke derived 8·964″. The close agreement of these results with those of Hansen and Le Verrier led to a general belief among astronomers that the true value of the parallax was between 8·9″ and 9·0″.

In 1867 Newcomb discussed all the observations of Mars made in 1862, and combined with the result a revision of the methods of Hansen and Le Verrier. His conclusion was that in the then state of astronomy the most likely value of the parallax was 8·848″. This result was so much smaller than others that it was received with distrust, but it was nevertheless adopted in the national ephemerides of the U. S., Germany, and Great Britain. In 1877, however, Gill, of England, made his well-known expedition to Ascension island, for heliometer measures on Mars, from which he concluded that Newcomb's result was much too large, and that the true value was 8·78″. About the same time Sir George Airy announced that the British observations of the transit of Venus in 1874 gave the surprisingly small result of 8·76″; but Capt. Tupman, from a more complete discussion, afterward raised the result to 8·813″.

In 1884 Newcomb, from observations of the velocity of light, combined with Nyren's determination of the constant of aberration, reached the result 8·794″.

In 1890, he rediscussed the transits of Venus in 1761 and 1769, and found for the parallax 8·79″.

In 1891 Harkness, from a general adjustment of astronomical constants, in which the parallax from the American photographs of the transits of Venus was included, concluded that the most probable value of the parallax, from all available data, was 8·809″.

Toward the end of 1891 Auwers, from the German heliometer measures of the transits of Venus of 1874 and 1882, found 8·87″.

Recent careful examinations of the data on which these results depend reduce their discordance, and lead to the conclusion that the value of the parallax is probably between 8·780″ and 8·790″. This gives, in round numbers, 93,000,000 miles for the distance of the sun, a result which is probably correct within 100,000 miles. S. NEWCOMB.

**Solar System**: the sun and the bodies which revolve around it as their center of motion. The main features of this system are the great mass of the central body, which is between 700 and 800 times the total mass of all the bodies which revolve around it; the orderly arrangement of the principal bodies of the system, which revolve around the sun in a fairly regular progression of distances, and in nearly circular orbits; and the complete isolation of the system from all the other bodies of the universe, the nearest fixed star being about 9,000 times the distance of the farthest planet.

The bodies which compose the system may be classified as follows:

1. The great central body, the sun.
2. The four inner planets, Mercury, Venus, the Earth, and Mars.
3. A group of several hundred minor planets, or asteroids, revolving outside the orbit of Mars. It is impossible to say how many bodies there are in this group; the number known is more than 400. See ASTEROID.
4. The four outer planets, Jupiter, Saturn, Uranus, and Neptune. These, with the four planets first named, are called *major planets.*
5. Twenty-one satellites revolving around the planets, of which one belongs to the earth, two to Mars, five to Jupiter, eight to Saturn, four to Uranus, and one to Neptune.

To these may be added an unknown number of comets, which may, if we choose, be considered as belonging to the system; and numerous clouds of meteoric particles, invisible in themselves, the presence of which is made evident by their combustion when they strike the atmosphere, forming shooting stars.

Considering these bodies in the order of their masses and influence upon other bodies, the first place must, after the sun, be assigned to the eight major planets. The principal features of the orbits of these bodies are their near approach to circles, and the fact that they lie nearly in the same plane. The most eccentric of their orbits is that of Mercury; yet the eye could scarcely distinguish its deviation from a circle, though it could readily perceive that the sun was not situated in the center of the circle. It is also the planet whose orbit is most inclined to the ecliptic, the inclination being 7°. See PLANET and ORBIT, and the names of the several planets.

The principal elements of the planetary orbits are shown in the following table:

TABLE OF THE PLANETARY ELEMENTS.

| PLANET. | Apparent semi-dia. | Diameter in miles. | Mass (⊙ = 1). | Density (earth = 1). | Diurnal revolution. | Mean distance from ⊙. | | Periodic time (days). | Eccentricity. | Longitude of perihelion. | Inclination of orbit. | Longitude of node. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | h. m. s. | In astronomical units. | In millions of miles. | | | ° ′ ″ | ° ′ ″ | ° ′ ″ |
| Mercury | 3·30″ | 2,955 | $\frac{1}{6000000}$ | 1·25 | 24 5 0 | 0·387099 | 36 | 87·96926 | 0·2056048 | 75 7 14 | 7 0 7·7 | 46 33 9 |
| Venus | 8·50″ | 7,610 | $\frac{1}{408000}$ | 0·875 | 23 21 24 | 0·723332 | 67 | 224·700787 | 0·0068433 | 129 27 14 | 3 23 34·8 | 75 19 52 |
| The Earth | 8·83″ | 7,912 | $\frac{1}{330000}$ | 1·000 | 23 56 41 | 1·000000 | 93 | 365·256358 | 0·0167711 | 280 21 22 | 0 0 0·0 | |
| Mars | 4·70″ | 4,210 | $\frac{1}{3090000}$ | 0·723 | 24 37·22 6 | 1·523691 | 141 | 686·979714 | 0·0932611 | 333 17 54 | 1 51 2·3 | 48 23 53 |
| | | | | | | | | (Years.) | | | | |
| Jupiter | 18·30″ | 85,300 | $\frac{1}{1048}$ | 0·249 | 9 55 21 | 5·20280 | 480 | 11·86197 | 0·0482273 | 11 54 51 | 1 18 41·1 | 98 56 10 |
| Saturn | 8·20″ | 70,080 | $\frac{1}{3502}$ | 0·134 | 10 16 | 9·53890 | 881 | 29·45694 | 0·0560660 | 90 6 26 | 2 29 39·2 | 112 20 0 |
| Uranus | 1·80″ | 30,900 | $\frac{1}{22000}$ | 0·249 | Unknown. | 19·18338 | 1772 | 84·0205 | 0·0463592 | 170 38 49 | 0 46 20·9 | 73 14 38 |
| Neptune | 1·30″ | 34,000 | $\frac{1}{19700}$ | 0·209 | Unknown. | 30·05682 | 2770 | 164·782 | 0·0084962 | 43 17 30 | 1 47 2·0 | 130 7 33 |

S. NEWCOMB.

**Solder** [(with *l* reinserted by analogy of Lat. *solida're*) from O. Fr. *souder*, to solder < Lat. *solida're*, *solda're*, make solid, fasten, deriv. of *so'lidus*, *sol'dus*, solid]: an alloy employed to unite pieces of metal by fusion upon the proposed joint. There are many solders, each designed for some special use. Three grades of solder are in common use: common solder, of equal parts of tin and lead; fine solder, of 2 parts of tin to 1 of lead; and a cheaper article, of 2 of lead to 1 of tin. The soft solders are usually of lead and tin, or lead, tin, and bismuth; these melt at a low temperature. The hard solders can not be melted at a low temperature; they are commonly of zinc and copper.

**Sold Note**: See BOUGHT NOTE.

**Sole** [viâ O. Fr. from Lat. *so'lea* (so named from its broad flat shape), liter., slipper, whence Eng. *sole* (of a shoe or of the foot)]: a flatfish of the family *Soleidæ*. The common sole, *Solea solea*, has the scales ctenoid, the vertical fins not confluent, the pectorals of both sides developed; it is dark brown on its upper and white on its lower side, with the pectoral fin blackish at its end; it generally ranges between 10 and 20 inches in length, and between 1 and 10 lb. in weight, although the latter dimensions are rarely attained. It is found along almost the entire coast of Europe, and is one of the most esteemed of fishes; the flesh is white and firm, and is in season in all months of the year except the spawning-time, which takes place toward the end of winter. It is chiefly taken on the coasts of the British Islands by trawling. Several attempts have been made by the Fish Commission to introduce it into U. S. waters. Another species found on the British coast is the *Solea* (*Pegusa*) *aurantiaca*, or lemon-sole. *Achirus lineatus* of the Eastern U. S. is the nearest American ally of the European species, but this is more popularly known as the hog-choker, coverclip, or calico; it is a worthless fish. In California several species of true *Pleuronectidæ*—e. g. *Parophrys vetula*, *Lepidopsetta umbrosa*, *Psettichthys melanostictus*, and *Orthopsetta sordida*—are called soles. Revised by F. A. LUCAS.

**Sole'idæ** [Mod. Lat., named from *So'lea*, the typical genus. See SOLE]: a family of flatfishes (*Heterosomata*). The body is oblong or elongated, and nearly equally developed above and below the lateral line; the scales are small, or absent; the lateral line mostly straight (sometimes double or triple); the head small, and with a rounded projecting snout, and more or less hooked upper jaw; the eyes are approximated, and the upper is further forward than the lower; the opercula concealed by the scales; the mouth unsymmetrical, and rather small and curved; teeth generally confined to the blind side of the jaws, and villiform (sometimes wanting); branchial apertures restricted above; the dorsal begins on the snout, the anal under the pectoral fin; pectorals small or (in some genera) absent; ventrals small and variously developed. The vertebræ are very numerous, but unequally distributed, in the typical forms the abdominal or rib-bearing ones being only eight or nine in number, and the caudal about forty. The family is well distinguished by the physiognomy from the *Pleuronectidæ*, especially so far as the European and American species are concerned, but some Australian types lessen the distance between them. Species are most abundant in the tropics, but are found in every sea except the extreme polar ones.
Revised by F. A. LUCAS.

**Solemn League and Covenant**: See COVENANT, NATIONAL.

**Solenocon'chæ** [Mod. Lat.; Gr. σωλήν, channel, pipe + κόγχη, shell]: the *Scaphopoda*, or tooth-shells, in allusion to the tubular nature of the shell. See MOLLUSCA.

**Solenogas'tres** [Mod. Lat.; Gr. σωλήν, channel + γαστήρ, belly]: an order of shell-less molluscs, embracing a few forms from the deep seas. They are of interest to zoölogists as being very simple and primitive forms. See MOLLUSCA.

**Solenog'lypha** [Mod. Lat.; Gr. σωλήν, channel, pipe + γλύφειν, carve, cut]: a sub-order of snakes. The maxillary bones are excessively shortened, and thereby assume a vertical aspect, and are thus adapted to support the venom-fangs; the fangs (except in *Causus*) are competely tubular; the pupils of the eyes are generally erect and elliptical; the occipital region is scaly. The sub-order includes the most poisonous and dreaded snakes of America; some equally dangerous in the Old World belong to the sub-order *Proteroglypha*. By Cope four families are recognized—viz.: (1) *Crotalidæ*, including the rattlesnakes and copperheads; (2) *Viperidæ*, typified by the vipers of Europe and Africa; (3) *Causidæ*; and (4) *Atractaspididæ* of Africa.
Revised by J. S. KINGSLEY.

**Soleure**, sō'lėr' (Germ. *Solothurn*): canton of Northwestern Switzerland; area, 302 sq. miles. The surface is covered by offshoots of the Jura Mountains, which here are very rich in iron and marble. The soil is fertile, and produces more corn and wine than is demanded for home consumption. The rearing of cattle, sheep, and swine is extensively carried on. Manufactures are confined to iron goods, glassware, and watches. Pop. (1894) 89,290, of whom 74 per cent. were Roman Catholics and the rest Protestants; they all speak the German language. The chief town is Soleure (Lat. *Solodurum*); pop. (1888) 8,460.

**Solfeggio**: See SOLMIZATION.

**Solferino**, sōl-fā-ree'nō: village of Mantua, Northern Italy; celebrated for the battle in which the French, under the command-in-chief of Napoleon II., and the Sardinians, under Victor Emmanuel, utterly defeated the Austrians (June 24, 1859) (see map of Italy, ref. 3–C). It was the decisive battle of the war of Italian independence. The forces of the allies numbered about 150,000, while the Austrians brought about 170,000 into the field. After their defeat the latter retreated toward Verona and left all Lombardy open to the allies. Napoleon, not caring to attack the strong position that the Austrians held in the Quadrilateral, concluded the truce of Villafranca.

**Soli**: See CILICIA.

**Solicitor** [in form viâ O. Fr. from Lat. *sollicita'tor*, deriv. of *sollicita're*; in meaning deriv. of Eng. *solicit* (in its legal sense), from Lat. *sollicita're*, urge, entice; *sol'lus*, whole + *cie're*, *ci'tum*, move]: in Great Britain (under the present statutes), an officer of the Supreme Court of Judicature who, and who only, is entitled to sue out any writ or process, or begin, or carry on, solicit, or defend any action or other proceeding in any court, his official title being solicitor of the Supreme Court.

Formerly the term solicitor was applied only to those who conducted such business in the court of chancery, the corresponding terms in the common-law courts being ATTORNEY (*q. v.*), and in the ecclesiastical and admiralty courts PROCTOR (*q. v.*); but it was the general practice to be admitted both as solicitor and attorney. The Scotch term corresponding to solicitor is *law-agent*, and the act regulating the admission to practice the privileges, etc., of law-agents is the Law-agents' Act, 1873 (36 and 37 Vict., c. 63). The solicitor is distinct in Great Britain from the counsel or barrister (called advocate in Scotland), not only as to the work performed by him for his client, but also as to the requirements for his admission to practice and his relations to his clients. These matters are minutely regulated by statute.

The Solicitors' Act of 1843 provides that with certain exceptions no person shall be admitted as solicitor or attorney unless he has served as an articled clerk for five years to a practicing attorney or solicitor, or in case of a person having a university degree three years, or has been previously admitted to the bar, or has been ten years clerk to an attorney previous to being articled. No solicitor is allowed to have articled clerks except when practicing, nor more than two at any time; and the clerk may not engage in any other employment without the consent in writing of the solicitor and the sanction of a judge of the high court. Examinations must be passed at times and upon subjects fixed in accordance with statutes.

A solicitor, unlike a barrister, is liable to his client for negligence in the conduct of his case; and may sue his client for his remuneration, and has a general lien for his costs on his client's papers. The remuneration of solicitors in conveyancing and other noncontentious business is fixed by law with "reference to such matters as the amount of money to which the business relates, and the skill, labor, and responsibility involved on the solicitor's part." He, being an officer of the court, is subject to the summary jurisdiction of the court for professional misconduct, etc.

Solicitors can not practice as advocates in the upper courts, but may before magistrates at petty sessions and quarter sessions where there is no bar, in county courts, at arbitrations, at judges' chambers, coroners' inquests, revising barristers' courts, under-sheriffs' and secondaries' courts, and the court of bankruptcy. He must, under a considerable penalty, take out a yearly certificate authorizing him to practice. See Cordery's *Law Relating to Solicitors* (2d ed. London, 1888); Turner's *Duties of Solicitor to Client* (London, 1884); Begg on *Law Agents*. F. STURGES ALLEN.

**Sol'idus**: the later Latin name for the Roman gold coin called *aureus*. It received this name first in 296 when Diocletian reformed the currency, and it retained its full weight and purity, seventy-two being struck to the pound, as long as the empire lasted. It was adopted by the Franks, under the Merovingians and Carlovingians, but was suppressed by Pepin. Afterward a solidus of silver (*solidus argenteus*), which weighed one-twentieth of a pound, was coined. This, in later times, under the name of solidus, sol or sou, underwent a number of changes in composition and value. In 1793 the sou was abolished in France, but the name has been retained by the equivalent coin of five centimes. The *soldo*, a coin formerly struck in some parts of Italy, and generally of about the same value as a sou, is also, in name at least, an historical representative of the solidus. In the Middle Ages the solidus denoted a money of account, and was translated into the Teutonic languages by the word shilling or its equivalent. It thus survives in the abbreviation *s.* of £ *s. d.*

**Solif'ugæ** [from Lat. *sol*, sun + *fu'gere*, flee, fly]: a group of spider-like animals, in which the head is distinct from the three-jointed thorax, and the abdomen is elongate and plainly segmented. The body is usually densely haired. The first pair of appendages ends in large pincers, the second pair are leglike. These animals, which live in the warmer parts, and especially the desert portions, of both hemispheres, breathe by means of tracheæ. They have the name of being very poisonous, especially in the Old World, and are correspondingly feared. There are about sixty species, distributed among some fifteen genera, of which *Solpuga* and *Galeodes* are best known. J. S. KINGSLEY.

**Solimões**, sō-lē-mois', or **Solimoens**, sō-lē-moiñs': the Brazilian name for the middle Amazon, from the Peruvian frontier to the junction of the Rio Negro. It was originally the name of an Indian tribe. See AMAZON.

**So'lingen**: town of Rhenish Prussia; 13 miles E. of Düsseldorf; famous for its manufactures of iron and steel goods, especially sword-blades, in the Middle Ages, and still an important center for such manufactures, especially of cutlery (see map of German Empire, ref. 4–C). In the district are about 3,700 metallurgical establishments, which employ 30,000 workmen. In the town, besides the large factories, there are 2,000 small forges and shops. Pop. (1895) 40,843.
Revised by M. W. HARRINGTON.

**Soli'nus**, GAIUS JULIUS (surnamed GRAMMATICUS): historian; lived in the first half of the third century, and wrote *Collectanea Rerum Memorabilium Polyhistor*, in which he gives a brief sketch of the world as it was known to him, accompanied with historical notices and remarks on the origin, habits, religious rites, and social conditions of the various nations. The greater part is derived through an intermediate source from the *Natural History* of Pliny and Pomponius Mela, and has no independent value. In the Middle Ages the book was much read. There are editions by Salmasius (1689) and by Mommsen (Berlin, 1864), and an English translation by Golding (1587).
Revised by M. WARREN.

**Solís**, sō-lēēs', JUAN DIAZ, de: navigator; b. probably at Lebrija, Asturias, Spain, about 1470. Of his early voyages nothing definite is known, but Varnhagen considered it probable that he was on the Brazilian coast with Gonçalo Coelho in 1503. In 1506 he was associated with Vicente Yañez Pinzon in an exploration of the coasts of Honduras and part of Yucatan; and in 1508, again with Pinzon, he followed down the eastern side of South America to lat. 40° S., entering the Bay of Rio de Janeiro, and passing the Plata without exploring it. In 1512 he was appointed chief pilot of Spain, succeeding Vespucci. In this capacity he was employed to seek a southwestern passage to the East Indies, sailing from Lepe with three vessels in Oct., 1515. Entering the Plata, he explored it for some distance, but, landing on an island, was killed by the Charruas Indians; the ships then returned to Spain. The Plata was for some time called Rio de Solís, though it is probable that Solís was not its first explorer. HERBERT H. SMITH.

**Solís y Ribadeneyra**, -ee-rēē-bāā-dā-nā'i-rāā, ANTONIO, de: author; b. at Alcalá de Henares, Spain, July 18, 1610. He studied law at Salamanca, and early became known as an author of poems and dramas; these brought him the friendship of Calderon, and the protection of the Count of Oropesa, who made him his secretary; later he was chief clerk of the Secretary of State, and in 1654 was made secretary to Philip IV. In 1666 he was appointed historiographer of the Indies; soon after he took orders, and his subsequent writings are mainly on historical subjects. His fame rests principally on the *Historia de la Conquista de México* (1st ed. 1684), which is one of the Spanish prose classics, and was translated into French, Italian, and English. Aside from its literary merits it shows little profundity of research, and is disfigured by bigotry and by the long imaginary speeches of the principal characters. It is the first connected history of the conquest. D. in Madrid, Apr. 19, 1686. H. H. S.

**Solitaire**, sol-i-tãr [= Fr., liter., solitary < Lat. *solita'rius*, deriv. of *so'lus*, alone]: the *Pezophaps solitaria*, a bird related to the DODO (*q. v.*), formerly inhabiting the island of Rodriguez. François Leguat, who was one of a colony of Huguenots who settled on the island in 1691, describes the solitaire in his *Voyages et Aventures*, and gives a wood-cut representing it. Numerous remains of the solitaire have been found. It was larger than the turkey, and did not use its wings for flight. It was a slow runner and defended itself with its wings and beak. Its flesh was good to eat.

**Solmization, Solfeggio**, or **Solfaing** [*solmization* is from Fr. *solmisa'tion*; *sol* + *mi*, notes of the scale; *solfeg'gio* = Ital., deriv. of *solfa*, the scale; *sol*, sol + *fa*, fa]: in music, the art of giving to each of the seven notes of the scale its proper sound or relative pitch. The acquiring of a true intonation of the scale, first by regular gradation upward and downward, and then by skips from one degree to another, is an object of primary importance in vocal music. To facilitate this, various expedients have been devised, but chiefly the association of the several sounds with articulate utterances, such as the numeral words, *one*, *two*, *three*, etc. Many centuries ago certain syllables, void of any special meaning, but containing the several vowel-sounds, were selected for this purpose, and are in general use. See GAMUT.
Revised by DUDLEY BUCK.

**Solmo'na** (Lat. *Sulmo*): town; in the province of Aquila degl' Abruzzi, Italy; in the plain S. W. of Chieti (see map of Italy, ref. 5–F). The cathedral and the Church of the Annunziata are noteworthy. It is the birthplace of Ovid. Pop. 14,170.

**Sol'omon** [from Heb. *Shᵉlōmōh*, liter., peaceable]: the son and successor of David, King of Israel. His name was given with reference to the peace which, it was promised, should attend his reign (1 Chron. xxii. 7–10). As the recipient of Jehovah's especial promise to the eternal line of David (2 Sam. vii.) he was also named Jedidiah, beloved of Jehovah (2 Sam. xii. 24, 25). His mother was Bathsheba, who had been the wife of Uriah, his birth occurring a considerable time after David's repentance for that worst of sins, his conduct in the matter of Uriah. In 1 Chron. xxiii. 1–xxix. 22a is an account of Solomon's being made king, followed (verses 22b–25) by an account of his being made king "a second time," this second account being clearly a condensation of the narrative in 1 Kings i. Apparently the first coronation occurred at or near the close of the fortieth year of David (his last year but one), and just before the outbreak of Absalom's rebellion (1 Chron. xxvi. 31; 2 Sam. xv. 7). At all events this interpretation gives a consistent meaning to the biblical data, while the different interpretation commonly received makes them inconsistent and unintelligible.

Solomon began his reign humbly and wisely, asking God for wisdom, which was granted. In his fourth year he began his great work, "the house of the Lord," for which David had laid plans and accumulated enormous treasures. It was completed and dedicated seven years later. This was but the beginning of his achievements as a builder. Among the structures attributed to him are his own palace, "the House of the Forest of Lebanon," and his wonderful throne, together with cities, fortifications, stations for commerce, reservoirs, and aqueducts. He also engaged in husbandry and in landscape-gardening. He peacefully consolidated the kingdom which his father had conquered. He reorganized and enlarged the civil service of David. He started the hitherto pastoral or agricultural Hebrews on the new road of commerce, sending ships to "Ophir," India, and Arabia in the East from the new-built port of Ezion-geber on the eastern arm of the Red Sea, and from Jaffa and Tyre, westward to "Tarshish" in Spain. Many kings were his tributaries; untold wealth and the wonders and curiosities of many countries flowed into or through the land. Many foreigners were attracted by his splendor and wisdom, notably the Queen of Sheba, with her marvelous retinue. His harem grew to number 1,000 inmates, and thus to accord with Oriental ideas of his royal magnificence. He appears as a person of fascinating beauty and grace, impetuous, generous, sympathetic, and at first humble; of fine humor and noble intellect, a man of broad views, a far-sighted statesman, most learned in the science of the day. He was an organizer of splendid executive powers, a great builder and artist, poet, philosopher, and had from the Lord preeminently "an understanding heart to judge." Unfortunately, there is another side to the picture. From motives of state policy Solomon married the daughter of Pharaoh of Egypt and many other wives from among the princesses of his tributary kingdoms. This led to latitudinarianism in religion, to extravagance in public expenditures, to oppression and disregard of human rights. The result was that his reign was partly a failure. Before his death Edom and Syria revolted and Jeroboam raised rebellion in Northern Israel. After his death the ten tribes revolted, so that the strictly Israelite portion of his kingdom was divided, while the tributary peoples fell away from their allegiance.

Revised by W. J. BEECHER.

**Solomon ben Gabirol′** (Arab. *Abu Ayyūb Sulaimān ibn Jabirol*; Lat. *Abi-gebrol, Avicebrol, Avicebron*): Jewish philosopher and poet; b. in Cordova, Spain; lived for a time at Saragossa; d. about 1041. His chief poem is the hymn *Kether Malkuth* (Crown of Royalty), a philosophical explanation of Jewish doctrine. His chief prose work, written in Arabic, is the *Source of Life*, in which "the theories of Plotinus are developed and the will plays a part almost as it does in the system of Schopenhauer." This work was freely used by Christian writers in the Middle Ages; the discovery of the identity of the author with Gabirol was made by Munk. Gabirol also wrote a work on ethics. See Steinschneider, *Hebr. Uebersetz. im Mittelal.* (vol. i., § 219); Stössel, *Sol. ben Gabirol als Philosoph* (Leipzig, 1881); Dukes, *Solomon ben Gabirol* (Hanover, 1860); Guttmann, *Die Phil. des Ibn Gabirol* (Göttingen, 1889).

RICHARD GOTTHEIL.

**Solomon ben Isaac**: See RASHI.

**Solomon** (Germ. *Salomon*) **Islands**: an extensive archipelago E. of New Guinea, from which it is separated by the Bismarck Archipelago and Louisiade islands. It extends in a line S. E. and N. W. from about lat. 4° S., lon. 154° E., to lat. 12° S., lon. 162° E., and consists of seven large islands and very many small ones. The islands forming the northern half of the archipelago were taken under German protection in 1886. The largest of these are Bougainville (pop. 10,000), Choiseul (5,850), and Isabel (5,840). The total area of the German Solomon islands is 8,708 sq. miles, with a pop. of 89,000. The remainder of the archipelago has an area of 8,357 sq. miles and a population of 87,000. It was brought within the British protectorate in June, 1893. The inhabitants are Papuan and Polynesian, the latter living especially on the smaller islands, where the population is often very dense. They are intelligent, quick, and crafty, but make good servants, and are in demand on the Bismarck Archipelago as laborers. They are cannibals; their weapons consist of the bow and arrow, spear, and club, which are all characterized by fine finish. Their canoes are the finest in the Pacific. The islands are essentially volcanic, but are surrounded by coral reefs. They were discovered in the sixteenth century, but were lost sight of until 1767, when they were rediscovered by Carteret. They are still the least-known group of the Pacific. See *Voyages* of Dalrymple, Hawkesworth, Fleurien, Labillardière, Dumont d'Urville, Brenchley, and Wood; Wallace, *Australasia*; and Woodford, *A Naturalist among the Headhunters* (1890).

MARK W. HARRINGTON.

**Solomon, Song of**: See CANTICLE.

**Solomon's-seal**: any one of the liliaceous herbs of the genera *Polygonatum*, *Vagnera*, and *Unifolium*. They are found in Europe and North America. The roots are popularly esteemed as a vulnerary, and have some use in domestic medicine. The name properly belongs only to the species of *Polygonatum*; the "seal" is the circular depressed scar left on the root-stock by the death and separation annually of the flowering stem. The common Solomon's-seal, *Polygonatum multiflorum*, is found in woods and copses in many parts of England, and also in a few places in Scotland. It has a stem about 2 feet high, the upper part of which bears a number of large, ovate-elliptical, alternate leaves in two rows. The flower-stalks are generally unbranched; the flowers, which are not large, are white and drooping.

Revised by CHARLES E. BESSEY.

**Solomon's Temple**: See JERUSALEM.

**Solomon, Wisdom of**: See WISDOM, BOOK OF.

**So′lon**: statesman, sage, and poet; the son of Execestides; filled the office of first archon in Athens (Ol. 46, 3; B. C. 594), and in that capacity established there the constitution framed by him. He is the noblest representative of the many-sidedness which distinguished the Athenian more than all other Hellenes. An Eupatrid by birth, he engaged also in trade and commerce by sea. By this means it was possible for him, after finishing all exercises, as well in music and poetry as in gymnastics, to become acquainted with the entire coast of the Archipelago. It was a time of fermentation in society: Psammetichus had opened the Nile region to the Greeks (B. C. 666); the first money had been coined in Ægina; navigation took all at once a gigantic stride forward; young adventurers gained in a few years great riches, and those parts of the communities engaged in trade took form as a new middle class, and stood defiantly opposed to the ancient families; property in land was outstripped by movable capital; around Athens on all sides—in Argos, Corinth, Sicyon, Megara—the old system of things had been broken, the ruling families had been overthrown, and through the downfall of the constitutions single tyrants had come to power, who shone by their riches, employed mercenary troops, and pursued a narrow policy of self-aggrandizement. In this revolutionary time, spite of all splendor, the best possessions of the nation were endangered—namely, the free citizen class and the sovereign authority of the law. For this reason Solon deemed it the work of his life to give his native city the benefit of all progress in culture which the times offered, without causing her to break with the past and be exposed to the deplorable evils connected with a revolution. A written criminal code, such as Dracon had issued (B. C. 621), was not able to supply the want; a thorough, peaceful reform of the state was needed, which should reconcile the differences which tore the communities asunder. For a moral and political renovation of the state was needed more than all else a vigorous self-consciousness. The Athenians, however, were feeling depressed; Megara held possession of Salamis, and was consequently mistress of the sea: the Athenians were like captives in their own land, and in deep despondency had renounced their own islands on the coast. Inflamed by Solon's inspiring poetry, they conquered Salamis (about 604). This was a turning-point for the history of Greece. From that day Megara sank, and Athens rose resistlessly to power.

Solon was the first man in Athens; he was at liberty to secure for himself absolute power for life, but it was his firm resolve to accomplish his purpose without any violation of law. As recognized mediator between all parties, and solely by the force of his genius, his impressive words, and his pure personality, he carried out the most important reforms, applying them to the evils of society at the very root. The radical evil was that the small landowners were hopelessly in debt. Owing to a hard debtor-law, they forfeited even their freedom; a wretched proletariat was thus formed, and the land fell more and more into the hands of the great capitalists. Solon caused Athens to alter its standard of coinage (probably after the example of Corinth) by adopting also for silver the Eubœan gold standard. The result was a lighter drachma, in which debts could be legally paid, so that the poor obtained a relief of 27 per cent. Other measures of alleviation were also introduced: the debtor-laws were made milder, and fixed limits set to the acquisition of large estates; and the surprisingly great success of this legislation (Seisachtheia) in lightening the burdens of the people is most plainly attested by the glorious poem of Solon, in which he calls Mother Earth to witness that she has been happily freed from the burden of many pawn-pillars (which were set up in the ground as tokens of alienated lands). Then followed the great political reform —the conversion of the state, ruled by families, into a timocracy. It seemed to the noble families only a new guaranty of their privileges that none could hold office as archons except the members of the first class, the Pentakosiomedimni (with a minimum of 500 bush. of barley net income, corresponding to a taxable capital of 6,000 drachmæ or one talent), while the citizens of the second class, the knights, with 300, and those of the third (Zeugitæ), with 150 medimni as minimum of each year's income, had access to the council and to the remaining offices. The mass of the people, the Thetes, who did not belong to the three classes, could not become members of the council nor fill any office, but took part in the public assemblies. No one, therefore, was excluded from public life, and even the meanest helped frame the laws which he had to obey. The prerogatives of the first class were also no longer dependent upon birth, but could be forfeited by a careless domestic economy, and won by others through industry. The love for agriculture was encouraged, the worth of landed property was increased, and even commoners could take full share in the management of public affairs if they reached that degree of prosperity which seemed necessary for the attainment of culture and independent leisure. In law, the important reform was carried through that the archons could no longer render final decision in suits, but that appeal to the commonwealth could be made in every case. The statutes by which the sacred, public, and private law was administered were inscribed on wooden frames with three or four sides, and brought to the notice of all. On private life also the laws took a firm hold: they emancipated the citizen from the family; they gave to the head of every household the free disposal of his acquired property; they allowed the claims of aged parents on their children for maintenance only on the condition that they had given them a careful education; they checked the luxurious adornment of tombs and extravagant display in the dirges for the dead.

In all his reforms Solon's purpose was to purify the public morals, banish all barbarous influences, and bring to perfection whatever was peculiarly Hellenic. He united religion, state, and house in a harmonious whole; every citizen was made responsible for the commonwealth, and on the other hand the prosperity of the state was based upon the stability of the family. The legislation of Solon is the greatest work of art which political wisdom has produced, the clarified expression of the Athenian consciousness—a work based upon the needs of the times, inasmuch as Solon gave a place in his laws to whatever of good had struggled to the light in the time of the tyrants, while he avoided violence and lawlessness like theirs. It is true that Solon's external success was slight, and he himself was to live to see a tyranny in Athens, but his laws remained in force; they protected the city like a palladium, and up to the latest times the Athenians found their better self in Solon's laws.

After the decisive year of office, during which he ruled Athens with dictatorial power, Solon is said to have traveled ten years in foreign countries. Solon lived retired in Athens until his death (about Ol. 55, 2; 559 B. C.), surrounded by a narrow circle, of whom Mnesiphilus, the teacher of Themistocles, was one. ERNST CURTIUS.

Revised by J. R. S. STERRETT.

**Solor′**: an island of the Malayan Archipelago, off the eastern extremity of Flores, in lat. 8° 47′ S., lon. 123° 8′ E. Area, 105 sq. miles. Pop. 15,000, mostly engaged in fishing and trading. Sulphur and edible birds' nests are the principal articles of exportation. The inhabitants are Malays, partly Mohammedans, partly Christians. The name is also applied to the small archipelago to which this island belongs. It contains two other larger islands—Adenara and Lomblem. Area of the group about 1,250 sq. miles. Pop. variously estimated at from 40,000 to 180,000.

Revised by M. W. HARRINGTON.

**Solothurn**: Swiss canton. See SOLEURE.

**Solo′viev**, SERGEĬ MIKHAĬLOVICH: historian; b. in Moscow, Russia, May 5, 1820; d. Oct. 4, 1879. During his life he was connected with the University of Moscow, where he studied, taught, and in 1871 was made rector, but resigned in 1877, owing to difficulties with the authorities. His writings are numerous; his *History of the Relations between the Russian Princes of the House of Rurik* (1847) laid down the principles of the modern school of historians just coming in from Germany; his *Historical Letters* (1858), his *History of the Fall of Poland* (1863), his *Schoolbook of Russian History* (7th ed. 1879), and others are of value, but his great work was his *History of Russia*, begun in 1851. He lived to complete twenty-nine volumes, carrying it down to the year 1774. It is a mine of information, clear and impartial, but unsuited for popular use. A. C. COOLIDGE.

**Solstice** [viâ O. Fr. from Lat. *solsti′tium*; *sol*, sun + *-stitium*, a standing, deriv. of *sta′re*, *sta′tum*, stand, stand still]: The inclination of the earth's equator to the ecliptic or plane of its annual motion about the sun is the cause that the latter is during half the year on the northern polar side of the equator, the other half on the southern, causing the vicissitudes of summer and winter to the respective hemispheres. The distance from the sun N. or S. of the equator (see DECLINATION) is thus constantly varying. The two points at which this apparent northern or southern motion ceases (or at which its progressive increase of declination appears to be arrested) are the summer and winter solstices. At these periods the day is the longest or shortest, according as the earth is in the summer (June 21) or winter (Dec. 21) solstice. See EQUINOX.

**Solution** [from Lat. *sol′vere*, *solu′tum*, loose, set free, dissolve, and *solu′bilis*, dissolvable]: the liquid product formed when a solid, a liquid, or a gas dissolves in a liquid. Thus when water is poured upon salt or sugar the solid substance disappears as such and passes into the liquid form. Any liquid which has the power to dissolve a substance is called a solvent, and the substance is said to be soluble in the liquid. Water is used as a solvent much more commonly than any other liquid, both because it is a common substance and because it dissolves many things. Alcohol is also much used, especially in the preparation of solutions for medicinal purposes. The so-called tinctures are such alcoholic solutions of constituents of plants which have value as remedies. Besides water and alcohol many other liquids, perhaps all liquids, have the power to dissolve other things, and some of them find employment for this purpose.

Liquids not only dissolve solids, but other liquids and also gases. Some liquids mix with one another, or, in other words, they dissolve one in the other. This is true, for example, of water and alcohol, which dissolve in all proportions. Other liquids, however, act differently. Thus water, as is well known, does not dissolve oily liquids. Ether and benzene, on the other hand, do dissolve oils. Some gases dissolve in water to a very remarkable extent. Thus water at about freezing temperature has the power to dissolve 1,000 times its own bulk of the gas ammonia. Water also dissolves carbonic acid gas, and all natural waters contain some of this gas in solution. These waters also contain ordinary air in solution. When a liquid is placed in a closed vessel, and gas forced into it by means of a pump, it dissolves more and more gas as the pressure increases, and when the pressure is removed—that is, when the vessel is opened—the gas passes rapidly out of solution, giving rise to the phenomenon known as effervescence. This is most commonly seen in the case of soda-water, which is a solution of carbonic acid gas in water under pressure. When the water is drawn out into the air the gas escapes.

In a solution, whether of a solid, a liquid, or a gas, the dissolved substance is uniformly distributed—that is to say, there is as much of it in one drop of the solution as there is in any other drop. A drop of a concentrated solution of the dye magenta brought into many gallons of water imparts a distinct color to all parts of the liquid. An experiment of this kind gives some idea of the extent to which the division of matter can be carried, for it is evident that in each drop of the dilute solution there must be contained some of the dye, though the quantity must be minute beyond our powers of imagination. While there seems to be no limit to the extent to which a solution can be diluted, and still retain the dissolved substance uniformly distributed through its mass, there is a limit to the amount of every substance that can be brought into solution in any given solvent. Some substances are easily soluble; others are difficultly soluble.

Little is positively known in regard to the nature of solution. There are facts that indicate that the particles of the solvent form unstable compounds with the particles of the dissolved substance. In some cases, further, it appears that the act of solution involves a complete breaking down of the dissolved substance. The subject is being actively investigated. Consult *Solutions*, by W. Ostwald, translated by M. M. P. Muir, 1891. IRA REMSEN.

**Solway Firth**: an inlet of the Irish Sea, 33 miles long, from 2½ to 20 miles broad; it separates Cumberland from the south of Scotland. It is noted for the swiftness and strength of its ebb and flow, the spring tide rushing in with a wave from 3 to 6 feet high, and with a speed of from 8 to 10 miles an hour. It receives the Esk, the Derwent, and several minor streams.

**Solyman**: same as SULEIMAN (*q. v.*).

**Soma′li Coast**: an ill-defined area occupying the eastern horn of Africa, and extending along the Gulf of Aden and the Indian Ocean from Zeila, in lat. 11° 18′ N., to the mouth of the Jub, in lat. 0° 14′ N.; claimed by the British (along the Gulf of Aden) and the Italians (along the Indian Ocean S. to British East Africa); area of the former part about

75,000 sq. miles. By an arrangement of the British and Italian governments in 1894 the limits of their protectorates were strictly defined. It is mountainous, rich in myrrh and incense, and inhabited by tribes related to the Abyssinians and Gallas, mostly nomads and ill famed on account of their savage and predatory habits. The principal port is Berbera, in lat. 10° 22′ N. It has an excellent harbor. During the hot season it is deserted, but in winter comprises a population of about 30,000 people, who gather to exchange the products of their industry. See James, *The Unknown Horn of Africa* (2d ed. 1890). Revised by M. W. HARRINGTON.

**Somatol′ogy** [Gr. σῶμα, σώματος, body + λόγος, discourse, reason]: the science of living organized bodies as far as relates to material conformation and not to psychological phenomena. Thus it is included within biology. In a limited sense it is applied to the science of the human body, when it is equivalent to human anatomy and physiology. The name somatology has also been given to the study of inorganic bodies, in which case it does not differ much in signification from physics. See ANTHROPOLOGY.

**Sombrere′te**: town of the state of Zacatecas, Mexico; 100 miles N. W. of Zacatecas (see map of Mexico, ref. 5–F); 8,432 feet above the sea. It is noted for its silver mines. The celebrated "black vein" of Sombrerete was formerly said to yield the richest ore in the world. The town had a mint in 1810–12. Pop. about 9,000. H. H. S.

**Somers**, JOHN, Lord: statesman; b. at Worcester, England, Mar. 4, 1651; educated at Trinity College, Oxford; studied law at the Middle Temple; called to the bar 1676, but remained at Oxford, engaged in classical, historical, and juridical studies; translated from classic authors and wrote pamphlets in vindication of the exclusion of the Duke of York from the succession and in defense of grand juries (1681); began legal practice at London 1682; soon became a leader of the Whigs; one of the counsel for the seven bishops 1688; sat as member for Worcester in the Convention Parliament Jan., 1689; was chairman of the committee which drew up the Declaration of Right; was made successively Solicitor-General, Attorney-General, Lord Keeper of the Great Seal, and in 1697 was appointed Lord Chancellor and raised to the peerage. His fidelity to William III. exposed him to frequent attacks, one of which resulted in his removal from the chancellorship Apr. 17, 1700, and another caused his arraignment for trial before the House of Lords with a view to impeachment on fourteen very miscellaneous charges Apr. 1, 1701, but the prosecution was withdrawn June 17, 1701. He recovered his influence at court; was chosen president of the Royal Society 1702; drew up the plan for the union of the crowns of England and Scotland 1706; became president of the council Nov., 1708, and resigned 1710. D. in London, Apr. 26, 1716. A valuable collection of state papers, known as the *Somers Tracts*, was edited from originals in his library (16 vols. 4to, 1748–52). A new edition of the *Tracts* was issued by Sir Walter Scott (London, 13 vols. 4to, 1809–15). His *Life* was written by R. Cooksey (1791). Revised by F. M. COLBY.

**Som′erset**: city; capital of Pulaski co., Ky.; on the Cin., N. O. and Tex. Pac. Railway; 6 miles N. of the Cumberland river and 79 S. of Lexington (for location, see map of Kentucky, ref. 4–H). It is in a grain, fruit, and vegetable growing region, near extensive mines of coal and iron, and contains 12 churches, 2 high schools, a national bank with capital of $100,000, a banking company with capital of $80,000, and 2 weekly newspapers. Pop. (1880) 805; (1890) 2,625; (1900) 3,384. EDITOR OF "REPORTER."

**Somerset**: village; Perry co., O.; on the Balt. and Ohio Railroad; 20 miles S. W. of Zanesville, and 24 S. by E. of Newark (for location, see map of Ohio, ref. 6–G). It is in a region abounding in coal, iron ore, and potter's clay, and contains flour-mills, planing-mills, woolen-mills, carriage-factories, a State bank with capital of $15,000, and a weekly newspaper. Pop. (1880) 1,207; (1890) 1,127; (1900) 1,124.

**Somerset**: borough; capital of Somerset co., Pa.; on the Baltimore and Ohio Railroad; 36 miles N. N. W. of Cumberland, Md.; 110 miles E. S. E. of Pittsburg (for location, see map of Pennsylvania, ref. 6–C). It is principally engaged in the lumber-trade and in the manufacture of maple-sugar, butter, and cheese, and contains a public high school, 2 national banks with combined capital of $100,000, and 4 weekly newspapers. Pop. (1890) 1,713; (1900) 1,834.

**Somerset**, EDWARD SEYMOUR, Duke of: b. about 1500; brother of Jane Seymour, third queen of Henry VIII. and mother of Edward VI. After the death of Henry he rose to the head of affairs; was created Duke of Somerset and earl-marshal of England in Feb., 1547, and in March was made lord protector and governor of the realm, becoming king in all but name. When the Scots opposed the marriage of Mary Stuart to Edward VI., Somerset invaded their country and defeated them in the battle of Pinkie. This drove them to form an alliance with France, and war followed between that country and England, resulting in the latter's loss of Boulogne. His arrogance and rashness provoked opposition, and among his political adversaries was his own brother, Sir Thomas Seymour, who was apprehended and executed by his orders Mar., 1549. This brought the protector into great odium, and in Oct., 1549, he was deprived by the young king of his protectorship and thrown into the Tower, but was released with a full pardon in a few months. Among his foremost rivals was the Earl of Warwick, afterward Duke of Northumberland. Somerset entered into a plot against his life; was again arrested, found guilty of felony and constructive treason, and was beheaded on Tower Hill, Jan. 22, 1552.

**Somerset**, FITZROY JAMES HENRY: See RAGLAN.

**Somerset**, ROBERT CARR, Earl of: See OVERBURY, SIR THOMAS.

**Som′ersetshire**: county of Southwestern England; bounded on the N. and W. by the Bristol Channel; area, 1,630 sq. miles. The surface is much diversified by ranges of low, rocky hills; the Mendip Hills in the N. and the Quantock Hills in the W. Coal and freestone are mined, and iron and lead in small quantities. Large tracts of meadow and marshes afford excellent pasturage. The cheese known as Cheddar and cider are largely produced. Good wheat is raised around Bridgewater. Dairy-farming is one of the principal occupations; leather, glass, paper, and iron goods are manufactured. Pop. (1901) 385,059.

**Somers's Islands**: See BERMUDA ISLANDS.

**Som′ervile**, WILLIAM: poet; b. at Edston, Yorkshire, England, in 1677; entered Westminster School in 1690; became a fellow of Oriel College, Oxford, and in 1704 succeeded to his patrimonial estate, where he lived like a jovial country squire, dividing his time between his hounds, his books, and his bottle. His poems are *The Two Springs, a Fable* (1725); *Occasional Poems, Translations*, etc. (1727); *The Chace*, his best production, a didactic blank verse poem in four books on the art of hunting (1735); *Hobbinol, or the Rural Games*, a burlesque in blank verse (1740); and *Field Sports* (1742). D. July 19, 1742. Revised by H. A. BEERS.

**Som′erville**: city; Middlesex co., Mass.; on the Mystic river, and the Boston and Maine and the Fitchburg railways; joining Boston on the N. W. (for location, see map of Massachusetts, ref. 2–H). It was formerly a part of the town of Charlestown, from which it was set off in 1842, and is a residential city whose inhabitants are largely engaged in business in Boston. It is connected with Boston by seven lines of electric and five of steam railway, contains 31 churches, 24 public-school buildings, valued at $790,000, a public library, hospital, old women's home, insane asylum, 3 public parks, a national bank with capital of $100,000, a savings-bank, and 2 weekly newspapers. The U. S. census returns of 1890 showed 387 manufacturing establishments (representing 58 industries), with a combined capital of $3,788,018, employing 3,126 persons, paying $1,716,496 for wages and $4,369,064 for materials, and turning out products valued at $7,324,082. The city was settled in 1629 and incorporated as a city in 1872. It is built on seven hills. The first vessel built in the State was launched from Gov. Winthrop's Ten Hill farm on the Mystic river in 1631; a powder-house erected on Quarry Hill about 1703 is carefully preserved and is now in the center of a public park; the strongest fortifications in the vicinity were built on Winter Hill during the siege of Boston; Gen. Putnam's "impregnable fortress" was on Cobble Hill; and the "citadel," where Washington raised the first colonial union flag, Jan. 1, 1776, was on Prospect Hill. Pop. (1880) 24,933; (1890) 40,152; (1900) 61,643. JOHN S. HAYES.

**Somerville**: borough; capital of Somerset co., N. J.; on the Raritan river, and the Central Railroad of N. J.; 11 miles W. N. W. of New Brunswick, and 36 miles W. S. W. of New York (for location, see map of New Jersey, ref. 3–C). It has gas and electric-light plants, sewers, water-works, 7 churches, graded public school with 16 teachers, a Baptist classical school, 3 primary schools, public library (founded in 1871), 2 national banks with combined capital of $142,340, a savings-bank, and a monthly and 3 weekly periodicals. The borough was founded about 1665, and was known as Raritan till 1809. During the Revolutionary war the American army was encamped in the immediate neighborhood of Somerville for a long time. Pop. (1880) 3,105; (1890) 3,861; (1900) 4,843.

D. N. MESSLER, "SOMERSET DEMOCRAT."

**Somerville**, MARY: scientific writer; b. at Jedburgh, Scotland, Dec. 26, 1780; daughter of Admiral Sir William Fairfax. In 1805 she married Samuel Greig; in 1808 was left a widow with two sons and an independent fortune; went through a course of pure and applied mathematics. In 1812 she married her cousin, William Somerville, who aided her in her studies. In 1830 her *Mechanism of the Heavens* was published. The preparation of this work, an attempt to bring the *Mécanique céleste* of Laplace within the reach of a larger range of students, was undertaken at the solicitation of Lord Brougham. In 1834 she published *Connexion of the Physical Sciences*; in 1849, *Physical Geography*; in 1869, *Microscopical and Molecular Science*. She was elected a fellow of the Royal Astronomical Society in 1832, and afterward a member of several other British and foreign scientific societies. D. in Naples, Nov. 29, 1872. An autobiography edited by her daughter appeared in 1873.

**Somme**, sŭm: a river of France. It rises in the department of Aisne, passes by St.-Quentin, Ham, Amiens, and Abbeville, and falls into the English Channel after a course of 152 miles. It is navigable to Amiens, and is connected with the Seine, Oise, and Scheldt by canals.

**Somme**: department of Northern France; bordering on the English Channel, on both sides of the river Somme; area, 2,379 sq. miles. The surface is flat, but the soil very fertile, and large crops of corn, hemp, hops, and fruit are raised. Cattle-breeding is extensively carried on, and the manufactures of velvet, silk, cotton goods, soap, chemicals, beetroot-sugar, paper, and linen are very important. It is traversed by the Northern Railway and the railway from Amiens to Boulogne. Pop. (1896) 543,279.

**Somnam'bulism** [Lat. *som'nus*, sleep + *ambula're*, walk]: a peculiar perversion of the mental functions during sleep, in which the subject becomes an automaton. The organs of sense remain torpid and the intellectual powers are blunted. During this condition some instinctive excitation may take place, and there may be the production of impulses, in consequence, of different kinds. One individual may walk along the ledge of the roof of a house, and another may jump into a river, or a third may commit homicide. The condition is very much less common than is supposed, although imperfect examples are seen in persons who walk at night in sleep. A slight stimulation of the organs of sense is sufficient to restore the person. Cases have been described where hysteria takes this form. Somnambulism may sometimes be induced by hypnotism, the patient walking about unconscious; but many such cases are fraudulent. See HYPNOTISM. WILLIAM PEPPER.

**Somnath'**: ancient and decayed town of the peninsula of Guzerat, India; in lat. 20° 53' N., lon. 70° 24' E.; contains a famous temple, now in ruins, but at one time one of the richest and most venerated places of Hindu worship (see map of S. India, ref. 2–B). Mahmud of Ghazni sacked the temple in 1024, and carried away its magnificent gates, celebrated as much for their exquisite workmanship as for the costliness of their materials. In 1842 some gates, said to be those of the temple at Somnath, were brought from Afghanistan by the British, but, to avoid exciting jealousy between the two great religious bodies of the Hindus, they were placed in the arsenal of Agra. Pop. about 6,600.

**Sona'ta** [= Ital. (sc. *cosa*, thing), liter., something sounded or played on an instrument, fem. perf. partic. of *sonare*, sound]: originally, in the latter part of the sixteenth century, any kind of composition for instruments, in contradistinction to vocal compositions, which were called *cantata*. Subsequently, especially after the time of Bach, the name was applied principally to compositions for solo instruments and of a certain form, consisting of several movements—first, three, the *allegro*, *adagio*, and *rondo*—to which afterward a fourth was added by Haydn, the *minuetto* or *scherzo*, which differed from each other in time and sentiment, but were held together by the general character pervading all. This form of composition was greatly developed by Haydn and Mozart, and culminated in Beethoven.

**Song-books** (Fr. *chansonnier*; Ital. *canzoniere*; Span. *cancionero*; Portug. *cancioneiro*): the manuscripts in which has come down to us the greater part of the lyric poetry of the Middle Ages in all the chief countries of Europe. As mediæval poets wrote for immediate delivery, either by themselves or by professional singers (*jongleurs*, etc.), their productions were easily scattered or even entirely lost. At first, perhaps, the song-books were merely single sheets containing isolated songs, put together for the sake of convenience; but later it grew to be the fashion for rich patrons of poetry to have collections of lyrics made for their own use. These were of the nature of anthologies, and successive generations of scribes constantly varied the contents of the older books in preparing the new. As poets and poems grew obsolete, their names and places were usurped by new ones. Hence only a small part of the work of any single mediæval lyric poet is extant. The collections that have come down to us, however, are very precious. They often contain the music to which the poems were sung, and are adorned with elaborate miniatures and other decorations.

The number of mediæval song-books in various languages in the libraries of Europe is very great. Those containing Provençal lyrics are enumerated by K. Bartsch, *Grundriss zur Geschichte der provenzalischen Literatur* (Elberfeld, 1872). The French *chansonniers* have been studied by G. Raynaud, *Bibliographie des chansonniers français des XIII^e et XIV^e siècles* (2 vols., 1884), and by J. Brakelmann, *Die 23 altfrz. Chansonniers in den Bibliotheken Frankreichs, Italien und der Schweiz* (in Herrig's *Archiv*, vol. xlii.). The most famous collection of early Italian lyrics is the *Cod. Vat.* 3,793, published by A. d'Ancona and D. Comparetti (5 vols., Bologna, 1875–88), though this has to be supplemented by several others in various libraries in Italy. For the early lyric poets of the Spanish Peninsula, who wrote in the Portuguese-Galician tongue, there are the magnificent *Cod. Vat.* 4,803 (known as the *Cancioneiro da Vaticana*) and several others. The Spanish lyrics of the fourteenth and fifteenth centuries are collected in a whole series of *Cancioneros*, of which the first is the so-called *Cancionero de Baeña*, made about 1450; and the most extensive is the *Cancionero General* of Fernando del Castillo, first printed at Valencia in 1511. Of all mediæval song-books, perhaps the most famous is the great German collection variously known as the Manessian (though with no good reason), the Paris, and the younger Heidelberg manuscript. This splendid volume became known to scholars in the sixteenth century, when it was in the possession of a certain Freiherr Hans Philipp von Hohensax, of Forstech, in the Rheinthal. Later it was at Heidelberg, but after the sack of this place in 1622 it made its way mysteriously into the royal library in Paris. Here it remained till 1889, when the Heidelberg Library obtained it at a valuation, it is said, of $100,000—probably the highest price ever given for a manuscript or book. In England there were many song-books, but not of distinguished character. A. R. MARSH.

**Songkoi**, or **Songtao** [*song* is Annamite for river]: the largest river of Eastern Indo-China and a trade-route of large potential importance. It rises in the mountains of Northern Yunnan, China, flows S. E. and empties into the Gulf of Tonquin after a course of about 750 miles, half of which is in Yunnan and half in Tonquin. The most important affluent is the Songbo, which rises near the source of the Songkoi, parallels its course, and enters the latter on the left hand, not far above Hanoi. Just below its mouth begins an enormous delta, which is increased in size by lateral communications of the Songkoi with the Songkan, the next river to the N. The lower river is subject to floods in the spring and early summer, when the water sometimes rises 15 or 20 feet in twenty-four hours, and much of the lower stream is diked. The waters during the inundations are reddened by the soil, whence the French name of the river (*Rouge*). In 1890 a steamer drawing 28 inches ascended the river to Laokai at the Chinese boundary in sixty hours from Hanoi. The stream has always been an important native trade-route. MARK W. HARRINGTON.

**Song of Birds**: the musical notes uttered by many birds, especially by oscine passerines, although others, as of the snipe family even, like the woodcock and Bartram's sandpiper, have a pleasing combination of notes. Nearly all birds, in fact, utter some kind of a cry, but in the majority it can scarcely be called a song. In man and other mammals sounds are produced in the larynx, but in birds musical sounds are produced in an enlargement of the windpipe, termed the syrinx, just above the forks of the bronchi. To the syrinx are attached the singing muscles, numbering in the oscines from four to six or even eight pairs. The apparatus is simple, and its modifications are comparatively slight. There is no reason to suppose that the tongue takes any, at least any important, part in the production of sounds even in birds which pronounce words. Song is almost exclusively an attribute of male birds, although the female may sing, as does the cardinal of the U. S., and it is heard most often during the time of pairing, so that springtime is pre-eminently the season of song; still some birds sing pretty much throughout the year, and even, like the Carolina wren, in winter. The bobolink, on the other hand, changes his manners with his coat, and sings only in full-dress plumage. Early morning is the favorite hour for song, next to that the sunset-hour, but some birds, like the scarlet tanager, sing during the torrid heat of a southern noonday, and many songsters besides the nightingale sing at night, notably the mocking-bird and yellow-breasted chat of the U. S. The gay-plumaged birds of the tropics belong largely to the harsh-voiced *Clamatores*, but a bright coat is not a sure sign of a discordant voice, for the majority of that strictly American family the tanagers inhabit the tropics, and sing as well as the familiar scarlet tanager of more northern climes. Not only do individuals of a given species vary considerably in their power of song, but certain localities seem to develop musical talent better than others. The meadow-lark sings better in Florida than in the northern parts of the U. S., while the western sub-species excels that of the east. F. A. LUCAS.

**Song of Solomon**: See CANTICLE.

**Songs** [O. Eng. *song*, *sang* : Germ. *sang* : Goth. *saggws*; cf. Gr. ὀμφή, tuneful voice, oracle < Indo-Eur. *songh-*]: from the literary standpoint, short lyric or dramatic poems suitable for setting to vocal music; from the musical standpoint, compositions of relative simplicity of form which carefully illustrate and enhance the sentiment expressed by the words. In the modern sense this form may be flexible as to development. The word *song* represents an indefinite quantity, in that its characteristics may range through a large scope as to musical value. There are short songs which may be compared to gems, in miniature, by the great painters. There are also the folk-songs of various countries (the *canti popolari* of the Italians), full of national characteristics, and immortal in their simplicity. Lastly, there are myriads of songs whose existence, both as to music and text, is fortunately but for a day. DUDLEY BUCK.

**Songtao**: See SONGKOI.

**Sonnet** [either directly or viâ Fr. *sonnet* from Ital. *sonetto*, which in its turn probably came from the Prov. and O. Fr. *sonet*, a diminutive derived from the Lat. *sonus*, a sound or air in music]: a poetical form which, as finally perfected by the Italian poets of the thirteenth and fourteenth centuries, consists of fourteen hendecasyllabic verses (corresponding to English decasyllables), arranged according to a rigid scheme. The main features of this are the division of the whole poem into two parts, the first of eight verses (called the octave), the second of six (called the sestet); the further division of the octave into two tetrastiches (called in Italian *piedi*); the employment of but two rhymes in the octave, arranged *a b b a a b b a*; the use of either two or three rhymes in the sestet, arranged as may suit the poet. The sestet, when it forms an indivisible whole, is often called in Italian *sirima*; when it falls into two tercets, *volte*. This severe form, however, has not been followed by all sonnet-writers, even from the earliest period. Shakspeare, for example, hardly observes the minor divisions of the sonnet at all. He arranges the rhymes of the octave *a b a b a b a b*, or even *a b a b c d c d*, thus neglecting all the subtle modulations of the Petrarchan type. He often allows the sense to run over from the octave to the sestet; and even when he parts the two he makes little effort to contrast the meaning and the harmony of the latter with those of the former. This loose type of the sonnet is often called the bastard or illegitimate sonnet; but this is hardly justified by the history of the form.

There has been much discussion of the origin and development of the sonnet. The word occurs in both the Provençal and the Old French languages earlier than in Italian. Investigation has shown, however, that here *sonet* means simply a short *son*—i. e. musical air or lyric set to music. There are a few real sonnets in Provençal, but all of them are by Italians, or considerably later than the rise of the Italian sonnet. Everything points, therefore, to Italy as the birthplace of the form; but there are difficulties as to the manner of its birth. A very widely accepted theory has been that it was originally simply one stanza of the lyric canzone. It is hard to see, however, the motive that should have led to such use of a single part of what was a very elaborately constructed and balanced poetical form. More probable is the theory first set forth by A. d'Ancona, in his *Poesia popolare italiana* (Leghorn, 1878), that the basis of the sonnet is purely popular. In fact, there exist even to-day popular lyrics, called *strambotti* and *rispetti*, whose existence is fairly assured for the earliest period of Italian poetry. The *strambotto*, whose home seems to have been Sicily, is an eight-lined stanza with rhymes arranged *a b a b a b a b*. The *rispetto*, on the other hand, which was Tuscan in origin, is a precisely similar stanza, but of six lines, with rhymes *c d c d c d*. D'Ancona believed that the sonnet was obtained by one of the early courtly poets of the so-called Sicilian school, through joining these two forms. This theory has been slightly modified by Cesareo (*La Poesia Siciliana sotto gli Svevi*, Catania, 1894), who thinks that a six-lined *strambotto* existed in Sicily, as well as that of eight lines, and that the combination was effected in Sicily alone. Indeed, Cesareo believes that the inventor of the new form was Jacomo da Lentino, the most original of the Sicilian poets, who flourished in the first half of the thirteenth century. These investigations also show that the earliest sonnet scheme was nearer Shakspeare's than Petrarch's, as the rhymes ran *a b a b a b a b c d c d c d*.

Though thus in all probability of popular origin, the sonnet form was from the start employed only by courtly poets. The subject-matter of the earliest sonnets is, like that of the rest of the poems of the first Italian cultivated poets, mainly derived from the poetry of Provence. During the thirteenth century it became more and more popular throughout Italy. Many experiments at refining and elaborating it were made. Gradually the rhyme system, *a b b a a b b a*, drove out the older system in the octave. Under the influence of Provençal poetical theories, the inner divisions were made sharper and clearer. On another side efforts were made to vary the fixed scheme, either by appending a couplet or group of couplets (*cauda* or *coda*) at the end or by inserting at fixed points subsidiary seven-syllabled lines, which rhymed with the preceding eleven-syllabled lines. According to the number of these insertions, such sonnets were called *sonetti doppi* and *sonetti rinterzati*. In some cases sonnets of twenty-eight verses were thus produced. The simpler form, however, proved the permanently satisfactory one; and this was finally fixed by the great master of all the Italian sonnet-writers—Petrarch.

The diffusion of the sonnet form outside of Italy began when the rest of Europe came to feel the powerful influence of the Italian Renaissance. In the Spanish Peninsula this took place in the fifteenth and early sixteenth centuries; and the earliest Catalan and Spanish sonnets belong to this period. In France, according to Joachim du Bellay, the sonnet was introduced from Italy by Mellin de Saint-Gelais, a poet of the early sixteenth century; but du Bellay himself and his friends of the Pléiade were the first to give it real vogue. In England it was introduced toward the middle of the sixteenth century by Wyatt and Surrey. The earliest German sonnet is to be found in a translation of an anti-papal tract by Bernardino Ochino. This translation, made by one Christoph Wirsung, appeared in 1556.

The best general account of the history of the sonnet is to be found in H. Welti, *Geschichte des Sonettes in der deutschen Dichtung* (Leipzig, 1884). The development of the sonnet in Italy is excellently treated by L. Biadene, *Morfologia del Sonetto nei secoli XIII. e XIV.* (fascicolo 10 of *Studi di Filologia Romanza*, Rome, 1888). Of value, but to be used with care, is Louis de Veyrières's *Monographie du sonnet, sonnetistes anciens et modernes* (2 vols., Paris, 1869–70). A. R. MARSH.

**Sonometer**: See RECORDING APPARATUS, PSYCHOLOGICAL, in the Appendix.

**Sono'ra**: the northwesternmost state of Mexico; bounded by the U. S. (Arizona) on the N., Chihuahua on the E., Sinaloa on the S. E., the Gulf of California on the S. W., and the territory of Lower California on the N. W. Area, 77,534 sq. miles. The Sierra Madre Range forms the eastern boundary, and its spurs and sub-ranges cover much of the eastern part of the state, which is very imperfectly known. Succeeding this region are plateaus and valleys with a rich soil, but only available for agriculture by irrigation. The lands along the coast are arid, except in the river valleys. The northwestern part is a desert, resembling the adjacent parts of Arizona. Of the few rivers the Yaqui is the most important. The climate is hot on the lowlands, mild on the plateaus and in the higher valleys; rains (principally from July to September) are scanty, and the northwestern deserts and parts of the coast-belt are essentially rainless. There is no true forest, except in the mountains. The state is rich in minerals; the mines of silver and gold have long been famous, lead occurs in conjunction with silver, and latterly important coal-beds have been opened in the Yaqui valley, the product being exported to Arizona. Mining is the only important industry; cereals, etc., are cultivated in the river valleys, and there are considerable herds of cattle in the north. A kind of guano is found on islands in the Gulf of California. The Sonora Railway (from the port of Guaymas, on the gulf, to Benson, on the Southern Pacific Railroad) was originally built as an outlet for the coal-fields. Pop. (1895 census), 191,281. A large proportion are Indians of the Opata, Pima, and other tribes, who retain their old customs and languages, and in many cases are practically independent. H. H. SMITH.

**Sonora**: city; capital of Tuolumne co., Cal.; on Wood's creek; 60 miles E. of Stockton, 90 miles S. E. of Sacramento; equidistant from the Yosemite valley and the Calaveras bigtree region (for location, see map of California, ref. 7-E). It is the center of a large gold-mining area; is principally engaged in mining, agriculture, lumbering, and grape-growing; and contains water-works, the Snell Library, an academy, foundry, quartz-mills, and three weekly newspapers. Pop. (1880) 1,492; (1890) 1,441; (1900) 1,922.

**Sonson′**: town of the department of Antioquia, Colombia; on the river Sonson; 33 miles S. S. E. of Medellin; 8,350 feet above the sea (see map of South America, ref. 2-B). It is the center of a rich grazing district, and is noted for its mild and salubrious climate and beautiful scenery. The river here forms a triple fall of 200 feet, and causes in its deep ravine a continual *son-son*, or echo, whence the name. Pop. about 12,000. H. H. S.

**Sonsona′te**: town of Salvador; beautifully situated on a plain by the Sonsonate river, and on the railway from Santa Ana to the port of Acajutla; 40 miles W. of San Salvador (see map of Central America, ref. 4-E). It was founded soon after the conquest, and is the center of a rich agricultural district and the capital of a department of the same name. Pop. about 9,000. H. H. S.

**Sontag**, zōn′taăkh, HENRIETTE: opera-singer; b. at Coblenz, Germany, Jan. 3, 1806; was gifted with fine vocal and dramatic powers, which were highly cultivated; excelled in German and Italian music, and at the age of twenty-five rivaled Malibran, Pasta, and Catalani; married Count Rossi, an Italian noble, in 1830, and retired to private life. She resumed her professional career in 1849, made a tour in the U. S. in 1853, and in Mexico. D. of cholera in Vera Cruz, June 18, 1854. Revised by B. B. VALLENTINE.

**Soo-Chow-Foo**: See SU-CHOW.

**Soodan**: another spelling of SUDAN (*q. v.*).

**Soofees**: See SUFIS.

**Soo′soo**, or **Susu**: the *Platanista gangetica*, a cetacean of the Ganges, the only living representative of the family *Platanistidæ*, which is allied to the *Iniidæ*, or fresh-water dolphins of South America. It is some 6 or 8 feet long, and is ordinarily very sluggish, but can move after its prey, which consists of fish and crustaceans, with much vigor. It has long beaked jaws, 120 teeth, and curious rudimentary eyes. Revised by F. A. LUCAS.

**Soot** [O. Eng. *sōt*: Icel. *sōt*; cf. Ir. *suth*: Lith. *sūdis*; Fr. *suie*]: a carbonaceous deposit from smoke, formed in chimneys. That which forms nearest the fire is often shining and varnish-like, consisting chiefly of dried tarry matters mixed with carbon, and giving a brownish-black powder, sometimes used as a pigment under the name of bistre. That which forms further up the chimney is more of the character of LAMPBLACK (*q. v.*).

**Sooty Tern**: See EGG-BIRD.

**Sooysmith**, soi′smith, WILLIAM: civil engineer; b. at Tarlton, O., July 22, 1830; graduated at the Ohio University in 1849, and at the U. S. Military Academy July 1, 1853. In 1854 he resigned from the army to engage in civil engineering; in 1855 became principal of the Buffalo High School. Resuming his profession in 1856 he was in 1859 placed in charge of the construction of a bridge over the Savannah river, the foundations of which consisted of pneumatic piles. In the civil war he served as colonel of the Thirteenth Ohio Volunteers in West Virginia till Jan., 1862, when transferred to the Army of the Ohio, and was engaged at the battle of Shiloh, Apr. 7. Commissioned brigadier-general of volunteers Apr. 15, he participated in the siege of Corinth; commanded a division at the battle of Perryville; was chief of the cavalry department of the Tennessee July-Oct., 1863, and of the division of the Mississippi Oct., 1863-July, 1864, when compelled by ill health to resign. He has since been engaged in sinking foundations for bridges and other structures. He was a member of the U. S. board of 1875-76 for testing iron and steel. Revised by M. MERRIMAN.

**Sophi′a** (anc. *Serdica*: Bulg. *Sredetz*): city; capital of Bulgaria; on a small tributary of the Iskra, and on the main railway between Vienna and Constantinople (see map of Turkey, ref. 3-C). Till 1878 it was "a dirty and pestilential village of wooden huts," but since Russia wrested from the Ottomans a semi-independence for Bulgaria (1878), it has marvelously improved. It now resembles a European city with its straight, clean streets and attractive houses. Over 7,000 Ottomans from among its former residents have emigrated, but the population has almost trebled in seventeen years. Sophia possesses a commodious palace, the residence of the prince, a cathedral, an excellent college and schools, and a public garden. It manufactures leather, earthenware, and woolen cloth, and carries on an active transit trade. Pop. (1893) 47,000. E. A. GROSVENOR.

**Sophists** [from Lat. *sophis′tes* = Gr. σοφιστής, deriv. of σοφίζεσθαι, be or become wise, play the wise man or Sophist]: name applied to the seven wise men of Greece; afterward to the teachers at Athens who gave lessons in the arts and sciences for money. The course of Greek philosophy begins with the establishment of a material first principle —water, air, fire, etc.—and tends toward the recognition of mind as this first principle. Anaxagoras explicitly announced mind (νοῦς) as such first principle. The first and most obvious phase of mind as an activity is its capacity to reflect, and hence to discover grounds and reasons. Each ground or reason in some measure communicates its peculiar character to the fact or opinion which it grounds. Hence from the standpoint of grounds and arguments all truth seems to be an arbitrary affair, depending upon the selection which one makes of grounds and reasons. Truth is supposed to be many-sided, and the point of view taken is supposed to justify one's difference in opinion. The art of presenting grounds or reasons to justify any view is the art of the Sophists. The fact that these many sides or grounds of truth are mutually interdependent, and therefore that each has truth only as seen in view of the rest—this is the further and deeper insight which it belonged to Socrates and Plato to discover and unfold. The universal or general is the net result, as well as the active principle, of that dialectic process which appears in the genesis and mutual destruction of different opinions—"different points of view." As a necessary elementary stage of human thinking, the work of the Sophists is of permanent importance in the history of philosophy. The Eleatics, who set up the doctrine of pure being, found it necessary to deny being to the phases of change, finitude, and negativity that appear in the world. Zeno accordingly discovered the dialectic of self-contradiction involved in those phases. This was adopted by the Sophists, of whom the chief were Protagoras the Individualist (b. 490 B. C.), Gorgias the Nihilist (came to Athens 427 B. C.), Hippias the Polymathist, and Prodicus the Moralist (the two latter being younger contemporaries of Protagoras). Everything that existed in the Greek consciousness as opinion, faith, custom, religious tradition, even the evidence of the senses, was sapped and rendered uncertain by the ratiocination of these Sophists. Protagoras asserted: Man is the measure of all things. Just as each thing appears to each man, so is it for him. All truth is relative. The existence of the gods is uncertain. Gorgias expressed his nihilism in three propositions: (*a*) Nothing exists; (*b*) if anything existed, it would be unknowable; (*c*) if anything existed, and were knowable, the knowledge of it could nevertheless not be communicated to others. "Common sense," so called, is the stage of naïve faith in one's point of view. The discovery of the equal validity of "many points of view" leads on the one hand to sophistical practices, or on the other to skepticism. Pyrrhonic skepticism in Greece connects back through the Megarian school to the dialectic of the Sophists and of Zeno the Eleatic. See articles SOCRATES, PHILOSOPHY (*History of Philosophy*), and MORAL PHILOSOPHY. WILLIAM T. HARRIS.

**Sophocles**, sof'ō-kleez (Gr. Σοφοκλῆς): the second in time of the three great tragic poets of Greece; b. of a wealthy family at Colonus, a beautiful deme of Attica near Athens, in 496 B. C. He was carefully trained in all the arts of a liberal education, in gymnastics and music. At the age of sixteen he led the chorus of boys who danced and sang the pæan in honor of the victory of Salamis, and there is other evidence of his personal beauty and grace. His first play, acted in 468, was a great success, and won the prize over Æschylus after a close contest which was finally referred for decision to Cimon and his fellow generals. For the next ten years Sophocles divided with Æschylus the empire of the stage, the older rival learning from the younger as the younger had already learned much from the older. After the death of Æschylus, Sophocles was the leading dramatist. He never failed of at least the second prize, and coped successfully with such plays as the *Alcestis* and the *Medea* of Euripides. But as Æschylus accepted the improvements of Sophocles, so Sophocles in his later plays was clearly influenced by Euripides, whose greatness he did not fail to recognize. Sophocles took an active part in public life, and was called to hold high positions. In consequence of the sentiments expressed in his *Antigone* (440) he was made a colleague of Pericles in the command of the forces sent against Samos. Before that he had been an Hellenotamias or treasurer of the Alliance, and in the troublous times of the Peloponnesian war he is said to have been one of the *probuli* (πρόβουλοι) or committee of safety appointed in 411. Love played a large part in his life, and his sweet and easy temper was often put to the test. According to a familiar tradition, when far advanced in years Sophocles was brought before a family court by his son Iophon on the charge of disordered intellect. The aged poet recited the famous encomium on Colonus from the *Œdipus Coloneus*, which he had just composed, and the charge was dismissed—as the story may be. He died an easy death in 405.

Of his 123 dramas seven are extant, *Ajax*, *Electra*, *Œdipus Tyrannus*, *Antigone*, *Trachiniæ*, *Philoctetes*, *Œdipus Coloneus*, the first three being the most popular in Byzantine times. Sophocles introduced the third actor and thus increased the life and movement of the drama, and life and movement were also enhanced by the change which made each drama of the trilogy (see ÆSCHYLUS) an independent play. These and other changes in the external form are manifestations of the same spirit that we find working in the heart of the Sophoclean drama. When we study Sophocles we are no longer in the Æschylean realm of Titanic beings, too vast for human sympathy, for while the heroes and heroines whom Sophocles brings before us are lifted above our level, they are of like passions with ourselves, and the motives are motives of flesh and blood, of human character and human will. His *dramatis personæ* are eternal types "writ large." In the construction of the plot Sophocles had no rival. His *Œdipus Tyrannus*, to cite but one instance, is a tragic web of unequaled subtlety and effectiveness. The lyric parts of his plays are in beautiful balance with the dramatic element. His language is more supple than that of Æschylus, but never falls short of elevation. It is sweet and yet does not lack a certain tang of austerity that saves it from cloying.

EDITIONS.—Among the most memorable editions of all the plays are those of G. Hermann (1830–41), Wunder-Wecklein (4th ed. begun in 1875), Schneidewin–Nauck (begun by Schneidewin in 1849 and repeatedly issued since), Campbell, in 2 vols. (1873, 1881, and repeated), Campbell-Abbott, 2 vols. (1886); above all, the monumental edition of Jebb (begun in 1883, nearly complete in 1895, with repeated issues of *Œdipus Tyrannus* and *Antigone*). Select plays by Wolf-Bellermann (begun 1858, often repeated). Text ed. by Dindorf (Teubner collection), by Schubert (Schenkl collection), by Nauck (Weidmann). Of noteworthy editions of single plays may be mentioned *Ajax*, by Lobeck (3d ed. 1866); *Antigone*, by Boeckh (1843), by Humphreys (1891); *Electra*, by Jahn (3d ed. 1882); *Œdipus Tyrannus*, by Elmsley (1821); *Œdipus Coloneus*, by Reisig (1820); *Philoctetes*, by Blaydes (1870), who has edited other plays of Sophocles also. Of translations into English verse may be noted Plumptre (1866) and Campbell (1874); of translations into English prose after Jebb's text, E. P. Coleridge (1893), and Jebb himself in the edition cited. For the enormous bibliography (down to 1874 only), see Genthe's *Index Commentationum Sophoclearum*. Invaluable is Ellendt's *Lexicon Sophocleum* (2d ed. by Genthe, 1872). See also Schöll's *Sophokles* (2d ed. 1870) and Patin's *Sophocle* (5th ed. 1877). B. L. GILDERSLEEVE.

**Sophocles**, EVANGELINUS APOSTOLIDES: Greek scholar; b. at Tsangaranda, Thessaly, Greece, Mar. 8, 1807; studied at the convent on Mt. Sinai; emigrated to the U. S.; entered Amherst College in 1829; was tutor in Harvard College, with a brief intermission, from 1842–49; assistant professor 1849–60, and in 1860 became Professor of Ancient, Modern, and Byzantine Greek. He published a *Greek Grammar* (1838; 3d ed. 1847); *First Lessons in Greek* (1839); *Greek Exercises* (1841); *Greek Lessons for Beginners* (1843); *Catalogue of Greek Verbs* (1844); *History of the Greek Alphabet*, etc. (1848); *Glossary of Later and Byzantine Greek* (1860), revised as *Greek Lexicon of the Roman and Byzantine Periods* (1870), etc. D. at Cambridge, Mass., Dec. 17, 1883.

**Sophonis'ba**: See MASINISSA.

**So'phron**: inventor or rather perfecter of the so-called MIME (*q. v.*); flourished at Syracuse in the middle of the fifth century B. C. The office of the mime was to represent in dramatic form a special situation or a special personage. It was a *commedietta* that lacked a chorus, that lacked an elaborate plot. The mimes of Sophron enjoyed a great reputation in ancient times; Plato read them again and again and slept with them under his pillow, and in Rome they were learned by heart and much imitated. A few fragments have been collected by Blomfield in *Museum Criticum* (vol. ii., 1826), and by Ahrens, *De Græc. Dialect.* (vol. ii., p. 464). Revised by B. L. GILDERSLEEVE.

**Soprano**: the highest type of the voice of women and boys. The compass of the high soprano may be said to extend from lower E on the treble staff to C above, and that of the mezzo-soprano from A below to A above. Among the high sopranos exceptional compass is sometimes found, reaching even to F and G in alt. D. B.

**So'ra**: town; in the province of Caserta, Italy; on the Garigliano; about 58 miles N. N. W. of Naples (see map of Italy, ref. 6–E). The manufactories of paper, woolen, and other stuffs here are on a considerable scale, and are provided with modern machinery. Pop. about 5,400.

**Sorac'te**: the present *Monte di San Oreste*, a mountain of Etruria, an outlying offset of the Apennines, from which it is detached by the valley of the Tiber. It rises with its bold and abrupt masses of the peculiar hard Apennine limestone 2,420 feet above the surrounding plain, and forms, especially when its top is covered with snow, a conspicuous and very picturesque feature in the views of the Campagna. (Horace, *Carm.*, i., 9.) In ancient times it was dedicated to Apollo, and bore on its top a celebrated temple of this god, to which large and peculiarly solemn processions were made from Rome, situated 26 miles to the S. In 746 Carloman, the brother of Pepin, founded the monastery of San Silvestro on the site of the old pagan temple. Its present name the mountain has received from a village, San Oreste, situated on its slope and well known for its sour wine. Revised by J. R. S. STERRETT.

**Sorata**: See ILLAMPU.

**Sorbian Language**: another name for Lusatian-Servian; see SLAVIC LANGUAGES.

**Sorb'ite**, or **Mountain-ash Sugar** [*sorbite* is from Lat. *sor'bum*, sorb-tree]: a saccharine substance formed in the juice of the berries of *Sorbus aucuparia*, the mountain-ash of Europe, as well as in the related American, *Sorbus americana*. The compound has the composition $C_6H_{14}O_6$, being isomeric with mannite. It belongs to the alcohols, and is in turn related to the sugars. I. R.

**Sorbonne**, sŏr'bŭn': the name generally applied to the theological faculty of the ancient University of Paris. It was derived from Robert de Sorbon (b. at Sorbon, in the Ardennes, in 1201, and afterward chaplain to Louis IX.; d. in Paris, renowned for sanctity and eloquence, 1274). In 1252 he founded an institution connected with the University of Paris, in which seven secular priests were to teach theology gratuitously to sixteen poor students, and in the following year the institution received its charter from Louis IX., which was confirmed in 1268 by Pope Clement IV. Connected with it was a preparatory school. Both were under a provisor. The severity of the examinations made its degrees of high esteem. The great care which was taken not to admit among the teachers any but men of the highest talents and attainments soon procured for the school a European fame, and in the fourteenth century the entire theological faculty of the university was merged into it. During the Middle Ages, the period of the Reformation, and even after that time, the Sorbonne was generally considered one of the highest authorities of the Christian Church, and its decisions were appealed to not only in theological controversies, but also in the contests between the popes and the secular powers. It demanded the condemnation of Joan of Arc; it justified the massacre of St. Bartholomew; it vigorously sided with the League and condemned both Henry III. and Henry of Navarre. On the other hand, it introduced printing into Paris immediately after its invention, and prevented the introduction of the Peter's Pence and the Inquisition into France. It was a stanch champion of the freedom of the Gallican Church, and strongly opposed to Ultramontanism. It condemned Jansen and the Jansenists in matters of doctrine, but it sided with them in their fight with the Jesuits. Its culmination was in the time of Cardinal Richelieu, who, himself a graduate of the school, provided it with a magnificent building and enlarged its library (1629). It was then that appeared the famous Latin couplet, which may be thus translated literally: "Renovated the Sorbonne goes to immediate ruin. While it was falling it stood unshaken; restored it will perish." In its contest with the philosophy of the eighteenth century it was unsuccessful, and it had outlived its fame when during the Revolution it was suppressed and bereft of its endowments (1790). At the reconstruction of the university in 1808 by Napoleon I., the building, still called the Sorbonne, became the seat of the *académie*, and between 1816 and 1827 was given to the theological faculty in connection with the faculties of science and *belles-lettres*. New buildings for the Sorbonne were erected 1884–89 at an expense of nearly $4,500,000. See T. I. Duvernet, *Histoire de la Sorbonne* (2 vols., Paris, 1790); A. Franklin, *La Sorbonne* (1867; 2d ed. 1875).

Revised by S. M. Jackson.

**Sorb-tree**, or **Wild Service**: the *Pyrus terminalis*, a small European tree (family *Rosaceæ*), the wood of which is very hard and valuable. Its fruit, the sorb, when overripened, is soft and mellow and very good eating. Hertfordshire, England, is famous for its sorbs, which are largely marketed in London. The name is sometimes applied to *P. domestica*. See Service-tree.

**Sorcery**: See Magic.

**Sorel′** (river): See Richelieu.

**Sorel**: *chef-lieu* of Richelieu co., Quebec, Canada; at the junction of the Richelieu with the St. Lawrence, and on the South Shore Railway, 45 miles below Montreal (see map of Quebec, ref. 5–B). It has an excellent harbor, which is used during the winter months as a place of refuge for the river steamboats. The trade is almost confined to the shipping of grain and farm produce. The manufactures are mostly connected with the repairing of steamboat machinery. The town has for its center a well laid-out square, and occupies the site of a fort built in 1665 by M. de Tracy. Its former name was William Henry. The Duke of Kent, the father of Queen Victoria, resided here for a time. There are 2 newspapers, 2 branch banks, and several hotels. Ship-building was formerly carried on. Pop. (1891) 6,669, of whom not more than 300 are English-speaking. J. M. Harper.

**Sorel**, Agnes: See Agnes Sorel.

**Sorel's Cements**: certain cements named from the inventor, a French chemist. The principle on which they are founded is the mixing of a concentrated solution of a metallic chloride with the oxide of the same metal to a pasty mass, when, in case of several metals, a solid insoluble oxychloride is rapidly formed, which is sometimes quite crystalline and hard. The most approved compositions of this class are those made with the chlorides of zinc and magnesium. A solution of magnesium chloride of a density of 20° to 30° of Baumé's hydrometer is mixed with magnesia to a paste, which may be applied and moulded like plaster. It solidifies to a white mass of the hardness of marble. Chloride-of-zinc solution mixed with oxide of zinc forms a similar cement-composition. Revised by Ira Remsen.

**Sorel-stone**: See Stone.

**Sorghum**: a tall, broad-leaved annual plant of the grass family, regarded as a variety (*Saccharatum*) of the polymorphous *Andropogon sorghum*. Its original home was doubtless the interior of Africa, but modern travelers do not report its having been found there in a wild state, and the wild forms, as in the case of the nearly related sugar-cane, appear to have been lost. Sorghum as a cultivated plant has been known from remote antiquity. It was introduced into Italy at the beginning of the Roman empire, but its culture did not flourish. Experiments were again conducted with it at Florence, Italy, in 1766, by Pietro Arduino, but with no practical results. In China it has been cultivated from the earliest historical times, but only as a cereal and for fuel and forage until recently. In 1840 Abadie sent some seeds to the museum at Paris, and about 1850 Montigny sent some from the north of China to the Geographical Society of Paris. About fifteen varieties were received, some of which contained saccharine juices.

Field of sorghum.

In 1853 W. R. Prince, of Flushing, L. I., obtained a few seeds from France. These produced a few pounds of seed, which were distributed in 1854. In 1857 Leonard W. Wray introduced into the Southern States seed which he obtained from Natal. The African varieties were called Imphee, while those originally derived from China were known as Chinese sugar-cane. In a few years sorghum was very generally known in different parts of the U. S., and some of the early varieties, such as the Amber, were found to mature as far N. as Minnesota.

During the civil war the culture of sorghum was carried on to a considerable extent, and by reason of the high price of sugar the products, mostly molasses, were brought into quite general consumption. Crystallizable sugar had been obtained as early as 1855, and was often made in the laboratory and in small amounts; but no systematic attempts were made to use the plant for making sugar until the subject was taken up in the department of agriculture in 1878 by Dr. Peter Collier. As a result of his investigations he predicted that sorghum could successfully compete with sugar-cane and sugar-beets as an economical source of the sugar-supply of the U. S., and attempts were made in many localities to manufacture sugar. In 1882 the commissioner of agriculture offered ten prizes of $1,200 each for the most successful attempts to make sugar from sorghum. The total amount of sugar reported by the ten successful applicants was 116,165·5 lb., of which 86,603 lb. was made by one firm. The department of agriculture at Washington made 165 lb. of sugar in 1881, and after making nearly 10,000 lb. in 1883 conducted experiments on a somewhat larger scale at Ottawa, Kan., in 1885, and at Fort Scott, Kan., in 1886–87. Large quantities of sugar were produced, but it was not demonstrated that it could be accomplished with economical results. With the exception of two factories in Kansas all commercial attempts at the manufacture of sugar from sorghum on a large scale have (1895) in a short time proved financial failures.

The difficulties attending the manufacture of sugar from sorghum depend on the presence of bodies such as starch, gum, non-crystallizable sugar, etc., which tend to prevent its crystallization. These bodies can be largely separated from the sugars by treating the partially evaporated juices with alcohol. Experiments made by the department of agriculture in 1891 indicated that fully 200 lb. of sugar per ton could be made from sorghum in this way. The character of the U. S. internal revenue laws, however, prevents the use of alcohol except under such restrictions as would render it unprofitable.

Extensive experiments were conducted by the department of agriculture from 1888 to 1893 at Sterling and Medicine Lodge, Kan., in the improvement of sorghum as a sugar-producing plant. New varieties were developed and the content of sugar therein greatly increased. Seeds selected from canes with a high content of sugar were carefully propagated and continued from year to year in a direct line of descent. The most approved varieties of sorghum as thus developed are Amber, Folger, Colman, Collier, McLean, Link, No. 8X, No. 112, No. 161, and Orange.

*Sorghum as a Food.*—Sorghum produces seeds which are quite equal to ordinary cereals for food. The composition of sorghum seed is shown in the following table:

| PARTS. | Seeds with glumes, per cent. | Seeds without glumes, per cent. |
|---|---|---|
| Moisture | 9·93 | 9·63 |
| Albuminoids | 10·54 | 11·39 |
| Petroleum spirit extract (oil) | 3·72 | 3·16 |
| Ether extract | 0·61 | 0·54 |
| Eighty-per-cent. alcohol extract (sugar) | 2·91 | 1·78 |
| Fiber | 3·17 | 1·83 |
| Ash | 2·05 | 1·69 |
| Starch and soluble carbohydrates | 67.07 | 69.98 |

Each ton of sorghum will yield from 100 to 150 lb. of seed. Sorghum is also valuable as forage when sown broadcast and harvested as hay or preserved in silos. It is chiefly cultivated for this purpose in Southern and Southwestern Kansas and in many other of the semi-arid regions of the U. S., as it yields a crop which can be relied upon in all seasons. In all parts of the U. S. sorghum is cultivated in a small way for molasses-making. The method of cultivation is almost identical with that of maize, but the young plants require more care. The ripe canes are relieved of their seed-heads and blades and crushed in small three-roll mills usually driven by animal power. The expressed juices are treated with cream of lime heated to the boiling-point and the scums removed. The clear juice obtained is rapidly concentrated in kettles or shallow pans to the consistence of molasses, yielding when carefully controlled a wholesome and pleasant product.

*Statistical.*—The number of gallons of molasses made in the U. S. from sorghum in the census year 1860 was 6,749,-123; in 1870, 16,050,089; in 1880, 28,444,202; in 1890, 24,-235,219. In the last-named year 415,691 acres were cultivated in sorghum. The yield of sugar reported to the internal revenue for the purpose of receiving bounty for the fiscal year ending June 30, 1892, was 1,136,186 lb., for that ending in 1893 1,026,100 lb., and for that ending in 1894 882,572 lb. The average yield of cane per acre was 5·3 tons, and the average yield per ton of cane manufactured 82·5 lb. Much sugar is also made as an incidental product in the manufacture of molasses. HARVEY W. WILEY.

**Soric'idæ** [Mod. Lat., named from *So'rex*, the typical genus, from Lat. *so'rex*, shrew]: a family of mammals of the order *Insectivora*, including shrews or shrew-mice. Externally they resemble mice, but are readily distinguishable by the longer and pointed snout. In contrast with the *Talpidæ*, to which they are most nearly related, they present the following characters: The skull is long, narrow, and pointed; the zygomatic arch is lacking, and there are no post-orbital processes; the tympanic is ring-like: the tibia and fibula are ankylosed; the halves of the pelvis do not meet; there is no cæcum; the teeth range in number from 26 to 36 (M. $\frac{3}{3}$, P. M. $\frac{1-2}{1-2}$, C. $\frac{1}{1}$, I. $\frac{2-4}{1-2} \times 2$); the cusps of the upper molars are arranged in a W; the upper incisors are large and hook-shaped, the first lower incisors are usually directed forward; the cervical vertebræ have well-developed hypapophyses, and the dorsal and lumbar distinct hyperapophyses; the sternum has a broad but not keeled manubrium. The family is a very homogeneous one, and representatives are found in the entire northern hemisphere, and extend southward into India and Eastern Asia in the Old World and into Mexico in the New. The species are all small, and some of them are among the least of mammals. They have certain glands near the fore limbs, on the sides, and behind at the base of the tail, in which is secreted a musky fluid. They feed not only on insects, worms, etc., but on such young vertebrates (birds, etc.) as they are able to overcome.

Revised by F. A. LUCAS.

**Soris**: the name given by Manetho to *Snofru* (*S-uefer-u*, *Snefru*), the first king of the fourth Egyptian dynasty. Little is known about the man himself except that he waged war in Sinai and opened the copper mines in Wâdi Ma'ârah, where the evidences of his labor are still visible. His tomb was the False Pyramid at Mêdûm, built of Mokattam limestone, well jointed, 115 feet high, but never completed. After death he was the recipient of divine honors, and evidences have survived which indicate that his cult continued throughout the remainder of Egyptian history. Monumental remains begin to be numerous from the time of Soris and his successors during the fourth dynasty, and the representations of scenes of private life preserved on the walls of tombs of the period (see MASTABA) show a remarkable degree of civilization. Unger (*Manetho*, p. 92) refers to Soris-Snofru the mention made by Macrobius (*Saturnaliorum conviviorum*, lib. i., 23, § 10) of Senemures or Senepos, whose name in turn has been compared by some with that of the Assyrian Semiramis. The entire identification is founded on conjecture. CHARLES R. GILLETT.

**Sorites**: See LOGIC.

**Soroban**: the Japanese abacus. It differs from the Chinese *swan-p'an* in having, as a rule, only one bead on each wire of the upper or smaller division. It is used in the same way as the Chinese use theirs. See ABACUS.

**Soroca'ba**: a town of the state of São Paulo, Brazil; on the Sorocaba river, a branch of the Tieté; 60 miles W. of São Paulo, with which it is connected by railway (see map of South America, ref. 6–F). It is the center of an important agricultural and grazing district, and is noted for its annual fairs, principally devoted to the sale of horses and mules; as many as 70,000 animals are sometimes placed on sale. Pop. about 12,000. H. H. S.

**Sorrel**: any one of several sour-leaved plants, especially those of the diœcious section, of the genus *Rumex* (family *Polygonaceæ*), to which genus the coarse herbs called dock also belong. The common sorrel of sterile fields is *Rumex acetosella*. Plants of the genus *Oxyria* (of the same family) are called mountain-sorrels. The wood-sorrels are of the genus *Oxalis* (family *Geraniaceæ*). There are numerous species of the genus *Rumex*, some of which are occasionally used as salad-herbs and as flavors for sauces. In Europe the sorrels, mountain-sorrels, and wood-sorrels are cultivated in gardens for table use. All these sorrels owe their sourness to the presence of oxalic acid and its salts.

Revised by L. H. BAILEY.

**Sorrel-tree**, or **Sourwood**: the *Oxydendrum arboreum*, a handsome tree of the U. S., found in Ohio and Pennsylvania and southward to the Gulf. Its leaves resemble those of the peach. They are sour, and from them a cooling drink is made for the sick. The wood is soft and very difficult to dry. It is sometimes planted as an ornamental tree.

**Sorren'to** (anc. *Surrentum*): town; in the province of Naples, Italy; situated on a small rocky peninsula on the south side of the Bay of Naples, protected from the sirocco by Monte Vico, and from the west wind by Monte Massa (see map of Italy, ref. 7–F). It contains an interesting church and numerous villas, with gardens of almost tropical luxuriance. It was a Greek settlement, was adorned with splendid temples during the Roman period, and after the fall of the Western empire was ruled by its own consuls and dukes. Of the old temples, a few fine marbles, mosaic pavements, etc., alone remain, besides the foundations. The climate of Sorrento, as agreeable as it is salubrious, the luxuriance of the vegetation, and the variety and beauty of the surrounding scenery, have made Sorrento one of the most frequented resorts in Southern Italy. There is a small coasting trade in the rich productions of the vicinity carried on by means of the little harbor. It is the birthplace of Torquato Tasso. Pop. about 6,090.

**Sotades**, sot'ă-deez (Gr. Σωτάδης): Greek poet of Maroneia in Thrace; a composer of indecent farces, whose jest at the marital relations of Ptolemy Philadelphus and his sister Arsinoë cost the jester his life. Sotades has given his name to a variety of Ionic verses, the *Metrum Sotadeum*. The fragments have been collected and restored by G. Hermann, *Elementa Doctrinæ Metricæ*, p. 445. B. L. G.

**Soter**: See PTOLEMY.

**Soteriol′ogy** [Gr. σωτηρία, salvation, deriv. of σωτήρ. savior + λόγος, discourse, reason]: that branch of theology which treats of the redemptive work of Christ. In its wider signification the term includes both the atonement which Christ made and its application through faith to individuals. Thus defined, it would comprise not only the doctrine of expiation, but also those of regeneration, justification, and sanctification. It is, however, used in a more restricted signification, to denote only the atonement. See ATONEMENT.

**Sothern**, sŭth′ern, EDWARD ASKEW: actor; b. in Liverpool, England, Apr. 1, 1830. He disappointed his parents by not entering the Church; made his *début* as an amateur actor in Jersey; went to the U. S. in 1852, and appeared first at the Boston National theater, under the stage name of Douglas Stewart; created the character of Lord Dundreary in the play of *Our American Cousin* at Laura Keene's theater, New York, 1858, and represented it many hundreds of times with great popularity in the U. S. and in England. Favorite parts of his were David Garrick, in the play of that name, Fitz Altamount in *The Crushed Tragedian*, and Brother Sam. Sothern was very popular socially, and a great practical joker. D. in London, Jan. 20, 1881.
Revised by B. B. VALLENTINE.

**Sothic Period** [*Sothic* is from Greek Σῶθις, Egypt. *Sopt*, the dog-star]: a period of 1,460 Julian years (of 365¼ days), equal to 1,461 vague years (of 365 days) of the Egyptian calendar. In the latter the year was reckoned by twelve months of thirty days, with the addition of five intercalary days. The difference between the two thus amounted to about six hours annually, so that the vague year receded about one day in each four years. The beginning of a Sothic period was marked by the coincidence of the heliac rising of Sirius with the calendar new year, and at the rate of divergence between the two systems this coincidence recurred once in about $4 \times 365 = 1,460$ solar years. In the course of a Sothic period any periodic event, such as the inundation of the Nile or the rising of the dog-star, fell upon each and every day of the civil calendar. The difference in the appearance of such periodic events was not marked in the life of an individual, being only about twenty-five days in a century. Consequently little attention was paid to the matter till in the Ptolemaic dynasty, when the Sothic period seems first to have been used in calculating time.

Dr. Mahler, of Vienna, has employed the Sothic period in calculating Egyptian chronology, starting with the statement of Censorious (239 A. D.) that the heliac rising of Sirius occurred on July 21, 139 A. D. Reckoning back, this event occurred on about the same day in (approximately) 1322 B. C., 2782 B. C., and 4242 B. C. By the use of monumental and other data he arrived at the conclusion that the reign of Thothmes III. extended from Mar. 20, 1503, to Feb. 14, 1449, B. C., a result agreeing remarkably with that derived from a "dead-reckoning" by lengths of reign as given by Manetho and the monuments. Similarly Petrie fixes provisionally the date of the beginning of the sixth dynasty at 3410 B. C., and, reckoning the preceding dynasties according to monumental and other evidence, he assigns the beginning of the first dynasty to the year 4777 B. C. There is uncertainty about this result, but it is apparently more exact than any given previously, and it is claimed that it reduces the margin of doubt from a thousand or more years to one or two hundred at the outside. CHARLES R. GILLETT.

**Sothis**: another name of SIRIUS (*q. v.*).

**Soto**, HERNANDO OR FERNANDO, de: discoverer of the Mississippi river; b. at Jerez de los Caballeros, Estremadura, Spain, about 1500. He went to Darien with Pedrarias in 1514, accompanied Cordoba in the conquest of Nicaragua 1524, and opposed his subsequent rebellion. In Apr., 1532, he joined Pizarro with re-enforcements; in the conquest of Peru he acquired great wealth, with which he returned to Spain in 1536. Soon after he was appointed governor of Cuba and Florida, with a commission to explore and settle the latter country, then including all the northern coast of the Gulf of Mexico. On May 12, 1539, he sailed from Havana with nine vessels and 600 (or 950) men. His explorations began at Tampa Bay July 15; they covered a large area, and the route can now be determined only approximately. It is certain that he passed through Northern Florida, Georgia, probably South Carolina, and Tennessee, and perhaps North Carolina, before descending the Alabama river. In Oct., 1540, he had a battle with the Indians near Mobile Bay; thence he again turned northward, and about May, 1541, crossed the Mississippi at the lower Chickasaw Bluffs; explored the river northward nearly to the Missouri, and, returning southward, died of fever near the junction of the Mississippi and Red rivers, probably on May 21, 1542. During the three years' wanderings 250 men had perished of disease and privation or in battle with the Indians. The survivors, under Moscoso, descended the river and reached Mexico. Soto is properly regarded as the true discoverer of the Mississippi, though Pineda found its mouth in 1519, and Cabeza de Vaca must have crossed it near the Gulf in 1528.
HERBERT H. SMITH.

**Souari-nut**: See CARYOCAR.

**Soublette**, soo-blet′, CARLOS: soldier and statesman; b. at Caracas, Venezuela, 1790. He joined the revolutionists in 1810, distinguished himself in the war for independence, especially under Bolivar in the New Granada campaign; attained the rank of general, was vice-president and general-in-chief in Venezuela 1821–23 and Minister of War for Colombia 1826–27. He supported Bolivar's attempt, in 1829, to maintain the union of Colombia; but when Venezuela seceded in 1830 he remained faithful to his native country, presided over the constitutional convention of that year, and was the Venezuelan Secretary of War 1830–34. In 1835 he was envoy to Spain, and was elected vice-president under Vargas; by the resignation of the latter soon after he became acting president. He left the government with Narvarte, and went on a special mission to Spain to arrange a treaty with that kingdom. In this he was unsuccessful. On his return he resumed the presidency, which he retained until Feb. 1, 1839. Under Paez, 1839–43, he was Secretary of War, and he succeeded him as president Jan. 28, 1843, to Mar. 1, 1847. During the disorders of 1848 he was banished, residing at Bogotá until 1858. Subsequently he held cabinet positions, and commanded the Venezuelan army. He was greatly respected. D. at Caracas, Feb. 11, 1870. HERBERT H. SMITH.

**Soudan**: See SUDAN.

**Soul** [O. Eng. *sāwel*, *sāwl*: O. H. Germ. *sēla* (> Mod. Germ. *seele*): Goth. *sai'wala*]: a term variously used to signify either the principle of life in an organic body, or the first and most undeveloped stages of individualized spiritual being, or, finally, all stages of spiritual individuality, incorporeal as well as corporeal. Aristotle, whose treatise *De Anima* (Περὶ ψυχῆς) is the first and perhaps the greatest work on the subject, has himself introduced this confusion by defining the soul in one instance as the self-determining power (ἐντελέχεια) of an organized body, and then afterward attributing to it reason (νοῦς), and making it as reason entirely separable from body. If strictly limited to the phases of relation which the mind has toward its organic conditions, the science of the soul is properly termed anthropology, and treats first of the cosmic, sideric, and telluric influences upon mind—the determining characteristics of race, age, the seasons, the climate, the solar and lunar periods, etc. Next comes the reaction against these determining influences of nature, as manifested in the antithesis of sex, the alternation of waking and sleeping, and in the phenomena of dreams, fœtal life, somnambulism, clairvoyance, catalepsy, St. Vitus's dance, and the various forms of vicarious sense-perception (where seeing, hearing, tasting, etc., are performed by the organ of feeling, the skin, in diseased states of the organism), trance-exaltation, etc. It considers next the questions of arrested development, such as appears in idiocy; the return to the previous stages out of the stage of consciousness, and the mingling of the two (earlier and later) phases in insanity (wherein the Ego is unable to distinguish between the phenomena of sense-perception and those arising from the influence of general external conditions, or from diseased activity of the nervous organism, and is thus confused, now acting upon one set of data and then upon another). Through the stages of feeling and the reduction of external relations to the abstract uniformities of habit, and especially in the creation of conventionalities whereby language becomes possible, and with it the formation and expression of general ideas, mind rises into the phase of Consciousness and Reason, knows itself as individual and independent of external natural influences, and accordingly subordinates and eliminates these in manifold ways through institutions—family, civil society, state, church, science, etc.—and learns to recognize conscious immaterial personality as the highest principle of the universe. The much-debated question of the immortality of the soul implies a definition of soul as including not only its phases of corporeal existence, but also the higher ones of thought and will. Hence if ψυχή (soul) be only the principle of organic life, and νοῦς (reason) be the principle of intelligence elevated above the former and transcending it, the immortality of the former is precluded by definition, for the principle of conscious individuality is placed in the latter.

Previous to Aristotle and Plato the theories regarding the soul were mostly crude suggestions. The Pythagoreans thought that the soul is a harmony—that it dwells in the body as in a prison, being confined there for punishment. Many conjectures as to the location of the soul have been made. Alcmæon of Crotona (according to Theophrastus) taught that the soul was located in the brain, "whither all sensations were conducted from the organs of the senses through canals." Like other Pythagoreans he held that the soul was subject to eternal motion, like the stars. Philolaus the Pythagorean held that the soul is united to the body, which is its organ, and at the same time its prison, by number and harmony, all things being known through number as a common principle of the soul and of things—like being known by like. Anaxagoras attributed souls to plants, and affirmed that they sorrow and rejoice. Democritus, who explained everything through the "atom and the void," held soul and fire to possess "round atoms," because they manifested the maximum of mobility. He affirmed that thought arises when the motions of the soul are "symmetrical"; and, further, that "the soul is the noblest part of man; he who loves its goods, loves what is most divine. He who loves the goods of the body, which is the tent of the soul, loves the merely human." Critias the Sophist considered the blood to be the substratum of the soul. Plato (in the *Phædrus*) makes three souls or phases of the soul: (*a*) the appetitive soul seeking happiness or sensual pleasure, the gratification of desire; (*b*) the irascible or courageous soul, manifesting itself in combative activity, as the former in passive receptivity; (*c*) the rational soul, which alone is immortal. The cognitive or rational soul is the soul in its totality, and the irascible and appetitive souls are merely phases of arrested development occasioned by the confinement of the body. The rational soul dwells in the head (agreeing with Alcmæon), the irascible in the heart, the appetitive in the organs of nourishment and reproduction. Plato defines (*Leg.*, cap. 10) the soul as a self-moving activity (κίνησις ἑαυτὴν κινοῦσα). Transmigration of souls (*Phædo*), a doctrine apparently borrowed from Egypt and the Orient, is consonant with his theory of the pre-existence of the soul, and of the origin of the appetitive and irascible phases of the soul through the descent of the rational soul into a body. Having made the discovery of general and necessary ideas, which could not have originated in sense-perception, he undertook to account for them through reminiscence: the soul had perceived them in a former life. These ideas, *a priori*, were simple and eternal: how could the soul in which they were contemplated be other than simple and eternal? While he condemned the Pythagorean view that the soul was a harmony, Plato employed symbolic expressions quite similar. In the same spirit his successor in the Academy, Speusippus, defined the soul as "extension, shaped harmoniously by number"; hence as, in some higher sense, a unity of the arithmetical and geometrical. So, too, Xenocrates of Chalcedon, the second director of the Academy, taught that the soul is a self-moving number. Aristotle repudiated the use of symbolic language in definitions to avoid ambiguity. He defined soul (*De An.*, ii., 1) as "the first entelechy [self-actualizing energy] of a physical, potentially living and organic body." The first entelechy is not a fully realized being, and hence it has been inferred that he intended to exclude the reason (νοῦς) from his definition of the soul, especially, too, as he makes the νοῦς to be independent of the body. But in another place he makes the soul to be "that by which we live, feel or perceive, move, and understand." The νοῦς ποιητικός = the *actus purus*, or pure reason, exists before the body, and enters it from without (θύραθεν) as something divine and immortal (*De Gen. et Corr.*, ii., 3). The νοῦς παθητικός = passive reason, including the nutritive (vegetable), sensitive (animal), and so much of the rational soul as includes memory, imagination, sense-perception, and discursive intellect, he regarded (*De An.*, ii., 2) as perishable like the body. Exactly what he meant by this was long in dispute. Alexander of Aphrodisias, the great commentator, held that the active reason is the world-soul, and that individuals are mere incarnations of it which perish with the body. Dicæarchus of Messene, pupil of Aristotle, had held this doctrine. The Stoics had held nearly the same doctrine, acknowledging that the soul outlives the body, but is not eternal. Cleanthes the Stoic asserted that all souls would exist until the general conflagration of the world; but Chrysippus limited this to the souls of the wise, while Panætius denied the future life altogether. The statements of Aristotle, taken together, indicate his belief in the existence of the soul independent of the body; and not merely as a general world-soul, but also as individual souls.

In the process of education, culture, or self-development the individual gradually eliminates his lower phases of thought; he depends less upon sense-perception, learning to know a great deal from seeing very little (Cuvier could describe the whole animal from one of its bones; Agassiz, a fish from one of its scales); mechanical memory likewise becomes less important as deduction from principles becomes more prominent; discursive intellect gives place to pure intellect. Thus the lower faculties die out, and give place to more perfect forms; they become useless in the presence of more adequate forms of cognition. Hence Aristotle was correct in describing them as transient and perishable like the body; and yet he did not at all deny, by this, future conscious identity to the individual. The active reason could energize as nutritive, locomotive, appetitive, and sensitive, organizing a new body; for organization was only a self-limitation of the active reason, a self-arrested development of it. Hence when Averroës revived the doctrine of Alexander of Aphrodisias, the great scholastic thinkers devoted themselves to this question until they reconciled Aristotle with himself through this theory of the union of the active and passive reasons—the former as independent and substantial, and the latter as eternally produced through its energy. Albertus Magnus held that the active reason bears within itself the vegetative, sensitive, appetitive, and motive faculties. Thomas Aquinas held, similarly, that as the soul is immaterial, it can not be destroyed through the removal of its substratum. The form-producing principle of the body, the vital force, the appetitive, sensitive, and motive powers, belong to the thinking substance, and do not inhere in the body; hence are immortal. Pure thought acts without organs; the lower functions of the soul act with organs created for temporary manifestation. This view substantially agrees with that of the Neo-Platonists, except as to the origin of the soul. "The soul is immaterial, and whole or entire in every part of the body"; this statement is constantly repeated by thinkers since Aristotle. Plato's doctrine of pre-existence and reminiscence is indorsed by some of the Platonizing Christian thinkers like Origen, Synesius, and Nemesius, but is generally repudiated, as by Arnobius, Justin Martyr, Gregory of Nyssa, St. Augustine, Æneas of Gaza. With Descartes, thinking substance is so sharply distinguished from matter that only divine intervention will account for their interaction. Geulincx, Malebranche, and Leibnitz presented different solutions of this dualism, but Spinoza boldly denied it altogether, making mind and matter two attributes of one substance. La Mettrie, a pupil of Boerhaave, observing the effect of the increased circulation of the blood upon his thoughts during a fever, concluded that psychical functions are all to be explained by the organization of the body. Diderot held that atoms are endowed with sensation, and that when combined in the animal organism they become conscious, thus reviving the doctrine of Democritus and Epicurus, who made the soul material, and perishable upon the separation of its constituent atoms. Carl Vogt makes the phenomena of the soul to be functions of the brain and nerves. Moleschott and Büchner have promulgated and popularized the same doctrine. Kant endeavored to show that the metaphysical argument which proved the immortality of the soul from its nature as simple substance is a paralogism, because the Ego which thinks is subject only, and does not appear as object in consciousness. Herbart, however, defends the idea of the soul as a simple, spaceless essence; and his disciple, Beneke, expounds the same doctrine. Trendelenburg returns to the Aristotelian definition: "The soul is a self-realizing, teleological idea; not a result, but a principle." At present there is great activity among the physiological school of writers, who are investigating the physical correlates of psychical action. See articles on PSYCHO-PHYSICS, PSYCHOMETRY, PSYCHOLOGY, HYPNOTISM, IMMORTALITY, and other topics relating to the soul. WILLIAM T. HARRIS.

**Soulé**, CAROLINE AUGUSTA: See the Appendix.

**Soule**, Joshua, D. D.: bishop; b. at Bristol, Me., Aug. 1, 1781; was licensed as a Methodist preacher 1798; was presiding elder of the Maine district 1804–13; was author of the plan for a delegated general conference of his Church, adopted at Baltimore 1808; was editor of *The Methodist Magazine* 1816–20; declined a bishopric 1820, but was again elected and accepted 1824; resided for several years at Lebanon, O.; was a delegate to the British Wesleyan Conference 1842; adhered to the Methodist Episcopal Church South on the division of the Church 1844; settled at Nashville, Tenn.; visited California on an episcopal tour 1853–54; continued active in the discharge of the duties of the post until his death at Nashville, Mar. 6, 1867.

**Soulé**, soo'lā', Pierre: U. S. Senator; b. at Castillon, France, in Sept., 1802; educated for the Roman Catholic priesthood in the Jesuit college at Toulouse; studied afterward at Bordeaux. Being implicated in a conspiracy against the government of Louis XVIII., he fled to a village in Navarre, where for more than a year he followed the occupation of a shepherd; then went to Paris; became a writer for a republican newspaper, *Le Nain*; was imprisoned in Ste.-Pélagie for an attack on the ministry; escaped to England; removed to the U. S. and settled at New Orleans 1825; was U. S. Senator 1847–53, and distinguished for extreme Southern views; was appointed minister to Spain 1853; had a duel with the French ambassador at Madrid; took part in the Ostend conference of Oct., 1854, intended to facilitate the acquisition of Cuba; returned to the U. S. 1855; opposed the secession of Louisiana, but ultimately adhered to the movement, and visited Europe as Confederate agent 1861; was imprisoned for disloyalty at Fort Lafayette 1862; was released on condition of leaving the country; went to Europe, where he remained six years; returned to Louisiana 1869. D. in New Orleans, Mar. 16, 1870.

**Soulié**, soo'li-ā', Melchior Frédéric: novelist and poet; b. at Foix, department of Ariège, France, Dec. 23, 1800; studied law; made his *début* in literature in 1824 with a volume of poems, *Amours français*, which passed by almost unnoticed, and wrote in 1828 *Roméo et Juliette*, and in 1829 *Christine à Fontainebleau*, which had much effect on the stage. Others of his dramas were also successful—*Clotilde* (1832) and *La Closerie des Genêts* (1846); but it was principally as a novel-writer that he became famous. He wrote about 150 volumes of novels, some of which became very popular, such as *Le Comte de Toulouse* (1835); *Un Été à Meudon* (1836); and *Mémoires du Diable* (1837–38). D. at Bièvre, near Paris, Sept. 23, 1847.
Revised by A. G. Canfield.

**Soulouque**, soo'look', Faustin Élie: soldier and politician; b. at Petit Goyave, Haiti, about 1785. He was originally a Negro slave; took part in the early insurrections and in the civil wars on the side of the blacks; rose to be general of division, and, owing to his race and long services, possessed great influence with the Negroes. On Riché's death the senate elected Soulouque president Mar. 1, 1847. Apparently the senators had imagined that he would be their facile tool, owing to his age and ignorance; but he displayed unexpected energy, and his leadership of the blacks soon gave him dictatorial power. In Mar.–Apr., 1849, he invaded the Dominican Republic, but was repulsed. Notwithstanding this reverse he was able to have himself proclaimed emperor Aug. 26, 1849, and was crowned as Faustin I. in 1852; he promulgated a constitution, but practically had despotic power. His rule in some respects was wise, but his persecution of the mulattoes was unrelenting. In 1855 he was disastrously defeated by Santana in a second invasion of the Dominican Republic. In Jan., 1859, a successful revolt of the mulattoes under Geffrard drove him into exile at Jamaica. He was allowed to return in 1867, and died at Petit Goyave, Aug. 6 of that year. H. H. Smith.

**Soult**, soolt, Nicolas Jean de Dieu, Duke of Dalmatia: soldier; b. Mar. 29, 1769, at St.-Amans-la-Bastide, department of Tarn, France; the son of a farmer; entered the ranks of the army in 1785; became a captain in 1793, brigadier-general in 1794, general of division in 1799, and marshal of France in 1804. He distinguished himself greatly in the battles of Austerlitz and Jena, and was made Duke of Dalmatia after the Peace of Tilsit. He was then placed in command of the second corps in Spain, and succeeded in forcing the British to evacuate the country. In 1809 he became commander-in-chief, and soon afterward gained the victory of Ocaña. On 1811 he lost the battle of Albuera, and, discouraged by his reverses and the obstinacy of Joseph Bonaparte, obtained his recall, but after the defeat of the French and Spanish at Vittoria was again placed in command. Though he displayed great skill and energy he was compelled to retreat into France, and was defeated at Orthez and before Toulouse. Made Minister of War during the first restoration, he joined Napoleon during the Hundred Days, and lived in exile at Düsseldorf from 1815 to 1819. Allowed to return in the latter year and reinstated in his dignities in the army, he soon won the favor of Charles X., and was made a peer of France in 1827. Under Louis Philippe, between 1834 and 1847, he was several times Minister of War, Minister of Foreign Affairs, and president of the cabinet, but in 1847 retired from public life, having been made a marshal-general of France—a dignity which had been conferred previously only on Turenne and Villars. D. at St.-Amans, Nov. 26, 1851. The first part of his *Mémoires* was published by his son in 1854, in three volumes.



**Sound**: See Acoustics.

**Sound, Diffraction of**: the deviation of sound-waves in passing an obstacle. It was shown by Huyghens, in 1678, that if a wave is propagated in an elastic medium each point in the wave-front is a center from which secondary waves are propagated. If the main wave passes an obstacle, the edge of this serves as a center around which the secondary waves become perceptible. The extent of this deviation depends jointly on wave-length and velocity of propagation, increasing with wave-length and diminishing with velocity. It follows that a mathematical shadow is not possible, but in the case of light the waves are so short and they are propagated so rapidly that the deviation due to diffraction is exceedingly small. Sound-waves, on the contrary, may be many feet in length, and the rate of propagation through air is only about a fifth of a mile per second. To render acoustic diffraction effects perceptible the waves must be very short, and this implies high pitch.

Lord Rayleigh was the first to demonstrate the diffraction of sound with any approach to exactness. (Royal Institution lecture, Jan. 20, 1888.) The source of sound was an adjustable whistle, or bird-call, the pitch of which exceeded 20,000 vibrations per second. This exceeds the limit of audibility for the average ear, and therefore a sensitive flame was employed as an indicator. An acoustic diffraction grating served to bring sound-waves to a focus, as light is focalized with a lens. Stevens (*American Journal of Science*, Apr., 1889), using the flame indicator and a whistle giving 13,000 vibrations per second, succeeded in mapping out the lines of interference produced by diffraction behind a screen, through which two openings had been made for the transmission of waves. Also aërial bands of noise and silence were traced out with the flame, these being produced by interference of direct and reflected waves of sound from the whistle. The position of these bands was found to accord well with the results of calculation based on the theory of interference. W. Le Conte Stevens.

**Sound-pendulum**: See Recording Apparatus, Psychological, in the Appendix.

**Sound, Refraction of**: See Refraction.

**Sou'ris**: port of entry of King's County, Prince Edward island, Canada; on both sides of the mouth of the river Souris (see map of Quebec, etc., ref. 1–C). There are two villages, East and West Souris. Fishing and ship-building are carried on. Pop. 700.

**Sour-sop**: the fruit of the *Anona muricata*, a beautiful tree of tropical America. The sour-sop often weighs 2 or 3 lb. Its taste is sour and pleasant. It is very soft and white, and is much eaten in the West Indies.

**Sourwood**: See Sorrel-tree.

**Sousa**, John Philip: See the Appendix.

**Sousa**, or **Souza**, soo'zaă, Martim Affonso, de: soldier and colonizer; b. at Bragança, Portugal, about 1500. He was of noble family, and a member of the royal council. In 1530 he was placed in command of five vessels and 400 men, with orders to explore the coast of Brazil and plant there a permanent Portuguese colony; at the same time he was created governor of New Lusitania, as Brazil was then officially named, and was empowered to distribute lands. After a careful survey, extending to the Rio de la Plata, he founded the first Portuguese colony, São Vicente (near the modern Santos), Jan. 22, 1532; soon after, Piratininga, now São Paulo, was founded by his orders. He then returned to Portugal, and on his recommendation the Brazilian coast was divided into the hereditary captaincies which, with various changes were the bases of the modern states. Martim Affonso himself received a grant of the most important of these captaincies, that of São Vicente, then comprising all of Southern Brazil. He did not personally return to it, but it flourished under governors whom he selected. He was admiral of the seas of India 1534–40, and gained there several brilliant victories; in 1542–45 he was governor of the Portuguese East Indies. D. in Lisbon, July 21, 1564.

HERBERT H. SMITH.

**South**, ROBERT, D. D.: preacher and controversial writer; b. at Hackney, London, England, in 1633; studied as a king's scholar at Westminster School under Dr. Busby; entered Christ Church, Oxford, and graduated 1654 (D. D. 1663); took orders in the Church of England 1658; was university orator 1660; became chaplain to the Earl of Clarendon and tutor to his children 1661; was made prebendary of Westminster 1663; chaplain to the Duke of York 1667; canon of Christ Church 1670; chaplain to Lawrence Hyde (afterward Earl of Rochester) 1676, and accompanied him on an embassy to John Sobieski, King of Poland, 1677; became on his return rector of Islip, Oxfordshire, 1678, and soon afterward chaplain to King Charles II.; was a vigorous advocate of passive obedience and of the divine right of kings, and a powerful opponent of Dissenters, and was esteemed one of the most eloquent preachers of the time. D. in London, July 8, 1716. He caused much talk in his time by his controversial publications against Rev. Dr. William Sherlock, dean of St. Paul's, whom he accused of tritheism. He published collected editions of his sermons (London, 1692, 6 vols.; 4th ed. 1715; new ed. enlarged 1744, 11 vols.; edited by W. G. T. Shedd, New York, 1867, 5 vols.). See his complete works, with memoir (Oxford, 1823, 7 vols.; new ed. 5 vols., 1842). A selection, with memoir, appeared in London 1867. Revised by S. M. JACKSON.

**South African Republic**, or **Transvaal' Republic**: formerly one of the independent Boer states in South Africa, now a colony of Great Britain, lying between the Vaal river on the S., the Limpopo river on the N., between the Portuguese coast possession on the E., and British Bechuanaland on the W. By treaty with Great Britain (1884 and 1890) the New Republic formed by the Boers in Zululand, and a small part of Swaziland and Amatongaland, were added to the South African Republic, which has an area of 113,642 sq. miles and a white population (estimated 1897) of about 250,000. The black population is estimated at about 375,000, East Bechuanas and various other Kaffir tribes. On Feb. 21, 1895, Swaziland was placed under the protection and administration of the republic. It has an area of 6,150 sq. miles, and a population of 60,000 natives, besides 600 (in winter 1,500) whites.

*Physical Features, Products, etc.*—The country is a healthful, high, and undulating plateau, with wide-spreading hill and mountain features extending through the interior, from the southern border almost to the northern frontier. It is abundantly timbered near its eastern border. Its western and northwestern portions are steppe-like in character. Its best agricultural resources are found on the high, well-watered plains of the southern portion, and the greater part of the country is well adapted for farming and stock-raising.

The Boers are pre-eminently stock-raisers and their sheep and cattle form their principal wealth. Great as the resources of the country are, the Boers are not yet able to supply all the food required by the enormous influx of gold-miners. About 50,000 acres are under cultivation.

The southern and southeastern districts are the greatest centers of South African gold-mining, and in a few years have made South Africa the third largest gold-producer in the world. The output in 1892 was 1,325,394 oz., by far the greater part of which came from the Witwatersrand and Barberton districts; in 1893, 1,610,335 oz.; in 1894, about 2,200,000 oz.; and in 1895, 2,494,487 oz. In 1886 the site of Johannesberg on the Witwatersrand was occupied by a few huts where now (1896) stands a city of 102,714 inhabitants. The capital is PRETORIA (*q. v.*). Excellent coal is also found; lead and silver are being mined, and there are rich resources of iron. In its mineral and agricultural resources the republic is one of the richest regions of like extent in the world, but, except in gold-mining, little has yet been done to develop its natural wealth.

The total mileage of railways open in Sept., 1898, was 774, under construction 270, and projected 252. The line from Capetown to Kimberley has been extended to Pretoria. The extension of the Natal line from Charlestown on the southern frontier to the capital was opened in 1895, as was the railway from Delagoa Bay to Pretoria (a distance of 295 miles). Important articles of export are gold, wool, cattle, grain, skins, leather, fruit, tobacco, butter, brandy, ostrich-feathers, ivory, silver, lead, and copper. The revenue in 1898 was £3,983,560 (£1,066,995 was from the gold-fields); expenditure, £3,971,473; imports, £10,632,893; exports, about £9,000,000. The public debt on Dec. 31, 1898, was £2,660,394. See SOUTH AFRICAN REPUBLIC in Appendix.

*History.*—For the early history of the Boers, who are of Dutch and Huguenot descent, see CAPE COLONY. A number of them, who had left Cape Colony for Natal, again removed from under British rule and founded the South African Republic, which was recognized as a free state by the British, in 1852. In consequence of trouble with the natives it was annexed by the British in 1877; but in 1880 the Boers revolted, and in 1881 the retrocession of the country took place under British suzerainty, which underwent a modification in 1884. There have been frequent wars with the Kaffirs, who in 1894 suffered a severe defeat Aug. 29. The constant friction between the Boers and the great number of British subjects, who emigrated into the country through the development of the gold mines, led up to the Transvaal war of 1899–1900. (See AFRICA.) After the capture of Pretoria by Lord Roberts it was made the Transvaal colony of Great Britain.

See Greswell, *Geography of Africa, South of the Zambezi*; Keltie, *The Partition of Africa*; Mather, *Zambesia*; and Silver, *Handbook of South Africa*. C. C. ADAMS.

**South Amboy**: borough (founded in 1835); Middlesex co., N. J.; on Raritan Bay at the mouth of the Raritan river, and on the Penn., the N. Y. and Long Branch, and the Raritan River railways; 37 miles S. W. of New York city, 60 miles N. E. of Philadelphia (for location, see map of New Jersey, ref. 3–D). It is a large coal-shipping point, and contains Baptist, Methodist Episcopal, Methodist Protestant, Presbyterian, Protestant Episcopal, and Roman Catholic churches, two large public schools, a large Roman Catholic parochial school, asphaltum-works, several potteries, clay-pits, sand-pits, a national bank with capital of $50,000, and a weekly newspaper. Pop. (1880) 3,648; (1890) 4,330.

M. N. ROLL, EDITOR OF "CITIZEN."

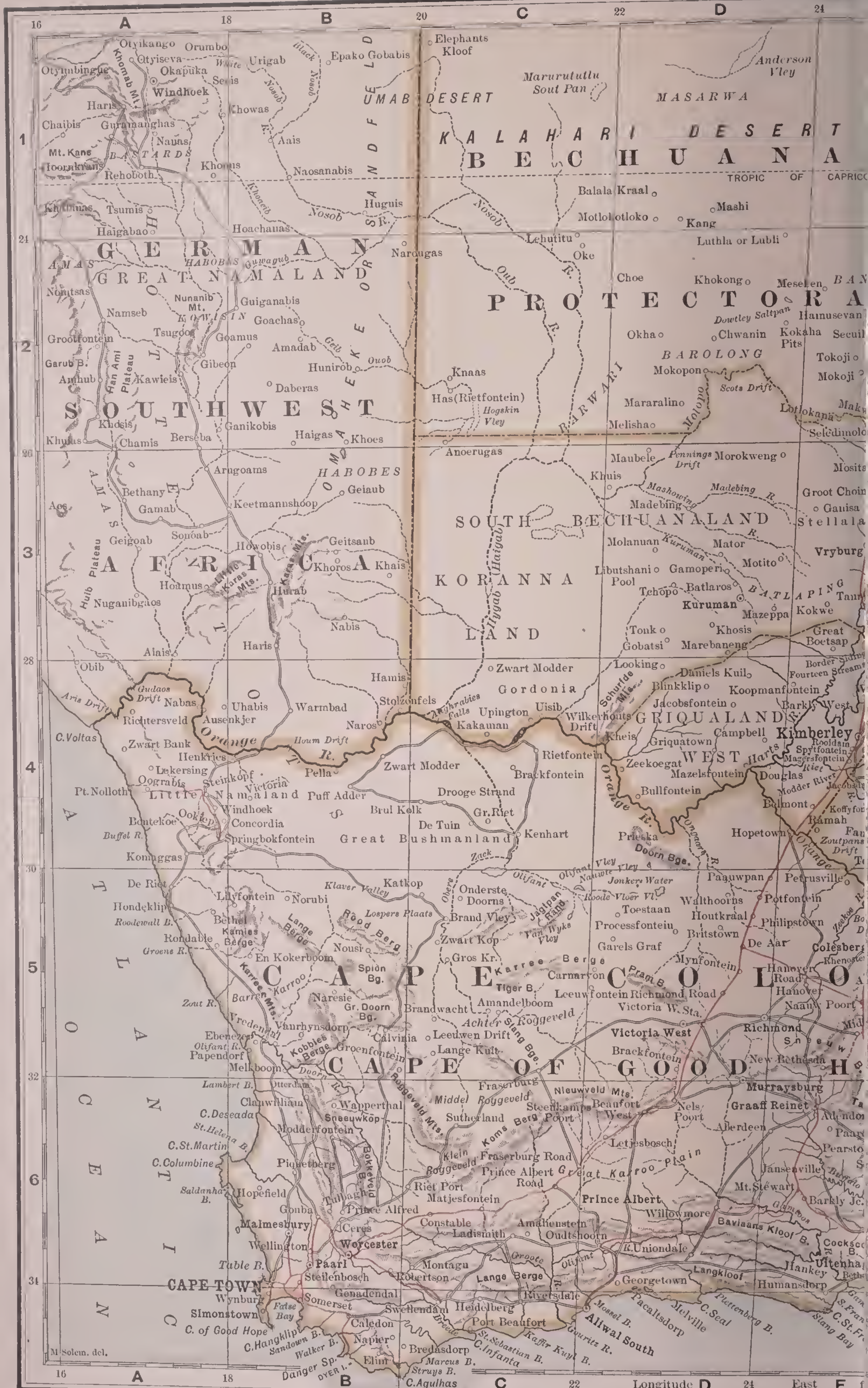
**South America**: See AMERICA, SOUTH.

**Southampton**, county of England: See HAMPSHIRE.

**Southampton**: seaport in Hampshire, England; on a peninsula, at the head of Southampton Water; between the estuaries of the Test and Itchen; 23 miles N. W. of Portsmouth and 79 miles by rail S. W. of London (see map of England, ref. 13–H). Of the walls built in the time of Richard II. there are considerable remains, and four of the seven gates are well preserved. Southampton contains many old buildings, among which is the *Domus Dei*, an hospital dating from the thirteenth century; also St. Michael's church (1080), since altered and restored. Among modern structures are the Watts Memorial Hall (1876); St. Mary's Church, designed by Street; and the Hartley Institution, a college with thirteen teachers. The old docks (1842 and 1851) have been greatly improved and extended, and a new tidal dock, 18 acres in extent, was opened in 1890. There are also four dry docks. A graving-dock, the largest in Great Britain, was opened in 1895. Mail steamers for the U. S., the West Indies, Brazil, and South Africa arrive and depart here, and vigorous efforts have been made to compete with Liverpool in this respect. There are large exports of British manufactures. Provisions, etc., from France and the Channel islands, and cattle from Spain and Portugal are imported. In 1893 the total tonnage entered and cleared, exclusive of that coastwise, was 2,130,753. Ship-building and the manufacture of engines are carried on. About a mile N. was the Roman station of Clausentum. The present town was founded by the West Saxons soon after 495; it is mentioned as Hantune in Domesday Book. The parliamentary borough returns two members. Pop. (1891) 82,126; (1900) 103,500.

**Southampton** (P. O. name SAUGEEN): a port of entry of Bruce County, Ontario, Canada; at the mouth of Saugeen river, on Lake Huron; 60 miles N. by E. of Goderich (see map of Ontario, ref. 3–C). It is the northwest terminus of the Wellington, Grey, and Bruce Branch of the Grand Trunk Railway. Grain and lumber are the chief exports. Pop. 1,200.

**Southampton**: village (incorporated in 1894); Suffolk co., N. Y.; on the south shore of Long Island, between



GERMAN SOUTHWEST AFRICA
GREAT NAMALAND
BECHUANA PROTECTORATE
KALAHARI DESERT
UMAB DESERT
SOUTH BECHUANALAND
KORANNA LAND
GRIQUALAND WEST
CAPE COLONY
CAPE OF GOOD HOPE
ATLANTIC OCEAN
Little Namaland
Great Bushmanland
Gordonia
TROPIC OF CAPRICORN
Windhoek
Rehoboth
Keetmannshoop
Gibeon
Bethany
Warmbad
Upington
Kakaman
Kimberley
Kuruman
Vryburg
Griquatown
Campbell
Barkly West
Hopetown
Prieska
Colesberg
Richmond
Victoria West
Beaufort West
Graaff Reinet
Murraysburg
Calvinia
Clanwilliam
Piquetberg
Malmesbury
Wellington
Paarl
Stellenbosch
Worcester
Ceres
Tulbagh
Robertson
Montagu
Ladismith
Oudtshoorn
Prince Albert
Willowmore
Uniondale
Georgetown
Riversdale
Heidelberg
Swellendam
Caledon
Bredasdorp
Napier
Somerset
Wynburg
Simonstown
CAPE TOWN
Table B.
False Bay
C. of Good Hope
C.Hangklip
C.Agulhas
Danger Sp.
Saldanha B.
St.Helena B.
C.Columbine
C.St.Martin
C.Deseada
Lambert B.
Zout R.
Groene R.
Hondeklip
Port Nolloth
C.Voltas
Springbokfontein
Concordia
O'okiep
Orange R.
Mossel B.
Allwal South
Port Beaufort
Great Karroo Plain
Nieuweveld Mts.
Roggeveld Mts.
Karree Bge.
Kamies Berge
Lange Berge
Hankey
Humansdorp
Uitenhage
Pt. Nolloth
M Solem. del.
Longitude
East
16 18 20 22 24
A B C D E
1 2 3 4 5 6


SOUTH AFRICA
SCALE OF MILES
0 20 40 60 80 100 200
Railroads
Roads
L.L.Poates, Engr., N.Y.
TRANSVAAL
SOUTH AFRICAN REPUBLIC
ORANGE FREE STATE
NATAL
BASUTO LAND
GRIQUALAND EAST
PONDO LAND
TEMBULAND
TRANSKEI
ZULU LAND
SWASI LAND
TONGA LAND
PORTUGUESE EAST AFRICA
INDIAN OCEAN
BAMANGWATO
BAKWENA
PRETORIA
Johannesburg
Pietersburg
Lydenburg
Barberton
Lourenço Marquez
Delagoa Bay
Mafeking
Potchefstroom
Kroonstad
BLOEMFONTEIN
Harrismith
Ladysmith
PIETERMARITZBURG
Durban
Port Natal
Aliwal North
Dordrecht
Queenstown
East London
Grahamstown
Port Alfred
Port Elizabeth
Algoa Bay
Port Shepstone
Port St. Johns
Kokstad
Maseru
Palapye
Shoshong
Molopolole
Limpopo R.
Vaal R.
Tugela R.
Umzimvubu R.
Umtata R.
Gr. Kei R.
Greenwich
E F G H J
26 28 30 32 34
1 2 3 4 5 6

Peconic Bay and the Atlantic Ocean, and on the Long Island Railroad; 90 miles E. by S. of New York (see map of the State of New York, ref. 8–F). It is the oldest English settlement in the State of New York; was known to the Indians as Agawam; settled by colonists from Lynn, Mass., in 1640; self-governed till 1645, when it attached itself to Connecticut; granted to the Duke of York by Charles II. in 1664; and has since belonged to New York. It was occupied by the British during the Revolutionary war, and has a well-preserved fort of that period. The village contains 4 churches, graded public school, kindergarten, Rogers Memorial Library (incorporated in 1893, building erected in 1895), a State bank with capital of $25,000, 3 halls, electric lights, and a weekly newspaper. It is principally engaged in agriculture, has brick and tile works, and is a popular summer resort. Pop. (1900) 2,289.

C. A. Jagger, Ph. D., editor of "Seaside Times."

**Southampton**, Henry Wriothesley, Third Earl of: statesman; b. Oct. 6, 1573; was a patron of Shakespeare, who dedicated to him the poems *Venus and Adonis* and *The Rape of Lucrece*. He was a friend of the Earl of Essex, whom he accompanied to Cadiz, and in 1599 to Ireland; was accused of complicity in the treasonable designs of Essex; protested his innocence; was convicted, and sentence of death and attainder was pronounced, but Elizabeth remitted the death-penalty, and the attainder was removed by Parliament soon after the accession of James I. He was an assignee of the patents of settlement of Sir Walter Raleigh, and took a prominent part in the early colonization of America, and in the second charter of Virginia his name occupies a leading position, and he became the governor of the Virginia Company. In Parliament he was a firm supporter of liberty; and in 1621 was committed to close custody by the king, but was released through the influence of Buckingham. He soon after went, accompanied by his son, Lord Wriothesley, to the Netherlands, to aid the Dutch in their struggle against Spain, and took command of a regiment. D. at Bergen-op-Zoom, Holland, Nov. 10, 1624.

**Southard**, Samuel Lewis, LL. D.: U. S. Congressman; son of Henry Southard, also a Congressman; b. at Baskingridge, N. J., June 9, 1787; graduated at Princeton 1804; taught school in New Jersey, and was a family tutor in Virginia several years, during which time he studied law and was admitted to the bar; settled at Flemington, N. J., 1811; appointed law-reporter by the Legislature 1814, associate justice of the Supreme Court 1815; was U. S. Senator from Jan. 22, 1821, to 1823, serving a considerable time as president *pro tem.* of that body; was appointed by President Monroe Secretary of the Navy 1823; was acting Secretary of the Treasury four months 1825, and for a short time acting Secretary of War; was chosen attorney-general of New Jersey 1829; Governor 1832; U. S. Senator 1833; resigned May 3, 1842. He became a trustee of Princeton College 1822, and soon afterward of the Theological Seminary, and was offered, but declined, the Whig nomination for Vice-President on the ticket with William H. Harrison, thereby losing also the post of President, to which he would have succeeded by Harrison's death, on which occasion, however, he was for the second time chosen president *pro tem.* of the Senate. D. at Fredericksburg, Va., June 26, 1842.

**South Australia**: one of the seven British colonies of Australasia, occupying a central north and south band of Australia, from the Arafura Sea to the Southern Ocean, with Queensland, New South Wales, and Victoria on the E. and Western Australia on the W.; between the parallels of 11° S. and 38° S. (see map of Australia). The meridian of 129° E. forms the western boundary; on the E. the boundary is the meridian of 138° from the Gulf of Carpentaria S. to 26° S., thence southward it is the meridian of 141° E. The greatest length is 1,850 miles N. and S., and the average breadth 650 miles. It also embraces a number of islands, of which the largest are Kangaroo island (1,700 sq. miles), off the mouth of St. Vincent Gulf in the Southern Ocean; Melville island (80 miles long by 30 broad) and Bathurst island, both off Port Darwin, in the Arafura Sea; and Groote Eylandt (about 40 miles in each direction) in the Gulf of Carpentaria. Total area, 903,690 sq. miles. The district N. of the parallel of 26° S. is called the Northern Territory.

*Physical Configuration.*—South Australia has a coast 2,000 miles long, of which 1,100 miles are on the Southern Ocean, in large part on the desolate shores of the great Australian Bight, which has a few minor bays, as Port Eyre and Denial, Smoky, Streaky, and Coffin Bays. On the meridian of 137° E. the shore is broken by the great Spencer Gulf, extending N. 200 miles, with a greatest width of 70 miles, and in the extension of its axis, but not connected with it, are Lake Torrens and the Eyre lakes, two of them the largest lakes in the colony. On the west side of Spencer Gulf the country is arid and infertile, but on the east it is fertile and has great mineral wealth. Further E. is the smaller St. Vincent Gulf, separated from Spencer Gulf by Yorke Peninsula and sheltered at its mouth by Kangaroo island. The country to the E. is the most thickly populated in the colony and contains Adelaide, the capital. Next E. is the broad shallow Encounter Bay, and behind its low sandy shores are Lakes Alexandrina and Albert, expansions of the Murray river, and connected with them the long, slender, coastal lagoon called Coorong.

The northern coasts about the great northern peninsula between the Indian Ocean and Gulf of Carpentaria are generally bold, very irregular, in places a continuous series of bays separated by peninsulas of odd and irregular forms. The chief port is Port Darwin, a narrow, deep bay near the northwestern angle of the peninsula, opening on Clarence Straits just S. of Melville island. On it is situated Palmerston, the capital of the Northern Territory and terminus of the transcontinental telegraph line and proposed transcontinental railway line.

The interior is little known, but in the center is a mountainous region, with the ranges running nearly E. and W., and reaching generally but slight elevations, rarely surpassing 3,000 feet anywhere in the colony. The culminating range seems to be the McDonnell, nearly under the Tropic of Cancer. To the S. of the central mountains is a great district with many bodies of water which are called lakes, and occupy much space on the map, but are really salt-water lagoons. W. of the mountainous and lagoon districts and along the whole western boundary is an arid, infertile, desolate region forming an extension of the Great Victoria Desert, the Gibson Desert, and the Great Sand Desert of Western Australia. The northeastern part of the great northern peninsula, or Arnhem Land, is an elevated plateau sloping gently toward the east and abruptly toward the north. To the W. of it the country is better watered and more fertile.

Very few of the streams of the colony reach the sea, and the most of these are in the Northern Territory. The largest are the Roper river, which empties into Limmen's Bight, Daly river, which contributes to Anson Bay, and the Victoria river, the largest on this coast, which empties into Queen's Channel. At less than 50 miles from its mouth it degenerates into a series of ponds, and fails to flow except in the rainy season. On the south coast the Murray passes for a short distance in its lower course through this colony, and, after expanding into Lakes Alexandrina and Albert, forms only a small and shallow stream over the littoral sands. It receives no important tributary in the colony. A few small streams empty into St. Vincent and Spencer Gulfs, but from the extreme of Eyre's Peninsula to the western boundary, along the Australian Bight, there are no streams. The interior streams are insignificant, except at times of flood. They are lost in the sands or find their way at high water to some of the lakes. They drain a great interior basin which, though it reaches within a few miles of the sea at the northern extremity of Spencer's Gulf, never contributes to it, nor apparently has it done so in the present geological period. The basin is broken up into several secondary basins which seem to be remnants left by progressive aridity.

*Climate.*—The temperatures in the settled districts about Adelaide are those of Southern France and Northern Italy. The winter mean temperature is from 50° to 55° F. near the coast, but ice forms inland at slight elevations, with light frosts on the plains. The summer has a moderate mean temperature (65° to 70° F.), but the clear skies, dry air, and hot winds from the interior make it disagreeable, with high shade-temperatures daily. The Northern Territory is tropical and hot, resembling Guinea, Guiana, and Central America, and in the interior the Sahara. The rainfall is less than 5 inches annually over the interior from lat. 20° S. to lat. 32° S., and gradually increases to the southeast to 30 inches and to the north to 60 inches. At Adelaide there are 120 days of rain annually, yielding 21 inches. On the northern coast the annual rainfall may reach 63 inches. Over most of the Northern Territory the rainy season is January and February, when the rain is very heavy; in the southeast there are summer and winter rainy seasons; and in the arid interior rain is very irregular in occurrence, sometimes lacking for years, at others coming in torrents for a few minutes or an hour or two. In general the colony is very healthful for colonists, but the northern coasts have the usual malarial diseases of a virgin tropical soil, with heavy rainfall. These are found to disappear in time after the soil is cultivated.

*Minerals.*—The mineral products of South Australia for 1892, and the entire production to the end of 1892, with the percentage of the total Australasian product, are given in the following table:

| MINERALS. | IN 1892. | | TOTAL TO END OF 1892. | |
|---|---|---|---|---|
| | Value. | Per cent. | Value. | Per cent. |
| Gold | £226,284 | 0·020 | £1,430,622 | 0·004 |
| Silver | ........ | ..... | 101,727 | 0·007 |
| Copper | 175,525 | 0·582 | 20,162,292 | 0·773 |
| Tin | 2,433 | ..... | 20,812 | 0·001 |
| Coal | ........ | ..... | .......... | ..... |
| Other minerals | 2,769 | 0·005 | 402,824 | 0·134 |
| Totals | £316,079 | 0·025 | £22,118,286 | 0·049 |

The most important mineral product is copper, and the colony owes its continued existence at a critical time to the opportune discovery of the famous Burra Burra copper-mining district, 90 miles N. of Adelaide. The mines were developed in 1845 and for some years paid their owners 800 per cent. on the investment, but were temporarily abandoned in 1864 because of the difficulty of transport, and reopened on the construction of the railway from Adelaide to Kuringa. There is a rich and large copper district 300 or 400 miles N. of Adelaide. Gold is obtained from mines in the southern hills S. of Adelaide (at Echunga, etc.), at Wakaringa, about 225 miles N. of Adelaide, and at other places, but chiefly from the Northern Territory, where there is a large alluvial and auriferous quartz region 100 to 150 miles S. of Port Darwin. Gold was discovered in the colony in 1852, the year after the rush to the Ballarat fields. The production of silver, never large, has nearly ceased. Among the other valuable or interesting minerals may be mentioned iron, marble, gypsum, mica (in the McDonnell range), garnets, and coorongite, an elastic mineral similar to elaterite, discovered in the Coorong lagoon on Encounter Bay.

*Agriculture.*—South Australia is essentially an agricultural and pastoral country. The value of the crops for the season 1892–93 was approximately £3,327,286, less than the corresponding values in Victoria, New Zealand, and New South Wales, but more than for the other Australasian colonies. The value of the crop per acre was £1 12*s.* 8*d.*, the least in the seven colonies, the greatest being Tasmania, where it is £5 15*s.* 1*d.*; but the value per head of population was nearly £10, the greatest in the seven colonies. In the season of 1892–93 the total area under crops was only one-third of 1 per cent. of the area of the colony, or 2,037,653 acres. Three-quarters of this was in wheat, 21 per cent. in hay, and only fractions of 1 per cent. in each of the other crops—vines, oats, barley, and potatoes. The area of land under cultivation has increased fivefold since 1861, about the same ratio as that throughout Australasia. Wheat is the staple crop, but the production per acre was only 6·1 bush. in 1892–93, while it was 22 bush. for New Zealand, and nearly 11 bush. for all Australasia; yet owing to favorable conditions of culture 7 bush. in South Australia is considered a satisfactory crop. The colony exported 4,000,000 bush.—as wheat or flour—in 1892. The average yield for oats was 11 bush. per acre, for barley 13 bush., for potatoes 4 tons (worth £10), of hay less than 1 ton per acre. Considerable attention is paid to the vine. In the season of 1891–92 594,000 gal. of wine and 3,640 tons of table-grapes were produced. About 80 gal. of wine per acre was the product for bearing vineyards—about that of Italy and Hungary.

The importance of irrigation has long been recognized in the other colonies, but only recently has it been attempted on a large scale in South Australia. In 1888 a private company began operations at Renmark, on the river Murray, close to the boundary of New South Wales, where an area of 250,000 acres was set apart for this purpose. Search for artesian sources of water has been carried on successfully. On the Nullarbor Plain, a part of the Victoria Desert, and near the shores of the Australian Bight, a well was drilled 777 feet and yielded 68,000 gal. per diem, and other wells have since brought water near to, or above, the surface. More successful are the wells near the central portion of the colony, and those at Herrgott Springs, Coward, Strangways, and Lake Harry give from 50,000 to 1,200,000 gal. a day.

The live stock possessed by the colony in 1892 gave a product valued at £3,086,930, or about 6 per cent. of that for all Australasia, and £9 6*s.* 5*d.* per head of population. Over 40 per cent. was given by the wool-clip alone. The number of animals in 1893 was: Sheep, 7,325,003; cattle, 675,284; horses, 201,484. In general, the number of stock is increasing nearly 3 per cent. yearly, and somewhat less rapidly than the population, but the number of swine is decreasing. The number of animals held by this colony is from 5 to 7 per cent. of those of Australasia, except the horses, of which the number is 11 per cent. The capacity of the colony for sheep is probably nearly reached, as the area adapted for them is relatively small and is being encroached upon by tillage. Should the expectation of finding artesian water over the arid regions generally be realized, however, an enormous area of land now worthless would be easily rendered suitable for tillage and pasture.

*Population.*—The population in 1844 was 17,366; in 1891, 320,431. Of the latter, 4,895 belonged to the Northern Territory, and 133,220 to the capital, Adelaide. On Dec. 31, 1893, the total population was 341,978 (177,219 males, 164,759 females), and that of Adelaide 140,549. In 1886 the number of aborigines living in the settled districts was 3,369. In 1891 the number was 3,134 (1,661 males, 1,473 females), and of Chinese 3,848 (adult males). In 1892 the number of marriages was 2,119; of births, 10,544; of deaths, 3,711; of immigrants, 15,688; of emigrants, 14,499.

The number of churches and chapels in the colony in 1899 was 969. As to religious denominations, the population in 1891 was divided as follows: members of the Church of England, 89,271; Wesleyans and Methodists, 50,813; Roman Catholics, 47,179; Lutherans, 23,328; Presbyterians, 18,206; Baptists, 17,457; Bible Christians, 15,762; Congregationalists, 11,882; Jews, 840. There is no state aid to religious establishments.

Education is compulsory and regulated by the state, but not free. In 1899 there were 284 public schools, 393 provisional schools, and 240 private schools, with an aggregate of 68,329 pupils; also a normal college and the University of Adelaide (founded in 1872).

In 1891 there were 28,847 persons (886 women) engaged in agriculture, 5,332 in pastoral pursuits, 582 in fisheries, and 4,992 in mining industries; 37,680 were engaged in other industrial pursuits, 26,209 in commercial, and 7,266 in professional pursuits.

*Commerce.*—Inclusive of bullion and specie, the value of the total imports in 1899 was £6,884,358, and of the exports £8,388,396, in both cases an increase on the preceding year. The principal exports are wool (£1,511,693 in 1899), wheat and flour (£761,259), and copper ore. The trade is almost entirely with the United Kingdom and the other Australasian colonies. The chief imports are iron, clothing, cottons, woolens, and machinery. In 1899 1,020 vessels entered and 1,025 cleared from the ports of the colony, and there were 227 sailing vessels and 108 steamers registered in it.

In 1899 there were 1,883 miles of railway in the colony, nearly all under state control. In 1886 the connection between Adelaide and Melbourne was completed, thus putting this colony in railway connection with the eastern colonies. In 1893 the transcontinental line between Adelaide and Port Darwin was completed from the S. to Oodnadatta, 686 miles N. of Adelaide, and from the N. to Pine Creek, 151 miles. Between these two places there remain 1,140 miles to be constructed. Aside from this the railways are all in the southeast corner of the colony. At the end of 1899 there were 5,691 miles of telegraph and telephone in use, with 16,937 miles of wire. This includes the 2,000 miles in the transcontinental telegraph line from Adelaide to Port Darwin, where connection is made with a cable to India and Europe.

*Administration.*—The executive functions are vested in a governor appointed by the crown and an executive council of six responsible members, viz., the chief secretary, premier and attorney-general, treasurer, commissioner of crown lands, commissioner of public works, and minister of education and agriculture. The constitution (dated 1856) vests the legislative power in a parliament of two houses—the Legislative Council, now of 24 members, each elected for nine years, and the House of Assembly, of 54 members, elected for three years. Each member of the council and assembly receives £50 a year and a free pass over the Government railways. There are 44 counties, 4 extensive pastoral districts, 33 municipalities, and 140 district councils in South Australia proper.

The administration of the Northern Territory is conducted by a government resident, who is directly responsible to the authorities of South Australia.

The colony has a supreme, a vice-admiralty, an insolvency, and 80 local and police courts. The force for defense consists of an efficient militia of 1,257 men and a volunteer force of 345. The chief port is protected by two forts and by a small armed cruiser of 920 tons. The revenue for the year ending June 30, 1900, was £2,780,858, and the expenditure £2,779,317. The most of the revenue is derived from customs, excise, post, telegraph and railway, and territorial receipts, while the expenditure is chiefly on account of state railways, and interest on the public debt. The last at the end of 1899 was £24,916,310, three-fourths of which was contracted for railways, water-works, and telegraphs, the net earnings from which exceed the interest charge.

*History.*—Lieut. James discovered Northumberland Cape in 1800, and in 1802 Lieut. Flinders completed a sketch of the south coast. The colony was founded in 1836 under the auspices of the South Australian Colonization Association, on a scheme of centralized colonization devised by Edward Gibbon Wakefield. The conditions were that the land should be sold at a high price—not less than £1 per acre—the money thus obtained to be used in importing laborers for pioneering and for the construction of roads, bridges, etc. Wakefield's plan resulted in a colonial bankruptcy in 1841, but the discovery of copper ore in large quantities soon after and gold in 1852, and the enlightened policies of Gov. McDonnell, resulted in the firm establishment of the colony with the constitution of 1856. Since that date the surplus energy of the colony has been chiefly expended in exploring its enormous domain and in constructing its transcontinental telegraph and railway. In 1831 a settlement was made at Port Essington, the northernmost part of the Northern Territory and used as a military post and harbor of refuge, but it was abandoned in 1850. In 1862 Stuart succeeded in crossing the continent from Adelaide to Adam Bay on the north coast, and in 1863 the whole of the Northern Territory was formally granted to South Australia. In 1864 a colony from Adelaide was established at Adam Bay, and in 1870 removed to Port Darwin. For Federation, see AUSTRALIA.

REFERENCES.—Coghlan, *The Seven Colonies of Australasia* (official, 1894); Harcus, *South Australia* (1876); Stow, *South Australia* (1885); Conigrave, *South Australia* (1886); Brown, *Mines of South Australia* (1890); Finnis, *Constitutional History of South Australia* (1886).

MARK W. HARRINGTON.

**South Bend**: city (settled by the French in 1820, incorporated as a town in 1835, as a city in 1865); capital of St. Joseph co., Ind.; on the St. Joseph river, at the source of the Kankakee river, and on the Chi. and Gr. Trunk, the Lake Shore and Mich. S., the Mich. Cent., the Ind., Ill. and Iowa, and the Vandalia Line railways; 85 miles E. of Chicago (for location, see map of Indiana, ref. 2–E). It is in a rich agricultural region, on a burr-oak plain, is regularly laid out with broad streets, and is noted for its great factories and attractive homes. The city has the stand-pipe system of water-works, supplied with pure artesian water from thirty-two flowing wells, which is pumped into a reservoir for distribution; complete system of trunk and local sewerage; gas and electric-light plants; electric street-railways connecting with Mishawaka, 4 miles distant; metropolitan police and paid fire departments; and many miles of paved streets and cement sidewalks.

*Churches and Schools.*—South Bend has 5 Methodist Episcopal churches, 4 Roman Catholic, 4 Baptist, 4 Lutheran, 3 Presbyterian, 2 Evangelical, 2 United Brethren, and 1 each Protestant Episcopal, Reformed, and Christian. There are 1 public high school and 9 ward schools, with public-school property valued at $1,500,000; St. Joseph's and St. Aloysius's academies; 6 parochial schools; commercial college; conservatory of music; a public and a school library; and a Roman Catholic and a Protestant hospital. South Bend is the seat of the University of Notre Dame (Roman Catholic, founded in 1842), and of St. Mary's Academy for young ladies (Roman Catholic, founded in 1845).

*Business Interests.*—The census returns of 1890 showed 161 manufacturing establishments (representing 46 industries), with a combined capital of $10,141,642, employing 5,341 persons, paying $2,389,858 for wages and $4,150,488 for materials, and turning out products valued at $8,427,158. The principal industry was the manufacture of carriages and wagons, with 9 establishments and $6,155,703 capital, and a product valued at $2,329,391. Agricultural implements ranked second, with 7 establishments and $1,919,708 capital, and products valued at $2,423,442. There were 10 tobacco-factories, 4 flour and grist mills, and 4 foundries and machine-shops. Other manufactures are sewing-machines, paper, pulp, patent medicines, woolen goods, chinaware, brick, varnish, windmills, and furniture.

*Finances and Banking.*—In 1894 the municipal receipts were $305,567; expenditures, $260,971; the net debt was $229,000; assessed property valuation, $20,000,000. There were 3 national banks with combined capital of $305,000 and a savings-bank with deposits of $1,500,000. Four building and loan associations in 1893 had 1,600 members, 495 borrowers, and 12,137 shares in force.

*History.*—South Bend is on historic ground, as past its northern border ran the old portage from the St. Joseph river to the head waters of the Kankakee, traversed by the red man for countless ages, and associated with the discovery of the great West as the spot where the white man first trod the soil of Indiana. Here La Salle landed in 1679 on his tour of exploration to the Mississippi, and here he camped many times thereafter. It was the site of a large village of the Miami Indians at that date and inhabited by the Pottawatomies in later years. Pop. (1880) 13,280; (1890) 21,819; (1900) 35,999.

R. H. LYON, EDITOR OF "TRIBUNE."

**South Berwick**: town; York co., Me.; on the Salmon Falls river, and the Boston and Maine Railroad; 10 miles E. of Rochester (for location, see map of Maine, ref. 11–A). It has manufactories of cotton and woolen goods, shoes, and carriages, and contains Berwick Academy (non-sectarian, chartered in 1791), public library, a national bank with capital of $100,000, and a savings-bank. Pop. (1880) 1,092; (1890) 3,434; (1900) 3,188.

**South Bethlehem**: borough; Northampton co., Pa.; on the Lehigh river, and the Lehigh Val. and the Phila. and Reading railways; 12 miles W. of Easton, the county-seat (for location, see map of Pennsylvania, ref. 4–J). It was settled in 1741, but its growth dates from 1850. The Bethlehem Iron Company, employing about 4,000 men, is the principal manufacturing establishment; it produces steel rails, billets, and forgings, and has large machine-shops, ordnance, and armor-plate works. Other industries are the Lehigh Zinc Works, Lehigh Brass Works, Bethlehem Foundry and Machine Company, several wood-working, knitting, and silk mills, and a cold-storage establishment. The Lehigh University, having eight large buildings and 500 students, is in the southern part of the borough. St. Luke's Hospital is in the western part, as also the Bishopthorpe School for girls. There are 13 churches, 2 daily newspapers, and an opera-house. The borough is lighted by gas and electricity, has two systems of water-supply, and is connected by electric railways with Bethlehem and with Allentown. Pop. (1890) 10,302; (1900) 13,241. M. M.

**Southboro**: town (incorporated in 1727); Worcester co., Mass.; on the N. Y., N. H. and Hart. Railroad; 28 miles S. W. of Boston (for location, see map of Massachusetts, ref. 2–G). It contains the villages of Southboro, Fayville, Cordaville, and Southville; has 4 churches, high school, 9 public schools, St. Mark's Academy, and a public library; and is principally engaged in agriculture and the manufacture of woolen goods. Assessed valuation (1894) nearly $1,500,000. Pop. (1880) 2,142; (1890) 2,114; (1900) 1,921.

**South Boston**: town; Halifax co., Va.; on the Dan river, and the Norfolk and West. and the Southern railways; 32 miles E. by N. of Danville, 109 miles S. W. of Richmond (for location, see map of Virginia, ref. 7–F). It is in a noted tobacco-growing region, has several large manufactories, and contains a public high school, female institute, 2 State banks with combined capital of $153,800, and 2 weekly newspapers. Pop. (1880) 328; (1890) 1,789; (1900) 1,851.

**Southbridge**: town (incorporated in 1816); Worcester co., Mass.; on the Quinnebaug river, and the N. Y. and New Eng. Railroad; 20 miles S. W. of Worcester, 70 miles S. W. of Boston (for location, see map of Massachusetts, ref. 4–F). It contains 7 churches, 19 public schools, 2 parochial schools, public library, a national bank with capital of $150,000, a savings-bank with deposits of over $1,500,000, and 3 weekly papers. The principal industries are the manufacture of optical instruments, cotton, woolen, and print goods, shuttles, and shoe-knives. Pop. (1880) 6,464; (1890) 7,655; (1900) 10,025. EDITOR OF "JOURNAL."

**South Caroli'na**: one of the U. S. of North America (South Atlantic group); the eighth of the original thirteen States that ratified the Federal Constitution; popularly known as the Palmetto State.

*Location and Area.*—It lies between lat. 32° 04′ 30″ and 35° 13′ 02″ N., lon. 78° 28′ and 83° 18′ W.; is bounded on the N. and N. E. by North Carolina, on the S. E. by the Atlantic Ocean, on the S. W. and W. by Georgia; coast-line, 210 miles; longest meridian and longest parallel, about 225 miles each, intersecting near Columbia; area (U. S. census), 30,570 sq. miles (19,564,800 acres), of which 400 sq. miles are water surface.

Seal of South Carolina.

*Physical Features.*—A great geologic break, passing through the State near Cheraw, Columbia, and Aiken, divides it into the "up country" and the "low country," and the two regions show marked differences. The up country is Primary in formation; the low country, Tertiary, with occasional Cretaceous outcroppings. The State is further divided by Mill (1825) and Hammond (1883) as follows: I. The Alpine region (1,000 sq. miles), in the northwest, has gneiss as its characteristic rock, with granite, hornblende, itacolumite-slates, limestones, and clays. The highest peaks in the State—Pinnacle, in Pickens County (3,436 feet), Cæsar's Head (3,118), Paris Mount (2,054), in Greenville, and King's Mount (1,692), in York—are capped with mica-slate, and have steep faces to the S. and E., contrary to the usual rule of the Atlantic slope. The mountains tend to break into isolated masses to the S. The soils are loams and clays, rich in lime and potash. Hills and valleys are clad in hardwood virgin forests. II. The Piedmont region (10,000 sq. miles) embraces the remainder of the up country. Excepting the Sea islands it is the most thickly settled portion of the State, and contains the center of white population. The surface is rolling, rising in places to 800 feet. Granite outcrops in three great parallel ridges. That of Fairfield has a national reputation for hardness, beauty, and ease of cleavage. Trappean rocks underlie large tracts of comparatively level lands. This region contains slates, and quartz is abundant as a surface-rock. The soil is chiefly granitic and porphyritic clays, with gray sands and clay-slates. A tenacious subsoil preserves fertility. The Alpine and Piedmont regions contain gold in paying quantities (Dorn's mine in Edgefield County and Brewer's in Chesterfield having yielded more than $1,000,000 each), besides copper and some silver. Inexhaustible deposits of iron have been partially developed. Limestone, baryta, whet-stone, and flagging-stone have been quarried. Graphite, itacolumite, asbestos, feldspar, spinel rubies, corundum, and beryl exist. III. The Sandhill or Pine region (2,000 sq. miles), the beach of a former age, stretches across the State. Generally level, it rises in the high hills of the Santee to 700 feet. Ironstone, sandstone, buhrstone, and kaolin of great purity outcrop in great beds of sand, whose want of tenacity is unfavorable to vegetation. IV. The Red Hills (1,500 sq. miles), skirting the sandhills, are Eocene, having red clays, yellow sands, buhrstone, and a stone resembling melinite, with excellent fire-clay and inferior lignite. V. The Upper Pine-belt (5,000 sq. miles), varies in breadth from 20 to 40 miles, and comprises some of the finest farming lands of the State. It contains both gray and "mulatto" or chocolate lands, and is comparatively level, rising only to 250 feet. Here was produced the largest yield of corn (256 bush. to an acre) ever gathered. VI. The Lower Pine-belt (9,000 sq. miles) comprises the lower tiers of counties, excepting the salt-water region. The soil is Tertiary. Here occur the famous phosphate deposits lying between Charleston and Beaufort, in river-beds and inland strata, 2 to 10 feet below the surface. They are the detritus of marl-beds subjected to aqueous action. VII. The Coast-region (1,500 sq. miles) is Post-Pliocene, resting on Eocene and Pliocene. A sand-ridge fronts the sea, backed by expanses of mud or sandy loams. Many creeks between Savannah river and Winyah Bay afford inland navigation and form islands which, when drained, are extremely fertile and healthful. The chief of these are Hilton Head, St. Helena, Edisto, John's, James's, North, and South islands. Sullivan's and Pawley's islands are sand-bars noted for surf-bathing.

*Rivers and Bays.*—The up country is hilly, with some level expanses, once prairies. Straight streams have a fall of 4½ feet to the mile, with rapids along the geologic break impeding navigation, but furnishing abundant water-power. The Catawba river falls 178 feet in 8 miles. The Columbia Canal on the Congaree has developed 13,000 horse-power. A potential energy of 1,000,000 horse-power exists in the State. The low country, while having a greater general slope to the ocean, is less undulating. Winding, sluggish streams, with a fall of a few inches to the mile, overflow in floods an area of 5,000 sq. miles. There are 2,400 miles of inland navigation, which might be increased by canals around the rapids. The chief rivers are the Savannah, the Santee (formed by the Congaree and Wateree, the Congaree formed by the Broad and the Saluda, and the Wateree known as the Catawba in its upper course), and the Pee Dee system, consisting of the Great Pee Dee (the Yadkin in North Carolina), the Little Pee Dee, Lynch's, Black, and Waccamaw. The Ashley and the Cooper rivers, forming Charleston harbor, the Edisto, Ashepoo, Combahee, and Coosawhatchie are smaller streams. There are no important lakes. The chief inlets are Port Royal, St. Helena, Stono, Charleston harbor, Bull's Bay, and Winyah Bay. Cape Roman is the chief promontory. Port Royal has one of the finest harbors in the world, with 21 feet of water at low tide, and a mean rise and fall of tide of between 7 and 8 feet. By jetties begun in 1878 Charleston bar has been deepened to 20 feet from Charleston and the ocean. The north jetty is 15,443 feet long, and the south 19,104 feet. Their cost up to 1899 was $4,037,256. Winyah Bay, leading to Georgetown, has 7 feet at low tide, and 10 to 12 feet at high.

*Fauna and Flora.*—Hammond's *Handbook of South Carolina* (1883) gives a list of 48 mammals, 179 birds, 43 serpents, 23 lizards and turtles, 44 amphibians, and 196 fishes, besides thousands of invertebrates not classified. There are 1,310 endogens, 500 exogens, and 2,582 cryptogams. Buffaloes and beavers, once plentiful, are extinct. A few bears and wolves are reported. The magnolia and the palmetto beautify the coast, and the orange, banana, olive, almond, and tea-plant are grown here. Pine and cypress characterize the low country, hardwoods the up country. All nuts, fruits, and berries of the temperate zone grow wild or can be cultivated here. Peaches, apples, grapes, and plums are the commonest fruits.

*Staple Productions.*—Cotton, maize, wheat, rice, peas, hay, and sweet potatoes are the chief staples. The Sea islands grow 10,000 bales of the famous long-staple cotton per annum, and the fields produce from 500,000 to 900,000 bales of the short staple. In 1900 the cotton crop amounted to 830,714 bales, and the rice crop (1899) to 23,054,720 lb. Tobacco-growing, truck-farming, and fruit-growing for market are rapidly developing. Stock-raising, once profitable, then neglected, has been revived with success. Hired field-labor is largely supplied by Negroes, but there are many small farmers among the whites, especially of the Piedmont region, who work their own crops.

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............ | 93,864 | 115,008 | 22·5* |
| Total acreage of farms............ | 13.457,613 | 13,184,652 | 2·1† |
| Value of farms, including buildings and fences........................ | $68,677,482 | $99,104,600 | 44·3* |

* Increase. † Decrease.

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

| CROPS. | Acreage. | Yield. | Value. |
|---|---|---|---|
| Corn...................... | 1,875,591 | 13,129,137 bush. | $8,402.648 |
| Wheat ............ ...... | 238,092 | 2,142.828 " | 2,164,256 |
| Oats...................... | 259,558 | 4,023,149 " | 1,931.112 |
| Rye...................... | 3,902 | 29,265 " | 30.728 |
| Potatoes................. | 4,307 | 335,946 " | 335,916 |
| Hay....................... | 145,798 | 192.453 tons. | 2,213,210 |
| Totals................ | 2.527,248 | .................. | $15,077,870 |


SOUTH CAROLINA
NORTH CAROLINA
GEORGIA
ATLANTIC OCEAN
OCONEE
PICKENS
GREENVILLE
SPARTANBURG
CHEROKEE
YORK
UNION
CHESTER
LANCASTER
CHESTERFIELD
MARLBORO
ANDERSON
LAURENS
NEWBERRY
FAIRFIELD
KERSHAW
DARLINGTON
MARION
HORRY
ABBEVILLE
GREENWOOD
SALUDA
EDGEFIELD
LEXINGTON
RICHLAND
SUMTER
FLORENCE
CLARENDON
WILLIAMSBURG
GEORGETOWN
AIKEN
ORANGEBURG
BARNWELL
BAMBERG
DORCHESTER
BERKELEY
COLLETON
HAMPTON
BEAUFORT
CHARLESTON
Columbia
Charleston
Savannah R.
Scale of Miles
0 10 20 30 40
County Towns
Longitude West from Greenwich

On Jan. 1, 1900, the farm animals comprised 68,319 horses, value $4,237,798; 98,331 mules, value $7,288,769; 122,959 milch-cows, value $2,366,961; 137,264 oxen and other cattle, value $1,478,267; 61,217 sheep, value $104,069; and about 900,000 swine, value $3,000,000—total head, 1,388,090; total value, $18,475,864.

*Climate.*—The climate is mild, and, except in the swamp and rice regions, is salubrious. The equable and dry climate of some portions, especially the pine-lands, is extremely favorable for persons suffering from pulmonary complaints. Aiken and Somerville are noted health resorts. Other localities attract winter tourists, and the Alpine and Piedmont regions are much frequented in summer. The mercury rarely reaches 100° in summer, or falls below 13° above zero in winter. Snow is practically unknown below Columbia. Cyclones visit the coast apparently in periods of four, seven, and eleven years each. One in Aug., 1893, did much damage to life and property in Beaufort, Charleston, and Port Royal, and on the Sea islands. Thunder-storms visit the interior, but tornadoes are rare. A very severe earthquake visited the State in 1886, doing great injury to Charleston. The prevailing winds in Charleston are from the N. W.; in Columbia, from the N. W. and N. E. The oldest record of meteorological observations in America is found in Charleston. It was begun in 1670, and has been continued more or less regularly since 1783. The record for the whole time and that of the U. S. Weather Bureau for twenty-three years, each shows: Annual mean temperature at Charleston, 66°; annual mean rainfall for the whole period, 48·6 inches, and for twenty-three years, 57·42 inches; average mean temperature for Columbia, 63·7°; for the State (at eight stations), 63°; average rainfall, Columbia, 46·76 inches; for the State, 52·31; highest temperature 104°, lowest 11° above zero.

*Divisions.*—For administrative purposes the State is divided into forty counties:

COUNTIES AND COUNTY-TOWNS, WITH POPULATION.

| COUNTIES. | * Ref. | Pop. 1890. | Pop. 1900. | COUNTY-TOWNS. | Pop. 1900. |
|---|---|---|---|---|---|
| Abbeville | 5–C | 46,854 | 33,400 | Abbeville | 3,766 |
| Aiken | 6–D | 31,822 | 39,032 | Aikeu | 3,414 |
| Anderson | 4–C | 43,696 | 55,728 | Anderson | 5,498 |
| Bamberg † | 6–E | ...... | 17,296 | Bamberg | 1,533 |
| Barnwell | 6–D | 44,613 | 35,504 | Barnwell | 1,329 |
| Beaufort | 8–E | 34,119 | 35,495 | Beaufort | 4,110 |
| Berkeley | 6–F | 55,428 | 30,454 | Monk's Corner | 202 |
| Charleston | 7–F | 59,903 | 88,006 | Charleston | 55,807 |
| Cherokee † | 4–D | ...... | 21,359 | Gaffney | 3,937 |
| Chester | 4–E | 26,660 | 28,616 | Chester | 4,075 |
| Chesterfield | 5–F | 18,468 | 20,401 | Chesterfield | 308 |
| Clarendon | 6–F | 23,233 | 28,184 | Manning | 1,430 |
| Colleton | 7–E | 40,293 | 33,452 | Walterboro | 1,491 |
| Darlington | 5–F | 29,134 | 32,388 | Darlington | 3,028 |
| Dorchester † | 7–E | ...... | 16,294 | Saint George | 576 |
| Edgefield | 6–C | 49,259 | 25,478 | Edgefield | 1,775 |
| Fairfield | 5–E | 28,599 | 29,425 | Winnsboro | 1,765 |
| Florence | 5–F | 25,027 | 28,474 | Florence | 4,647 |
| Georgetown | 6–G | 20,857 | 22,846 | Georgetown | 4,138 |
| Greenville | 4–C | 44,310 | 53,490 | Greenville | 11,860 |
| Greenwood † | 5–C | ...... | 28,343 | Greenwood | 4,824 |
| Hampton | 7–D | 20,544 | 23,738 | Hampton | 536 |
| Horry | 5–G | 19,256 | 23,364 | Conway | 705 |
| Kershaw | 5–E | 22,361 | 24,696 | Camden | 2,441 |
| Lancaster | 4–E | 20,761 | 24,311 | Lancaster | 1,477 |
| Laurens | 5–C | 31,610 | 37,382 | Laurens | 4,029 |
| Lexington | 6–D | 22,181 | 27,264 | Lexington | 806 |
| Marion | 5–G | 29,976 | 35,181 | Marion | 1,831 |
| Marlboro | 5–F | 23,500 | 27,639 | Bennettsville | 1,929 |
| Newberry | 5–D | 26,434 | 30,182 | Newberry | 4,607 |
| Oconee | 4–B | 18,687 | 23,634 | Walhalla | 1,307 |
| Orangeburg | 6–E | 49,393 | 59,663 | Orangeburg | 4,445 |
| Pickens | 4–C | 16,389 | 19,375 | Pickens | 449 |
| Richland | 5–E | 36,821 | 45,589 | Columbia | 21,108 |
| Saluda † | 5–D | ...... | 18,966 | Saluda | 289 |
| Spartanburg | 4–C | 55,385 | 65,560 | Spartanburg | 11,395 |
| Sumter | 5–F | 43,605 | 51,237 | Sumter | 5,673 |
| Union | 4–D | 25,363 | 25,501 | Union | 5,400 |
| Williamsburg | 6–F | 27,777 | 31,685 | Kingstree | 760 |
| York | 4–D | 38,831 | 41,684 | Yorkville | 2,012 |
| Totals | | 1,151,149 | 1,340,316 | | |

* Reference for location of counties, see map of South Carolina.
† Organized since 1890.

*Principal Cities and Towns, with Population for 1900.*—Charleston, 55,807; Columbia, 21,108; Greenville, 11,860; Spartanburg, 11,395; Sumter, 5,673; Anderson, 5,498; Rock Hill, 5,485; Union, 5,400; Greenwood, 4,824; Florence, 4,647; Newberry, 4,607; Orangeburg, 4,445; Georgetown, 4,138; Beaufort, 4,110; Chester, 4,075; Laurens, 4,029.

*Population and Races.*—In 1860, 703,708; 1870, 705,606; 1880, 995,577; 1890, 1,151,149 (native, 1,144,879; foreign, 6,270; males, 572,337; females, 578,812; white, 462,008; colored, 689,141, of whom 688,934 were persons of African descent, 34 Chinese, and 173 civilized Indians).

*Industries and Business Interests.*—The census returns of 1890 showed 2,382 manufacturing establishments, with a combined capital of $29,276,261 (of which $9,644,578 was invested in machinery, tools, and implements, and $5,591,670 in buildings), employing 24,662 persons, paying $6,590,983 for wages, $18,873,666 for materials, and $1,792,386 for miscellaneous expenses, and turning out products valued at $31,926,681. In 1880 there were 2,078 establishments, with 15,828 employees; wages were only $2,800,000, materials $9,900,000, and products $16,700,000. In 1894 there were 62 cotton-mills containing 655,223 spindles, 17,740 looms, and 1,262 cards, and working up about 115,000,000 lb. of cotton per annum. In 1900 there were 93 mills with 1,693,649 spindles, and 25 new mills under construction. The cotton-seed industry is new but growing. In 1890 27 mills (cost $1,000,000), crushed annually about one-fourth of the crop (75,000 tons of seed worth $800,000) into oil, hulls, meal, and ash, all valuable as food or fertilizers. The phosphate industry is important. Land companies mine their own rock, and river companies pay a royalty of 50 cents (formerly $1) per ton to the State. The royalty sometimes exceeds $200,000 per annum. The rock mined in 1899 aggregated 356,650 long tons. The fertilizer mills do a business of $5,000,000 to $6,000,000. Mineral products have an aggregate value of about $3,000,000 annually.

*Commerce.*—The State has a large foreign and domestic trade. During the fiscal year ending June 30, 1900, the imports at Beaufort and Charleston aggregated in value $1,205,713, and the exports, $7,341,628.

*Finance.*—On Dec. 31, 1898, the bonded debt was $6,494,657.47; in addition there was $350,208 of old debt outstanding. The assessed valuations in Oct., 1894, were—Real property, $102,137,777; personal, $53,120,863; railway, $27,771,973; total, $183,030,613.

*Banking.*—On Sept. 5, 1900, there were 17 national banks with a combined capital of $2,083,000, individual deposits of $5,171,643.71, and surplus and profits of $1,265,335; on June 30, 27 State banks, with capital of $1,307,224, deposits $3,263,144, and surplus and profits $318,297; and 11 stock savings-banks, with capital of $628,150, surplus $451,997, and $5,086,451 in savings-deposits from 25,150 depositors.

*Post-offices and Periodicals.*—In Jan., 1901, there were 1,435 post-offices, of which 36 were presidential (1 first-class, 5 second-class, 30 third-class) and 1,399 fourth-class. Of these 284 were money-order offices, and 4 money-order stations. The newspapers and periodicals in 1901 comprised 10 daily, 1 tri-weekly, 1 semi-weekly, 94 weekly, 2 semi-monthly, 8 monthly, and 2 bi-monthly—total publications, 118.

*Means of Communication.*—Three systems control most of the railways in the State: the Southern (formerly the Richmond and Danville), 688 miles; the Atlantic Coast Line, 423 miles; and the Seaboard Air Line, 211 miles. The Georgia and Carolina (formerly the South Carolina Railroad), one of the first in the U. S., has 267 miles of track, and there are several shorter lines. The total mileage in 1899 was 2,694.

*Churches.*—A majority of the first settlers were Dissenters. The first Huguenot church (the only one in America still preserving its old form of worship) was built about 1681; first English church about 1682; first Baptist, 1685; first Quaker, 1696; first Scotch Presbyterian, 1696; first Jewish, 1750; first Lutheran (in Charleston), 1759; and the first Methodist, 1785; and the first Mass was celebrated (in Charleston) in 1786. An act of the Assembly in 1712 allowed Negro slaves to join the Church. Since emancipation the colored people have generally formed separate associations. The census of 1890 gave the following statistics of the religious bodies having each a membership in the State of over 3,000:

| DENOMINATIONS. | Organizations. | Churches and halls. | Members. | Value of church property. |
|---|---|---|---|---|
| Baptist, Regular, Colored | 892 | 905 | 129,147 | $743,999 |
| African Methodist Episcopal | 229 | 491 | 88,172 | 356,362 |
| Baptist, Regular, South | 727 | 729 | 72,641 | 850,686 |
| Methodist Episcopal South | 686 | 683 | 68,092 | 796,846 |
| African Methodist Episcopal Zion | 130 | 130 | 45,880 | 126,325 |
| Methodist Episcopal | 335 | 337 | 43,200 | 292,235 |
| Presbyterian Church in the U. S. | 226 | 248 | 16,561 | 652,335 |
| Lutheran, United Syn. in the South | 74 | 79 | 8,757 | 339,250 |
| Presb. Church in the U. S. of A. | 77 | 73 | 6,829 | 173,900 |
| Protestant Episcopal | 94 | 87 | 5,742 | 571,833 |
| Roman Catholic | 66 | 26 | 5,360 | 384,500 |
| Colored Methodist Episcopal | 34 | 34 | 3,468 | 65,325 |

*Schools.*—The first free school was established in 1710, ten years after the first public library was opened. In 1785 four colleges were provided for. Two were established, of which one, Charleston College, survives. In 1805 the South Carolina College (known as the University of South Carolina between 1866 and 1877 and 1887 and 1890) was opened in Columbia. Free schools were established in 1811, but private effort bore the chief burden. In 1860 the State ranked fifth in college endowment and sixth in college income. The war of 1861–65 closed many schools. In 1868 a public-school system was provided, which has steadily improved. The races are taught separately. In 1894 there were in round numbers 2,600 white and 1,950 colored teachers, and 106,000 white and 120,000 colored pupils. Almost every town has a graded school. The State has four higher institutions—the South Carolina College, the South Carolina Military Academy (chartered in 1842), the Clemson Agricultural and Mechanical College for males (opened in 1893), and the Winthrop Normal and Industrial College for females. These form the University of South Carolina. The total expenditure for public education in 1899 was $769,815, which was raised by a two-mill tax, a poll-tax of $1, and local taxes. Among the private institutions of note are the College of Charleston (non-sectarian, chartered in 1785); the Presbyterian College of South Carolina (opened 1879); Allen University (Methodist Episcopal colored, chartered 1880); Erskine College (Associate Ref. Presb., opened 1839); Furman University (Baptist, chartered 1850); Newberry College (Lutheran, chartered 1856); Wofford College (Methodist Episcopal South, chartered 1852); Wallingford Academy (Presbyterian); Benedict Institute (colored Baptist); and female colleges and institutes at Columbia, Due West, Gaffney, Greenville, Reidville, Spartanburg, Sumter, and Walhalla. Claflin University, at Orangeburg, chartered in 1872, is endowed by part of the national land grant. Charleston contains the Medical College of the State of South Carolina and the department of pharmacy of the University of South Carolina.

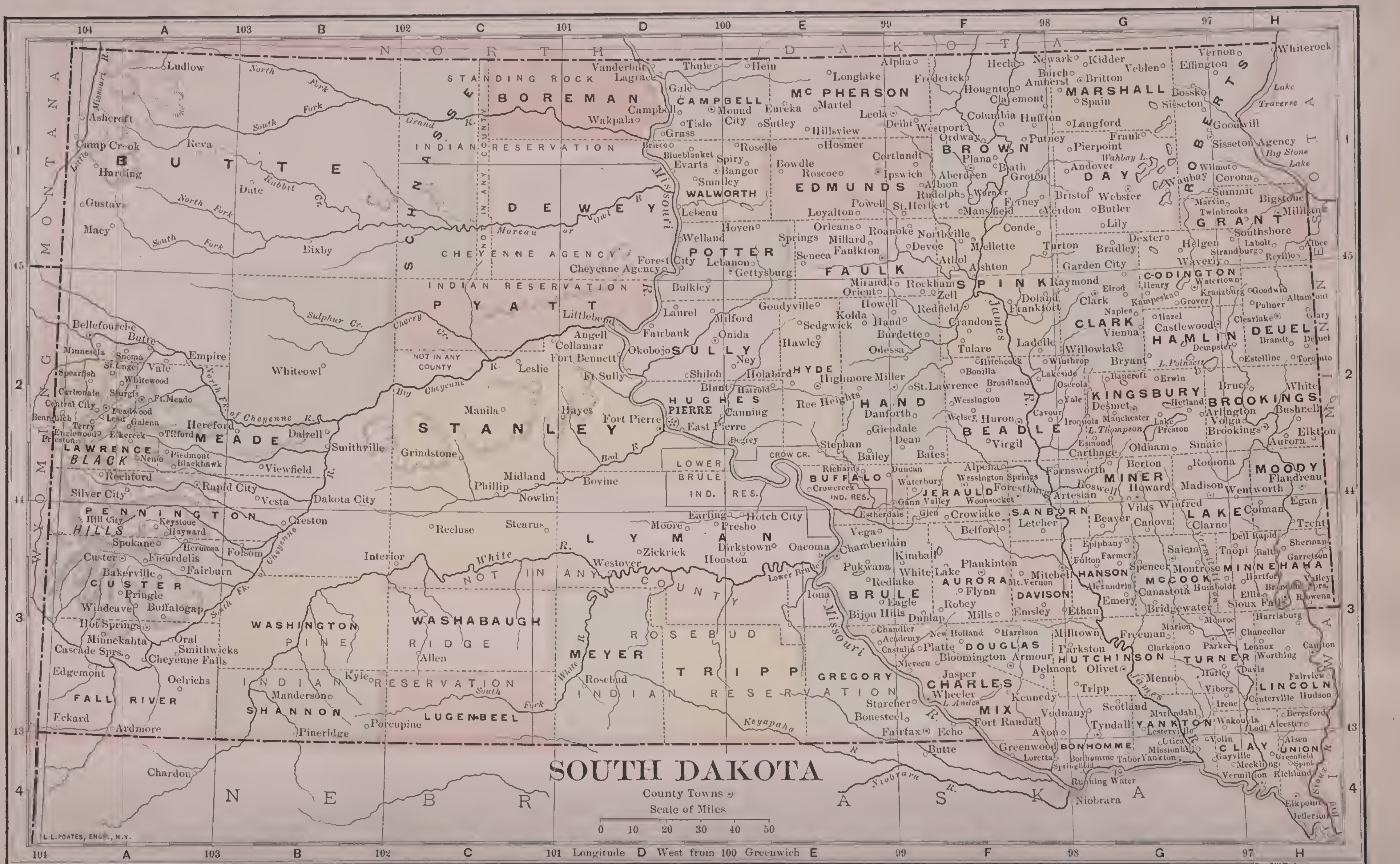
*Libraries.*—According to a U. S. Government report on public libraries of 1,000 volumes and upward each in 1891, South Carolina had 33 libraries which contained 183,982 bound volumes and 19,650 pamphlets. The libraries were classified as follows: General, 9; school, 3; college, 11; college society, 3; law, 1; theological, 3; medical, 1; Y. M. C. A., 1; and scientific, 1.

*Charitable and Penal Institutions.*—The State maintains a lunatic asylum, a penitentiary, and farms for convict labor. There are no reform schools. Almshouses and jails are maintained by the counties.

*Liquor Legislation.*—In 1892 the Legislature prohibited the sale of liquor by private persons and established State and county dispensaries. Liquors, chemically pure, put up in sealed packages, are sold by salaried county dispensers in the daytime to temperate persons, who are not allowed to open the package on the premises. The profits are divided between the State and local treasuries. Constables with extraordinary powers search for and seize illicit liquors. This law was declared unconstitutional by the State Supreme Court in 1893, but with a change in the personnel of the court the decision was soon reversed. On Oct. 31, 1894, there were 69 selling dispensaries; from July 1, 1893, to Oct. 31, 1894, $573,000 worth of liquors had been bought by the State, and this was sold (or was to be sold) to consumers for $679,000.

*Political Organization.*—The constitution of 1776 was changed in 1778. A third instrument, framed in 1790 and in operation till 1865, devolved most of the government upon the Legislature, which elected the Governor, State officers, and many other State officials. The constitution of 1868 gives the Governor, elected by the people for two years, great powers. A Lieutenant-Governor presides over the Senate. The Legislature, meeting annually, is composed of 36 Senators (2 from Charleston and 1 from each other county, elected for four years), and 124 Representatives, elected two years and apportioned according to population. It elects judges and a few other public officers. State and most county officers are chosen by the people. Judicial power is vested in a Supreme Court of three justices (term six years) and eight circuit judges (term four years). Circuit solicitors, county probate judges, and trial justices complete the system. All males over twenty-one years of age, except those convicted of felony, lunatics, and paupers, are allowed to vote. A strict registration law prevails. A voter who has lost his ticket must have it renewed before the next general election or be disfranchised. Eight boxes are provided for separate groups of officials. They are labeled, and the managers must read the labels when required. Outsiders are not allowed inside the booths. Ballots must be of uniform size, color, and unmarked. Votes in the wrong box are not counted. A State board of canvassers has final jurisdiction, except for Governor and Lieutenant-Governor, whose votes are counted by the House of Representatives.

*History.*—1. *The People.*—In 1520 Spaniards visited Port Royal and kidnaped Indians. Returning five years later, they were decimated by Indians and disease and abandoned the idea of settlement. Jean Ribault attempted to establish colonies of Huguenots in 1562 and 1565, but failed. Raleigh accomplished nothing. Heath's patent was repealed for non-performance. Charles II. of England in 1663 granted lands between lat. 31° and 36° N. (extended in 1665 to lands between 29° and 36° 30′) to eight proprietors, who had power to make laws with the assent of the freemen. In 1666 Sandford took possession of the land "by turff and twigge." In 1670 Sayle with three ships reached Port Royal and proceeded to the left bank of the Ashley river, where he founded Charlestown, which ten years later was removed to its present site. Locke and Shaftesbury had prepared "Fundamental Constitutions" resting on church membership and lands, but allowing toleration. The settlers swore allegiance to temporary instructions based on this draft. A second draft established the Church of England. The settlers, chiefly Dissenters, refused to accept either this or four other subsequent drafts, claiming that they had sworn to the first. After 1698 the proprietary government was conducted under the king's charter; but estrangement increased, and in 1719 a revolution overthrew the proprietary *régime.* The king sent Sir Francis Nicholson as first royal Governor in 1721, with instructions that were in force till the Revolutionary war. During all this time the Assembly gained power, and finally claimed all the rights of the House of Commons. In 1765 the people captured Fort Johnson, in which stamps were stored, and sent them back to England. Later they refused to allow tea to be landed and sent £3,000 worth of provisions to aid Boston. A council of safety was formed 1774, and Gov. William Campbell sailed away with the seal of the province in 1775. South Carolina heartily seconded the call for a congress, and was the first to frame a State constitution, May, 1776. In June following Moultrie, behind his palmetto fort, repulsed a British naval attack. This victory, physical as well as moral, gave respite from war for three years. The siege and fall of Charleston, 1780, were followed by partisan warfare, till the rising of the back country and the great victory of King's Mountain in Oct., 1780, forced the British slowly back to Charleston, which was evacuated Dec., 1782. Columbia was made the capital in 1790. After long debate the State made a Federal union possible by accepting conditionally the Constitution of the U. S. May 23, 1788. At this time the low country was generally Federal and the up country anti-Federal. Jefferson's doctrines gained ground, and C. C. Pinckney lost his State in the presidential election of 1800. Since then a strict-construction view has prevailed among the whites. In 1832 a convention nullified the tariff as unconstitutional and also the bill passed to enforce it. After Clay's compromise the anti-tariff ordinance was repealed, but the other was not. All State officers were required to swear paramount allegiance to the State. A small but determined minority opposed nullification. Later on, the idea of complete separation gained ground. A convention in 1852 asserted the right, but thought the occasion did not justify it. Subsequent events fanned the flame. Dec. 20, 1860, a convention unanimously declared South Carolina an independent sovereignty. With other States the Confederacy was formed. South Carolina sent 60,000 men to battle, of whom 12,000 perished. Port Royal was taken in 1861, and the coast was the fighting-ground. Charleston was besieged, but not taken until after the march of Sherman in 1865, when it was evacuated. By the war the assessed property of the State was reduced from $550,000,000 to $100,000,000 ($200,000,000 being the value of the slaves set free). President Johnson appointed B. F. Perry provisional Governor and a government was formed. Congress placed the State under military rule, and ordered a convention, which in Sept., 1865, declared the secession ordinance null and void, repudiated the Confederate State debt, and framed a new constitution. A constitution was adopted in 1865 repealing the ordinance of secession and slavery. A refusal to ratify the Fourteenth Amendment led to a reconstruction by Congress. The Ne-


SOUTH DAKOTA
County Towns
Scale of Miles
0 10 20 30 40 50
101 Longitude D West from 100 Greenwich E
NORTH DAKOTA
NEBRASKA
MONTANA
WYOMING
MINNESOTA
IOWA
L. L. POATES, ENGR., N.Y.

groes were enfranchised, and a constitution was adopted in 1868, upon which the State was restored to the Union in June of that year. In 1876 the State Government fell into the hands of her more intelligent citizens.

2. *Military History.*—Three years after Sayle landed the Spaniards attacked the colony unsuccessfully. Cardross's colony at Port Royal was destroyed by them in 1686. In 1702 Gov. Moore headed a costly and abortive expedition against St. Augustine, and four years after Gov. Johnson defeated a combined French and Spanish attack on Charleston. The Yamassee and Tuscarora Indians were defeated after a severe struggle. Carolinians accompanied Oglethorpe on his ill-starred campaign against Florida in 1740, and were compelled to repel a counter-attack. Pirates infested neighboring waters, and Bennett and his crew were hanged in Charleston harbor 1718–19. Indians joined the British during the Revolution, but were driven from the State in 1777. The back country, having been settled by inland migration, had little communication with the coast. Lack of tribunals in the interior led to the formation of bands of regulators, who in time became involved with the court. The Revolutionary war renewed old feuds, and partisan warfare was desperate between the regulators or Whigs and the Scovilites or Tories, who were finally crushed. In 1812 Gen. Hampton fought in the Northwest. During the Seminole war South Carolina sent many companies of troops to Florida. In the war with Mexico the Palmetto Regiment fought gallantly, and was the first to plant a banner on the halls of the Montezumas. In the war of 1861–65 South Carolina soldiers displayed great valor. At the time of Sherman's march every able-bodied white male between sixteen and sixty years of age was in service.

GOVERNORS OF SOUTH CAROLINA.

| | | | |
|---|---|---|---|
| John Rutledge (pres.) | 1775–78 | John P. Richardson | 1840–42 |
| Rawlins Lowndes (pres.) | 1778–79 | James H. Hammond | 1842–44 |
| John Rutledge (governor) | 1779–82 | William Aiken | 1844–46 |
| John Mathews | 1782–83 | David Johnson | 1846–48 |
| Benj. Guerard | 1783–85 | W. B. Seabrook | 1848–50 |
| William Moultrie | 1785–87 | John H. Means | 1850–52 |
| Thomas Pinckney | 1787–89 | John L. Manning | 1852–54 |
| Charles Pinckney | 1789–92 | James H. Adams | 1854–56 |
| Arnoldus Vanderhorst | 1792–94 | Robert F. W. Allston | 1856–58 |
| William Moultrie | 1794–96 | William H. Gist | 1858–60 |
| Charles Pinckney | 1796–98 | Francis W. Pickens | 1860–62 |
| Edward Rutledge | 1798–1800 | Milledge L. Bonham | 1862–64 |
| John Drayton | 1800–02 | A. G. Magrath | 1864–65 |
| James B. Richardson | 1802–04 | Benj. F. Perry (provis.) | 1865 |
| Paul Hamilton | 1804–06 | James L. Orr | 1865–68 |
| Charles Pinckney | 1806–08 | Robert K. Scott | 1868–72 |
| John Drayton | 1808–10 | Franklin J. Moses, Jr. | 1872–74 |
| Henry Middleton | 1810–12 | Daniel H. Chamberlain | 1874–76 |
| Joseph Alston | 1812–14 | Wade Hampton | 1876–78 |
| David R. Williams | 1814–16 | W. D. Simpson (acting) | 1878–80 |
| Andrew Pickens | 1816–18 | T. B. Jeter (acting) | 1880 |
| John Geddes | 1818–20 | Johnson Hagood | 1880–82 |
| Thomas Bennett | 1820–22 | Hugh S. Thompson | 1882–86 |
| John L. Wilson | 1822–24 | John C. Sheppard (acting) | 1886 |
| Richard I. Manning | 1824–26 | John P. Richardson | 1886–90 |
| John Taylor | 1826–28 | Benj. R. Tillman | 1890–94 |
| Stephen D. Miller | 1828–30 | John Gary Evans | 1894–96 |
| James Hamilton | 1830–32 | William H. Ellerbe | 1896–98 |
| Robert Y. Hayne | 1832–34 | M. B. McSweeney | 1898– |
| George McDuffie | 1834–36 | | |
| Pierce M. Butler | 1836–38 | | |
| Patrick Noble | 1838–40 | | |
| B. K. Hennegan (acting) | 1840 | | |

AUTHORITIES.—Hammond, *Handbook of South Carolina* (1883); Rivers, *Historical Sketches* (to 1719); Ramsay, *History* (to 1808); Simms, *History*; Davidson, Weber, and Chapman, *School Histories*; Logan, *Upper South Carolina*; Gregg, *History of the Cheraws*; Carroll, *Collections*; Gibbes, *Documentary History*; Weems, *Marion*; Moultrie, *Memoirs*; *Tarleton's Campaigns and Memoirs*; Johnson, *Traditions of the Revolution*; and Mills, *Statistics*. The State has copies of all colonial records relating to the province, and has in the Secretary of State's office a complete MS. journal of the provincial parliament to 1776, besides other records of more recent date. ROBERT MEANS DAVIS.

**South Carolina College**: See the Appendix.

**Southcott**, JOANNA: religious enthusiast; b. at Gittisham, Devonshire, England, Apr., 1750; was a domestic servant at Exeter; joined the Methodist Church about 1790, and in 1792 announced herself as a prophetess, giving forth an extraordinary series of revelations in ungrammatical prose and doggerel verse, e. g. *Effects of Faith* (1801), *Free Exposition of the Bible* (1804), *The Book of Wonders* (1813–14), *Prophecies announcing the Birth of the Prince of Peace* (1814), and many others; and obtained such success that in a few years her believers were numbered by thousands. She established herself at London; announced herself as the woman spoken of in Rev. xii. as being driven into the wilderness; sold 6,400 sealed packets to her followers, which were warranted to secure the salvation of the purchaser; and at last declared herself pregnant, and that she should give birth to "Shiloh" or "the Prince of Peace" at midnight on Oct. 19, 1814, but the occasion was marked only by the prophetess falling into a trance. She died in London, Dec. 27, 1814. A *post-mortem* examination showed that she had been suffering from dropsy. Four congregations of believers, comprising 198 persons, were reported in England by the census of 1851, a community was founded at Wenthorp in 1857, and they were not extinct in 1887. See Roberts, *Observations on the Divine Mission of Joanna Southcott* (1807); Richard Reece, *A Correct Statement of the Circumstances that attended the Last Illness and Death of Mrs. Southcott* (2 eds.. 1815); P. Mathias, *The Case of Joanna Southcott* (1815), and *Joanna Southcott's Prophecies and Case stated* (1832). Revised by S. M. JACKSON.

**South Dako'ta**: one of the U. S. of North America (North Central group), the twenty-seventh State admitted into the Union.

*Location and Area.*—The State lies a little N. of the center of the continent, on the middle section of the Missouri river, between lat. 45° 57 ′N., and 42° 28′ (extreme southeast point; W. of the Missouri the boundary is 43° N.) and between lon. 96° 26′ (extreme east point) and about 104° 03′ W. of Greenwich—the west boundary is 27° W. of Washington. It is bounded on the N. by North Dakota, E. by Minnesota and Iowa, S. by Nebraska, and W. by Wyoming and Montana; extreme length from E. to W., 386 miles; extreme breadth N. to S., 240 miles; area, 76,700 sq. miles, excluding the rivers (Missouri and Big Sioux) and lakes (Big Stone and Traverse) which form part of the boundary of the State; those portions of these properly belonging to South Dakota have an area of about 115 sq. miles.

Great seal of South Dakota.

*Physical Features.*—The Missouri river divides the State into two nearly equal portions. Except a very limited area at the northeast corner, the southeast part is lowest, and all the State slopes and all the streams flow in that direction. That part E. of the Missouri river is generally smooth and gently rolling in surface, rising into hills in a small area in the northeast part and in the central part near the Missouri where are the Wessington Hills and Ree Heights. W. of the Missouri the country rises more rapidly and culminates in the Black Hills, an elevation in elliptical form about 100 by 60 miles in extent, the central point of which is Harney's Peak, with an elevation of 7,400 feet. The western half is more rolling and broken, but has a large part of smooth lands. The Bad Lands (French, *Mauvaises Terres*), near the head of White river and extending into Nebraska, are a striking feature, with cañons, depressions, walls, and castles of white earth, a desert region rich in soil-making chemicals and abounding in highly interesting fossils. The gently sloping lands of the eastern portion, and the intervals and parks of the Black Hills and the valleys near them, are the most fertile soils. The river-bottoms are very rich and fertile, while the more rolling or hilly lands are dry and less productive. The Big Sioux river flows S. near the east border and forms the boundary for 75 miles. Its current is somewhat swift, and there are rapids falling 110 feet at Sioux Falls. The Dakota (or James) river, 80 miles W., is a sluggish stream 200 to 400 feet lower than the Big Sioux. The surface rises westward from this stream, which is thus at the bottom of a wide trough or valley, and follows what was the preglacial course of the Missouri, the latter stream forming its new course along and near the southwestern edge of the great ice-sheet. W. of the Missouri the streams in the order of their size are the Cheyenne, Grand, White, Bad, and Moreau.

*Geology**.—Igneous rocks appear in a few spots, one a dike of diabase, on Split Rock creek, N. E. of Sioux Falls, and five or six small areas in the northern part of the Black Hills, and include the porphyries. The Archæan appears in the east-central part of the Black Hills, lying N. and S., with Harney's Peak a little S. of its center. A somewhat larger area enters the State from Minnesota, in width from Canton to Flandreau and narrowing westward to a point a little S. of Mitchell. There is another small area below the southeast end of Big Stone Lake. In the Black Hills it consists of schists, partly Early Huronian, and slates and quartzites, with eruptive masses of granite. The east area is red quartzite (Huronian), while near Big Stone Lake a reddish granite is exposed only under the drift. The Palæozoic rocks lie around the core of Archæan in the Black Hills, being wider on the W., and comprise 200 to 300 feet of Potsdam sandstone, about 30 feet of Trenton limestone, a few feet of clay (possibly Devonian), then 600 or 700 feet of Carboniferous limestones. The Jura-Trias encircles the Palæozoic of the Black Hills, and includes 200 to 350 feet of red marly clays with purple limestone and gypsum (Trias), and 75 to 150 feet of sandstone, marls, and clays of the Jurassic. Encircling the last-named formation in the Black Hills and bordering the larger Archæan area in the east part, broadly on the S. and W. and less on the N., is the Dakota, a formation of several thick beds of sandstone separated by layers of clay of irregular thickness. The Colorado extends from the Black Hills to a little beyond the branches of the Cheyenne, and includes the intermediate valleys and the country between the Cheyenne and Bad rivers, and nearly all the unmentioned part E. of the Missouri and a margin of irregular width along the west side of the Missouri. It represents the Fort Benton clay, 50 to 100 feet; the Niobrara chalkstone, 50 to 150 feet; and the Fort Pierre clays, 600 to 700 feet. The Fox Hills comprise 100 to 150 feet of sands, clays, and sandstone in the region near the Missouri and N. of the Cheyenne. The Laramie or lignitic is the great lignite-bearing formation, with rocks similar to the Fox Hills, in the northwest part of the State. It comes down near the Belle Fourche, extends E. half way to the Missouri, then N. E. to near that river. The Miocene covers the region S. of Bad river and E. of the south branch of the Cheyenne to near the Missouri, and includes the white clays, marls, and sandstones of the Bad Lands, known as White river beds, also the Loup Fork beds. In this State the two may be 250 to 400 feet thick. The drift or bowlder clay covers all the surface W. to a line a little beyond the Missouri river, following closely its general course to within 60 miles of the northern boundary, where it deflects some 40 miles W. from that stream. The outlines of the older formations are less confidently stated where they are covered by drift. The artesian basin includes the region W. of the following line: Beginning near Vermillion on the Missouri river, thence N. W. to Ethan, S. of Mitchell, thence N. E. some 25 miles, thence a little W. of N. to the northwest corner of Clark County, thence N. N. E. to the northern boundary. On the S. it follows near and a little S. of the Missouri. Many powerful wells flow in the region W. of this line to the Missouri, and the pressure rises rapidly toward the W. It is probable that it extends along the White and Cheyenne rivers to near the Black Hills, where a flowing well was sunk at Belle Fourche. The water-bearing strata, the Dakota sandstone, are somewhat irregular in distribution, conducting power, and depth. The wells are used to supply towns, furnish power, and to irrigate lands.

*Productions.*—At Sioux Falls, Dell Rapids, Spencer, Rockport, and near Alexandria are extensive and valuable quarries of red quartzite, and at Yankton are extensive and thick beds of Fort Benton clay and chalkstone, from which a superior Portland cement is made. Brick clays are found in many localities. Custer County contains manganese, but there is little use for it locally, and the cost of transportation is too great to justify shipments except of the highest grade ore. Tin is found in the Harney Peak and Nigger Hill regions of the Black Hills, and the first tin-mill in the U. S. was opened near the mines in 1890. During the calendar year 1899 the Black Hills mines yielded 312,962 fine ounces of gold, valued at $6,469,500, and 145,600 fine ounces of silver, valued at $188,251. Very rich gold mines were opened in 1895 near Hill City, and the aggregate product is materially increased. The granite produced by the State in 1899 was valued at $91,049, the sandstone at $18,325, and the limestone at $45,808. The Sioux Falls quartzite has been used for paving in Chicago and other Western cities with satisfactory results. The chief industry of the State is agriculture. Stock-raising has become an important interest. The State has a variety of native grasses, and many cultivated species have been introduced profitably in the old settled parts of the east and south. In 1890 South Dakota had 50,158 farms, containing 11,396,460 acres, valued with buildings and fences at $75,310,305. The following table shows the acreage, yield, and value of the principal crops in the calendar year 1900:

| CROPS. | Acreage. | Yield. | Value. |
|---|---|---|---|
| Corn | 1,200,697 | 32,418,819 bush. | $9,401,458 |
| Wheat | 2,920,244 | 20,149,684 " | 11,686.817 |
| Oats | 588,524 | 12,653,266 " | 3,036.784 |
| Rye | 2,623 | 27,804 " | 10,844 |
| Barley | 107,942 | 1,543,571 " | 478,507 |
| Potatoes | 55,217 | 4,030,841 " | 1,451,103 |
| Hay | 1,749,319 | 2,064,196 tons. | 8,153,574 |
| Totals | 6,624,566 | .................. | $34,219,087 |

On Jan. 1, 1900, the farm animals comprised 287,839 horses, value $11,236,671; 6,626 mules, value $330,266; 398,383 milch-cows, value $13,305,992; 48,817 oxen and other cattle, value $14,237,235; 381,882 sheep, value $1,257,156; and about 200,000 swine, value $2,000,000—total head, 1,755,547; total value, $42,367,320.

*Divisions.*—For administrative purposes the State is divided into a number of counties, many of which are still unorganized and have very few inhabitants.

COUNTIES AND COUNTY-TOWNS, WITH POPULATION.

| COUNTIES. | * Ref. | Pop. 1890. | Pop. 1900. | COUNTY-TOWNS. | Pop. 1900. |
|---|---|---|---|---|---|
| Armstrong | 6–C | 34 | 8 | .................. | ..... |
| Aurora | 7–E | 5,045 | 4,011 | Plankinton | 465 |
| Beadle | 6–F | 9,586 | 8,081 | Huron | 2,793 |
| Bon Homme | 8–F | 9,057 | 10,379 | Tyndall | 1,167 |
| Boreman | .... | .... .. | ...... | .................. | ..... |
| Brookings | 6–G | 10,132 | 12,561 | Brookings | 2,346 |
| Brown | 5–F | 16,855 | 15,286 | Aberdeen | 4,087 |
| Brulé | 7–E | 6,737 | 5,401 | Chamberlain | 874 |
| Buffalo | 7–E | 993 | 1,790 | Gann Valley | .... |
| Butte | 6–B | 1,037 | 2,907 | Belle Fourche | 451 |
| Campbell | 5–D | 3,510 | 4,527 | Mound City | ..... |
| Charles Mix | 8–E | 4,178 | 8,498 | Wheeler | ..... |
| Choteau † | 5–B | 8 | ...... | .................. | ..... |
| Clark | 6–F | 6,728 | 6,942 | Clark | 684 |
| Clay | 8–G | 7,509 | 9,316 | Vermillion | 2,183 |
| Codington | 6–F | 7,037 | 8,770 | Watertown | 3,352 |
| Custer | 7–B | 4,891 | 2,728 | Custer | 599 |
| Davison | 7–F | 5,449 | 7,483 | Mitchell | 4,055 |
| Day | 5–F | 9,168 | 12,254 | Webster | 1,506 |
| Delano ‡ | 6–B | 40 | ...... | .................. | ..... |
| Deuel | 6–G | 4,574 | 6,656 | Clear Lake | 491 |
| Dewey | 5–C | ...... | ...... | .................. | ..... |
| Douglas | 7–F | 4,600 | 5,012 | Armour | 912 |
| Edmunds | 5–E | 4,399 | 4,916 | Ipswich | 397 |
| Ewing † | 4–B | 16 | ...... | .................. | ..... |
| Fall River | 8–B | 4,478 | 3,541 | Hot Springs | 1,319 |
| Faulk | 5–E | 4,062 | 3,547 | Faulkton | 539 |
| Grant | 5–G | 6,814 | 9,103 | Milbank | 1,426 |
| Gregory | 8–E | 295 | 2,211 | Fairfax | ..... |
| Hamlin | 6–F | 4,625 | 5,945 | Castlewood | 430 |
| Hand | 6–E | 6,546 | 4,525 | Miller | 544 |
| Hanson | 7–F | 4,267 | 4,947 | Alexandria | 680 |
| Harding † | 5–A | 167 | ...... | .................. | ..... |
| Hughes | 6–D | 5,044 | 3,684 | Pierre | 2,306 |
| Hutchinson | 7–F | 10,469 | 11,897 | Olivet | 156 |
| Hyde | 6–D | 1,860 | 1,492 | Highmore | 376 |
| Jackson # | 7–C | 30 | ...... | .................. | ..... |
| Jerauld | 7–F | 3,605 | 2,798 | Wessington Sps. | 320 |
| Kingsbury | 6–F | 8,562 | 9,866 | De Smet | 749 |
| Lake | 7–G | 7,508 | 9,137 | Madison | 2,550 |
| Lawrence | 6–B | 11,673 | 17,897 | Deadwood | 3,498 |
| Lincoln | 8–G | 9,143 | 12,161 | Canton | 1,943 |
| Lugenbeel | 8–C | ...... | ..... | .................. | ..... |
| Lyman | 7–E | 233 | 2,632 | Oacoma | ..... |
| McCook | 7–F | 6,448 | 8,689 | Salem | 741 |
| McPherson | 4–E | 5,940 | 6,327 | Leola | ..... |
| Marshall | 5–F | 4,544 | 5,942 | Britton | 519 |
| Martin † | 5–B | 7 | ...... | .................. | ..... |
| Meade | 6–B | 4,640 | 4,907 | Sturgis | 1,100 |
| Meyer | 8–D | ...... | ...... | .................. | ..... |
| Miner | 7–F | 5,165 | 5,864 | Howard | 588 |
| Minnehaha | 7–G | 21,879 | 23,926 | Sioux Falls | 10.266 |
| Moody | 7–G | 5,941 | 8,326 | Flandreau | 1,244 |
| Nowlin # | 7–C | 149 | ...... | .................. | ..... |
| Pennington | 7–B | 6,540 | 5,610 | Rapid City | 1,342 |
| Potter | 5–D | 2,910 | 2,988 | Gettysburg | ..... |
| Pratt ‖ | 7–D | 23 | ...... | .................. | ..... |

* Reference for location of counties, see map of South Dakota.
† Annexed to Butte in 1899. ‡ Annexed to Meade in 1899.
# Annexed to Stanley in 1899. ‖ Annexed to Lyman in 1899.

* The writer is indebted to Prof. J. E. Todd, of the State University, for the geological information here given.

COUNTIES AND COUNTY-TOWNS—CONTINUED.

| COUNTIES. | * Ref. | Pop. 1890. | Pop. 1900. | COUNTY-TOWNS. | Pop. 1900. |
|---|---|---|---|---|---|
| Presho † | 7–D | 181 | ...... | .................. | ...... |
| Rinehart ‡ | 5–B | ...... | ...... | .................. | ...... |
| Roberts | 5–G | 1,997 | 12,216 | Wilmot | 352 |
| Sanborn | 7–F | 4,610 | 4,464 | Woonsocket | 648 |
| Schnasse ‡ | 5–C | ...... | ...... | .................. | ...... |
| Scobey # | 6–B | 32 | ...... | .................. | ...... |
| Shannon | 8–B | ...... | ...... | .................. | ...... |
| Spink | 6–F | 10,581 | 9,487 | Redfield | 1,015 |
| Stanley | 6–D | 1,028 | 1,341 | Fort Pierre | 395 |
| Sterling ‖ | 6–C | 96 | ...... | .................. | ...... |
| Sully | 6–D | 2,412 | 1,715 | Onida | ...... |
| Todd ¶ | 8–E | 188 | ...... | Fort Randall | ...... |
| Tripp | 8–D | ...... | ...... | .................. | ...... |
| Turner | 8–G | 10,256 | 13,175 | Parker | 893 |
| Union | 8–G | 9,130 | 11,153 | Elk Point | 1,081 |
| Wagner ‡ | 5–C | ...... | ...... | .................. | ...... |
| Walworth | 5–D | 2,153 | 3,839 | Bangor | ...... |
| Washabaugh | 7–C | ...... | ...... | .................. | ...... |
| Washington # | 7–B | 40 | ...... | .................. | ...... |
| Yankton | 8–F | 10,444 | 12,649 | Yankton | 4,125 |
| Ziebach ‡ | 7–B | 510 | ...... | .................. | ...... |
| Cheyenne, Pine Ridge, Rosebud, and Standing Rock reservations | .... | ...... | 16,043 | .................. | ...... |
| Totals | .... | 328,808 | 401,570 | | |

* Reference for location of counties, see map of South Dakota.
† Annexed to Lyman in 1899.
‡ Annexed to Butte in 1899.
‖ Annexed to Stanley in 1899.
¶ Annexed to Gregory in 1899.
\# Annexed to Meade in 1899.

*Principal Cities and Towns, with Population in 1900.*—Sioux Falls, 10,266; Lead City, 6,210; Yankton, 4,125; Aberdeen, 4,087; Mitchell, 4,055; Deadwood, 3,498; Watertown: 3,352; Huron, 2,793; Madison, 2,550; Brookings, 2,346; Pierre, 2,306; Vermillion, 2,183; Canton, 1,943; Webster, 1,506.

*Population and Races.*—The part of Dakota now in the limits of the State had in 1880 an estimated population of 98,268; in 1890 the population of the State was 328,808 (native, 237,753; foreign, 91,055; males, 180,250; females, 148,558; white, 327,290; colored, 1,518, of whom 541 were of African descent, 195 Chinese, and 782 civilized Indians).

*Manufactures.*—The census returns of 1890 showed 499 manufacturing establishments, with an aggregate capital of $3,207,796 (of which $322,855 were invested in land, $512,142 in buildings, and $1,329,023 in tools, machinery, and implements), employing 2,422 persons, paying $1,098,418 for wages, $268,214 for miscellaneous expenses, and $3,523,840 for materials, and turning out products valued at $5,682,748.

*Finance.*—The assessed valuations in 1900 aggregated $331,269,000, and the total funded debt on July 1, 1900, was $540,811.09. The tax rate is $2 on $1,000.

*Banking.*—On Sept. 5, 1900, there were 28 national banks with combined capital of $1,502,500, surplus and profits of $534,991.43, and individual deposits of $6,081,124.71; on June 30, 109 State banks with capital of $1,245,227, surplus and profits of $351,972, and deposits of $5,322,384; and 70 private banks with capital of $945,076, surplus and profits of $292,732, and deposits of $3,329,486.

*Means of Communication.*—Transportation to and within the State is provided by four great railway lines, the Chicago, Milwaukee and St. Paul, the Chicago and Northwestern, the Fremont, Elkhorn and Missouri Valley, and the Burlington and Missouri River, and by thirteen local and minor ones. The total mileage within the State in 1899 was 2,818, of which the greater part was operated by the four great lines in the order given. The State receives about $250,000 annually from taxes on railway property.

*Churches.*—The census of 1890 gave the following statistics of the religious bodies having a membership of 1,000 or more each in the State:

| DENOMINATIONS. | Organizations. | Churches and halls. | Members. | Value of church property. |
|---|---|---|---|---|
| Roman Catholic | 177 | 169 | 25,720 | $246,030 |
| Methodist Episcopal | 254 | 248 | 11,371 | 375,260 |
| Lutheran, United Norwegian | 148 | 138 | 7,922 | 54,655 |
| Congregational | 138 | 142 | 5,164 | 200,665 |
| Lutheran, General Council | 100 | 97 | 4,770 | 40,125 |
| Presb. in the U. S. of America | 124 | 125 | 4,413 | 156,940 |
| Baptist, Regular | 83 | 85 | 3,856 | 227,175 |
| Lutheran, Synodical Conference | 71 | 35 | 3,097 | 20,770 |
| Lutheran, Norwegian Evang | 46 | 43 | 3,030 | 25,700 |
| Protestant Episcopal | 83 | 74 | 2,649 | 234,532 |
| Lutheran, Hauge's Synod | 36 | 36 | 2,239 | 11,700 |
| Evangelical Association | 74 | 74 | 1,628 | 20,450 |
| Reformed, in the U. S | 16 | 14 | 1,000 | 11,750 |

*Schools.*—The act of Congress creating the State set apart 2,823,320 acres of land for the support of public schools, and both the act and the State constitution fixed the minimum price at which this land should be sold at $10 per acre. More than 100,000 acres have been sold at an advance on the minimum price, and should the remainder fetch only $10 per acre, the permanent school fund would amount to more than $28,000,000. In 1899 there were in the State 119,579 children of school age, of whom 98,540 were enrolled in the public schools. There were 3,755 schools; and 4,806 teachers, receiving an average monthly salary of $33.63. The public-school property was valued at $2,905,924. The total revenue was $1,645,529, and the expenditure (1898) $1,605,623. The institutions for advanced instruction include the University of South Dakota at Vermillion (opened in 1883); Dakota University at Mitchell (Methodist Episcopal, 1885); Pierre University at East Pierre (Presbyterian, 1883); Sioux Falls University at Sioux Falls (Baptist, 1883); Scotland Academy at Scotland (Presbyterian, 1876); Augustana College at Canton (Lutheran, 1884); Redfield College at Redfield (Congregational, 1887); All Saints' School at Sioux Falls (Protestant Episcopal, 1886); Black Hills College at Hot Springs; Academy of the Sacred Heart at Yankton (Roman Catholic); Yankton College at Yankton (Congregational, 1882); Ward Academy at La Roche (Congregational); and the Wessington Springs Seminary (Free Methodist). There are also a State Agricultural College with an experiment station near Brookings and a State School of Mines at Rapid City.

*Libraries.*—According to a U. S. Government report on public libraries of 1,000 volumes and upward each in 1891, South Dakota had 11 libraries, containing 23,366 bound volumes and 8,230 pamphlets. The libraries were classified as follows: General, 3; college, 5; scientific, 1; garrison, 1; and society, 1.

*Post-offices and Periodicals.*—In Jan., 1901, there were 678 post-offices, of which 51 were presidential (8 second-class, 43 third-class) and 627 fourth-class. There were 296 money-order offices. The newspapers and periodicals in 1901 comprised 17 daily, 235 weekly, 3 semi-monthly, and 18 monthly publications—total, 273.

*Charitable, Reformatory, and Penal Institutions.*—These include a State School for Deaf Mutes at Sioux Falls; a Hospital for the Insane at Yankton; a Soldiers' Home at Hot Springs; a Reform School at Plankinton; and a State Penitentiary at South Falls; and the Legislature has authorized an additional hospital for the insane at Redfield and a school for the blind at Gary.

*Political Organization.*—The constitution vests the legislative authority in a Legislature consisting of a Senate and House of Representatives, which in 1900 had 45 and 87 members respectively. The Legislature meets biennially and sessions are limited to sixty days. It is prohibited from enacting private or special laws for granting divorces; changing the names of persons or places; constituting one person the heir-at-law of another; locating or changing county-seats; regulating county and township affairs; granting to an individual, association, or corporation any special or exclusive privilege; or authorizing any game of chance, lottery, or gift enterprise. The executive authority is vested in a Governor elected for two years. There is also a Lieutenant-Governor chosen in the same way and for the same term as the Governor. The Governor may disapprove of any separate item or items in a bill. Bills may be passed over his veto by a two-thirds vote of both houses, and those not returned by him within three days of reception become laws. The Governor is assisted in the discharge of his duties by a secretary of State, auditor, treasurer, superintendent of public instruction, commissioner of school and public lands, and an attorney-general, all elected for terms of two years. The judicial authority is vested in a Supreme Court, circuit courts, county courts, and justices of the peace, and such other courts as may be created for cities and incorporated towns. The constitution contains a "bill of rights," guaranteeing that the right to worship God according to the dictates of conscience shall never be infringed; that no person shall be denied any civil or political right on account of his religious opinions; that no person shall be compelled to attend or support any ministry or place of worship against his consent; and that no money or other property of the State shall be given for any religious or sectarian purpose. The voting privilege is extended to every male person who is a citizen of the U. S. or an alien who has declared his intention of becoming a citizen, who has resided in the U. S. one year, in the State six months, in the county thirty days, and in the precinct ten days, next preceding any election, provided he is not under guardianship, insane, an idiot, or an unpardoned person convicted of treason or felony. Women with the foregoing qualifications may vote at any election held solely for school purposes. A modification of the Australian ballot law is in force. The constitution authorized the enactment of a State prohibition law. The Legislature passed one in 1891. It was immediately contested, and a county court declared it unconstitutional, but on an appeal in 1892 the Supreme Court affirmed its validity.

*History.*—The early history of the State is identical with that of NORTH DAKOTA (*q. v.*). In 1890–91 the Indian Messiah craze among the Sioux led to grave apprehensions, the intervention of U. S. troops, and the death of Sitting Bull, a great Sioux chief; in 1892 the Yankton Sioux Indians signed an agreement with U. S. commissioners to cede to the U. S. a large part of their reservation between the Choteau and Missouri rivers; and in 1893 the Legislature passed acts to promote irrigation, to prohibit the introduction into the State of armed bodies of police or detectives, and to create a number of State commissioners.

GOVERNORS OF SOUTH DAKOTA.

| | | | |
|---|---|---|---|
| Arthur C. Mellette | 1889–93 | Charles N. Herreid | 1901– |
| Charles H. Sheldon | 1893–97 | | |
| Andrew Lee | 1897–1901 | | |

AUTHORITIES.—Child, *South Dakota: Resources, People, Statehood* (1888); Beadle, *Dakota* (1889); Hagerty, *The State of South Dakota: Statistical, Historical, and Political Abstract* (Aberdeen, 1889). WILLIAM H. H. BEADLE.

**South Dakota, University of**: an institution located at Vermillion by the first territorial legislature (1862), and first known as University of Dakota, but not opened by the Territory until 1883. The city and county opened an independent school in the court-house in 1882, to which they applied the original name, University of Dakota, and erected one building, which was, with the school, accepted as the territorial university by the Legislature in 1883, when the first appropriation was made. The name was changed to University of South Dakota in 1891. It has one brick and two large stone buildings, a 20-acre campus, and 86,000 acres of land. There is a College of Arts and Sciences, with four bachelor and four master courses; colleges of music and business; military and preparatory departments. It has three laboratories and a museum on the "typical" plan. The faculty consists of the president, and 27 professors and assistants. The students number 400. J. W. MAUCK.

**South Deerfield**, Mass.: See DEERFIELD.

**Southern Confederacy**: See CONFEDERATE STATES.

**Southern Crown**: See CORONA AUSTRALIS.

**Southern-wood**: a plant. See ARTEMISIA.

**Southey**, CAROLINE ANNE (*Bowles*): poet; b. at Lymington, Hants, England, Dec. 6, 1787. At an early age she wrote for *Blackwood's Magazine* and other periodicals. In 1820 a collection of her pieces was made, which speedily won for her a place in the world of letters. In 1839 she became the second wife of Robert Southey. *The Pauper's Deathbed* is, perhaps, the best known of her poems, which were prevailingly of a moral, religious, and domestic character. Her published works are *Ellen Fitz-Arthur*, a poem (1820); *The Widow's Tale, and other Poems* (1822); *Solitary Hours*, prose and verse (1826); *Chapters on Churchyards* (1829); *The Birthday*, a poem (1836); *Tales of the Factories*, in verse; and *Robin Hood*, a fragment of a poem begun jointly by herself and her husband, to which were added other fragments by both (1847). D. at Lymington, July 20, 1854. See *Southey's Correspondence with Caroline Bowles*, by Dowden (1881). Revised by H. A. BEERS.

**Southey**, ROBERT: author; b. at Bristol, England, Aug. 12, 1774, the son of a linen-draper. Early left an orphan, he was cared for by an uncle; received his early education at Westminster School; in 1793 entered Baliol College, Oxford, with the design of taking holy orders, but, becoming unsettled in his religious and political views, left Oxford after two years, and entered upon a career of authorship in verse and prose, his first published work being a small volume of poems (1794). In 1795 he married Edith Fricker, whose sister soon after became the wife of Coleridge; set out with his uncle for Portugal; published an account of his six months' residence (1797); was made secretary to the Chancellor of the Exchequer for Ireland, a sinecure with a salary of £350; resigned the position, and in 1804 settled for life at Keswick in the lake country. From this time his life is mainly the history of his numerous writings in almost every department of literature. In early manhood he had imbibed strong radical ideas; proposed, in conjunction with Coleridge and Lovel, to set up a socialistic community or "pantisocracy" on the banks of the Susquehanna; and wrote a drama, *Wat Tyler* (printed in 1793, but first published in 1817, without his consent), which was denounced in the House of Commons as seditious. In the course of years he went over to the opposite extreme of conservatism in Church and state, and became considered the exponent of high Tory opinions. He was named poet-laureate in 1813. In 1807 he received a Government pension of £160 a year, increased to £460 in 1835. His wife, who had for several years been hopelessly insane, died in 1837, and two years afterward he married Caroline Bowles. (See SOUTHEY, CAROLINE ANNE.) But Southey's own faculties had begun to give way, and on the day when he brought his wife to their home he fell into a state of mental prostration which soon grew into complete imbecility, that continued to his death, on Mar. 21, 1843. Southey's principal poems are *Joan of Arc* (1795); *Thalaba the Destroyer*, an Arabian tale (1801); *Madoc*, founded on legends of early Welsh voyages to America (1805); *The Curse of Kehama*, based upon Hindu mythology (1810); *Roderick, the Last of the Goths*, founded on Spanish history (1814); *A Vision of Judgment*, an apotheosis of George III. (1821); and *A Tale of Paraguay* (1825). Among his numerous prose works are *History of Brazil* (1810–19); *Life of Nelson* (1813); *Life of John Wesley* (1820); *History of the Peninsular War* (1820–32); *Book of the Church* (1824); *Sir Thomas More, or Colloquies on Society* (1829); *Life of John Bunyan* (1830); and *The Doctor* (1834–37). He also contributed largely to *The Quarterly Review* for many years. His poetical works were collected by himself (10 vols., 1837), and have been several times republished in different forms. His *Life and Correspondence*, edited by his son, Rev. C. C. Southey, appeared in 1849, and a selection from his *Commonplace Book*, by his son-in-law, Rev. J. W. Warter, in 1856. Southey was one of the most indefatigable and voluminous of English authors, his published works in verse and prose numbering over 100 titles. His reputation as a poet, imposing in his own lifetime, has steadily declined. His poetry is commonplace, without inspiration, spontaneity, or charm of style. A few of his less ambitious pieces, such as *My Library*, *The Holly Tree*, and *The Battle of Blenheim*, keep a place in popular remembrance. Of his prose writings the lives of Nelson and Wesley are among the best, and indeed are among the best standard biographies in the language. His whimsical and mystifying book *The Doctor* is a favorite with many readers. The worth of Southey's character, his wide learning and incessant productiveness, his dignified social standing, and his intimate association with Wordsworth and Coleridge, men of a higher genius than his own, still make him an important figure in English literary history. Revised by H. A. BEERS.

**South Framingham**: village; Framingham town, Middlesex co., Mass.; on the Boston and Albany and the N. Y., N. H. and Hart. railways; 21 miles W. by S. of Boston, and 23 miles E. of Worcester (for location, see map of Massachusetts, ref. 2-G). It contains 8 churches, a national bank with capital of $100,000, 2 saving-banks, and 3 weekly newspapers, and is principally engaged in the manufacture of straw goods, woolens, shoes, paper, and rubber goods. Pop. (1895) 5,770; not returned separately in 1900.

**Southgate**, HORATIO, D. D.: clergyman and author; b. at Portland, Me., July 5, 1812; graduated at Bowdoin College 1832, and at Andover Theological Seminary 1835; took orders in the Protestant Episcopal Church 1836; traveled as a missionary in the East; was chosen missionary bishop of Constantinople 1844; resigned his charge in 1850 and returned to the U. S. the following year, in which he became rector of St. Mark's, Portland, of the Church of the Advent, Boston, 1852, of Zion church, New York, 1859–72, and of St. Thomas church, Ravenswood, L. I., 1882. The episcopate of California was tendered to him by a convention of clergy and laity, but the plan miscarried. D. Apr. 11, 1894. He was the author of *A Tour through Armenia, Kurdistan, Persia, and Mesopotamia* (New York, 2 vols., 1840); *A Visit to the Syrian Church of Mesopotamia* (New York, 1844); *The War in the East* (1855); and *Parochial Sermons* (1859). Revised by W. S. PERRY.

**South Georgia**: a group of uninhabited islands, generally icebound, in lat. 54° 30′ S., lon. 36°–38° W.; nearly 800 miles E. by S. of the Falkland islands, of which they are a dependency. Area about 1,000 sq. miles. They were first discovered in 1675.

**South Hadley**: town (incorporated in 1753); Hampshire co., Mass.; on the Connecticut river, which here has a fall of 40 feet, and near the Boston and Me. and the N. Y., N. H. and Hart. railways; 5 miles S. E. of Northampton and 14 miles N. of Springfield (for location, see map of Massachusetts, ref. 3–E). It is the seat of MOUNT HOLYOKE COLLEGE (*q. v.*), the oldest collegiate institution for women in the U. S., and contains the villages of South Hadley and South Hadley Falls, a high school, 21 public schools, 5 churches, and cotton, woolen, and saw mills. In 1894 it had an assessed valuation of nearly $2,000,000. Pop. (1880) 3,538; (1890) 4,261; (1900) 4,526. HENRIETTA E. HOOKER.

**Southington**: town (incorporated in 1779); Hartford co., Conn.; on the N. Y., N. H. and Hart. Railroad; 23 miles N. of New Haven (for location, see map of Connecticut, ref. 9–G). It has manufactories of general and carriage hardware, tinmen's supplies, pocket cutlery, wood screws, and ceiling and floor plates, and contains the Lewis High School, a national bank with capital of $100,000, a savings-bank, and a weekly newspaper. In 1894 it had an assessed valuation of over $2,000,000. Pop. (1890) 5,501; (1900) 5,890, borough 3,411. WILLIAM J. HOLDEN, EDITOR OF "PHŒNIX."

**South McAlester**: town; Choctaw Nation, Ind. Terr.; on the Choctaw, Okl. and Gulf Railroad; 64 miles W. of Wister Junction (for location, see map of Indian Territory, ref. 4–F). It is in a rich coal-mining region, and contains a private bank and three weekly newspapers; and in 1895 was made the headquarters of the part of the U. S. Geological Survey detailed under act of Congress to make a survey of the territory preparatory to its being opened to general settlement. Pop. (1900) 3,479.

**South Manchester**: village; Manchester town, Hartford co., Conn.; on the N. Y. and New England Railroad; 9 miles E. of Hartford (for location, see map of Connecticut, ref. 8–I). It is noted for its extensive manufactories of silk and paper, and contains a public library (founded in 1870) and a weekly and a monthly periodical. Pop. (1890) not separately reported; (1900) not returned separately.

**South Norwalk**: city; Fairfield co., Conn.; on Long Island Sound, the Norwalk river, and the N. Y., N. H. and Hart., and the Shepaug, Litch. and N. railways; 33 miles S. W. of New Haven, and 42 miles N. E. of New York (for location, see map of Connecticut, ref. 13–D). The city has a fine location and an excellent harbor. The surface begins to rise within the city limits and in the western suburbs reaches an altitude of 160 feet above sea-level, affording choice locations for residences, with extensive views of the Sound and harbor. Steam freight-boats ply between the city and New York all the year and passenger boats during the summer season. The city contains a public high school, 2 opera-houses, 2 electric railways, a public library (founded in 1877), 2 national banks with combined capital of $200,000, a savings-bank, and 2 newspapers. The chief industries are the manufacture of hats, corsets, shoes, locks, bronze goods, force-pumps, steam-engines, machinery, air-compressors, stone and earthenware, and paper boxes; ship and boat building; and the cultivation of oysters. Pop. (1880) 3,726; (1890) not separately reported; (1900) 6,591.
EDITOR OF "EVENING SENTINEL."

**South Omaha**, Neb.: See OMAHA.

**South Orange**: village and township; Essex co., N. J.; on the Rahway river, and the Del., Lack. and West. and the Newark and S. Orange electric railways; 15 miles W. of New York and 5 miles N. W. of Newark, the county-seat (for location, see map of New Jersey, ref. 2–D). It is picturesquely located on the Orange Mountains, has many fine residences, particularly of New York business men, and contains a new town-hall (completed in 1895), Seton Hall College (Roman Catholic, opened in 1856), a Roman Catholic parochial school, 3 public and 3 private schools, a public library, and a weekly newspaper. Vailsburg, formerly a part of South Orange township, between South Orange and Newark, was incorporated as a borough in 1894. Pop. of South Orange (1880) 2,178; (1890) 3,106; (1900) 4,608.
EDITOR OF "BULLETIN."

**Southport**: town; in Lancashire, England; at the mouth of the Ribble estuary; 18 miles N. of Liverpool (see map of England, ref. 7–F). Southport from being a sandy waste has rapidly developed into a popular watering-place. It has an esplanade 3 miles long, a pier (1,465 yards), a pavilion and winter gardens, a public library and art gallery, a market-hall (1881), schools of science and art (1887), besides large baths, hotels, etc. Pop. (1891) 43,026.

**South Sea Bubble**: a financial speculation which arose in England about the same time as Law's Mississippi Scheme in France. The South Sea Company was established by Lord Treasurer Harley in 1711 with the design of providing for the extinction of the public debt, then amounting to about £10,000,000. The debt was assumed by a number of merchants, under an engagement of the Government to pay 6 per cent. interest for a certain period, securing this sum by making permanent certain import duties. The Government further granted the purchasers of the fund a monopoly of the trade to the South Sea or the coast of Spanish America, and the company was organized under the name of the South Sea Company. Though the South Sea trade yielded no great profit, the company flourished from the prevailing delusion with regard to the riches of Spanish America, and became so well established as to vie with the Bank of England in controlling the finances of the country. In 1720 the company assumed the entire debt of over £30,000,000, bearing interest of 5 per cent. The ministers intended to give the South Sea Company a good bargain, but when the plan was proposed in the House of Commons that body voted to open the scheme for competition to the Bank of England also. The company was thus compelled to offer £7,500,000 for its privilege. Notwithstanding this drawback the stock of the company was in great demand, under the extravagant expectation of profits from the American trade and the prevalent rage for speculation. It was increased by successive subscriptions, the price of shares rapidly rising till £1,000 was paid for a single share of £100. Other bubbles were started, such as schemes for a fishery of wrecks, to make salt water fresh, to make oil from sunflowers, to extract silver from lead, all with promises of enormous profits. For lack of office-room the streets near 'Change Alley were lined with desks. The action of the South Sea Company itself in proceeding against some of these bubbles turned attention to its own affairs, and distrust arose, under which the stock rapidly declined. Confidence was further weakened when it became known that some of the directors had sold out. The news of the failure of Law's scheme and its consequences in Paris opened all eyes to the delusion, and as the year 1720 closed the bubble burst, bringing ruin to the company and to thousands of families. Revised by F. M. COLBY.

**South Shetland** or **New South Shetland Islands**: an Antarctic archipelago, S. of South America, beween 61° and 63° 30′ S. lat., consisting of Clarence, George First, Livingston, and Smith islands, discovered in 1819. Area about 850 sq. miles. The islands are mountainous, destitute of vegetation, in the interior covered with perpetual snow and ice, and rise out of very deep water. They are visited by whalers, but navigation is dangerous on account of the ice.

**South, University of the**: See the Appendix.

**Southwell**, ROBERT: ecclesiastic and author; b. at Horsham St. Faith's, Norfolk, England, in 1560; educated in Paris and, it is said, also in the Roman Catholic seminary at Douay, France; became a Jesuit at Rome 1578; prefect or rector of the English Jesuits' college at Rome 1585; sent as a missionary to England 1586; chaplain to Anne, Countess of Arundel, and secretly administered the rites of his Church to the English Roman Catholics; was thrown into the Tower July, 1592, on an accusation of complicity in a plot against Queen Elizabeth; was ten times subjected to torture, but made no confession beyond that of being a Jesuit and having exercised his priest's office; was condemned to death for constructive treason in refusing to take the oath of supremacy Feb. 22, 1595, and on the following day was hanged, drawn, and quartered at Tyburn, meeting his fate with firmness and composure. He was the author of several pieces of prose and verse published in London immediately after his death, among which were *The Triumph over Death* and *Epistles of Comfort to those Catholics who Lie under Restraint*. A complete edition of his *Poems* appeared in 1856 (London). Revised by S. M. JACKSON.

**Southwest Pass**: See LIGHTHOUSE.

**Southworth**, CONSTANT: colonist; b. at Leyden, Holland, in 1614, son of Edward Southworth, a merchant and business agent of the Leyden Pilgrims (d. 1621); was taken to Plymouth, Mass., in 1621 by his widowed mother, Alice (Carpenter) Southworth, who became the second wife of Gov. William Bradford, under whose care he was educated; was one of the early colonists of Duxbury; was often a magistrate and representative in the Legislature; served as commissioner for the united colonies; governor of the Kennebec plantation and assistant governor of Plymouth. D. at Duxbury about 1685. He was supposed to be the author of the *Supplement* to the *New England's Memorial* of his cousin, Nathaniel Morton.—His brother THOMAS, b. at Leyden in 1616, was also prominent in public affairs. D. 1690.

**Southworth**, EMMA DOROTHY ELIZA (*Nevitt*): novelist; b. in Washington, D. C., Dec. 26, 1818; was married in 1841 to Frederick H. Southworth, of Utica, N. Y., and two years later was thrown wholly upon her own exertions for a livelihood; engaged in teaching, and wrote for the Washington *National Era* a novel entitled *Retribution*, which was published in book-form in 1849, since which time she has put forth in rapid succession a series of novels numbering nearly sixty. A uniform edition of her stories to date was published at Philadelphia in 1872 and contained forty-two titles, among which were the following: *The Family Doom, The Changed Brides, The Fortune-seeker, The Fatal Marriage, The Lost Heiress, The Three Beauties, The Haunted Homestead, Retribution, India, or the Pearl of Pearl River, The Curse of Clifton,* and *The Spectre Lover.* From 1853 to 1876 Mrs. Southworth resided in a country-house on the Potomac, near Washington. In 1876 she removed to Yonkers, N. Y. Her novels relate largely to Southern life, and have been widely popular, and some of them have been translated into several foreign languages. Their literary value is not high. D. June 30, 1899. Revised by H. A. BEERS.

**Souvestre**, sōō'vest'r', ÉMILE: novelist and dramatist; b. at Morlaix, department of Finistère, France, Apr. 15, 1806. After editing for some time a liberal newspaper at Brest, he settled in 1836 in Paris, where he attracted attention first by his sketches of Brittany, and became soon exceedingly popular as a writer. D. in Paris, July 5, 1854. The most remarkable of his novels are *Les Derniers Bretons, L'Homme et l'Argent, Confessions d'un Ouvrier, Un Philosophe sous les Toits* (the last named receiving in 1851 a prize from the French Academy); and of his dramas, *Henri Hamelin, L'Oncle Baptiste, Le Mousse*, etc. All his works have a strongly marked tendency, representing morality and riches as incompatible. He is sometimes sad, and even bitter, but he often gives most delightful pictures of the innocence of simple surroundings and the cheerfulness of humble circumstances. Revised by A. G. CANFIELD.

**Souza**: See SOUSA.

**Sovereign**: the British coin representing the pound sterling of 20*s.* It first appeared in 1817, and now weighs 123·27447 grains troy, and is worth $4·866 in U. S. money. The English coin first called double royal (afterward replaced by the guinea), first struck about 1489, was often called the sovereign. Its value varied from 20*s.* to 30*s.*, but its original value was 22*s.* sterling. See POUND STERLING.

**Sovereignty** [O. Eng. *soverainetee*, from O. Fr. *sovrainete*, deriv. of *sovrain*, sovereign < Late Lat. *supera'nus*, supreme, principal, deriv. of Lat. *su'perus*, upper, higher, deriv. of *su'per*, above]: the possession of the highest power in any given sphere, as in the state. The debates concerning the supreme power, whether it resides by right in the people—i. e. the organized people—ultimately, or in some ruler who received it from God, led to the application of the word to the former as the source from which the right of the particular magistrate or line of kings was derived, and to the latter as invested by the former with his power according to the will of God. In the English usage the king or queen is called sovereign, although possessed of an authority limited on every side by law. Yet as in theory all executive power is derived from that of the monarch, the term sovereign contains no absolute misnomer.

Sovereignty in public law is the right to exercise uncontrolled the powers of the state.

As a state's relations are of two sorts—(1) with its own subjects, (2) with other states—so its sovereignty is said to be internal and external. The internal sovereignty of a state includes all those powers of government which it possesses over its own subjects and transient foreigners within its territorial limits and on its merchant ships on the high seas. Such powers or rights are those of eminent domain, taxation, legislation, punishment, etc. With their exercise foreign states, unless unduly discriminated against, have nothing to do; nor does it depend upon their recognition. Thus the internal sovereignty of the U. S. was complete from the date and fact of the declaration of its independence.

External sovereignty, however, being the right to enter into relations with other states, for which intercourse their consent is necessary, does depend upon their recognition. In the case of the U. S. this was made by France through the treaty of 1778; by Great Britain in express terms by the treaty of 1782.

When a state exercises some but not all of the powers of external sovereignty it is called a dependent or semi-sovereign state, e. g. Bulgaria.

Under the U. S. Constitution the question whether the several States or the U. S. are invested with the sovereignty has been made a matter of great contention. On this subject the following considerations are especially worthy of notice:

(1) In the provisional articles of peace between the U. S. and Great Britain (1782), and in the definitive treaty of 1783, the king acknowledges the thirteen U. S. "to be free, sovereign, and independent States," "treats with them as such," and "relinquishes all claims to the government, propriety and territorial rights of the same, and of every part thereof." The meaning of this is that he and no one else had any claims of sovereignty over the territory of the U. S., and that by relinquishing those claims he left them in the same condition in which other states independent of all external powers were by the nature of their situation placed. The thirteen States were at that time confederated, but of this confederation he took no notice.

(2) In the new Constitution, framed in 1787, important limitations were put on the power of the thirteen States, all of them tending to throw power into the hands of the general Government. Among these were the powers to declare war, to make peace, to send and receive ambassadors, to raise and support armies, to coin money, to emit bills of credit, to provide for calling forth the militia of the States in order to execute the laws of the Union, to decide in all questions, whether questions of interpretation or of other kinds, arising under the Constitution; and it is added that "the Constitution, and the laws of the U. S. which shall be made in pursuance thereof, and all treaties made or which shall be made under the authority of the U. S., shall be the supreme law of the land; and the judges in every State shall be bound thereby, anything in the constitution or laws of any State to the contrary notwithstanding." (Art. VI., 2.) This section is immediately followed by one to the effect that the Senators and Representatives of the U. S., and all judicial and executive officers, both of the U. S. and of the several States, shall be bound by oath or affirmation to support the Constitution. The President especially is required to declare on oath or affirmation that he will to the best of his ability preserve, protect, and defend the Constitution of the U. S. So far from being sovereigns, then, the States composing the U. S. have not the attributes of sovereignty belonging, according to international law, to a sovereign and independent state. They can have no other or higher relations to foreign powers than any municipality, private corporation, or individual. If they differ with the general Government on the interpretation of laws or treaties, the difference must be drawn before the courts of the Union, and their interpretation must decide the judgments of all State courts thereafter. The Constitution is thus supreme, and as a supreme instrument it prohibits the States (Amendments, Art. X.) from exercising certain powers.

All this is well expressed in President Jackson's proclamation of Dec., 1832: "The States severally have *not* retained their entire sovereignty. It has been shown that in becoming parts of a nation, not members of a league, they surrendered many of their essential parts of sovereignty. The right to make treaties, declare war, levy taxes, exercise exclusive judicial and legislative powers, were all of them functions of sovereign power. The States, then, for these important purposes were no longer sovereign. The allegiance of their citizens was transferred, in the first instance, to the Government of the U. S.; they became U. S. citizens, and owed obedience to the Constitution of the U. S. and to laws made in conformity with the powers it vested in Congress. This last position has not been and can not be denied. How, then, can that State be said to be sovereign and independent whose citizens owe obedience to laws not made by it, and whose magistrates are sworn to disregard [its own] laws when they come into conflict with laws passed by another? What shows conclusively that the States can not be said to have reserved an undivided sovereignty is that they expressly ceded the right to punish treason—not treason against their separate power, but treason against the U. S. Treason is an offense against *sovereignty*, and sovereignty must reside with the power [able] to punish it." See the articles GOVERNMENT, INTERNATIONAL LAW, MONARCHY, NULLIFICATION, REPUBLIC, and TREASON.

Revised by T. S. WOOLSEY.

**Sowerby**, JAMES: painter and botanist; b. at Lambeth, London, Mar. 21, 1757. Among his works are *English Botany*, containing colored figures of all the native plants of Great Britain (36 vols., with descriptions by Sir James Edward Smith, 1792–1807; supplement by his son, James De C. Sowerby, 4 vols., 1815–49; new ed. by J. T. B. Syme, 11 vols., 1863–72); *English Fungi or Mushrooms*, with 440 colored figures (3 vols., 1797–1803); *British Mineralogy*, with 550 colored plates (5 vols., 1804–17); *Exotic Mineralogy*, with 169 colored plates (2 vols., 1811–17); and *Mineral Conchology of Great Britain*, with 600 plates (6 vols.; the last two by his son, J. De C. Sowerby, 1812–30). D. Oct. 25, 1822.

**Sowing and Sowing-machines**: the act or process of depositing seed in the ground, and the machines used for the purpose. When seeds are deposited singly or with only a few in a definite spot, the act is usually called *planting*, the term *sowing* being restricted to cases where the seed is thrown broadcast or deposited in rows or drills. Sowing or planting is usually performed in the spring, but sometimes, and with some kinds of crops, in the autumn, so that the plants may have a fair start when the spring opens. The seeds are usually covered over by harrowing, brushing, or rolling the soil after they have been deposited. As a rule, it may be laid down that when the soil is rather firm and the climate moist, little depth of covering is required; but when the soil is loose and the climate dry, the seeds should be covered to a depth of twice or more their thickness. Machines, more or less complex, have been in use from time immemorial for performing the operation of sowing or planting in all its forms. Some scatter the seed broadcast; others dibble it into the ground in rows or drills, and then cover it, the general principle being that the drills should be at such a distance apart that a horse drawing a light plow may pass between the drills without injuring the plants. In the larger machines, often drawn by horse-power, the seed is often placed in small cups, from which it passes through tubes so arranged as to allow them to drop regularly into shallow furrows cut by coulters just in front of the escape-orifice of the tubes, the furrows being closed up by a kind of rake or harrow following immediately after and forming a part of the machine. There are many kinds of seed-drills and planters in use.

Revised by L. H. BAILEY.

**Soy-bean**: the *Glycine* (or *Soja*) *hispida*; a bean extensively grown in Japan, China, India, and the Spice islands, where it is much used as food. The sauce called soy is, when genuine, made of boiled soy-beans, mixed with wheat-meal and fermented. It is then salted and mixed with water, and after daily stirring for a long time the supernatant liquid is poured off and preserved for use. Good soy is a spirited and excellent sauce, and is believed to improve with age. The plant is coming into notice in the southern parts of the U. S. for forage. Revised by L. H. BAILEY.

**Soyer**, swaa-i-ā', ALEXIS: cook and author of books on gastronomy; b. at Meaux, France, 1809; served as cook in several restaurants in Paris; went to London in 1830; was cook in the Reform Club in that city 1837–50; during the war in the Crimea voluntarily visited the British camps and hospitals there to introduce a better system of cookery for the soldiers. He published *Culinary Relaxations* (1845); *Gastronomic Regenerator* (1847; 9th ed. 1861); *Modern Housewife* (1849; new ed. 1872); *Shilling Cookery-book* (1854; 1858); *Culinary Campaign* (1857); and other works. D. Aug. 5, 1858.

**Space** [viâ O. Fr. from Lat. *spa'tium*, room, space, interval, public square]: as defined by Aristotle (*Phys.*, iv., 1–5), "the first and unmoved limit which bounds body" when taken as finite space or *place*; taken as space in general, it is "the unmoved limit of whatever is moved"—i. e. of all bodies. Time, on the other hand, should be, according to him, the number and measure of movement. The existence of pure space is evident, he says, from the fact that things change places; yet in spite of its three dimensions it is not to be confounded with body, for in that case two bodies would coincide; it is not cause; there is no place in which space itself exists; nor does space grow with what grows. Matter and form are inseparable, but extension and limiting surface are separable; hence matter and form do not explain them, as was thought by Plato in the *Timæus*, where he makes space to be the primitive matter of the universe; it is not form, for space remains when the form is removed. In these distinctions Aristotle lays especial stress on the idea of limit, negation, discreteness in relation to body as essential to the definition of space. In philosophy there is scarcely any subject upon which there is more apparent diversity of opinion or more fruitless attempts at definition. The difference, however, is not really so great as it seems. Space has been made identical with pure extension, but this leaves no definition for time, which likewise involves extension. Leibnitz made it "the order of things coexisting, as time is the order of things successive," so that if the totality of things could be moved, space, being their arrangement, would likewise be moved. It has been defined to be pure nothing, thus omitting its specializing attribute. For while "nothing" may be regarded as the potentiality of all (of events and ideas as well as of bodies), space can be regarded only as the potentiality of bodies. It has been made an accident or attribute or relation inhering in bodies; but this would involve the absurdity that annihilation of bodies destroyed space. As the ultimate logical condition for the coexistence of bodies, space is itself a correlate of time as regards motion and actually existing matter—time by itself being the ultimate logical condition of all succession. As ultimate logical condition it has quite frequently been identified with the infinite, or made to be a divine attribute. Sir Isaac Newton suggested that God by existing constitutes time and space. Samuel Clarke expanded this suggestion into a system of theology, and held a long discussion with Leibnitz on the subject. Akin to this view is that which makes space and time to be forms of mind when it thinks nature. Kant laid great stress on this, making space and time subjective forms of intuition and devoid of objective validity as regards "things in themselves." By this, however, he must not be understood to mean that they are subjective to the mere individual mind, and to be refused validity as regards objects in nature and history; for Kant regards all nature and all history as necessarily conditioned in and through space and time. His doctrine, therefore, does not narrow or belittle space and time, but only magnifies and glorifies mind, which is thus shown to transcend the world and to be of an eternal nature.

Much labor has been expended by sensationalists on the problem of accounting for the origin of the idea of space. Locke thought that he could trace it to the senses of touch and sight; most of his followers have adopted the same doctrine, making it a generalization from experience gained in the perception of bodies. Accordingly, they ignore in different ways the attributes of universality and necessity which are the distinctive characteristics of *a priori* ideas, and make unbroken custom or habit to be the explanation of the inability or impotence of the mind which we call inconceivability. That geometry rests upon the *a priori* cognition of space, as arithmetic and algebra rests upon a similar cognition of time, is not conceded by them. But Kant saw and stated with great clearness the grounds for all transcendental or spiritual philosophy as involved in the question, "Are *a priori* synthetical judgments possible"? i. e. Can we enounce the universal and necessary conditions of experience? The answer being affirmative, instancing mathematics, the next question is, "How are they possible"?—that is, What does this presuppose in regard to mind? Instead of deriving the idea of space from experience in regard to bodies, he saw that by no possibility could the mind conceive a body in the first instance without already having the idea of space. The mind uses the idea of space as an indispensable instrument in thinking the idea of a body. Moreover, space is not a generalized idea (discursive), inasmuch as it is not abstracted from spaces, but is thought as the logical condition of all possible spaces or bodies, and therefore as infinite from the first. (See refutation of Hamilton's doctrine of the inconceivability of infinite space in article on INFINITE.) Hegel unites in his view of space the doctrine of the Christian Mystics with that held by such thinkers as Newton and Clarke; making God's thinking and willing to be identical, he holds this self-knowledge to be a creation of the world—the making an object of himself to be the creative act. The self-consciousness of God being self-externalization, as well as return out of self-externalization through the act of recognition, nature and man (in whom nature is perpetually sacrificed and subordinated for spirit) come into being. Accordingly, the lowest, most elementary, abstract, and inadequate form of the divine self-knowing is space; time being at once the needed correlate to correct its imperfection, and reflect God's unity with himself, which is essential to destroy his self-alienation. The more orthodox view, however, holds that space, time, and the world arise not as direct object of the divine consciousness, but as a secondary reflection upon the derivation implied in the fact that the absolute as subject makes of himself an object of himself. Meister Eckhart, Jacob Böhme, Angelus Silesius, Franz Baader, Schelling, and others have explored this abyss of the creative idea, and with substantially the same results. Indeed, the Oriental mysticism which underlies Gnosticism, Neo-Platonism, and the Jewish Cabbalah is not essentially different as regards its logical movement, but only in its construction of the "return," and its assertion of the principle of emanation instead of creation. Spinoza's "thought and extension" as the two attributes of God suggest the view which he held of the relation of space to the divine activity. WILLIAM T. HARRIS.

**Spaeth**, spāt, ADOLPH, D. D.: theologian; b. at Esslingen, Würtemberg, Germany, Oct. 29, 1839; educated at the University of Tübingen. After being vicar in Würtemberg, and tutor in the family of the Duke of Argyle in Scotland, he went to the U. S. in 1864, and entered upon a pastorate in Philadelphia. In 1874 he became Professor of New Testament Exegesis in the Theological Seminary of the Lutheran Church in Philadelphia. He has been president of the General Council, and actively connected with all its literary and benevolent operations. He is the chief editor of its *German Church Book*, an American edition of Büchner's *Hand-concordance*, and published *Saatkörner* (1893), on the Gospels for the Church Year. H. E. JACOBS.

**Spagna**, spaan'yaa, **Lo**, or **Lo Spagnolo**: the usual name of the painter GIOVANNI DI PIETRO, one of the most distinguished scholars of Pietro Perugino. His work has often been taken for that of Perugino or of the young Raphael. Very little is known about his life. In 1503 he was an established painter, in 1516 he was made a citizen of Spoleto, and in the following year he was elected head of the society of painters there. His masterpiece, *The Madonna Enthroned*, painted in 1516, is in the chapel of St. Stephen in the lower church of St. Francis at Assisi. Lo Spagna was still living in 1530. The National Gallery in London possesses an *Agony in the Garden* by him, formerly attributed to Raphael. W. J. STILLMAN.

**Spagnolet'to, Lo**: See RIBERA, JOSÉ.

**Spahr**, CHARLES B.: lecturer and writer; b. in Columbus, O., July 20, 1860; A. B., Amherst, 1881; Ph. D., Columbia, 1886; studied at Leipzig; assistant editor of *The Outlook* since 1886; on the editorial staff of *The Commercial Advertiser* 1889–91; lecturer on Taxation and the Distribution of Wealth Columbia College, 1890. Author of *Taxation of Labor* (*Political Science Quarterly*, 1886) and *The Single Tax* (*Political Science Quarterly*, 1891). C. H. T.

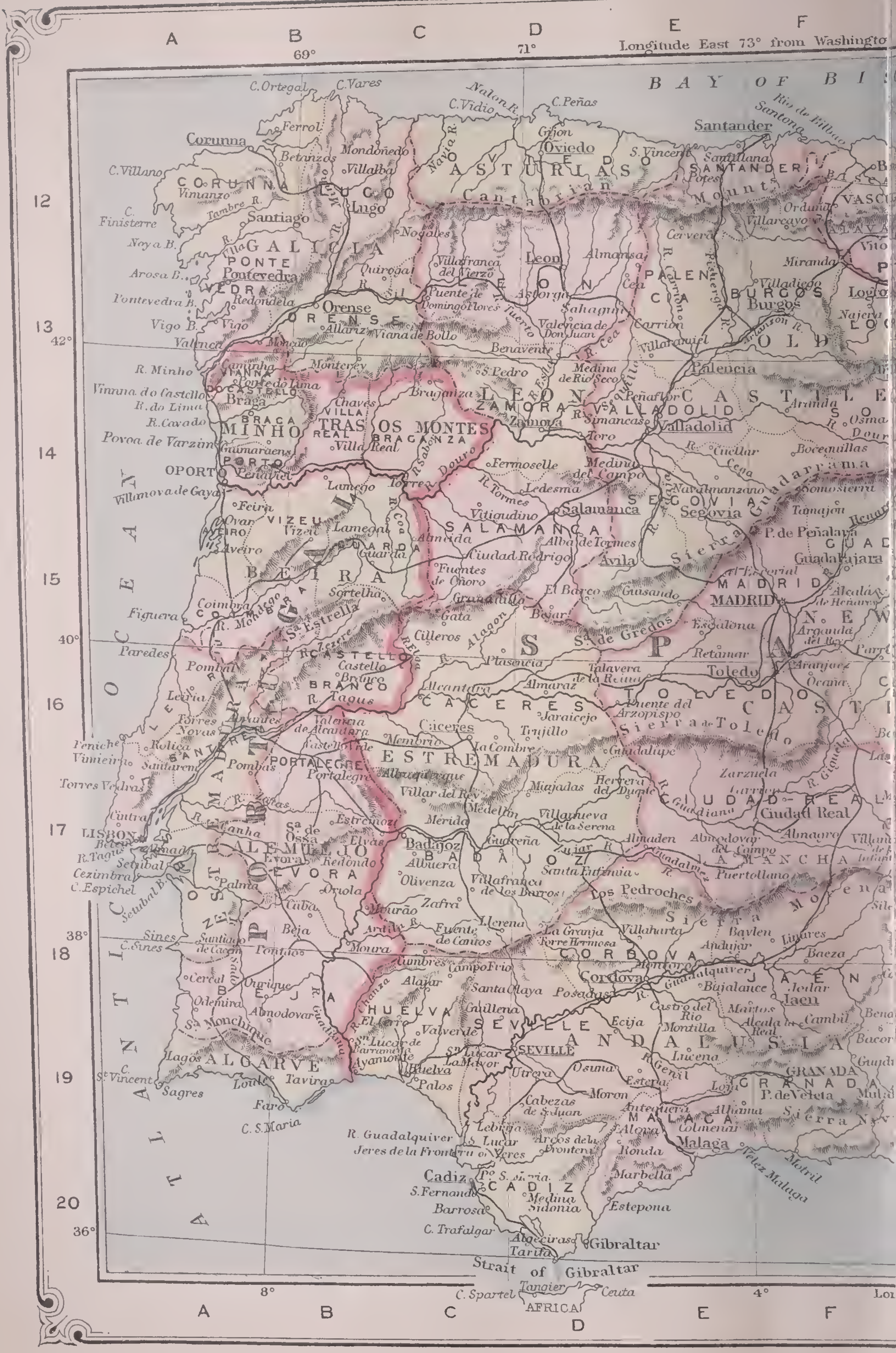
**Spain** [from Lat. *Hispa'nia* (> Span. *España*), Spain, deriv. of *Hispa'ni*, the name of the people of Hispania or ancient Spain]: a kingdom of Europe occupying more than four-fifths of the Iberian Peninsula, which it divides with Portugal, and separated from France by the Pyrenees. It includes the Balearic islands, in the Mediterranean, and the Canary islands, off the west coast of Africa (as the provinces of Baleares and Canarias respectively), and the town of Ceuta on the Moroccan coast, attached administratively to Cadiz. As thus defined it consists of forty-nine provinces, having an area of 197,670 sq. miles, and a population of 17,565,632 (1887). In 1898 it also had colonies in various parts of the world—in America, Cuba and Puerto Rico; in Asia, the Philippine, Sulu, Caroline, and Marianne islands; in Africa, Rio de Oro, Adrar, and several small towns and islands on the north and west coasts, making altogether under Spanish control an area of 603,000 sq. miles, with a total population of 27,261,200 (1887).

*Configuration.*—The Peninsula is separated from Africa by the Straits of Gibraltar, 15 miles across. The coast measures 1,000 miles on the Atlantic side, and 715 miles on the Mediterranean, and is much indented, with many good harbors. The center of the Peninsula is formed by a mass 1,500 to 3,000 feet high, and separated into several river basins by mountain chains running approximately E. and W. The plateaus of Leon and Old Castile occupy the north, and that of New Castile the center. From these to the N. E. extends the basin of the Ebro, to the E. and S. E. the plains of Valencia and Murcia, to the S. those of Andalusia, and to the W. Portugal. The Pyrenees cross the isthmus from the Bay of Biscay to Cape Creus on the Mediterranean, with an average breadth of 75 miles, and their main mass is in Spain. The principal peaks are in the middle of the chain, and the culminating points are Mt. Perdo (10,997 feet), on the international boundary, and Posets (11,047 feet) and Mt. Aneto (11,170 feet) within Spanish territory. Toward the eastern end of the chain the little republic of Andorra lies between France and Spain. The Pyrenees are continued westward by the Cantabrian Mountains for 350 miles, nearly to Cape Finisterre. They rise directly from the ocean on the N., but on the S. they pass more gently into plains 2,500 to 3,000 feet above sea-level. The highest point is the Torre de Ceredo (8,786 feet). The Sierra Nevada borders the Mediterranean along the south coast, and, although short, is higher than the Pyrenees. Between the northern and southern coast ranges are four other principal and many minor chains, which divide the river-basins, ramify, join together, or are lost in the central mass already mentioned, covering Spain with mountains usually rough and wild, yet not offering material difficulties to intercommunication. The Pyrenees have perpetual snow and some glaciers.

*Rivers.*—The main watershed is along the eastern margin of the central table-land, and the largest streams flow W., through Portugal, into the Atlantic Ocean. The largest stream flowing into the Mediterranean is the Ebro (440 miles long; basin, 38,580 sq. miles), which drains the Pyrenees and Eastern Cantabrian slopes, has a basin of typical triangular form, and projects a considerable delta into the sea. The longest river is the Tagus (566 miles long, 374 miles in Spanish territory; basin, 31,865 sq. miles), which crosses the Peninsula nearly centrally, flowing westward, and empties into the Atlantic through a large estuary, on which Lisbon is placed. The next in size is the Douro, the Portuguese name; the Spanish is Duero. It drains the table-land of Old Castile, for about 60 miles forms the boundary between Spain and Portugal, and empties into the Atlantic at Porto. The Guadalquivir and Guadiana empty into the Atlantic on the Gulf of Cadiz. The former is in exclusive Spanish territory, is 316 miles long (basin, 25,300 sq. miles), and has its mouth at San Lúcar, just N. of Cadiz. The Guadiana rises as the Zancara, on the E. of the plateau of La Mancha, and flows first westward, then southward, forming in part, in the latter part of its course, the boundary between Spain and Portugal. The length of the Guadiana proper is 316 miles, but with the Zancara it is 510 miles. The rivers, so far as they lie in Spanish territory, are of little use for navigation, except the Guadalquivir, but are much used for irrigation, and the waters of the lesser rivers spread on the gardens of Valencia and Murcia give the soil a prodigious productivity. The amount of flow in the rivers generally is unequal, being very small in summer and autumn.

*Climate.*—The climate of the interior table-lands is generally continental, rigorous and dry, that of the east coast dry and mild, that of the south coast moist and hot, and that of the northern slope cool, wet, and stormy. The annual rainfall is generally only from 8 to 20 inches, or about that of the Missouri valley; that of the southern coast from 20 to 50 inches; and that of the northern coast upward of 40 inches (at Oviedo 81). Madrid has only 11 inches of annual rainfall, less than that of Denver, but more than that of El Paso. The summer temperatures in the interior are the hottest in Europe, and are of the same degree as those of the middle Euphrates valley, but the winter temperatures are less extreme, being like those of Sicily and the Peloponnesus.

*Productions.*—The mineral wealth of Spain has been known from the most ancient times, and its richness in gold made it the California of the Carthaginians and Romans. The production of gold has long failed, but Spain still continues the richest country in Europe in other mineral products. Iron is extremely abundant in the mountains, especially in the Biscayan provinces; lead is very abundant, especially in the Sierra de Gador, W. of Almeria; argentiferous lead is extensively distributed, and the mines at


Longitude East 73° from Washington
69°
71°
8°
4°
42°
40°
38°
36°
BAY OF BISCAY
ATLANTIC OCEAN
C. Ortegal
C. Vares
C. Villano
C. Finisterre
Ferrol
Corunna
Betanzos
Mondoñedo
Villalba
CORUNNA
LUGO
Lugo
Santiago
GALICIA
PONTEVEDRA
Pontevedra
Redondela
Vigo B.
Vigo
Orense
ORENSE
Allariz
Viana de Bollo
Quiroga
Nogales
C. Vidio
C. Peñas
Gijon
Oviedo
ASTURIAS
Cantabrian Mounts
S. Vincent
Santander
Santillana
SANTANDER
Potes
Santona
Rio de Bilbao
Orduña
Villarcayo
Miranda
Logroño
Najera
Villafranca del Vierzo
Puente de Domingo Flores
Astorga
LEON
Leon
Almansa
Sahagun
Valencia de Don Juan
Benavente
Cea
PALENCIA
Carrion
Cervera
Villadiego
BURGOS
Burgos
OLD CASTILE
Villaramiel
Palencia
Medina de Rio Seco
Peñaflor
VALLADOLID
Valladolid
Simancas
Toro
ZAMORA
Zamora
Braganza
BRAGANZA
TRAS OS MONTES
Chaves
VILLA REAL
Villa Real
Monterey
R. Minho
Caminha
Ponte de Lima
Braga
BRAGA
MINHO
Povoa de Varzim
Guimaraens
PORTO
OPORTO
Villanova de Gaya
Penafiel
Lamego
Torre de Moncorvo
Feira
Ovar
AVEIRO
Aveiro
VIZEU
Vizeu
GUARDA
Guarda
Almeida
BEIRA
Coimbra
COIMBRA
Figuera
Paredes
R. Mondego
Sa. Estrella
Sortelha
Fermoselle
Ledesma
R. Tormes
Vitigudino
Salamanca
SALAMANCA
Ciudad Rodrigo
Fuentes de Oñoro
Alba de Tormes
Avila
Medina del Campo
Cuellar
Cega
Boceguillas
Aranda
Osma
Douro
Navalmanzano
SEGOVIA
Segovia
Sierra Guadarrama
Somosierra
Tamajon
P. de Peñalara
Guadalajara
El Escorial
MADRID
MADRID
Alcala de Henares
Arganda del Rey
NEW CASTILE
Aranjuez
Ocaña
El Barco
Guisando
Bejar
Sa. de Gredos
Escalona
Retamar
Toledo
TOLEDO
Talavera de la Reina
Puente del Arzopispo
Sierra de Toledo
Gata
Cilleros
Alagon
Plasencia
SPAIN
CASTELLO BRANCO
Castello Branco
R. Tagus
Pombal
Leiria
Torres Novas
Abrantes
Peniche
Vimieiro
Rolica
SANTAREM
Santarem
Torres Vedras
Cintra
LISBON
Belem
R. Tagus
Almada
Setubal
Cezimbra
C. Espichel
Setubal B.
PORTUGAL
ESTREMADURA
Alcantara
Almaraz
CACERES
Caceres
Jaraicejo
Trujillo
La Cumbre
Membrio
Valencia de Alcantara
Castello de Vide
PORTALEGRE
Portalegre
Albuquerque
Villar del Rey
Guadalupe
Miajadas
Medellin
Merida
Villanueva de la Serena
Herrera del Duque
Estremoz
Elvas
ALEMTEJO
EVORA
Evora
Redondo
Badajoz
BADAJOZ
Albuera
Olivenza
Villafranca de los Barros
Zafra
Mourão
Fuente de Cantos
Llerena
Guareña
Zujar
Almaden
Santa Eufemia
Los Pedroches
Sierra Morena
Palma
Cuba
Beja
Serpa
Moura
Sines
C. Sines
Santiago de Cacem
Cercal
Ourique
Odemira
BEJA
Almodovar
Sa. Monchique
Lagos
ALGARVE
Tavira
Loulé
Faro
C. S. Maria
C. St. Vincent
Sagres
Cumbres
Campo Frio
Alajar
HUELVA
Valverde
El Cerro
Aracena
Lucar de Barrameda
Ayamonte
Huelva
Palos
R. Chanza
Guadiana
Santa Olaya
Guillena
SEVILLE
SEVILLE
St. Lucar La Mayor
Utrera
Osuna
Moron
Cabezas de S. Juan
Lebrija
S. Lucar
Arcos de la Frontera
Jeres de la Frontera
R. Guadalquiver
Cadiz
S. Fernando
Barrosa
C. Trafalgar
Pº. S. Maria
CADIZ
Medina Sidonia
Algeciras
Tarifa
Gibraltar
Strait of Gibraltar
C. Spartel
Tangier
Ceuta
AFRICA
Estepona
Marbella
Ronda
Alora
Antequera
Estepa
MALAGA
Malaga
Colmenar
Velez Malaga
Motril
Alhama
Loja
GRANADA
GRANADA
P. de Veleta
Sierra Nevada
Genil
Lucena
Montilla
ANDALUSIA
Ecija
Posadas
Cordova
CORDOVA
Montoro
Castro del Rio
Martos
Alcala la Real
Cambil
Jaen
JAEN
Bujalance
Baeza
Linares
Andujar
Baylen
Villaharta
La Granja
Torre Hermosa
Puertollano
LA MANCHA
Almodovar del Campo
Almagro
CIUDAD REAL
Ciudad Real
Zarzuela
Guadiana
R. Gigüela
Alcaraz
Guadalimar
A
B
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F
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13
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20

SPAIN
AND
PORTUGAL
English Miles
10 20 40 60 80 100
Names of provinces in Spain are underlined thus. NAVARRE.
The towns underlined thus. GRANADA give names to the provinces.
F R A N C E
PYRENEES MOUNTAINS
BALEARIC ISLANDS
MEDITERRANEAN SEA
MINORCA
Mahon
MAJORCA
Palma
Soller
La Puebla
Manacor
Cabrera I.
IVIZA
Iviza
PITHYUSA ISLES
Formentera
Columbretes Rocks
ARAGON
CATALONIA
NAVARRE
HUESCA
LERIDA
GERONA
BARCELONA
TARRAGONA
TERUEL
CASTELLON
VALENCIA
ALICANTE
MURCIA
ALBACETE
Bayonne
Irun
Pamplona
Roncesvalles
Saragossa
Huesca
Lerida
Tarragona
Tortosa
Castellon de la Plana
VALENCIA del Cid
Alicante
Cartagena
Murcia
Albacete
Teruel
Port Vendres
C. Cervera
C. Creux
Figueras
G. of Rosas
C. Bagur
Palamos
S. Feliu de Guixols
Mataró
R. Ebro
C.S Martin
C. Palos
C. Gata
Denia
Torrevieja
B. of Almeria
Mojacar
Vera
Longitude West 2° from Greenwich
0°
Longitude East
2°
75°
77°
79°
81°
42°
40°
38°
36°
G H I J K L M
12 13 14 15 16 17 18 19 20

Linares, in Andalusia, are very important; copper is worked at many places, principally to the N. of Huelva; cinnabar has been taken out at Almaden from the time of the Romans; and rock-salt, marble, plaster, mineral fertilizers, and coal offer large resources. In 1899 the production of copper ore was 2,443,044 tons, valued at $8,500,000; of silver-lead ore, 184,906 tons, valued at $7,406,640; of lead ore, 123,750 tons, value $4,641,300. Of the copper ore, over 90 per cent. was exported, chiefly to Great Britain. In 1894 over 15,000 mines were registered, of which about 2,000 were worked.

The wealth of Spain in mineral and thermal springs is even more unique than her wealth in minerals. In 1765 Bedoya enumerated 2,000 such springs; in 1844 the number of such springs used by the sick was more than 1,200, while in France the number was 864. These springs occur chiefly at the foot of the Pyrenees and of the Sierra Nevada. Guipuzcoa, the smallest of the provinces, has the largest number, 84 springs, of which 55 have accommodations for baths; next is Granada, with 65 springs and 25 baths; then Malaga, with 58 springs and 31 baths.

Of the lands, 80 per cent. is classed as productive, and of this 34 per cent. is devoted to agriculture, 21 to fruits, 20 to meadows, 4 to vineyards, and 2 to olives. The great variations in altitudes permit the productions to range through those of the sub-tropic and temperate zones. The cereals are abundant and of excellent quality. The leading crops are wheat, rye, barley, maize, rice, esparto, flax, hemp, and pulse. The product of wine is very large and highly valued; it is the chief item of export; value in 1899, 103,562,987 pesetas ($19,987,656). Raisins, almonds, oranges, olive oil, and conserves are also exported in great quantities. Cork is chiefly furnished by Spain, though the cork-tree grows in Southwestern Europe and Northern Africa. The exported Spanish product in 1892 was valued at over $5,000,000. Pastoral pursuits occupy the peasantry of the interior, and the Spanish races of sheep, cattle, and horses are all celebrated for excellence. The wool export in 1892 was valued at $2,000,000, and that of boots and shoes at $5,000,000.

*Commerce.*—The imports of merchandise in 1900, including the precious metals, were valued at 862,396,600 pesetas ($166,442,544) and the exports at 723,867,883 pesetas ($139,706,501). The imports are chiefly wheat, cotton, raw or manufactured, coal and coke, drugs and chemicals, sugar, machinery, tobacco, and woolen goods. The chief exports were wine, minerals and ores, cork, boots and shoes, cotton textiles, fruits, oil, and wool. The trade was chiefly with France, Great Britain, and the United States. The merchant navy consisted in 1898 of 436 steamers and 1,145 sailing vessels of over 100 tons. In 1900 17,722 vessels entered and 16,910 cleared from the Spanish ports, and about half carried the Spanish flag.

In 1899 there were 8,068 miles of railway open, all of private ownership. On Jan. 1, 1898, there were 19,868 miles of telegraph line, with 45,790 miles of wire.

The unit of money is the *peseta*, of the value of a franc, or 19·3 cents. The gold coins in common use are worth 5, 10, and 20 pesetas, and the silver coins 1 and 5 pesetas. Weight and fineness are those of the corresponding French coins. The ratio of gold to silver is 15½ to 1, and the 5-peseta silver-piece is legal tender. The metric system was introduced in 1859, but the old weights and measures are still largely used. The *libra* is 1·014 lb. avoirdupois, and the *quintal* = 100 libras. The *arroba* = 3¼ imperial gal. for wine or 2¾ gal. for oil, and the *fanega* = 1½ imperial bush.

*Administration.*—Spain is a monarchy, under the constitution of 1876. The legislative power is vested in a parliamentary body called the Cortes, consisting of a Senate and a Congress. The senators in part hold life positions by inheritance or *ex officio*, in part are nominated by the crown, and in part elected, and together number not more than 360. The Congress has 431 elected deputies. All are elected for five years, or until the Cortes are dissolved by the crown. The ministry is responsible, and consists of nine members. The local governments are generally representative.

For the fiscal year 1898–99 the total revenue was 842,532,714 pesetas ($162,608,814) and expenditures 878,398,568 pesetas ($169,530,923). The revenue is derived from direct and indirect taxation, stamp-duties, monopolies, and income of public property. The monopolies are the tobacco-trade, the lottery, the mint, and others. The public debt of all kinds (funded and floating) on July 1, 1900, exceeded 9,307,798,721 pesetas ($1,796,405,153), and the principal item in the public expenditure is the payment of the interest charges.

Spain possesses about fifty fortified places, mostly ports, but Gibraltar, which controls the Straits, is in the hands of the British. The army and navy are recruited by conscription. The permanent army consists of 98,140 men, and this force can be increased to 1,083,595 in time of war. There are 13 military schools and colleges. At the beginning of 1898 Spain had 1 first-class battle-ship, 1 port-defense ship, 10 first-class cruisers, 7 second-class, 11 third-class, 80 gunboats, and 27 torpedo boats, 137 in all, manned by 14,000 seamen, 9,000 marines, and 1,000 officers, including engineer officers; but in the war with the U. S. Spain lost many of her ships and men. See ARMY and SHIPS OF WAR.

Of the colonies in 1898 Rio de Oro and Adrar were governed by the province of Canarias, and the others were controlled by governors appointed by the crown. Cuba had 46 representatives in the Cortes. As a result of the war with the U. S., Cuba, Porto Rico, Guam, and the Philippines were lost to Spain.

*Divisions.*—The forty-nine provinces of Spain, including the Canary islands, with population of each, according to a census taken in 1897, are as follows:

| Provinces. | Pop. | Provinces. | Pop. |
|---|---|---|---|
| Alava | 94,622 | Logroño | 186,223 |
| Albacete | 233,005 | Lugo | 459,119 |
| Alicante | 451,174 | Madrid | 737,444 |
| Almeria | 344,681 | Malaga | 485,132 |
| Avila | 197,636 | Murcia | 518,263 |
| Badajoz | 490,551 | Navarra | 302,978 |
| Baleares | 306,926 | Orense | 402,873 |
| Barcelona | 1,034,538 | Oviedo | 612,663 |
| Burgos | 340,001 | Palencia | 193,668 |
| Caceres | 354,245 | Pontevedra | 447,612 |
| Cadiz | 434,250 | Salamanca | 317,005 |
| Canarias | 334,521 | Santander | 263,673 |
| Castellon de la Plana | 304,477 | Segovia | 156,086 |
| Ciudad-Real | 305,002 | Sevilla | 547,020 |
| Cordoba | 443,582 | Soria | 147,787 |
| Corunna | 631,419 | Tarragona | 334,343 |
| Cuenca | 241,566 | Teruel | 239,831 |
| Gerona | 298,497 | Toledo | 370,012 |
| Granada | 477,768 | Valencia | 775,995 |
| Guadalajara | 199,290 | Valladolid | 276,366 |
| Guipuzcoa | 191,822 | Vizcaya | 290,222 |
| Huelva | 253,970 | Zamora | 275,354 |
| Huesca | 238,935 | Zaragoza | 413,480 |
| Jaen | 463,806 | N. and W. coast of Africa | 11,003 |
| Leon | 384,197 | | |
| Lerida | 274,867 | Total | 18,089,500 |

*Population.*—The native tribes of the Peninsula known to the Romans may be called Iberian. The present population consists of Iberians, modified successively by intermixture with Celts, Carthaginians, Romans, Goths, Jews, and Moors. With the last came some Negro blood, and to the slight intermixture of this blood is probably due the well-known Spanish and Portuguese capacity for tropical colonization. At the same time from Spain has poured out an enormous wave of emigration, which has left its mark on the most of America and several oceanic archipelagoes, and this has had its reaction on purity of Spanish blood. Yet notwithstanding these numerous intermixtures, each lasting through centuries, the people are among the most characteristic, self-contained, and sharply defined of Europe. The linguistic type evolved is essentially Roman, but the ethnic includes the Portuguese, and is clearly distinct from the rest of Europe. The Spaniard, somewhat swarthy, is well-balanced as to virtues and vices, vigorous, original, serious, proud, dignified, courteous, tenacious, patriotic, thrifty, sometimes vain, bigoted, intolerant, and vindictive. In the Roman conquest Spaniards were found gallant and warlike, and when overcome they made the most faithful and conservative of the Roman provinces. They formed a fertile and easy field for early Christian missionary effort, and having accepted the Roman supremacy and Christianity they were tenacious of them, and for the next 1,000 years were chiefly occupied in defending themselves and their religion. With the discovery of America this race displayed to the world its amazing supply of courage, enterprise, and endurance, as well as its indifference to the sufferings of inferior races.

The growth of the population has been slow. Philip II. took a census (imperfect as compared with modern ones) in 1594, giving 8,206,791 inhabitants; in 1797 another census gave 10,268,150—a very small increase in two centuries, due to enormous colonization. The increase during 1877–87 was at the rate of ·47 per cent. per annum. The density of population is over 88 per square mile, and decreases from coast to center. The females are in surplus of 104 to 100. The principal cities are Madrid (pop. (1897) 512,150), Barcelona (509,589), Valencia (204,768), Seville (146,205), Malaga (125,579), and Murcia (108,408), and there are no other cities with a population more than 100,000.

In 1889 4,854,742 persons were following agricultural pursuits, 823,310 the arts and trades, 409,549 domestic service, 243,867 industrial (textile and mineral), 194,755 commercial, 115,764 merchant marine, 97,257 public employees, 91,226 were inmates of asylums, etc., 84,510 professional, 72,077 religious, and 1,719,955 were school and college pupils. In 1892 the surplus of emigration over immigration was 8,258. Emigration is chiefly to Brazil, Uruguay, and Argentina.

The national church is the Roman Catholic, and the only professed dissenters in 1887 were 9,645 rationalists, 6,654 Protestants, 402 Jews, and 510 of other religions. In 1884 there were 32,435 priests, 1,684 monks resident in 161 monastic houses, and 14,592 nuns in 1,027 convents. There were 65 cathedrals, 18,564 churches, 30 religious colleges, and 11,202 other buildings used for religious purposes. Since 1876 private Protestant worship has been permitted.

In 1860 only 20 per cent. of the population could read and write; in 1889 this percentage had grown to 28·5. Compulsory primary education is statutory, but is not enforced. In 1885 there were 24,529 public free primary schools and 5,576 private ones, with a total enrollment of 1,843,183 pupils. The secondary schools are less efficient. There are 10 universities with 16,000 students in all; also various special schools supported by the Government.

*History.*—The colonization of the coasts of the Peninsula by the Phœnicians (Cadiz), Greeks (Saguntum), and Carthaginians (Cartagena) began about 1100 B. C. The Carthaginians extended their conquest over about a half of the Peninsula in the third century B. C. This was inherited by the Romans as the result of the Punic wars, and the conquest was completed 19 B. C. The Spanish provinces were very thoroughly Romanized. The Gothic invasion was begun in the fifth century of our era, but the Gothic kingdom was overthrown by the Arabs in 711, who remained in control of most of the Peninsula for three centuries. Christian kingdoms were gradually established from the eleventh century until the marriage of Ferdinand V. of Aragon and Isabella of Castile united these kingdoms in 1479, and began a career of prosperity, which resulted in the conquest of the Moors and the discovery of America, and gave Spain the form and character which it yet bears. The marriage of Isabella's daughter Johanna with Philip I., son of the Emperor Maximilian, made Spain a part of the Hapsburg empire, with Germany, the Netherlands, Milan, Naples and Sicily, Sardinia, Burgundy, and the colonies, under Charles I. of Spain, V. of Germany (1516). The despotism of Charles was followed by the tyranny of the bigoted Philip II. (1556–98), who, with the aid of the Inquisition, undertook to root out Protestantism, and he with his no less despotic and intolerant successors succeeded in bringing to a close before the eighteenth century the brilliant period of Spanish history, which began with Ferdinand and Isabella. The line of Hapsburg princes closed with Charles II. (1665–1700). On his death followed the war of the Spanish succession (see SUCCESSION WARS), which resulted in placing a Bourbon prince on the throne, and with two brief interruptions this dynasty has since remained in power. The first interruption was in 1808–14, during which time Joseph was kept in power by his brother Napoleon. This was the period of the Peninsular war, in which successful resistance to the self-aggrandizing schemes of Napoleon was for the first time offered. Upon the dethronement of their king and the occupation of his throne by Joseph Bonaparte the entire Spanish people rose in arms, and, though ill disciplined and unorganized, showed such vigor and courage as to require the personal presence of Napoleon in Spain in order to restore the French authority. Subsequently, however, he left to his marshals the difficult task of subduing the Spaniards, whose persistent efforts, aided and directed by the military genius of Wellington, resulted in driving out the intruders and contributed to the final overthrow of Napoleon. (For an account of the causes of the Peninsular war, see NAPOLEON I. (*Spanish Campaign*), and for further details WELLINGTON, ARTHUR WELLESLEY, DUKE OF.) The second interruption of the Bourbon rule was from 1868 to 1874, during which years a regency, a short-lived monarchy under Amadeus, and a republic were successively established. The Bourbons were restored Dec. 30, 1874, in the person of Alfonso XII., eldest son of Isabella. He died in 1885, and was succeeded by his posthumous son, Alfonso XIII., with Maria Christina, his mother, as regent. A rebellion in CUBA (*q. v.*) led, in 1898, to a war with the U. S., in which the flower of the Spanish navy was destroyed. See SPAIN, HISTORY OF, in the Appendix.

REFERENCES.—Murray's *Handbook of Spain* (1888); Willkomm, *Die Pyrenäische Halbinsel* (1885); Gallenga, *Iberian Reminiscences* (1883); Riera y Sans, *España y sus Colonias* (1891). MARK W. HARRINGTON.

**Spal'ato**, or **Spalatro**: town and railway station; in the province of Dalmatia, Austria; on a peninsula jutting out into the Adriatic (see map of Austria-Hungary, ref. 10-E). It has a good harbor, is defended by a citadel, and carries on an active trade in grain, cattle, horses, swine, fruits, wine, and rosoglio, besides an extensive transit trade between Italy and Turkey. It is situated near the ancient *Salona*, on the site of the famous palace of Diocletian, called *Salonæ Palatium*, or, in an abbreviated form, *S. Palatium*; hence the name of the modern town. Of the magnificent palace, which covered 8 acres of ground and which it took twelve years to build, many remains are extant. Pop. (1890) 15,697. Revised by M. W. HARRINGTON.

**Spalax**: a small rodent (*Spalax typhlus*) having the habits and very much the appearance of a mole. The incisors are large, the molars, three on each side of either jaw, have roots. The external ears are rudimentary, as are also the eyes, which are covered by the skin; the tail is rudimentary; the fore feet modified for digging. The silky fur is of a general yellowish brown; the length is 5 or 6 inches. The animal is also known as the mole-rat. It ranges from Southeastern Europe into Asia. F. A. L.

**Spalding**, JOHN FRANKLIN, D. D.: bishop; b. at Belgrade, Me., Aug. 25, 1828; graduated at the North Yarmouth Classical Academy, Maine, in 1849, at Bowdoin College, Maine, in 1853, and at the General Theological Seminary of the Protestant Episcopal Church, New York, in 1857; minister of St. James's church, Oldtown, Me., 1857–59; was rector of St. George's church, Lee, Mass., till 1860, when he became assistant minister of Grace church, Providence, R. I., for one year; rector of St. Paul's church, Erie, Pa., 1862–74: member of the general board of missions from 1865; dean of the Erie convocation Jan., 1866: elected Oct. 24, 1873, missionary bishop of Colorado, with jurisdiction in Wyoming and New Mexico; consecrated bishop Dec. 31, 1873. He published *The Threefold Ministry* (1864), *Manual of Prayers* (1872), and various articles, sermons, pamphlets, etc.

**Spalding**, JOHN LANCASTER: bishop; b. at Lebanon, Ky., June 2, 1840; educated at Mt. St. Mary's, Emmitsburg, Md., at the University of Louvain, and in Rome. He was secretary to the bishop of Louisville in 1865, built a church there for colored Catholics, and became chancellor of the diocese in 1871. He was made bishop of Peoria, Ill., in 1877. His published works include *Essays and Reviews* (1876), *Religious Mission of the Irish People* (1880), *Education and the Higher Life* (1891), *Things of the Mind* (1894), and two volumes of poems.

**Spalding**, MARTIN JOHN, D. D.: bishop; b. in Marion co., Ky., May 23, 1810; graduated at St. Mary's College in 1826, and in 1830 went to Rome to enter the College of the Propaganda; returning to Kentucky, was ordained priest in 1834; appointed pastor of the cathedral church at Bardstown, and established *The Catholic Guardian*, with which he retained his connection until 1858; lectured in favor of Roman Catholicism in the U. S. and Canada, his lectures being published under the title *Evidences of Catholicity* (1847; 4th ed. 1866); in 1848 appointed coadjutor of the Roman Catholic diocese of Louisville; in 1850 became Bishop of Louisville, where he erected a cathedral. In 1864 he succeeded Dr. Kenrick as Archbishop of Baltimore; in 1866, as apostolic delegate, convened the second national council at Baltimore, and drew up the acts of the council. He took a prominent part in the Vatican Council of 1870–71, where he urged an immediate decision on the subject of papal infallibility, but wished it to be indirect and implied, rather than positive and affirmative; but he, with the other Roman Catholic bishops from America, yielded in favor of a positive declaration. His principal works are *Early Catholic Missions of Kentucky* (1844); *History of the Protestant Reformation in Germany and Switzerland*, written in opposition to Merle d'Aubigné (1860); and a translation, with notes and an introduction, of Darras's *General History of the Catholic Church* (1866). His miscellaneous essays have also been published in book form, and his *Life* by John L. Spalding. D. in Baltimore, Feb. 7, 1872.

**Spallanza'ni**, LAZARO: naturalist and physiologist; b. at Scandiano, duchy of Modena, Jan. 12, 1729; was appointed Professor of Logic, Metaphysics, and Greek at Reggio di Modena in 1754, and at Modena in 1761. At the reestablishment of the University of Pavia in 1768 he became Professor of Natural History, made extensive scientific travels in Italy and Sicily, Switzerland and Germany, Turkey, Asia Minor, Corfu, and Cyprus. D. at Pavia, Feb. 12, 1799. His polemics against Needham and Buffon, whose theory of spontaneous generation among the infusoria he contested, attracted special attention, showing by a series of ingenious experiments that these animals originated from germs existing in the atmosphere. Among his works are *Viaggi alle Due Sicilie ed in alcune parti degli Apennini* (Pavia, 1792); *Opuscoli di fisica animale e vegetabile* (Modena, 1780), in which he demonstrated the true nature of digestion; and *Expériences pour servir à l'histoire de la génération des animaux et des plantes* (1786), in which he determined the relative functions of the ovum and spermatozoön. R. A. ROBERTS.

**Spandau**, spaan'dow: an old fortified town and military station; province of Brandenburg, Prussia; at the confluence of the Havel and the Spree; 9 miles W. N. W. of Berlin (see map of German Empire, ref. 3–G). The citadel stands on an island in the Havel, and is used by the Prussian Government as a prison for military and political criminals. The city is well built, has manufactures of hosiery, woolen fabrics, gunpowder, and arms, and carries on a large transit trade between Berlin and Hamburg. Pop. (1895) 55,841.
Revised by M. W. HARRINGTON.

**Spang'enberg**, AUGUST GOTTLIEB: bishop; b. at Klettenberg, Germany, July 15, 1704; graduated Ph. D. at Jena 1726; became a professor at the University of Halle and assistant superintendent of Francke's orphan-house in the same city 1731; was dismissed at the instigation of the Pietists of Halle because he associated with the Moravians, and had expressed the opinion that Pietistic religion was formal and worldly 1733; naturally on his dismission he joined the Moravians and became assistant to Count Zinzendorf at Herrnhut. From 1733–62 his care was the superintendence and organization of their missionary operations. With this end he visited England 1734; obtained lands from the trustees of Georgia for a Moravian settlement in that colony; landed at Savannah with nine Moravian settlers, the first who located in America, 1735; labored as a missionary among his German countrymen in Georgia and Pennsylvania 1735–39, after which he returned to Europe; was instrumental in procuring the establishment of the settlement at Bethlehem, Pa.; founded in London 1741 the first regular Moravian society in England; became general deacon, and in 1744 bishop, of his Church; proceeded to Pennsylvania the same year; repeatedly visited the Oneida Indians; made another visit to Europe 1749–51; organized a Moravian community in North Carolina 1752; was elected successor of Count Zinzendorf in the supreme council; returned finally to Europe 1762. For the next thirty years he was the guide of the Moravians in the consolidation of the home Church, and paid particular attention to their educational methods. He became in 1789 president of the general directory. D. at Berthelsdorf, near Herrnhut, Saxony, Sept. 18, 1792. Author of a *Life of Zinzendorf* (6 vols., Barby, 1772–75; abridged English trans., London, 1838, by B. La Trobe), and of *Idea Fidei Fratrum* (1779; English trans. *Exposition of Christian Doctrine*, London, 1784; 2d ed. 1796), the authoritative manual of Moravian theology. See the biographies by J. Risler (Barby, 1794); C. F. Ledderhose (Heidelberg, 1846; Eng. trans. London, 1855); and G. C. Knapp, *Beiträge zur Lebensgeschichte A. G. Spangenbergs* (Halle, 1884; edited by O. Frick). Revised by S. M. JACKSON.

**Spaniard's Bay**: a fishing-town on the west side of Conception Bay; 7 miles S. of Harbor Grace, Newfoundland; is surrounded by high hills and has some fine views. The inhabitants are mostly engaged in the Labrador cod-fishery. Pop. 1,200.

**Spaniels**: See DOGS and SPRINGER.

**Spanish-American Literature**: the literature of the Spanish-speaking peoples of America. This is of no recent growth. Early in the sixteenth century civilized communities were established in Cuba, Mexico, Peru, and at the mouth of the Plata; and numerous other localities were rapidly colonized. In succeeding centuries intellectual activity steadily increased; so that Spanish America has furnished a long list of eminent men of letters.

Literary culture was more distinctive of the Spanish colonist than of his northern and Saxon brother. While the natural implements of the latter were the axe, the plow, and the hammer, those of the former were the sword and the pen. Moreover, the British settlers of North America were political or religious refugees who received little attention or support from the home government; whereas the colonization of Spanish America was a national project, in the success of which the sympathies, ambitions, and pride of all classes were involved.

The cities of Mexico and Lima had universities half a century before Cape Cod was discovered or John Smith had entered the Chesapeake; and when Harvard College was founded in 1636, Spanish America possessed sixteen flourishing universities and colleges, including the Universidad de Sau Gregorio at Quito and the Universidad de Santo Tomás at Bogotá. Peru with its present shrunken boundaries has six universities and fifty-one colleges, and a national library which contained over 56,000 volumes before the war with Chile in 1882, and now numbers about 35,000; Venezuela has two great universities and six smaller ones, together with fifty-four colleges and other higher institutions of learning; the library of the University of Caracas numbers 30,000 volumes. Spanish America produces many extensive and erudite works of history, archæology, jurisprudence, and natural science, and the most beautiful editions of the classics are to be found there. Educational books and works of direct utility are numerous, and descend to stock-raising, gardening, cooking, carpentry, and locksmithing. An official catalogue shows thirty-seven native text-books in use in the Argentine schools. Spanish-American thoroughness sometimes tends toward prolixity, and voluminous works are not uncommon. The *Historia de México*, by Nieeto de Zamacóis, fills twenty octavo volumes; and the recent collaboration, *México á través de los siglos*—historical and descriptive, from the conquest to the present day—is embellished with nearly 3,000 illustrations.

A great part of the pictorial and hieroglyphic writings of the native races were destroyed by the Spanish conquerors. Yet considerable fragments remain, such as the *Popol Vuh* and the Inca drama of *Ollantay*, translated by Carraseo and others. A great amount of labor was expended, especially by the Jesuit fathers, on these relics and the languages to which they pertain. The *Bibliothèque México-Guatémalienne*, of Brasseur de Bourbourg (Paris, 1871), gives much minute information regarding what has been written on the subjeet in Spanish America.

*Writers of the Colonial Period.*—In the early part of the colonial period writers in Spanish America were generally visitors from the Old World. Yet occasionally there appeared Ameriean writers whose brilliancy was enhanced by their isolation. Chile claims an epic poet prior to the seventeenth century in Pedro de Oña, the author of *El Arauco domado* (pub. 1595). Mexico had Juana Inés de Abajé y Ramírez, or Sor Juana Inés de la Cruz (d. 1695). Reared in the viceregal court of Mexico, she dazzled equally by her beauty and her immense learning; then, disappointed in life, she retired to a convent. Contemporary with her was Carlos de Sigüenza y Góngora (d. 1700), also of Mexico, who was one of the most diligent and versatile writers of the age. His works on all subjects from astronomy to rural life would fill a catalogue.

The very interest that was felt in Spain for matters Spanish-American, and which tended as an incentive and a support to culture in the colonies, eventually acted as a detriment; for the literary decadence in Spain from the latter part of the sixteenth century to the beginning of the eighteenth, could not fail to be reflected in the New World. Still there was no such literary blank in the colonies as existed in Spain. The revival which came with the eighteenth century was quickly felt in America, but the initial movement was scientific rather than literary. A long list of eminent physicists and naturalists might be given, but the three most prominent must suffice. José Antonio Alzate y Ramírez (Mexico, d. 1790), besides being a writer of note, did a great deal indirectly for scientific progress by means of the *Gaceta de Literatura*, of which he was editor. In what is now Colombia, Francisco José de Caldas (1686–1770) and José Celestino Mutis (1732–1800) rendered lasting services to natural science. Their investigations were principally in the fields of botany, geology, and astronomy; but their descriptive writings are extremely interesting and entitle their names to honorable places in the literature of the New World. The most distinguished master of style of this period was Pedro de Peralta y Barnuevo (1670–1748), the Peruvian jurist, historian, and poet. His best-known work is the epic *Lima fundada*.

*Writers of the Nineteenth Century.—Poets.*—The nineteenth century has naturally produced more eminent writers than all previous ages. Foremost of these is Andrés Bello (b. Venezuela, 1781; d. Chile, 1865), revered in South America for his vast and varied learning and for his labors as jurist, educator, and poet, and conceded even by Spanish critics to be one of the greatest masters of Castilian that the nineteenth century has produced. His georgic *La agricultura en la zona tórrida* is especially admirable both for the beauty of its language and sentiment, and for its faithful descriptions of rural scenes and life in South America.

Spanish-American poetry and fiction, as might be expected, treat principally of three themes—the exploits of the early Spanish conquerors, the struggles of the colonies for independence, and the phases of life peculiar to a new country—which impart to the literature a unique and distinctive local coloring. Moreover, a number of poems and romances are founded on Indian legends, or tell of Indian life and customs, after the manner of Cooper and Longfellow. Two of the best of these are the *Painé* and *Relmú* of the Argentine publicist Estanislao S. Zeballos, who combines every form of literary activity. The earliest work of Juan León Mena (Ecuador, b. 1832) was an Indian epic which earned for him the title of Poet of the Indians. The *Huincahual* of the Chilean Alberto del Solar is one of the most powerful productions of this class. The dialect sketches of Estanislao del Campo, descriptive of the gauchos and life on the pampas, are especially quaint and entertaining. Nearly all the contemporaries of the struggles for independence were inspired by the patriotic deeds of America's heroes, but no one gave them more fitting expression than did the "American Pindar," José Joaquín Olmedo (Ecuador, d. 1857), a classicist of the purest type. His *Canto á Junín* is an epic ode without equal in the language. Some of the patriotic poems of Numa Pompilio Llona, of Peru, are especially fine; and the sonnet to Bolívar by the Peruvian Adolfo García is one of the most beautiful compositions of its kind. The best poetic productions based upon the days of the conquerors are *La grandeza de Méjico* of Bishop Valbuena (d. 1625); the beautiful epic *Gonzalo de Oyón*, by Julio Arboleda (Colombia, d. 1862); and Peralta's *Lima fundada* (already mentioned).

The Spanish language lends itself so readily to versification, especially when assonance is accepted instead of rhyme, that it may almost be assumed that every writer, not a scientific specialist, is also a poet. Juan León Mena published in 1868 a critical history of the poets of Ecuador, at a time when few were aware that that country had ever possessed any. Cuba has, of all Spanish-American countries, produced relatively the largest number of lyric poets. Gertrudis Gómez de Avellaneda, the greatest poetess of the language, was a native of Cuba; and persons of the lowest condition break forth in song. There the slave Juan Francisco Manzano (*fl.* 1830) won his freedom by his pen. Gabriel de la Concepción Valdés, another humble Negro, the author of *Siempreviva*, won laurels under the pseudonym of *Plácido*. Ramón Vélez Herrera's tragedy of *Napoleón en Berlín*, the *Pasionarias* of Rafael M. Mendive, and the *Margaritas* of the unfortunate Francisco J. Blanchié may also be mentioned. Some of the odes of the Cuban José María Heredia, in particular *Al Niágara*, *Á la noche*, *Al sol*, and *Versos escritos en una tempestad*, compare well with the best of Coleridge and Bryant. Turning to the continent one finds vigorous descriptive work in *La cena de Baltasar*, by Manuel Carpio (Mexico, d. 1860). In *La salida del sol*, by his compatriot Ignacio M. Altamirano, is description of a more placid kind. Altamirano is also the author of one of the best recent novels, *Clemencia*. The poems of Arnaldo Márquez and Clemente Althaus, of Peru, take very high rank for their beauty and tenderness of sentiment as well as purity of style. The *Noche de dolor en las montañas* and the *Canto de la vida* of the Peruvian Numa Pompilio Llona are compositions which will be admired for centuries. The *Flores del aire* of Dr. Adán Quiroga, of Argentina, is a collection of poems of great merit and originality. Compositions of remarkable beauty will be found in the *Brisas del mar* of the Peruvian Manuel Nicolás Corpancho, the *Lágrimas y recuerdos* of Doña Silveria Espinosa de Rendón, of Colombia, and the *Flores silvestres* of Francisco Javier de Acha, of Uruguay. José Batrés y Montúfar, of Guatemala, a lyric poet of merit, is one of the most noted satirists of America. Matías Córdoba and García Goyena, of Guatemala, have been justly compared as fabulists to Æsop and La Fontaine.

*Novelists and Dramatists.*—The novels most widely known are the *Amalia* of José Mármol (Argentina); the *María* of Jorge Isaacs (Colombia); *La linterna mágica* of José T. de Cuellar (Mexico); *Alberto el jugador*, by Doña Rosario Orrego de Uribe (Chile); the historical novel *El Padre Orani*, by Narciso Aréstegui (Peru); and the sparkling romance of the Colombian Julio Arboleda, entitled *Casimiro el montañés*. The Mexican historian Orozco y Berra wrote a beautiful novel, *Escenas de treinta años*, relating the experiences of an unfortunate, disappointed invalid. Among the most powerful recent novels are the *Libro extraño* of Dr. Francisco Sicardi, of Argentina, and *Contra la marea*, by the Chilean Alberto del Solar.

Among noted dramatists of the century have been, in Mexico, Rodríguez Galván, author of the first national drama, Fernando Calderón, and Manuel E. Gorostiza, author of *Independencia para todos* and *Contigo pan y cebollas*; in Peru, Manuel Nicolás Corpancho and Manuel A. Segura; in Uruguay, Francisco J. Acha.

Two fine specimens of prose word-painting deserve mention here, namely, the description of the Falls of Tequendama, by the Colombian botanist Fran. Antonio Zea (1770–1822), and Simón Bolívar's *Delirio sobre el Chimborazo*.

*Historians and Geographers.*—Spanish America has been especially prolific of historians and writers of descriptive geographical works. The names of some of the most famous of these, with their principal works, are as follows: Rafael María Baralt (d. 1860), *Resumen de la historia antigua y moderna de Venezuela*; Lucas Alamán (d. 1853), *Historia de Méjico*, 5 vols.; José Manuel Restrepo, *Historia de la revolución de Colombia* (1827); José Antonio de Plaza, *Historia de la Nueva Granada*; Joaquín Acosta (d. 1852), *Viajes á las regiones ecuatoriales*; Manuel Orozco y Berra (d. 1885), *Historia antigua y de la conquista de México* (4 vols.); Antonio García Cubas, *Diccionario geográfico, histórico y biográfico de los EE. UU. Mexicanos* (5 vols.); Manuel José Cortés, *Ensayo sobre la historia de Bolivia* (1861); Antonio de Alcedo (Ecuador, d. 1812), *Diccionario geográfico histórico de las Indias occidentales* (5 vols.); Miguel Lobo, *Historia general de las antiguas colonias hispano-americanas*; Pío Benigno Mesa, *Anales del Cuzco*; Miguel Luis and Gregorio Victor Amunátegui, *Los precursores de la independencia de Chile* (1872); Diego Barros Arana, *Historia de la independencia de Chile* (1870); Bartolomé Mitre, *Historia de Belgrano y de la independencia argentina* (3 vols.) and *Historia de San Martín y de la emancipación sud-americana* (4 vols.). Special mention should be given to Antonio Raimondi's great descriptive work, *El Perú*, which was cut short by the author's death in 1890, only four volumes and a part of the atlas having been published, and to the *Historia Argentina* of Mariano A. Pelliza, now in preparation, the fourth volume having been published in 1894.

AUTHORITIES.—*Lira Americana*, by R. Palma (Paris, 1865); *América Poética* and the *Diccionario Biográfico Americano*, by Domingo Cortés (Paris, 1875); Francisco Largomaggiore, *América Literaria* (Buenos Ayres, 1883); Francisco Pimentel, *Historia crítica de la literatura y de las ciencias en Méjico*; J. M. Torres Caicedo, *Ensayos biográficos y de crítica literaria sobre los principales publicistas y literatos de la América Latina*; Marcelino Menéndez y Pelayo, *Antología de poetas hispano-americanos* (3 vols. already published; Madrid, 1893–94); *Bocetos literarios de escritores argentinos*, by Martín García Merou (Buenos Ayres, 1892). García Merou's *Confidencias literarias* (1894), although treating principally of Argentine writers, devotes considerable space to the leading authors of other Spanish-American countries. MARATHON MONTROSE RAMSEY.

**Spanish Armada**: See ARMADA, THE SPANISH.

**Spanish Fly**: See CANTHARIS.

**Spanish Fork**: city (founded in 1851); Utah co., Utah; on the Spanish Fork river, and the Rio Grande W. and the Union Pac. railways; 12 miles S. by E. of Provo (for location, see map of Utah, ref. 4–M). It is a trading-point for a large agricultural region, and contains Lutheran, Mormon, and Presbyterian churches, ten public and denominational schools, an incorporated bank with capital of $25,000, and a weekly newspaper. The battle of Diamond Creek was fought here on June 20, 1866. Pop. (1880) 2,304; (1890) 2,214; (1900) 2,735. EDITOR OF "SUN."

**Spanish Grass**: another name for ESPARTO (*q. v.*).

**Spanish Language**: the national language of Spain and also of some other countries where it has been carried by colonists from Spain, as Mexico and the rest of Spanish America so called. In Spain itself certain regions are not properly included in the territory of the Spanish language; thus the dialect of Galicia belongs rather to Portuguese, and there is a small territory in the north where the language is Basque (see BASQUES), while Catalan is spoken in Catalonia, Valencia, and the Balearic islands. The dialect-forms of Spanish spoken in various parts of Spain have not yet been fully investigated, and the variations and peculiarities of American Spanish also need further study, though something has been done in this direction. (See the references below.) No even approximate statement of the number of those whose native tongue is Spanish in some form or other is possible; for Spain itself estimates vary from less than 11,-000,000 to 14,000,000.

The sounds of the standard or literary language may be approximately described as follows: There are five vowels only, *a, e, i, o, u*; *e* and *o* being intermediate between the close and open sounds of those letters in Italian, for instance. There are twenty-three (or twenty-four) consonants: *p, b* (written *b* and even *v*), *f, v* (a bilabial *v*, written *b* or *v*; it is only as a result of education that *b* and *v* are distinguished as written), *w* (a consonantal *u*, written *u*), *m, t, d* (the last two more dental than in English), a voiceless spirant like *th* in English *thin* (written *z*, or, before *e* or *i, c*; sometimes even *d* is the sign used), a voiced spirant like *th* in English *this* (written *d*), *l, n*, two forms of *r*, one strongly trilled (written *r, rr*), the other (written *r*) not so, *s* (more "cerebral" or "lingual" than in English), a palatalized *l*, nearly like *lli* in English *million* (written *ll*), a palatalized *n*, nearly like *ni* in English *union* (written *ñ*), *y* (two forms of *y* are recognized by Araujo, one a consonantal *i*, written *i*, the other more like German *j*, written *y*), *k, g* (these two varying somewhat in sound according to the following vowel; written *c, g*, or, before *e* or *i, qu* and *gu* respectively), an aspiration resembling *ch* in German *ach* (written *j*, or, before *e* or *i*, sometimes *g*), a voiced spirant (the voiced form of the German sound just mentioned, written *g*), and the sound of *ng* in English *sing, song* (written *n*). The voiced sound of *s*, namely *z*, occurs occasionally, but is not commonly recognized. An important consonant group is that written *ch*, with the sound of *ch* in English *church*. Noteworthy is the almost total lack of doubled consonants in Spanish words. The orthography, as regulated by the Academy, is a fairly good representation of the spoken language.

The pronunciation of modern Spanish is not the same as that of the older language, in which some sibilant sounds existed which have been lost. Thus *x* formerly had in popular words the sound it has in Portuguese, or that of *sh* in English *she* or French *ch*, but this has become the aspiration written *j* or *g*; compare *Quijote*, formerly *Quixote*, with the French form *Quichotte*, or English *sherry*, that is, wine of *Xerez* (now written *Jerez*). An initial *h*, now silent, often stands for older *f*.

The grammatical structure of the language is very similar to that of the other Romance languages. Certain neuter uses, especially of the neuter form (*lo*) of the article with adjectives, are noteworthy; so, too, are the frequent use of a preposition (*á*, "to") before the direct object of a verb, the distinction between the two words *ser* and *estar*, "to be," and that between *haber* and *tener*, "to have." The verb-tenses formed without the aid of separate auxiliary words are the same as in French, with the addition of a second conditional (also used as an imperfect subjunctive, and found in old Spanish in its original sense as a pluperfect indicative), and of a future subjunctive. Among the sources of the Spanish vocabulary, besides Latin, Greek, and old Germanic dialects (Gothic), should be noticed especially the Arabic.

As in the case of the other Romance languages, there is no sharp line of division to be drawn between vulgar Latin and early Spanish, the latter being the vulgar Latin of Spain when this assumes a form characteristic enough to have a new name. Traces of this vulgar speech are to be found in Latin documents as early as the eighth century, but distinctly Spanish texts are not preserved to us from an earlier time than the twelfth century. A Latin-Spanish dictionary (*Universal vocabulario en latin y en romance*) by Palencia belongs to the year 1490, and in 1492 came the lexicon (Latin-Spanish and Spanish-Latin) and the grammar of Lebrija (Lebrixa, Nebrixa). Among the most noteworthy early grammatical or lexicographical works are Aldrete, *Del origen de la lengua castellana* (1606), and the etymological dictionary of Sebastian de Covarrúbias Orozco (*Tesoro de la lengua castellana o española*, 1611). The Spanish Academy, established in 1713, published a *Diccionario de la lengua castellana*, 6 vols. (1726–39), condensed into one volume in 1780 (12th ed. of this condensed form 1884). The Academy published in 1741 an *Orthographia española*, and in 1771 the first edition of its grammar. An outline of the historical grammar of the language is given by Baist in Gröber's *Grundriss der romanischen Philologie*, i. (1888), where many other references are given.

Additional references: V. Salvá, *Nuevo diccionario de la lengua castellana* (7th ed. 1865); R. J. Domínguez, *Diccionario nacional ó gran diccionario clásico de la lengua española*, 2 vols. (15th ed. 1882); Barcia, *Primer diccionario general etimológico de la lengua española*, 5 vols. (1881–83); M. Velazquez de la Cadena, *Pronouncing Dictionary of the Spanish and English Languages* (1852 and since); Tolhausen, *Nuevo diccionario español-alemán y alemán-español*, 2 vols. (1888–89); Monlau, *Diccionario etimológico de la lengua castellana* (2d ed. 1881); R. J. Cuervo, *Diccionario de construcción y régimen de la lengua castellana*, i., A–B (1886), ii., C–D (1894); Dozy and Engelmann, *Glossaire des mots espagnols et portugais dérivés de l'arabe* (2d ed. 1869); *Gramática de la lengua castellana por la real Academia española* (new ed. 1890); A. Bello and R. J. Cuervo, *Gramática de la lengua castellana* (1892); P. Foerster, *Spanische Sprachlehre* (1880); W. I. Knapp, *Grammar of the Modern Spanish Language* (1882 and since); M. M. Ramsey, *Text-book of Modern Spanish* (1894); A. Keller, *Historische Formenlehre der Spanischen Sprache* (1894); F. Araujo, *Estudios de fonétika kastelana* (1894; see also his articles in *Phonetische Studien*, iii., v., vi.); F. Wulff, *Un chapitre de phonétique*, etc., in *Recueil de mémoires philologiques présenté à M. G. Paris* (1889); R. Lenz, *Chilenische Studien*, in *Phonetische Studien*, v., 272 ff., vi., 18 ff., 151 ff., 274 ff.; *id.*, *Beiträge zur Kenntnis des Amerikospanischen*, i., in *Zeitschrift für romanische Philologie*, xvii., 188 ff., and articles by Schuchardt, Baist, etc., in this and other periodicals; C. Michaelis de Vasconcellos, *Romanische Wortschöpfung*, 1876; R. J. Cuervo, *Apuntaciones críticas sobre el lenguaje bogotano* (4th ed. 1885); P. de Mugica, *Dialectos castellanos, montañés, vizcaino, aragonés* (i., 1892); *id.*, *Gramática del castellano antiguo* (i., 1891), etc. See also ROMANCE LANGUAGES.

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**Spanish Law**: See the Appendix.

**Spanish Literature**: the literary productions of Spain, or all compositions in the Spanish language. The latter application seems the more appropriate, but its two divisions are considered separately; the present article is confined to productions of the Iberian Peninsula in the language known as Spanish or *Castilian*,* while the literature of Spanish America is treated in a separate article.

Several circumstances tended to stamp the Spanish character with a distinct individuality. Long a favored Roman province, permeated by the language, the literature, and the religion cultivated in the later empire, Spain learned to look to Italy for support and guidance material, intellectual, and spiritual. Eight hundred years of war against an alien race with an Asiatic tongue and an infidel religion produced in the Spaniard a devotion to country and king and mother Church nowhere else to be found. The wars with the Moors, being largely a matter of border forays, encouraged personal prowess and a spirit of romantic adventure. It thus came about that the literature of Spain had three great sources—love, war, and religion.

*Ballads and Songs.*—As in other countries, the earliest essays at composition were songs, and ballads or tales in verse. Their most usual and seemingly oldest form is in lines of eight syllables, not divided into stanzas, but matching lines 2 and 4, 6 and 8, etc. These did not rhyme, but were assonant—an easy compromise between rhyme and blank verse thought to be native and peculiar to Spanish. The style of these old ballads is extremely diversified; their tone is by turns devout, plaintive, gay, lightly satirical, or intensely heroic, according to the author and his subject, but without the coarse ferocity of the songs of the north. They were a spontaneous growth, preserved only by memory, chanted to simple music in social gatherings or by strolling singers. The first attempt at a printed collection of such

* There remains nothing in this language of a date known to be earlier than A. D. 1150. The Moors had then been in possession of the largest and best part of Spain for nearly 440 years.

songs was the *Cancionero General*, published in 1511. A later and more valuable collection, the *Romancero General*, was completed in 1614. Over 1,000 pieces have thus been rescued from oblivion. Many of them cluster around centers, partly historical, but largely imaginary. Twenty are devoted to Charlemagne and his peers, 50 gather around the name of Bernardo del Carpio, and 200 are songs of the Cid.

*Epic Poetry.*—The earliest Spanish epic is the *Poema del Cid*, which relates the adventures, real and imaginary, of the early hero Rodrigo (or Ruy) Díaz de Vivar. Although his death occurred as early as 1099, no portion of the poem is older than the twelfth century. It is without beginning, date, or name of author, and contains 3,744 assonant lines of fourteen syllables, more or less, arranged in quatrains. In its execution it is one of the finest productions of the Middle Ages. See CID.

It is at least 350 years from the supposed date of the *Poema del Cid* to the next great outburst of the epic Muse, in the reign of Philip II. In 1560 Sempere published the *Carolea*, to glorify the victories of Charles V. Five years later appeared the *Carlo Famoso*, wherein Luis de Zapata celebrates the achievements of the same monarch in 5,000 prosy octave stanzas. Alonso de Ercilla y Zúñiga, courtier, soldier, and poet (d. 1596), wrote an epic, one-third longer than the *Iliad*, on the suppression of the Araucan Indians of Chile, in which he bore an active part. Portions of the poem are of great beauty, and its merit elicited praise even from Voltaire. Gabriel Laso de la Vega published *La Mexicana* (1594) in honor of the conquest of Mexico by Cortés; and five years later Antonio de Saavedra issued a romantic life of the conqueror in his *Pelegrino Indiano*. About the same time Juan de Castellanos composed a rhyming chronicle of the conquests in South America in some 90,000 lines, a narrative that strongly attracted the attention of Humboldt and Southey; and Juan de la Cueva (1603) produced the *Bética*, on the recapture of Seville from the Moors, in imitation of Tasso's *Jerusalem Delivered*.

*Romances.*—Besides epics resting on Spanish history, there were others having either no basis of fact or only a very remote one. All Europe swarmed for many centuries with marvelous recitals that gave rise to the modern words *romance* and *romantic*. The Scriptures, the lives of the saints, Greek and Roman antiquity, the legends of Charlemagne and of King Arthur, afforded inexhaustible material that was handled with the utmost disregard of proprieties of time and place; and peerless knights, giants, necromancers, dragons, and fair ladies imprisoned in enchanted castles were furnished regardless of cost. The earliest Spanish romance was the *Alexandro* of Juan Lorenzo Segura, priest of Astorga, in the second half of the thirteenth century. By far the most important and popular work of this class was the *Amadis de Gaula* (see AMADIS OF GAUL), conjectured to have been written in Portuguese about 1360. It was followed by an extensive aftergrowth of romances and *caballerías* (books of chivalry and knight-errantry) that became ever more fantastic and insipid, until put down by the strong but gentle hand of Cervantes.

In the pastoral romances that supplanted them fancy was not at such a high tension. The earliest of these in Spain was the *Diana Enamorada* of Montemayor (d. 1561)—an imitation of the *Arcadia* of Sannazaro, the Neapolitan. Later appeared the *Fílida* of Gálvez de Montalvo, the *Galatea* of Cervantes, and the *Arcadia* of Lope de Vega.

But romance was destined to seek a still lower level. Diego Hurtado de Mendoza (1503–75), a member of one of the noblest families of Spain, and almost equally distinguished as soldier, statesman, scholar, poet, historian, and writer of fiction, chose a strange subject for a romance. His hero, *Lazarillo de Tormes* (Little Lazarus, Luke xvi. 20), was an outcast from his birth, and the guide of a blind beggar. His genius and assiduity secure promotion, until he reaches the height of roguish ambition as a kind of king among thieves. This was followed in 1599 by Mateo Alemán's similar story of *Guzmán de Alfarache*; and in 1626 appeared the exploits of the *Gran Tacaño Pablo de Segovia*, into which the author, Quevedo, put some of his most brilliant work. This style of literature became and remained popular. It had a foundation in real life, however low, and was called "picaresque" from *pícaro*, rogue. The *pícaro* was an intelligent scoundrel, and had the genial humor of the South that made him almost lovable. Out of the three kinds of fiction named has been developed the modern novel.

*Rise of the Drama.*—While the remains of the Greek and Roman theater had become so debasing that the Church exerted all its power to suppress them, the advantage was seen as early as the fifth century of presenting something to catch the eyes and attention of its less educated members. Representations of the stable, the temptation, Gethsemane, the judgment-hall, and Calvary were given by servants of the churches and school-children. Scriptural readings and choral hymns were added. Buffoons were gradually introduced, and the devil and his imps were given humiliating positions. In time the devils and the fools became the favorite characters, and the Church had unwittingly created a comic theater of its own. A feeble attempt to keep these exhibitions within bounds was made in the code of Alfonso X. (1260). Still they kept growing in number and complexity, until in the seventeenth century, in the hands of Calderón, they became great allegorical sermons. In the meantime the worst of them had been turned into the streets, where they continued to be presented to the multitude. In 1492 appeared *La Celestina*, a book which in the U. S. would be excluded from the mails. Its merit lay in presenting live men and women—even though at their worst—instead of the allegorical figures to which the public had been accustomed. It was never acted nor intended to be acted, yet it had an immense popularity and a powerful effect in developing the drama. More than thirty editions were made of the work, at least seven translations, and a swarm of imitations.

The next important step was made by Juan de la Encina, musician, poet, and priest, who (1496–98) brought out eleven pieces, which show little of the playwright in their construction, but were really acted; hence their author is recognized as the founder of the Spanish stage. Bartolomé de Torres Naharro (1517) composed eight comedies in easy verse, and gave a more regular form to the drama, dividing it into five acts (*jornadas*), and prescribing sound regulations for maintaining consistency and truth to nature. But he gave little heed to his own rules, introducing allegorical and impossible persons and incidents. About 1553 Francisco de Avendaño wrote several plays of three acts. Lope de Rueda (d. 1567), a gold-beater of Seville, who turned actor and dramatist, wrote sixteen plays, and first introduced interludes (*entremeses* and *pasos*) between the acts. Juan de la Cueva, a poet of Seville (1579), adapted the great historical romances to the stage, and introduced the division into four *jornadas*.*

*Religious and Historical Works.*—As might be expected, there were from a very early period pieces in prose and verse intended for edification. The *Life of Saint Mary of Egypt*, the *Adoration of the Three Holy Kings*, and the *Danza General*, or Dance of Death, are so old as to be without known date or author. Then follow at irregular intervals *Miracles of the Virgin*, by Gonzalo de Berceo (1246); the *Caballería Celestial* of Hierónimo de San Pedro (1554); the *Monserrate* of Virués (1581); the *Redención Universal*—30,000 lines—by Fran. Hern. Blasco (1584); and Diego de Hojeda's *Christiada* (1611). The excessive fondness for allegory, prevailing when these poems were written, makes them seem irreverent to modern readers. In the *Caballería*, Christ and Lucifer, as Spanish knights, with their followers, maintain a war with varying success from Bethlehem to Calvary. The *Christiada* covers the period from the Last Supper to the crucifixion. The whole is connected and well sustained, but disfigured by the symbolism which was exuberant in the Middle Ages.

Alfonso X. of Castile (1252–84), surnamed *el Sabio*, the most enlightened prince of the age, has been called the father of Spanish prose, although his part must have been chiefly to foster and direct. To him are due a translation of the Scriptures, *Libros de Astronomía* (containing the famous Alfonsine Tables), a *Lapidario*, a *Crónica General* or Universal History, *La Crónica ó Historia de España* down to his own time, and a great compendium of law still known and respected as the *Siete Partidas*. Other chronicles were written by Fernán Pérez de Guzmán, Diego Enríquez and Alonso de Palencia, Ambrosio de Morales, and Gerónimo Zurita. Fernando del Pulgar and Andrés Bernaldés recorded the reign of Ferdinand and Isabella. But these old chronicles merely narrate a succession of occurrences without logical connection. The first real historical work is the *Historia de España* by the Jesuit Juan de Mariana (1601). In his time Spain produced a galaxy of eminent historians. Among the most prominent works may be mentioned the

* All this time the exhibitions were given in gardens, courtyards, or the public streets, without scenery or costumes. The first theater for the reception of the public was opened in 1743.

*Guerra de Granada* of Hurtado de Mendoza (1602); the *Historia de las Indias* of Herrera, as well as that of Bartolomé de las Casas; Moncada's *Expedición de los Catalanes* (1623); Melo's *Guerra de Cataluña* (1645); and the magnificent work of Antonio Solís, the *Conquista de México*.

*Lyric poetry*, especially that of the highest order, was much indebted to Italian models. Íñigo López de Mendoza, Marquis of Santillana (d. 1458), had an extensive acquaintance with the literature of Provence and Italy, and was largely influenced by their masterpieces. Most of his writings were infected with the learned conceits of the court and the Italian school; yet when he escaped to the free air of the mountains, nothing could exceed the sweet grace of his songs. His *Serranilla*, or the Milkmaid of Finojosa, is often given as a beautiful example, and may be found in Sismondi's *Literature of the South of Europe*, ii., 162. The marquis deserved the love and esteem of his country as much for his encouragement to men of letters as for his own productions. Juan de Mena (d. 1456), one of his *protégés*, was court historian to John II., and a sort of poet-laureate. Also a follower of Italian models, he did much to improve the Castilian language by enlarging its vocabulary and perfecting literary style.

Garcilaso de la Vega (d. 1536), descended from the Cid, and Juan Boscán (d. 1540) were the introducers of blank verse, and in their time the pillars of the Italian school. Cristóbal Castillejo (d. 1556), author of short poems, religious, playful, and satirical, opposed the growing fashion with patriotic zeal. Two priests, Luis Ponce (Fray Luis) de León and Fernando de Herrera (d. 1597), were lyric poets of the first rank. Fray Luis held ideas too advanced, and had to seek solace in song from the consequent persecution. Herrera's principal pieces were a triumphal ode on the battle of Lepanto and an elegy on the defeat and death of Sebastian of Portugal. Luis de Góngora (d. 1627) did so much to promote the growing pedantic style that it took the name of Gongorism. At first simple and natural, he became the most absurd writer of his day. His stanzas became so intricate and full of strange words and meanings, metaphors, and obscure allusions, that a lexicon of 1,500 pages was compiled as a key to them. His style was imitated in the translations, satires, and other short poems of Francisco Gómez de Quevedo (d. 1645).

*The classic era*—1550 to 1650 approximately—produced writers more numerous and more distinguished than any equal period before or immediately after. A fair idea of their numbers may be gained from the long lists given by Cervantes in his *Galatea* and *Viaje al Parnaso*, and by Lope de Vega in his *Laurel de Apolo*.

*Don Quixote de la Mancha* (1605), the classic work of Miguel de Cervantes Saavedra (see CERVANTES SAAVEDRA and NOVEL), marks the central point of the golden era, as it is often called. *El Quijote* (as the Spaniards call the work) was brought out in two parts, the second appearing in 1615. Cervantes also wrote twelve *Novelas Exemplares* (model novels), *Viaje al Parnaso*, and a number of plays, of which few were successful. Cervantes's work was better appreciated after his death, for it soon was considered the perfection of Spanish style. His writings had almost the effect of checking originality of expression, and for many centuries Spanish writers hesitated to say anything in a way not authorized by him. Gregorio Garcés, in his *Fundamento del vigor y elegancia de la lengua castellana* (1790) draws 65 per cent. of his examples from Cervantes.

Lope Félix de Vega Carpio, the contemporary of Cervantes and his junior by fifteen years, far surpassed him in popularity. He wrote 2,200 dramatic pieces, large and small, and an incredible number of other poems. His productions took every form of which poetry is capable—by turns solemn, severe, coarse, and frivolous. Luis Vélez de Guevara (d. 1644), a disciple of Lope, was a favorite both with the court and with the public. Of his 400 plays a few of great power remain. Juan Pérez de Montalbán (d. 1638), a follower and biographer of Lope, wrote about fifty dramatic pieces, of which his tragedy *Los Amantes de Teruel* has remained longest in favor.

The excellent comedies of Gabriel Téllez (d. 1648), better known as Tirso de Molina, and Ruiz de Alarcón (d. 1639) are still admired. Pedro Calderón de la Barca (d. 1681) was one of the most prolific and admired writers of Spain, and is, after Cervantes, the one best known abroad. Among the mass of matter that circulated under his name, he admitted 111 full dramas and seventy sacramental *autos* as genuine. His comedies being generally cast in high life, he made much turn upon "the point of honor." He was the first to give prominence to the *gracioso*—the gentleman's confidential valet, who needed to be a rogue and a wit. He and Lope controlled the theater ninety years.

*Decline of Literature.*—Toward the middle of the seventeenth century, literary activity began to decline, and the period from 1650 to 1750 is almost a blank. The best youth of Spain had been drawn away to colonize America or wasted in fruitless foreign wars. The country was exhausted by insurrections, civil strife, and the War of Succession, while the censorship of the press by Church and state was fatal to all freedom of thought. Philip V., the first Bourbon king of Spain, coming fresh from the brilliant court of his grandfather Louis XIV., set about reviving the literary spirit, and to that end established (1714) the Royal Spanish Academy, after the model of that of France. But the influence of Philip and his court was essentially French, and the old Spanish literature had been too seriously blighted to revive rapidly, so that nothing of importance was effected during the forty-six years of Philip's reign except the inception of the Academy's dictionary. Benito Feijóo, a quiet, laborious monk, had heard of Galileo, and Bacon, and Newton, and what the outside world was thinking of, and between 1726 and 1760 published thirteen volumes entitled *Teatro Crítico* and *Cartas Eruditas*, which did much to advance the intellectual life of his time. Ignacio de Luzán (d. 1754), a disciple of Boileau and an advocate of the French doctrines, wrote an *Arte Poética* based on them. Padre Isla (d. 1781) wrote a satirical romance, *Fray Gerundio*, which had an immense popularity, and translated the *Gil Blas* of Le Sage into Spanish. Nicolás Fernández Moratín (d. 1780) was the author of a small volume of minor poems and two long narrative poems, one, entitled *Diana*, on the chase, and the other on the burning of the ships by Cortés. The last is the finest epic which Spain produced during the century. His *Hormesinda* was the first original drama, according to the principles of Corneille and Racine, admitted to the Spanish stage. José Cadalso (d. 1782) was the author of *Moorish Letters* in imitation of Montesquieu and Marana; also of a satire on the still favorite system of acquiring all knowledge by a few easy lessons. Tomás de Iriarte (d. 1791) issued a little volume exposing the prevailing faults and follies in eighty fables, written with great ingenuity and elegance in half as many kinds of verse. Literature began gradually to revive, and in 1780 the young poet Meléndez Valdés obtained a prize from the Spanish Academy for a most original and delightful eclogue. All his lyric and pastoral poems show a true poetic spirit. Ramón de la Cruz produced (1765–95) a number of clever, short farce-comedies, and Ignacio González Castillo (d. 1800) left about thirty plays, all in a vein of light and graceful satire.

*Literature of the Nineteenth Century.*—From 1793 to 1874 foreign domination, invasion, civil war, and the rapid alternation of hostile parties maintained a state of continual unrest. Interests of Spain, of France, and of Great Britain, claims of royal houses, of the Church, and of the rights of man were the warring elements. Men of liberal sentiments, if timid, were silent; if outspoken, were imprisoned or exiled. The long roll of those persecuted contains the names of many of the brightest lights of the age: Meléndez Valdés, mentioned above, and his disciple Nicasio Alvárez de Cienfuegos; Gaspar Melchor de Jovellanos, philosopher and poet, whose writings stand pre-eminent for purity of style and beauty of diction; Manuel José Quintana and Leandro Fernández Moratín, whose lyrics and comedies are still among the most popular; José Antonio Conde, the distinguished Orientalist, author of *Historia de la dominación de los Árabes en España*; Ruiz de Saravia, Conde de Toreno, the celebrated historian; Fran. Martínez de la Rosa, poet and dramatist; Ángel de Saavedra, Duque de Rivas, lyric poet and romanticist; and José de Espronceda, who has been called the Byron of Spain. Yet the reviving literature steadily gathered strength, and every year saw new authors established in public favor.

Three well known *críticos de costumbres*, Mariano José de Larra (1809–37), Ramón Mesonero Romanos (1803–82), and Serafín Estébanez Calderón (1799–1867), who wrote under the respective pseudonyms of *Fígaro*, *El Curioso Parlante*, and *El Solitario*, were to Spanish manners and customs what *The Spectator* had been to those of England. The most prominent dramatists belonging to the first generation of the century were Juan Eugenio Hartzenbusch (1806–80) and Antonio Gil y Zárate (1796–1861), who were followed by Manuel Tamayo y Baus (b. 1829) and Adelardo López de

Ayala (1828–79). Manuel Bretón de los Herreros (1796–1873) was foremost among writers of comedies. His numerous plays were ably devised, well written, and full of life and gaiety, and many of them are as popular to-day as when first presented. The great literary critics were Alberto Lista (1775–1848), Agustín Durán (1793–1862), Hartzenbusch, and Eugenio de Ochoa (1815–72). Cecilia Böhl de Faber (1796–1877), better known as Fernán Caballero, a woman of extraordinary capacity for seeing, grouping, and delineating real life, was the founder of the modern realistic novel. Gertrudis Gómez de Avellaneda (1816–73), whose writings exhibit every phase of woman's love and sorrow and religious feeling, is reckoned the most brilliant poetess in Spanish literature. Nearly all Spanish authors wrote more or less poetry; but of those who were essentially poets may be named Ventura de la Vega (1807–65) and Gaspar Núñez de Arce (b. 1834), dramatists and lyric poets, José Selgas (1824–82), poet of rural life and scenes, José Zorrilla (b. 1817), who sang of Spain's departed grandeur, and Ramón de Campoamor (b. 1817), the poet philosopher.

With the quiet and prosperity which the termination of the Carlist wars brought to Spain in 1876 came a period of enlightenment as great as that enjoyed by any other country of Europe. The spirit of progress is nowhere more evident than in the domain of letters. In every class of composition there are works of genuine talent, but the subjects in which contemporary Spanish literature chiefly excels are history, criticism, and fiction. Two political leaders, Emilio Castelar (b. 1832), the most eloquent speaker of the present day, and Antonio Cánovas del Castillo (b. 1830) are both eminent historians. Cánovas is moreover an able critic, as are also Juan Valera, the diplomat and novelist, and Emilia Pardo Bazán, the de Staël of modern Spain; but the most brilliant genius in the domain of literary criticism and history is Marcelino Menéndez y Pelayo (b. 1856), whose elegance of style and thoroughness of research have seldom been equaled. In Spain, as in the U. S., the novel is the principal feature of literature as distinguished from science. There too it has attained a high development, and is the chief agency in advancing the public sentiment. Spanish novels are second only to English; among the best-known are those of Pedro Antonio de Alarcón (1833–91), José María de Pereda (b. 1834), Juan Valera (b. 1827), Benito Pérez Galdós (b. 1845), Armando Palacio Valdés (b. 1831), and Doña Emilia Pardo Bazán (b. 1851), and the short stories of Antonio de Trueba (1819–89).

AUTHORITIES.—The American reader who is not a specialist will require nothing more before the nineteenth century than Ticknor's *History of Spanish Literature* (New York, 1849, 3 vols.; 4th ed. Boston, 1872, 3 vols.). Some additions have been made in the Spanish translation (Madrid, 1851–56) and the German (Leipzig, 1852–67). For the nineteenth century, Francisco Blanco García's *Literatura Española en el Siglo XIX.* (2 vols., Madrid, 1891); *Literatas españolas del Siglo XIX.* of Juan P. Criado y Domínguez; and the *Historia de la Literatura Española* of Manuel de la Revilla and Pedro de Alcántara may be consulted. MARATHON MONTROSE RAMSEY.

**Spanish Mackerel**: either of two scombroid fishes. (1) Along the eastern coast of North America, *Scomberomorus maculatus*, a very slender, compressed fish, bluish-green above, satin-like white below, with yellowish spots on the back and sides, and with the first dorsal fin blackish before and along its margin. It attains a length of 2½ feet. It is a native of the tropical seas, but ranges from Southern Brazil to Cape Cod, and is one of the most esteemed of salt-water fishes. (2) In Europe, *Scomber colias*, distinguished externally from the common mackerel (*Scomber scombrus*) by the larger eye and the diminished number of wavy streaks. It is known in the U. S. as the chub-mackerel and the thimble-eye.

**Spanish Main**: an old term still occasionally used for those portions of South and Central America which border on the Caribbean Sea, i. e. the modern Venezuela, Colombia, and the Central American states. The original Spanish term, *Tierra Firme*, included only the coasts from the mouth of the Orinoco to Costa Rica. Some writers erroneously use the name for the Caribbean Sea. H. H. S.

**Spanish War of Succession**: See SUCCESSION WARS.

**Span-worm**, or **Measuring-worm**: the larva of any geometrid moth; so called from the elevation of its body in locomotion, as if measuring. The CANKER-WORM (*q. v.*) is an example.

**Spar**: in mineralogy, a term used vaguely for several crystalline minerals of nonmetallic luster and smooth cleavage. See BARYTA, CALCAREOUS SPAR, FELDSPAR, and FLUORSPAR.

**Spar'idæ** [Mod. Lat., named from *Spa'rus*, the typical genus, from Gr. σπάρος, a kind of fish, the gilt-head]: a family of acanthopterygian fishes, comprising the porgy, sheepshead, and related forms. The body is compressed and oblong; the scales have obsoletely pectinated margins and striæ diagonally crossing the surfaces and meeting the sides at acute angles; lateral line continuous to the caudal fin; head compressed; mouth terminal, with an oblique lateral cleft; upper jaw moderately protractile, and with the supramaxillaries partly sliding under the preorbital bones; teeth in the jaws either developed on the sides as molars, or in front as more or less defined incisors, or of both kinds; dorsal fin elongated, with its spinous portion rather longer than the soft, and folding in a dorsal groove; anal with three spines; caudal fin with pointed lobes; pectoral fins pointed and with the rays branched; ventrals thoracic, each with a spine and five branched rays, and with pointed axillary scales. The family is well represented in all warm and temperate seas. There is a considerable range of variation in dentition and squamation, as well as in osteological characters. No typical sparoids have yet been detected along the Pacific coast of the U. S. See SHEEPSHEAD.

Revised by F. A. LUCAS.

**Spark, Electric**: See ELECTRIC DISCHARGE.

**Sparks**, JARED, LL. D.: historian; b. at Willington, Conn., May 10, 1789; graduated at Harvard 1815; was mathematical tutor there 1817–19, studying theology meanwhile; became pastor of a Unitarian church at Baltimore, Md., May, 1819; was chosen chaplain to the U. S. House of Representatives 1821; conducted at Baltimore a periodical, *The Unitarian Miscellany*, 1821–23; retired from the ministry on account of ill health, and removed to Boston 1823; purchased *The North American Review*, of which he was sole editor until 1830; visited Europe 1828; spent considerable time in examining the English and French archives for materials of American history: founded in 1830 *The American Almanac*; edited for the U. S. Government *The Diplomatic Correspondence of the American Revolution* (12 vols., 1829–30); published *The Writings of George Washington, with a Life of the Author* (12 vols., 1834–37); *The Life of Gouverneur Morris* (3 vols., 1832); conducted two series of a valuable *Library of American Biography* (1st series, 10 vols., 1834–38; 2d series, 15 vols., 1844–48), for which he wrote several of the lives; edited *The Works of Benjamin Franklin, with Notes and a Life of the Author* (10 vols., 1836–40), and *The Correspondence of the American Revolution* (4 vols., 1854); published two or three controversial pamphlets in defense of his editorial conduct in correcting Washington's orthography and grammar, and upon other similar topics, besides a number of works on religious subjects. Dr. Sparks was McLean Professor of History at Harvard 1839–49, and president of that institution 1849–53. D. at Cambridge, Mass., Mar. 14, 1866. See the *Memoir* by Rev. George E. Ellis, D. D. (Cambridge, 1869).

**Sparrow** [M. Eng. *sparwe* < O. Eng. *spearwa*: O. H. Germ. *sparo* (> Mod. Germ. *sper*ling): Goth. *sparwa*]: any one of various birds of the family *Fringillidæ*. The term is generally applied to those *Fringillidæ* with a streaked plumage in which some shade of brown or chestnut predominates. The most familiar species is *Passer domesticus*, called in the U. S. English sparrow, from the country whence it was introduced, and more correctly known in Great Britain as the house-sparrow. It is too well known to need a description. Its original habitat was the greater part of Europe and temperate Asia and Northern Africa. The English sparrow was introduced into the U. S. in the fall of 1850, when Nicolas Pike and other directors of the Brooklyn Institute imported eight pairs. These did not thrive, but others were brought over in 1852 and at numerous subsequent dates, and by the end of 1886 the sparrow had spread over the greater portion of the U. S. E. of the Mississippi and N. of Florida, and extended in the northwestern portion of its range into Iowa and Minnesota and beyond the Missouri. It was also abundant about San Francisco, Salt Lake City, and New Orleans, while there were many scattered colonies beyond the frontiers of its domain. Since then it has steadily spread, but exactly how much territory it covers is not definitely known. The sparrow has also been introduced by thoughtless individuals into Australia, New Zealand, and the Hawaiian islands, where, as in the U. S., it has multiplied and become a pest. Evidence is overwhelmingly against the sparrow. It is convicted of being destructive to various crops, of crowding out native birds by eating their food and occupying their nesting-places, and also of actually driving them away. It is particularly harmful to grain, grapes, peaches, and pears, while the number of injurious insects destroyed by it is trivial. Its phenomenal increase is largely due to its fecundity, as a pair of sparrows raise on an average three or four broods a season, and may, under favorable circumstances, raise as many as six, each brood numbering four or five.

In New Zealand and the Hawaiian islands the injurious effect of the sparrows on the native bird-faunas is particularly obvious and regrettable.

The American sparrows have a more slender bill than the introduced species. See *The English Sparrow in North America*, a Bulletin of the Department of Agriculture (Washington, 1889). F. A. Lucas.

**Sparrow**, Anthony: bishop; b. at Depden, Suffolk, England, in the beginning of the seventeenth century; was a fellow of Queen's College, Cambridge, but was ejected in 1643 for refusing to sign the Covenant. Soon after he became rector of Hawkedon, but in five weeks was ejected for reading the Book of Common Prayer. He was restored in 1660, and was made Bishop of Exeter in 1667 and of Norwich in 1676. D. at Norwich in 1685. He published *A Rationale or Practical Exposition of the Book of Common Prayer of the Church of England* (London, 1643). It has been often reprinted, the last time in 1852. The seventh edition (1722) first contained the celebrated *Lives of the Compilers of the Liturgy, and an Historical Account of its several Reviews*, by Samuel Downes, a work which forms the true source of much of the English liturgical learning that has since been put forth. He also published *A Collection of Articles, Injunctions, Canons, Orders, Ordinances, and Constitutions Ecclesiastical, with other Public Records of the Church of England, chiefly in the Times of Edward VI., Elizabeth, James I., and Charles I.* (London, 1661; often reprinted; best edition that of 1684); also *Confession of Sins and the Power of Absolution, Authority of the Church*, and other works. Revised by W. S. Perry.

**Sparrow-hawk**: any one of several small species of the genus *Falco*. They have two primaries emarginated along their inner webs, the second to third longest, and the first shorter than the fourth; the tarsus longer than the middle claw; and the basal joints of the toes provided with transverse scutellæ; the color of the sexes is very different at all ages, but the old and young of each sex are alike. The common American species is *Falco* (*Tinnunculus*) *sparverius*. Its diagnostic characteristics are the bluish crown (with or without a patch of rufous), whitish front and auriculars, conspicuous "moustache" across the cheeks, the rufous back, the white or whitish abdomen, and the barring of the inner webs of the primaries with white and dusky; in the male the upper part of the head, as well as wings, is ashy blue or slate-colored, the scapulars, back, rump, and tail rufous; the primaries, secondaries at their basal halves, and broad subterminal band of tail, black; in the female the head is bluish above, but the bluish on other parts is replaced by rufous, which is barred by blackish. Its length is about a foot. The species is an inhabitant of North as well as South America, but is divided by Ridgway into five sub-species or races, limited to various countries; the only U. S. form is the typical *sparverius*, and this is found from the sub-polar regions to the Isthmus of Panama. It preys upon small birds as well as mice and reptiles. It may be frequently seen perched on the top of a tree nearly erect and motionless, surveying the country around. It breeds in the northern parts of the U. S., as well as farther N., and selects for its nest a hollow tree, in which it lays five to seven dark cream-colored, nearly spherical eggs. It is one of the most useful of the small hawks, feeding upon insects, and particularly grasshoppers, whenever they can be obtained.

Revised by F. A. Lucas.

**Sparrow's Point**: town; Baltimore co., Md.; on the Patapsco river, and the Northern Central Railway; 10 miles S. E. of Baltimore (for location, see map of Maryland, ref. 2-F). It contains four churches, large Y. M. C. A. building, the largest public school in the county outside of Baltimore, and a weekly newspaper. The Maryland Steel Company began to build a town here in 1887, as a part of the plant of the Pennsylvania Steel Company, of Steelton, Pa.; the enterprise was reorganized in 1892 under the name of the Maryland Steel Company; and in 1893 it had become one of the most prosperous steel-manufacturing places in the U. S. The town has iron-furnaces, rail-mill, foundry, machine-shops, and an extensive plant for ship-building. Pop. (1890) 2,507; not returned separately in 1900.

James Fraser, Ph. D., editor of "Times."

**Sparta** [= Lat. = Gr. Σπάρτη, Sparta, Lacedæmon]: in antiquity, the capital of Laconia and chief city of the Peloponnesus. The Greek name of the city signifies sown land (σπαρτή, sc. γῆ). It is true that the city did not stand upon rocky heights, as was the case with nearly all Hellenic towns, but upon a group of knolls, which are seen on the right bank of the Eurotas, an hour's journey E. of Mistra, at the spot where now stands a new Sparta (see map of Greece, ref. 17-K). The first glance at the surroundings makes it clear that the springing up of a city in this place was only accidental; it was the camp of the Dorians, who, coming from the N., gained a firm foothold first on this spot, while the Achaians still held possession of the strongholds and cities of the land.

The appearance of Sparta was different from all other Grecian cities. The situation had nothing imposing in it. The small hilly undulations by the Eurotas vanish in face of the enormous rocky walls of Taygetus, which rise steeply from the plain to a height of 7,500 feet. No monuments exist which characterize the mistress of Hellas. The whole locality gives only the impression of rural grace, and the prophetic words of Thucydides (i., 10) have been literally fulfilled, that in contrast to Athens, Sparta's ruins would give no sign of the former greatness of the city. Yet the historic character of Sparta is to be plainly seen in all the surroundings. The old city never confined itself within narrow walls; the citizens dwelt beside each other, as it were, in the open country. The canals, whose ditches are seen extending diagonally over the site of the old city, watered the gardens and plantations; there was no distinction between town and country. The laws of Lycurgus forbade the luxury of municipal architecture; even the dwellings of the kings preserved a patriarchal simplicity. The city, as it became powerful, was filled with votive offerings to the gods, especially with tripods, but the sacred center of the land was not Sparta, but the Amyklaion. In Sparta also, after the Persian wars, a more imposing style of architecture was introduced, as is shown by the Persian porch; but the more Athens took the lead in the arts, so much the more remained Sparta behind, and even Lysander's victories brought the city no new adornments. It only lost more and more its old Doric character; the dwindling numbers of the citizens drew closer together; they themselves were no longer a sufficient protection; ditches and intrenchments were constructed against Demetrius (296), and against Pyrrhus (279), and at last the city was inclosed with a wall, the extent of which Polybius gives as 48 stadia (ix., 21). As Polybius says that Sparta within this circuit was much larger than Megalopolis within its wall of 50 stadia, the conclusion is that the wall had a circular form and the city a dense population. The wall was a symptom of degeneration and loss of freedom (Livy, xxxix., 37); under the tyrant Nabis it did not inclose the town completely, but only protected the open sides. It was restored after the capture of the city under Philopœmen, and remained under the Romans, under whose sway Sparta was one of the most populous and prosperous cities of the peninsula.

As Sparta was never destroyed in antiquity, and was uninhabited in the Middle Ages, it is reasonable to suppose that many antiquities are buried in the deep soil. Very remarkable reliefs of the old style have come to light; especially worthy of mention is the four-sided pedestal with the reliefs, published in the *Annali del Instituto* (1861, tav. d'agg. C), and the relief with Dionysus and Ariadne (1870, p. 272). Since the foundation of the kingdom of Greece the capital city of the Eurotas valley is no longer Mistra, situated near Taygetus, but has been removed again to the Eurotas, and new Sparta spreads itself out on the hills of the old city. See Crosby's article on *The Topography of Sparta* in *The American Journal of Archæology* (1893, p. 335 f.). See also Greece, History of Ancient. Ernst Curtius.

Revised by J. R. S. Sterrett.

**Sparta**: city; Randolph co., Ill.; on the Centralia and Chester and the Mobile and Ohio railways; 20 miles N. by E. of Chester, the county-seat, and 50 miles S. E. of St. Louis (for location, see map of Illinois, ref. 10–D). It is the center of a natural-gas region, and contains a woolen-mill, cannery, plow-factory, creameries, an incorporated bank with capital of $25,000, a private bank, and a weekly newspaper. Pop. (1880) 1,754; (1890) 1,979; (1900) 2,941.

**Sparta**: city; capital of Monroe co., Wis.; on the La Crosse river, and the Chi. and N. W. and the Chi., Mil. and St. P. railways; 25 miles N. by E. of La Crosse (for location, see map of Wisconsin, ref. 6–C). It is in an agricultural and fruit-growing region; is a popular summer resort; and contains medicinal artesian wells, free public library, high school, paper-mills, planing-mills, and flour-mills, carriage-factories, machine-shops, 2 State banks with combined capital of $40,000, and 3 weekly newspapers. Pop. (1880), 2,387; (1890) 2,795; (1900) 3,555. EDITOR OF "HERALD."

**Spar′tacus**: leader of the slaves in the Servile war (73–71 B. C.); b. in Thrace; was at first a shepherd and afterward chief of a gang of robbers, but was captured by the Romans, sold as a slave, and trained as a gladiator in a school at Capua. By showing how much better it would be to die in an attempt at freedom than to be butchered in the arena for a Roman holiday, he succeeded in forming a conspiracy among the pupils of the schools. Seventy of the conspirators, headed by Spartacus, fought their way out of Capua and took refuge in the crater of Vesuvius. Here they were soon joined by numbers of runaway slaves; an organization was accomplished: Spartacus was chosen leader, and formidable predatory expeditions were undertaken against the neighboring towns. C. Claudius Pulcher was then sent against them with an army of 3,000 men and blockaded them in the crater, but his force was suddenly attacked in the rear and almost annihilated. After this success the insignificant mutiny of a few slaves rapidly grew into a formidable war. The peculiar state of affairs in Southern Italy contributed much to this result. The soil of that region was almost exclusively owned or leased in large allotments by the Roman nobles, whose estates were cultivated by a numerous slave population, which lived in the most abject condition. Spartacus proclaimed the abolition of slavery, and before long he was at the head of an army of 70,000 men. His plan was to force the passes of the Alps, lead his army out of Italy, and then send every man to his home. With a victorious army of about 100,000 men he passed by Rome, and penetrated into the regions of the Po, where he was met by two consular armies. He defeated and routed them both, and at the funeral games which he celebrated in honor of Crixus he compelled the Roman knights among his prisoners to fight as gladiators in the arena. Unable to induce his soldiers to follow him out of Italy, he marched S. and went into winter quarters in Thurii. The defection of some of his troops and dissensions in his camp led to his defeat by Crassus. He then tried to cross over to Sicily, but was betrayed by the Cilician pirates who had agreed to transport his forces. A part of his army fell into the hands of Crassus, but Spartacus and the remainder of his troops effected their escape. Lucullus was now recalled from the East, Pompey from the West. After new victories, Spartacus went to Brundisium with the purpose of seizing the shipping in the harbor and crossing over to Thrace. Falling in with the army of Crassus, near the source of the river Silarus, he was defeated and slain. The fugitives were hunted down and slaughtered, and the revolt was completely suppressed. Revised by F. M. COLBY.

**Spartanburg**: city; capital of Spartanburg co., S. C.; on the Port Royal and W. Car. and the Southern railways; 73 miles W. S. W. of Charlotte, N. C., 93 miles N. W. of Columbia, the State capital (for location, see map of South Carolina, ref. 4–C). It is in a gold and iron mining and limestone-quarrying region; is the seat of Wofford College (Methodist Episcopal, established in 1853); and contains a high school, a national bank, 2 State banks, and a daily, a semi-weekly, and 3 weekly newspapers. Pop. (1880) 3,253; (1890) 5,544; (1900) 11,395.

**Spartel, Cape**: See the Appendix.

**Spartianus Ælius**: See AUGUSTAN HISTORY.

**Spasm** [from Gr. σπασμός, σπάσμα, spasm, derivs. of σπᾶν, draw, draw apart, pull, rend]: sudden and involuntary muscular contraction. The relaxation and tension of muscular tissue are dependent on nerve-force. Spasm of muscle may result from disturbance of the nerve-centers, from peripheral irritation of the affected part, or from irritation of other organs or surfaces reflected from the nerve-centers. When spasmodic rigidity is persistent for any length of time it is termed *tonic* spasm. Such is the period of rigidity at the beginning of the epileptic attack and the prolonged rigidity of tetanus and cerebro-spinal meningitis. When spasm is brief and recurs rapidly, it is termed *clonic* spasm. Such are the intermitting and repeated muscular contractions following the inception of the true epileptic attack, and constituting the more ordinary epileptiform attacks or "fits" of children. The graver spasmodic diseases are true epilepsy; epileptiform attacks from many causes, as indigestion and worms in children, renal disease in adults, and in the course of severe acute diseases, narcotic poisoning, etc.; chorea or St. Vitus's dance; tetanus; hydrophobia. Many lesser and local states of spasm frequently occur. Sneezing and coughing are spasmodic contractions of the respiratory tracts excited by irritation of the nasal or bronchial mucous membrane. Asthma is spasmodic constriction of many bronchial tubes, producing dyspnœa. Whooping-cough unites extreme hyperæsthesia and spasm of the bronchi with spasmodic constriction of the larynx. Intestinal colic and cholera morbus are conditions of painful spasmodic constriction of the intestines, due to cold or bad diet. In invalids and persons of sensitive nervous system painful spasms of various internal and external parts may develop suddenly from unknown or trivial exciting causes. The immediate relief of spasm is secured by so-called anti-spasmodics or nervines, as valerian, musk, camphor; by anæsthetics, narcotics, and sedatives, as potassium bromide, hyoscyamus, belladonna, opium. The permanent cure, when attainable, follows the correction of known causes. Revised by W. PEPPER.

**Spatan′gidæ**: See ECHINOIDEA.

**Spathe** [from Lat. *spatha* = Gr. σπάθη, any broad flat blade, spatula, stem of a palm-leaf, broadsword, whence (viâ Lat. and O. Eng.) Eng. *spade*]: the single sheathing bract which incloses a cluster of one or more flowers in many species of monocotyledonous plants. Sometimes the inclosed flowers are arranged on a spike of the form called *spadix* (σπάδιξ), and in numerous palms the spadix is branching, and besides the principal spathe there are numerous secondary ones on the spadix. Revised by C. E. BESSEY.

**Spaulding**, LEVI: missionary; b. at Jaffrey, N. H., Aug. 22, 1791; graduated at Dartmouth College 1815 and at Andover 1818; went to Jaffna, Ceylon, as a missionary of the American Board; remained on that island fifty-three years, during which time he made but one visit to the U. S. (1844); superintended a boarding-school for girls at Uduville; prepared tracts, hymns, and school-books in the Tamil language, into which he translated several religious works; prepared (with Rev. J. Knight) a *Tamil Dictionary* (Madras, 1844), and issued a revised translation of the Bible. D. in Ceylon, June 18, 1873.

**Spaulding**, SOLOMON: clergyman; b. at Ashford, Conn., in 1761; was a soldier in the war of the Revolution; graduated at Dartmouth College 1785; became a Congregational minister in Connecticut 1787; settled in Ohio some years later, and while residing at Salem in that State about 1812 wrote a novel entitled *The Manuscript Found*, suggested by the opening of an Indian mound. It is claimed that this fiction became known to Sidney Rigdon at Pittsburg in 1814, and that it was the origin of the *Book of Mormon*. D. at Amity, Pa., Oct. 20, 1816.

**Spa′vin** [M. Eng. *spaveyne*, from O. Fr. *esparvain* > Fr. *éparvin*, spavin]: certain swellings upon the hock-joint of the horse. In bog spavin the swellings and lameness are due to undue secretion of synovia (the lubricating fluid of joints). The most successful treatment is entire rest, with frequent bathing of the parts with cold water, and bandaging, accompanied by firm pressure upon the swelling, secured by means of compresses or spring trusses. Bone spavin, or spavin proper, is bony enlargement (exostosis) of the hock-joint, usually beginning at the lower part of the joint on the inside, and involving the heads of the splint and cannon bones, and of the small bones with which they articulate. It causes lameness, observable even in the early stages, and an imperfect action of the joint, gradually growing worse until finally the various bones become to a great extent united and solidified by the mass of fibrous bone which grows over them. The disease is caused by strains, to which the hock is particularly subject in work-horses drawing heavy loads, especially when starting them, and in race-horses and saddle-horses accustomed to leaping. When taken early, rest and counter-irritants will effect a cure; but when a considerable growth of bone has taken place, no absorption sufficient to cause a permanent cure can be expected, although setons, iodine blisters, or firing may cause an absorption of the bony excrescence, or even of the contiguous bone to some extent. The wisest course in an attempt to cure a spavined horse, when the disease is taken early, is to turn the animal out to grass, or otherwise regulate his diet so that his food shall be nutritious, yet cooling and laxative. At the same time the spavin may be bathed for a week daily with salt and vinegar, and then a blistering salve of iodide of mercury rubbed in. The salve may be applied once in three or four days, and both the strength and frequency of the application should be graduated according to the amount of excitement produced in the skin, avoiding any considerable blistering, but maintaining irritation upon the surface. After several applications, the spavin may be let alone until all heat and evidence of excitement in the skin have gone down, and the treatment then renewed. When not taken at its earliest stage, entire rest in the stall will promote a solid union (ankylosis) of the bones affected, and cooling lotions, salt and vinegar and iodide of potassium in solution in water, with attention to diet, will reduce the swelling of the contiguous parts, which is often considerable. Thus after a while the horse will be able to labor with little or no pain, but with more or less stiffness of the joint. Though caused by strains and overwork, spavin is peculiarly hereditary, and a spavined horse or mare should never be used as a breeder.

**Speaker of the House**: the presiding officer of the British Houses of Parliament, of the House of Representatives of the Congress of the U. S., of the lower houses of State Legislatures in the U. S., and in legislatures of the British colonies. In England the title was first employed in the reign of Edward III., but the office is much more ancient. The Lord Chancellor is usually the Speaker of the House of Lords. As the representative of the House, the Speaker communicates its resolutions to others and conveys its thanks or censures. In the U. S. House of Representatives the Speaker presides over the deliberations of that body, appoints its committees, supervises its journal, certifies to the amount of compensation due its members, signs its bills, resolutions, writs, warrants, subpœnas, etc., and has the right as a member to participate in debate after calling another member to the chair. He is chosen by the House from its own number, and can be removed from office by the House.

**Speaking-trumpet**: an instrument, usually in the form of a hollow truncated cone, the mouth-piece at the smaller end, and the larger end with a reflected lip. It is used for intensifying the sound of human speech and causing its further propagation in one direction. Its chief uses are on shipboard and in giving commands to firemen during conflagrations. The trumpet is of wood or metal. Its invention is ascribed to Kircher and to Sir Samuel Morland. When the instrument is used the air immediately in front is acted upon over so wide a surface that it becomes subject to greater compression and rarefaction, in consequence of the diminished lateral overflow or inflow. Thus the air retains its vibrations better and propagates the sound more effectively.

**Spear**: a weapon of offense, consisting of a wooden handle of greater or less length and a pointed head usually of metal. The general name spear includes all weapons of this class, such as darts, javelins, pikes, lances, etc., whether used as missile or thrusting weapons. The Macedonian and Swiss pikes were from 15 to 20 feet long, the mediæval lance of equal length, and the more modern pike from 10 to 14 feet. The dart and javelin were usually from 4 to 6 feet long and were essentially the same as the Zulu assagai. J. M.

**Spear, Cape**: See Cape Spear.

**Spearmint**: a plant, *Mentha viridis*, of the family *Labiatæ*, found abundantly in Europe and the U. S., generally upon moist soil. It is frequently cultivated for the sake of its leaves, which are used as the chief ingredient in a popular sauce for roast meats and for imparting a flavor to alcoholic beverages. An oil is also distilled from spearmint, and from this an essence is prepared, both possessing valuable medicinal uses. It is a handsome plant, with deep-green, lanceolate, acutely serrate, and nearly sessile leaves, and pale-purple flowers springing from an erect stem, usually 2 feet in height. Revised by Charles E. Bessey.

**Special Issue** (in law): See Issue.

**Spe′cies**: [≐ Lat., liter., sight, look, hence appearance, form, kind; deriv. of *spe′cere*, look, look at]: in biology, the smallest group recognized in ordinary classification. In general words the members of a species differ only in minor features, they are capable of interbreeding indefinitely among themselves, and the characters which separate them from other allied forms are capable of definition and are practically permanent. It must be noted, however, that the idea of species belongs rather to metaphysics than to nature, for in the living world sharp distinctions do not really exist, and if we take into account extinct forms all so-called species really intergrade. In classification the species is the lowest subdivision to which a name is usually applied, and in the binomial nomenclature the specific name is always written after that of the genus. Thus in the name of the lion, *Felis leo*, *Felis* is the generic name and indicates a cat-like animal, while the specific name *leo* indicates the particular kind of cat. J. S. Kingsley.

**Specific Gravity**: See Gravity, Specific.

**Specific Heat**: the thermal capacity of a substance expressed in terms of the thermal capacity of water.

Specific heats are usually measured by heating the body in question to a known high temperature and determining the amount of heat in calories which it gives up in falling to a second, lower, known temperature. This quantity, divided by the number of degrees between the lower and the higher temperature and also by the mass of body in grammes, gives the mean specific heat for the interval of temperatures used. The amount of heat above mentioned is either measured (1) by noting the rise of temperature which it will cause in a given mass of water (method of mixtures), or it is measured (2) by determining the amount of ice which it will melt (method of the ice-calorimeter).

By far the most delicate of all calorimetric operations is the modification of the latter method invented by Bunsen, in which the amount of ice liquefied is indicated by the change of volume which it undergoes (method of the Bunsen ice-calorimeter).

The following tables give the specific heats of some well-known elements and compounds:

TABLE I.—METALS.

| | | | |
|---|---|---|---|
| Aluminium | 0·2140 | Magnesium | 0·2450 |
| Antimony | 0·0510 | Mercury (solid) | 0·0319 |
| Bismuth | 0·0305 | Mercury (liquid) | 0·3332 |
| Copper | 0·0933 | Platinum | 0·0323 |
| Iron | 0·1116 | Silver | 0·0559 |
| Lead | 0·0314 | Tin | 0·0550 |
| Lithium | 0·9408 | Zinc | 0·0935 |

TABLE II.—MISCELLANEOUS SOLIDS AND LIQUIDS.

| | | | |
|---|---|---|---|
| Ice | 0·51 | Sulphur | 0·176 |
| Glass | 0·1 | Iodine | 0·054 |
| Wood | 0·5–0·6 | | |
| Alcohol | 0·566 | Glycerin | 0·555 |
| Benzene | 0·392 | Chloroform | 0·233 |
| Carbon disulphide | 0·218 | Turpentine | 0·423 |
| | | Ether | 0·520 |

TABLE III.—GASES AND VAPORS.

| SUBSTANCE. | Specific heat (by constant pressure). | Relative specific heats. |
|---|---|---|
| Air | 0·2375 | 0·2375 |
| Oxygen | 0·2175 | 0·2405 |
| Nitrogen | 0·2438 | 0·2370 |
| Hydrogen | 0·4090 | 0·2359 |
| Carbon monoxide | 0·2479 | 0·2399 |
| Chlorine | 0·1214 | 0·2962 |
| Carbon dioxide | 0·2164 | 0·3308 |

The specific heats of water and of steam are given in the article Steam (*q. v.*).

Specific heat depends upon the temperature. Thus for platinum, which may be taken as typical, the values (according to Kayser, *Physik*, p. 182) are as follows:

| Range of temperature. | Mean specific heat. |
|---|---|
| 0° to 100° C. | 0·0335 |
| 0° to 300° | 0·0343 |
| 0° to 500° | 0·0352 |
| 0° to 1,200° | 0·0382 |

The effect of temperature upon the specific heat of liquids is in general more than in the case of solids. There are, however, some anomalies among the latter. The diamond, for example, according to Weber, possesses a specific heat of 0·0947 at 0° C., which becomes 0·1905 at 100° and 0·2791 at 200°.

See, further, HEAT, LIQUIDS, and STEAM; also Regnault, *Quelques Expériences*; Preston, *On Heat*; Stewart, *Heat*; Tait, *On Heat*; or any of the larger treatises on physics.

E. L. NICHOLS.

**Specific Inductive Capacity**: See INDUCTIVE CAPACITY.

**Specific Performance**: in the equitable jurisprudence of the U. S. and of England, the species of remedy conferred by courts of equity, in which a party is compelled to perform the very thing which he has undertaken to perform in behalf of the person to whom the undertaking is given. In its broadest sense, the phrase would properly describe all the varieties of equitable relief which consist in procuring a defendant upon whom an obligation rests to do the very specific acts which such obligation requires him to do; but in its technical and more restricted signification it is confined to cases in which the obligation arises out of a contract entered into by the defendant. The common law knows but one form of remedy for the breach of any and all contracts—a recovery of money either as debt or damages. Whatever be the nature of the agreement, whatever be its subject-matter, whatever acts or omissions it calls for, a pecuniary compensation for its non-performance is the only judgment that can ever be obtained against the defaulting party by means of the common-law courts. It is very plain that in the innumerable variety of relations incident to modern society contracts will necessarily be made for whose breach this mere pecuniary payment would be an utterly inadequate and often impracticable relief; and a system of municipal law which provided no other kind would fail in maintaining and dispensing the justice which is the final object of all enlightened jurisprudence. To supply this defect in the common-law methods the courts of equity began long since to decree the specific performance of contracts in certain cases; and the general principles which determine the classes of agreements to which this remedy may be applied are now ascertained and well settled, and constitute a distinct department of equity. The doctrine as thus established is shown in the simplest and clearest manner by enumerating the instances in which a specific performance will not be decreed, and which are therefore left within the exclusive jurisdiction of the common-law tribunals and to the application of the common-law remedies:

1. The fundamental and most important rule is, that a specific performance will not be ordered when the complaining party can obtain adequate relief by means of a purely legal judgment. If, therefore, the contract vests the plaintiff with property in a chattel, so that he can recover its possession through an action at law, or if by the money recovered he can restore himself to the same position, in contemplation of law, which he would have occupied if the defendant had fulfilled his agreement, he will be left to his legal remedy alone, and courts of equity will not interfere in his behalf. As an illustration: If the contract relates to ordinary goods and chattels, or to any kind of personal property having a marketable value, and contemplates a delivery thereof in any manner or a transfer of title, since a sufficient sum of money paid to the injured party will always enable him to purchase or procure other articles of a like nature, amount, and value to those stipulated for such a pecuniary compensation is deemed an adequate remedy, and a specific performance will be refused. The example here given, and the fundamental rule which it illustrates, have a very wide application, and they remove at one blow all ordinary agreements concerning personal property, especially those which are mercantile in their character, from the operation of this equitable mode of enforcement. The mere fact, however, that an agreement deals with or relates to personal property does not necessarily withdraw it from the jurisdiction of a court of equity. The subject-matter may be a chattel of some peculiar, intrinsic, but not marketable value, which can not be elsewhere purchased or reproduced, so that the pecuniary damages will not compensate for its loss; and in such cases, although they are exceedingly rare, the specific relief may be obtained. A certain class of covenants, also, wherein the parties promise to execute some further and more formal agreements—as, for example, to execute a marriage or family settlement on wife and children—may be specifically enforced by compelling an execution of the contemplated instrument, although it relates to personal property and not to real estate. These instances, however, are comparatively few, and in the vast majority of contracts concerning personal property or personal services the money-recovery granted by the law courts is regarded as an adequate relief, and the extraordinary remedy administered by the equity tribunals is denied. In all the subsequent rules it is of course assumed that the agreement, if judged by the principle alone which has already been stated, is one to which the equitable method of enforcement might be applied.

2. In order that a specific performance may be decreed, such a performance must be reasonably possible by the contracting party. If, therefore, by the original terms of the contract he did not have the power to fulfill, or if from circumstances occurring after its execution the power has been lost, even through his own voluntary act, a court of equity will not go through the empty form of ordering an impossibility to be accomplished, and the plaintiff must be contented with an award of pecuniary damages, which perhaps may be enhanced by reason of the defendant's conduct. For example, if the owner of a farm should, by a valid agreement of sale, bind himself to convey it to the purchaser on a future day named, but before that time had arrived should actually convey it to another *bona-fide* grantee, a specific performance of the contract would not be decreed at the suit of the original vendee, because a transfer of the title to him by the vender would then be impossible, and he would be left to his action for damages. Specific performance can be obtained, however, against a person who buys with notice of a prior contract for the sale of land, or who acquires title to the property without paying value. As a corollary of this rule, it is requisite that the terms of the contract should be so plain and unambiguous that there can be no reasonable doubt as to the intention of the parties, and that this design may be directly carried into effect by the judgment.

3. Not only must the performance be possible by the party upon whom the obligation rests, but the subject-matter of the agreement, and its stipulations in regard thereto, must be of such a nature that the court, by means of its ordinary administrative instruments and machinery, can compel the specific performance which it decrees. Cases may arise, and are not infrequent, in which the court, after directing a performance according to the provisions of the contract, would have no power to enforce its decision directly without departing from its customary functions or incurring an amount of trouble, care, and responsibility incompatible with the discharge of its regular duties; a specific performance will then be refused, however inadequate might be a mere recovery of damages. Under the operation of this principle the agreement of an actor, a singer, a painter, or other artist to employ his talents in a specified manner can not be specifically enforced; and the rule applies in general to all stipulations for personal services, notwithstanding the fact that these services may be of such exceptional value that they can not be procured from any other person but the defendant. For the same reason it has been decided that the specific performance of a contract to construct a railway will not be decreed, since such an undertaking is too extensive and burdensome to be carried on under the direction of a court of equity. See, however, *Wilson* vs. *Furness Railway Co.*, L. R. 9 Eq. 28; *Lawrence* vs. *Saratoga R. R. Co.*, 36 Hun. 467.

4. Finally, the agreement and the relations of the parties must be such that a decree of specific performance will be reasonable, just, and equitable. It is sometimes said that this remedy is never a claim of right, but is always a matter of discretion. The doctrine as thus stated simply means that in determining whether the relief shall be granted in a given case certain equitable considerations are to be taken into account, and not the mere fact that the agreement is valid in law. The beneficent principle is applied that he who seeks equity must do equity. If, therefore, the contract was procured by overreaching or artifice, although not so tainted with fraud as to be invalid, if it is unfair or oppressive in its terms, if the consideration is grossly inadequate, if its specific enforcement would be unreasonably burdensome to the defendant without any corresponding benefit to the plaintiff, if the plaintiff has been guilty of unnecessary delay in prosecuting the action whereby his opponent has been prejudiced—in these and in similar cases showing a want of good faith or diligence on one side or serious injury on the other, the equitable considerations become controlling, and lead to a denial of the specific remedy.

As the practical result of these rules, the usual contracts enforceable by a decree for a specific performance are those directly relating to land as their subject-matter. It is a settled doctrine of the equity courts that money-damages are not an adequate relief for the breach of such agreements.

This conclusion is partly based upon the fact that a special value may be attributed to the very premises bargained for which is not susceptible of pecuniary estimate and compensation, but chiefly upon the pre-eminence which the English law has always given to the ownership of land in comparison with every other species of property. Subject, however, to the qualifications hereinbefore stated, specific performance will be decreed of any contract where the remedy at law is inadequate and specific performance is reasonably possible. On this principle specific performance has been decreed of contracts for the sale of property that could not be purchased in the market (*Thorn* vs. *Commissioners*, 32 Beavan 190; *Equitable Gas Light Co.* vs. *Baltimore Coal Tar Co.*, 63 Md. 285), of contracts for the sale of debts of an insolvent (*Adderly* vs. *Dixon*, 1 Sim. and St. 590; *Cutting* vs. *Dana*, 25 N. J. Eq. 265), of contracts to give security for a debt (*Taylor* vs. *Eckersley*, 2 Chancery Division 302), and of contracts for the sale of letters patent (*Somerly* vs. *Buntin*, 118 Mass. 279). A contract for the conveyance of land, or for the creation of an estate therein, if valid by the statute of frauds, and if complying with the conditions above described, will in general be enforced by a decree of specific performance compelling the execution of the proper instruments and the creation or transfer of the proper interests. What contracts are thus valid under the statute, and how far courts of equity have grafted exceptions upon this enactment, enforcing specific performance of oral contracts, are questions of the highest importance, but can not be treated here. It may be stated, however, in general terms that if the vendee has so far performed the contract that he can not be put *in statu quo*, an oral contract will be enforced, notwithstanding the statute of frauds requires a memorandum in writing of contracts for the sale of an interest in land. This exception is put upon the ground that the defendant shall not be allowed to plead the statute of frauds to perpetrate a fraud, a clear case of judicial repeal of legislation. See FRAUDS, STATUTE OF.

Revised by WILLIAM A. KEENER.

**Specific Volume of Gases**: See HEAT (*Density of Gases and Vapors*).

**Spectacles** [from Lat. *specta'culum*, sight, show, spectacle, deriv. of *specta're*, frequentative of *spe'cere*, look at]: a device for the improvement of defective sight. (See the article VISION, DEFECTS OF.) The invention of spectacles has been variously ascribed to Alexander da Spina, of Florence, or to his contemporary and fellow townsman, Salvinus Armatus (d. 1317); also to Roger Bacon (d. about 1294). It is more probable, however, that the knowledge of them in Europe came through the Saracen Alhazen (d. 1038). The Chinese have for ages employed spectacles for the relief of defective eyesight, and probably they were known to the ancients. (Consult *History of Spectacles*, by Dr. L. W. Fox, in *Medical and Surgical Reporter*, May 3, 1890.) Lenses for spectacles are spherical and cylindrical. In a *spherical lens* the surface on one or both sides is a section of a sphere. Rays of light passing through it are refracted equally in all planes. In a *cylindrical lens* the surface on one side is a section of a cylinder parallel to its axis. Light passing through a cylindrical lens in a plane parallel to its axis is not refracted. At right angles to its axis parallel rays are rendered convergent or divergent according as the cylindrical surface is convex or concave.

*Convex spherical lenses* ground into spectacles are used (*a*) to correct presbyopia (a diminution of the range of accommodation, interfering with vision of near objects); (*b*) to correct hypermetropia, or far sight (over-sight), by increasing the refraction of the eye, so that distant rays instead of coming to a focus behind the retina are accurately focused upon it; (*c*) to supply the loss of refractive power caused by removal of the crystalline lens, e. g. after extraction of cataract; these must be powerful glasses having an optical value of about eleven diopters. *Concave spherical lenses* are used to correct myopia, or short sight, by lessening the refraction of the eye, so that distant rays instead of coming to a focus in front of the retina are focused accurately upon it. *Cylindrical lenses* are used to correct astigmatism, or a condition in which the refraction varies in the different meridians of the eye. The cylindrical surfaces may be either concave or convex, according as the faulty meridian is myopic or hypermetropic. *Prismatic glasses* are used to relieve muscular weakness of the eye, because a prism will alter the direction of the ray from the point of fixation, so that it coincides with the visual line of the weaker eye.

If there is a combination of astigmatism and hypermetropia or myopia, *compound lenses* are used. On one face of the glass is ground the spherical curvature (convex or concave, according as there is hypermetropia or myopia), and on the other the cylindric curvature, to neutralize the astigmatism. Prisms may also be combined with this formula.

Lenses are numbered according to one of two systems. In the first or old system a strong lens of 1-inch focal length is the unit. Lenses weaker than the unit are expressed by fractions; thus a lens of 2 inches focus is expressed as $\frac{1}{2}$, one of 10 inches focus as $\frac{1}{10}$, etc. In the second or new system a weak lens of 1 meter (100 cm.) focus is the unit, and is called a *diopter* (abbreviated D.); a lens twice the strength of the unit is 2 D., and has a focal length of 50 cm. Prisms may be designated by their refracting angles or by their angular deviation.

Lenses used to correct optical defects may be mounted in spectacle-frames or in eye-glasses. When separate glasses are required for distance and reading they may be combined in one frame by cementing the stronger lens upon the lower portion of the distance glass. These are called cemented bifocals or double-focus glasses, and have replaced largely the old-fashioned Franklin glasses, which were made of two pieces divided horizontally and joined by their cut surfaces. Instead of double-focus glasses the reading-lens may be added as a separate glass in a hook-front.

Spectacles should never be worn unless the eyes have been carefully examined by a competent physician, who then writes the formula from which an optician may grind the proper lenses. Glass used in spectacles should be of the best quality, and have an index of refraction of 1·53. Pebble-glass is sometimes employed, but has no special advantages.

GEORGE E. DE SCHWEINITZ.

**Spectacle-snake**: See COBRA DE CAPELLO.

**Spectrophotom'eter**: an instrument for the comparison of any color or wave-length from any given source of light with the same color or wave-length from a standard source.

In the instruments described under PHOTOMETER (*q. v.*) the comparison is made between the two lights as a whole, and furnishes no indication of the relative intensities of different wave-lengths with each other or with the same wave-lengths from a standard source. For the more detailed comparison of the lights from two sources, each must be resolved into its constituent parts as shown by its spectrum and the two spectra compared, small similar regions of each at a time.

The use of the instrument depends on the fact that the eye readily and accurately compares lights of the same wave-length, while between different wave-lengths only the roughest comparison is possible. See PHOTOMETRY.

The instrument is exceedingly variable in form, according to the particular purpose in view. It must, however, include the following elements: (1) Provision for producing in juxtaposition the two spectra with a definite line of demarkation between. (2) Provision for bringing into the field of view separately any given small region of the two spectra. (3) Provision for varying the relative intensity of the light from the two sources so that the intensities of the two constituent parts under observation as judged by the eye may be made equal. The extent to which the relative intensities as a whole are thus modified becomes then a means for the comparison of the intensities of the two particular wave-lengths under observation.

Requirement (1) may be provided either by prisms, as in the ordinary spectroscope, or by a ruled grating, proper provision being made for the introduction and collimation of the two beams of light. Requirement (2) is provided by adjustments similar to those in the spectroscope, and by an adjustable diaphragm in the focal plane of the eyepiece, by means of which the field of vision may be reduced to as narrow a region as desired. Requirement (3) may be provided (*a*) by an adjustable slit, whereby the extent of the openings for the two beams may be made to vary relatively; (*b*) by a pair of Nicol's prisms in the optical path of each beam, whereby the relative intensity may be varied according to the relative angle between the polarizer and analyzer; (*c*) by varying the relative distances between the instrument and the two sources of light, as in the ordinary photometer; (*d*) by a combination of the preceding.

So far as possible the optical paths of the two beams should be similar, i. e. they should consist of the same number of reflections, refractions, and polarizations, and at the same angles, and they should traverse the same amounts of glass, calcite, and other media. If the paths are essentially different in these particulars, selective absorption and reflection and other disturbing causes may introduce errors into the final comparison.

Various sources of light, such as the sun, the incandescent filament of the glow-lamp, and a standard gas-flame, have been used as standards in work with this instrument.

W. F. DURAND.

**Spec′troscope** [Mod. Lat. *spec′trum* + Gr. σκοπεῖν, view]: any instrument for the production and study of spectra. Spectroscopes designed for the precise determination of wave-length are called spectrometers. Spectroscopes may be classified with reference to the nature of the dispersing device, whether prism or grating; or with reference to the dispersing power (high or low); or according to the special purpose to which the instrument is to be put (telespectroscope, microspectroscope, etc.).

Whatever the type of spectroscope, its action is always based upon the principles stated in the article SPECTRUM (*q. v.*). The essential parts are the slit and the dispersing device, to which may be added the focusing arrangement, and the means of identifying and determining the positions of the various regions of the spectrum under investigation. The slit possesses the same features in nearly all forms of spectroscope. It consists of two parallel jaws of metal, very accurately worked and adjusted. One or both have freedom of motion in a direction at right angles to the length of the slit. Fig. 1 shows one of the best-known methods of producing these motions. The device is due to Hilger. The two edges should be so true in workmanship that when brought within a small fraction of a millimeter of one another the aperture will still be approximately of uniform width throughout. This aperture when illuminated from behind forms the source of light the image of which, dispersed and focused upon a screen, or within the eyepiece of an observing telescope, is to form the spectrum.

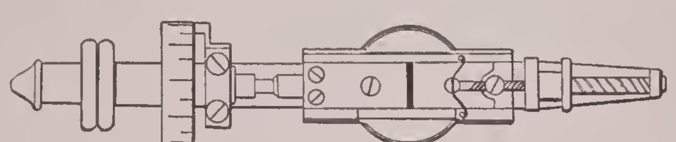


FIG. 1.

*Dispersing Devices.*—(1) *The Prism.*—The usual material is glass, although for special purposes rock-salt, quartz, fluorspar, carbon bisulphide, etc., are used. Rock-salt possesses the advantage of extreme transparency for the longer waves of the infra-red to which glass is opaque; quartz has the equally desirable property of transparency in the ultra-violet. Fluor-spar is unique in having a law of dispersion which gives great separation to the longer waves, thus permitting the extension of measurements to regions unattainable with prisms of other materials. This property combined with very complete transparency in the same regions makes fluor-spar one of the most valuable of substances to the student of radiation. Carbon bisulphide is used where a dispersing medium is desired, the law of dispersion of which is known. Cauchy's formula,

$$N_\lambda = \alpha + \frac{\beta}{\lambda^2} + \frac{\gamma}{\lambda^4},$$

where $N_\lambda$ is the index of refraction for a wave-length, $\lambda$, and $\alpha$, $\beta$ and $\gamma$ are constants, when applied to nearly all substances available in spectroscopy, gives false values for the infra-red. Carbon bisulphide appears to obey the above law for all wave-lengths.

In glass an important quality is high dispersing power, and this is a property which the variety known as flint glass possesses in a high degree. How great is the difference between different sorts of glass will appear from Fig. 2, which shows the spectra produced by similar prisms of crown and of flint glass under like conditions. It will be seen that the distance between the Fraunhofer lines A and H, or, in other words, between the extreme red and the extreme violet, is nearly twice as great in the one case as in the other. Flint glass has one very serious disadvantage for spectroscopic work, viz., that as its dispersive power increases, its transparency, particularly for the shorter wave-lengths, diminishes. Even ordinary optical glasses are far from completely transparent, and the densest varieties are nearly opaque to the extreme violet of the spectrum. In spectroscopes with a single prism the latter is usually equiangular. Where a train of prisms is used to secure high dispersion, lesser angles are frequently employed.

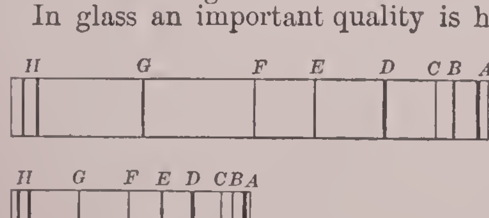



FIG. 2.

*Trains of Prisms and Direct Vision Combinations.*—Whenever high dispersion is desired and a prismatic spectrum is preferred to the normal spectrum produced by means of the diffraction grating, a train of prisms is employed. Kirchhoff and Bunsen used for this purpose simply a set of independent equiangular prisms, each mounted upon three pins. These were set up upon a metallic plate, and were adjusted separately by hand until the entire train was symmetrically arranged. As the positions for minimum deviation differed with the wave-length, this laborious operation had to be continually repeated. Later workers with the spectroscope devised automatic trains, such that the movement of the eye-telescope shifted all the prisms simultaneously into their proper positions. Fig. 3 shows the automatic arrangement due to Rutherfurd. In the astronomical spectroscope depicted in Fig. 11 a similar train is used.

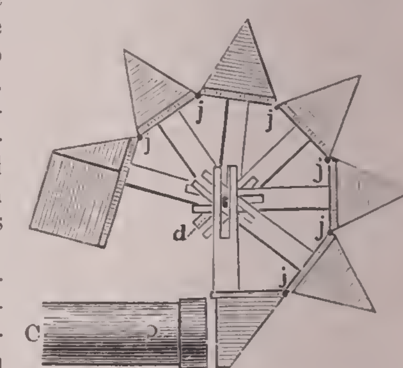



FIG. 3.

To avoid the inconvenience of having the collimator and observing telescopes make an angle with one another, as in Figs. 8, 12, and 13, combinations of flint and crown glass prisms are sometimes used in spectroscopes of small dispersion to produce a spectrum without any considerable deviation of the rays from direction of their original path. Fig. 4 shows the usual arrangement, in which *c c c* are crown-glass and *f f* are flint prisms. It is an extension by Jansen of the original idea of Amici, who used three prisms, two crown prisms with one flint prism between them. The action of both the three and five prism systems depends upon the difference in the dispersing powers of crown and of flint glass.

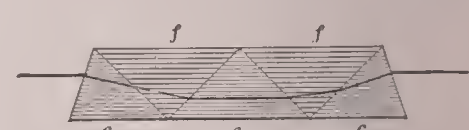



FIG. 4.

It is evident that if the system is so constructed that a certain ray of wave-length, $\lambda$, so selected as to lie near the center of the spectrum, emerges with its path parallel to the incident path (as in Fig. 4), rays of other wave-lengths will suffer more or less divergence from that direction. There is a resultant dispersion by such a system, although the mean direction is unchanged.

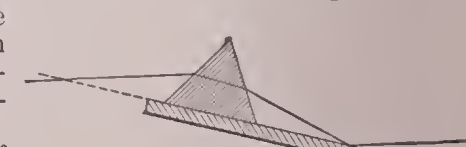


FIG. 5.

There are a variety of other methods for rectifying the direction of the dispersed rays in the spectroscope, some involving subsequent reflection by means of a mirror (Fig. 5), others total reflection either within the dispersing prism (Fig. 6) itself (a construction ascribed to Herschel) or by means of a separate rectangular prism properly placed for that purpose (Fig. 7). None of these devices, however, has come into very general use.

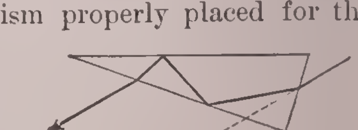


FIG. 6.

FIG. 7.

(2) *Gratings* for the production of diffraction-spectra are frequently used in the spectroscope instead of prisms as dispersing apparatus. It is used in spectroscopic work (1) whenever a normal spectrum rather than a prismatic spectrum is desired—that is to say, when direct absolute determinations of wave-length are to be made; (2) when high dispersion is wanted. Gratings give relatively greater openness in the longer wave-lengths and less in the violet and ultra-violet than do

prisms. They are objectionable in some kinds of work on account of the faintness of the spectra produced, of the overlapping of the spectra, and of the fortuitous and altogether irregular distribution of intensities. For photographic work, however, gratings are especially advantageous because the strong absorption which violet light suffers in passing through flint glass (as indicated in a previous paragraph) may be avoided.

*Collimator and Observing Telescope.*—Spectroscopes of the usual form (Fig. 8) have between the prism or grating and the slit a lens (C), the purpose of which is to bring light to the prism in parallel rays. This lens is attached by means of the connecting tube to the slit at such a distance that the latter is at the principal focus. This arrangement is called the collimator. Beyond the prism the dispersed rays enter the observing telescope (T), which having been focused for parallel light brings the portion of the spectrum under observation to a focus in the eyepiece. Collimator-tube and telescope swing upon a common vertical axis at the center of the instrument. By means of the position of the telescope, as indicated upon a divided circle ($a$), about which it moves, the region of the spectrum which is in coincidence with the cross-hairs in the eyepiece is identified.

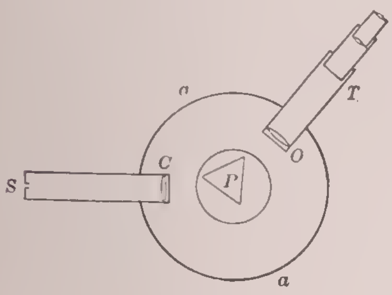



Fig. 8.

Where a grating is used the position of the parts of the spectroscope is that shown in Fig. 9, the telescope being placed on either side of the collimator according as the right-handed or left-handed spectra are to be observed, and at various angles according to the order of the spectrum.

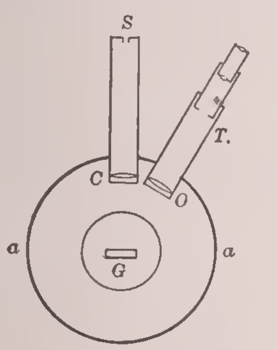



Fig. 9.

Formerly a train of prisms was used, as in the spectrometer of Kirchhoff and Bunsen (Fig. 10). The automatic train depicted in Fig. 3 was a later form. It found one of its most important applications in the telespectroscope, a well-known form of which is shown in Fig. 11. This instrument, which could be adjusted so as to give any dispersion up to that corresponding to twelve prisms, is constructed in compact form and attached as an eyepiece of a large telescope.

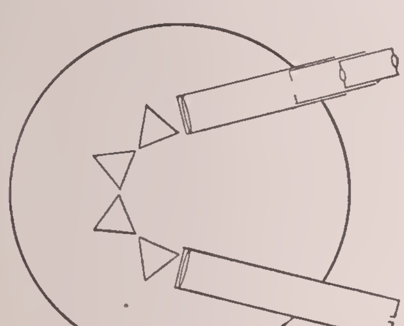


Fig. 10.

*Chemical Spectroscopes.*—For many purposes the exact but laborious method of determining the position of lines in the spectrum by making readings upon a finely divided circle may be advantageously supplanted by a less precise but more expeditious process. This is true, for example, in the identification of substances by means of their bright-line spectra or in the study of absorption spectra. The first instrument especially designed for such work was the chemical spectroscope of Bunsen (Fig. 12). The circle in this apparatus is dispensed with and both collimator and telescope are fixed. The dispersion is so small as to bring the entire spectrum into the field of view. A third tube, S, carries a transparent scale (photographed upon glass). In Fig. 13 the letter $a$ shows the position of this scale. There is a lens at $b$ by means of which the image of the scale is brought to focus in the eyepiece of the telescope. The rays are reflected from the face of the prism as shown in the figure. The scale is illuminated from behind by means of a flame, $L_2$. The appearance of the field of view when a spectrum consisting of bright lines is under observation is shown in Fig. 14.

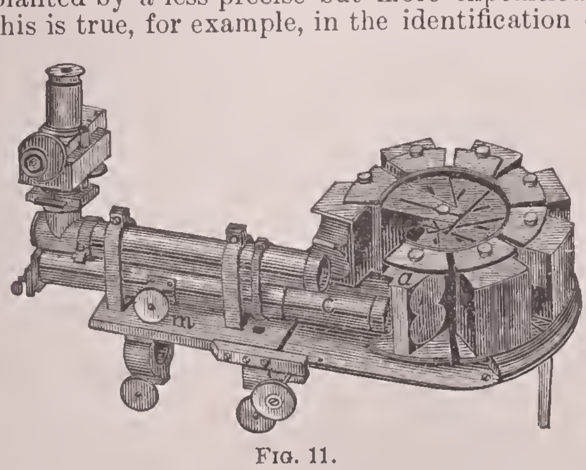


Fig. 11.

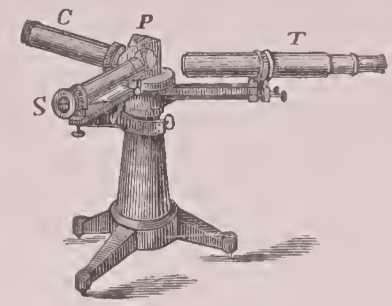



Fig. 12.

At the hands of Hofmann and of Krüss and others, the chemical spectroscope has undergone many improvements, among which may be mentioned the introduction of direct-vision prisms and of a scale reading directly in wave-lengths. Fig. 15 shows such an instrument, with diagram of its parts. In the microspectroscope also, or spectroscopic eyepiece, direct-vision prisms are used and the direct-reading scale. This instrument indeed is simply a direct-vision spectroscope of small proportions and adapted to the eyepiece of the compound microscope. In Fig. 16 the cross-section of a microspectroscope is shown, with prism ($p$) for introduction of a reference spectrum and a scale ($s$).

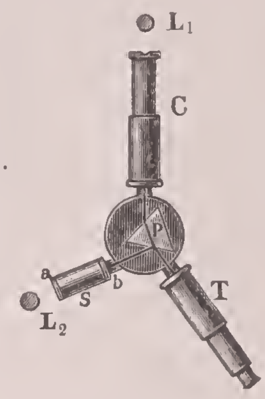



Fig. 13.

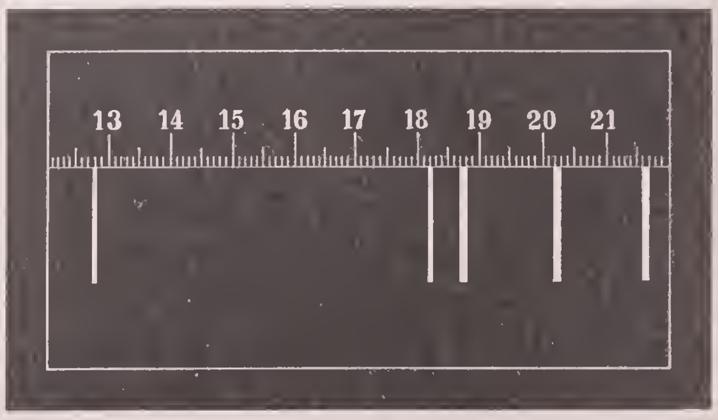



Fig. 14.

*Spectroscopes for the Infra-red and the Ultra-violet.*—For the study of the invisible spectrum spectroscopes of the usual forms are ill adapted. Various special types have accordingly been developed.

*In the infra-red* the conditions are transparency to the longer waves and sufficient dispersion of that part of the spectrum. Rubens uses in such work an instrument with a prism of fluor-spar. Lenses are dispensed with altogether in favor of concave mirrors, which bring the spectral image to a focus upon the filament of a linear bolometer.

*In the ultra-violet*, where the method is photographic, the best results are obtained by the use of the concave grating of Rowland.


Fig. 15.

Brashear, in his grating spectroscope for the ultra-violet, mounts grating (G) and plate-holder (P) at the ends of a rigid bar (B, Fig. 17). The grating is placed upon a car with two wheels, which runs along a metal track, S $R_1$. This track extends from the slit in the incident ray. Another track (S $R_2$) at right angles to the

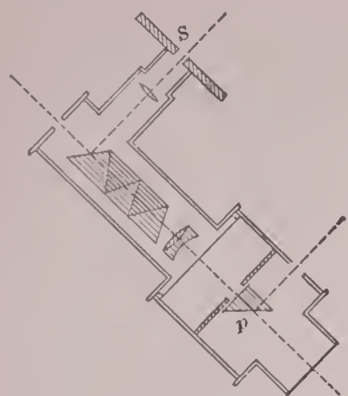



Fig. 16.

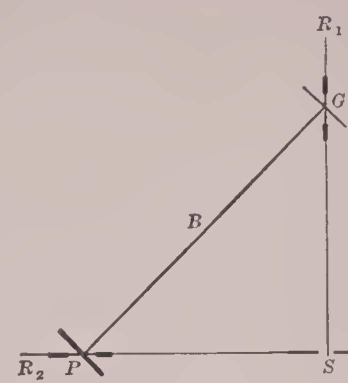



Fig. 17.

first carries a plate-holder. The bases upon which grating and plate-holder are mounted are pivoted to the cars on which they are placed, so that the bar can be brought to any angle with the incident ray, both grating and plate-holder remaining always normal to the direction of the bar and at the same distance apart. The law of the grating is such that if the distance between the grating and plate is equal to the radius of the curvature of the former the spectrum will be in focus upon the plate in all positions of the bar. The light to be investigated is focused upon the slit by means of a quartz lens or sometimes by a concave mirror of long focus. Fig. 18 shows the general form of the apparatus.

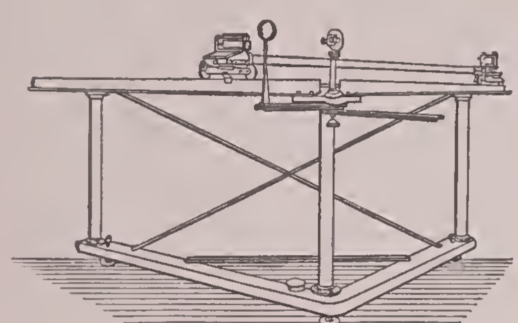


Fig. 18.

A description of some of the varied applications of the spectroscope is given in the article Spectrum (*q. v.*); see also Spectrophotometer: also the various treatises named at the end of the former article. E. L. Nichols.

**Spec'trum** [= Mod. Lat., from Lat. *spec'trum*, appearance, image, apparition, deriv. of *spe'cere*, look at]: in optics, the image obtained when a ray after dispersion, either by passage through a prism or by diffraction, is brought to a focus. The composite nature of light, through which a spectrum is possible, is explained in the article Light.

The first systematic studies of the spectrum were made by Newton, 1666, and it was he who appears to have first recognized the supreme importance of the phenomena encountered in such observations. Modern spectroscopy, however, may be regarded as having its beginning in the experiments of Fraunhofer, who in 1817, by the use of a narrow slit, first produced well-defined and pure spectra.

The essential parts of the apparatus for the production of such a spectrum are (1) a slit illuminated from behind; (2) a dispersing device (usually a prism or a diffraction grating); (3) a focusing device (a lens or system of lenses, or sometimes a mirror); (4) a screen or an observing telescope, according to the method to be pursued in studying the spectrum.

In Fig. 1 is shown a slit through which light of a wave-length, λ, passes in the direction indicated by the arrow. But for the interposition of the prism P, the lens L would produce an image of the slit $S_1$ at the conjugate focus $S_2$. The prism, however, diverts the ray, and it comes to focus upon the screen *i*, *u*. The position of this refracted image depends upon the wave-length. If, for example, the wave-length is one which produces the impression of red upon the retina it will come to focus at *r*; if of violet, at *v*. If the ray passing through the slit be of white light, the entire space between *r* and *v*, which we may suppose to be respectively the longest and the shortest rays capable of affecting the eye, will be filled by colored images of the slit, each differing insensibly from its neighbors in hue. This infinite series of elementary images constitutes what is called a continuous spectrum. Each image has a width proportional to that of the slit, but the centers of contiguous members of the series are only infinitesimally distant from one another. Neighboring images overlap, therefore, with consequent color-mixing.

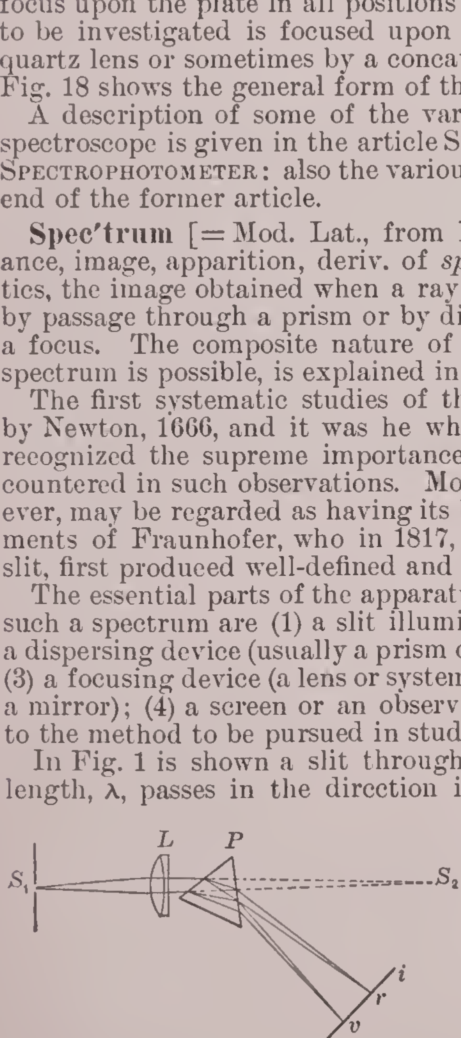



Fig. 1.

*A pure spectrum*, in the language of the spectroscopist, is one in which the effect of this color-mixing by fusion of the overlapping images is absent. In a strict geometrical sense a pure spectrum would be produced only by the use of a linear slit. The successive elementary images differ from one another, however, only infinitesimally in color, and a definite finite difference must exist before the effect of the blended images upon the retina will differ from that of their components. In practice the spectra produced by the dispersion of the light from any narrow slit (up to perhaps ·05 cm. for an ordinary spectroscope) may be regarded as pure. The distribution of wave-lengths, and consequently of colors, in the prismatic spectrum is determined by what is called the *law of dispersion* of the prism. It has not been found possible to give a general expression to this law, applicable to all substances. The phenomenon of dispersion differs indeed in various transparent media, such as calcite, fluorite, rock-salt, quartz, etc., in ways the explanation of which has not yet been attained. In glass, which is an artificial mixture with varying components, the dispersion is to a considerable extent under the control of the maker.

For any particular case the dispersion can be indicated graphically in a simple manner. An important example is that of an equiangular prism of flint glass, the dispersion diagram of which appears in Fig. 2. The ordinates of the

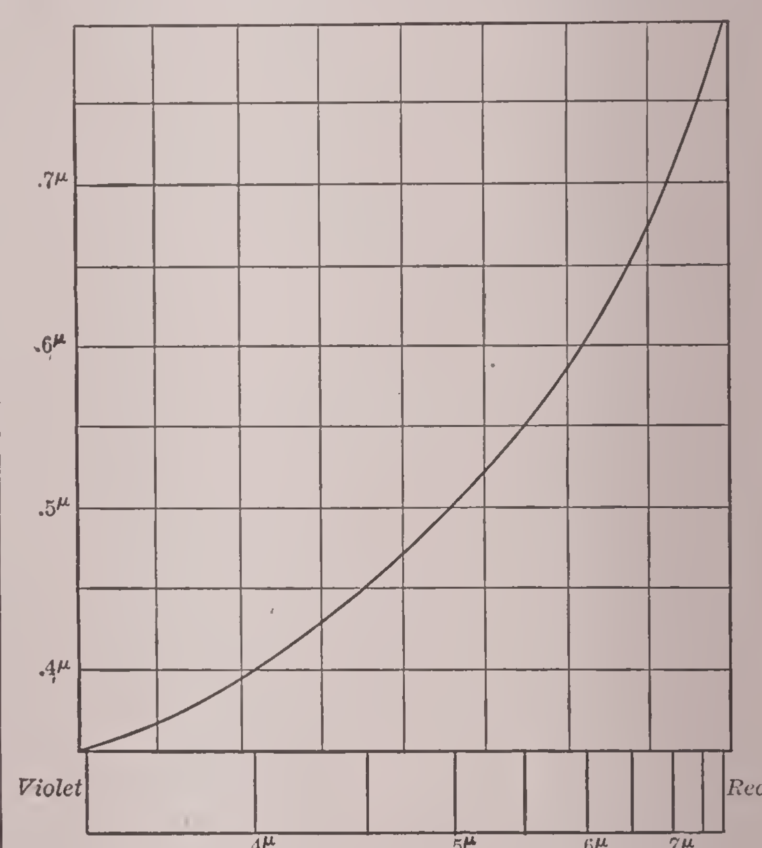



Fig. 2.

curve are wave-lengths in millionths of a meter; the abscissas are distances in passing through the spectrum from violet to red. The vertical lines at the base of the diagram show by their distances apart the relative spaces which exist between wave-lengths 0·40μ, 0·50μ, etc.

While this diagram applies only to a particular specimen of glass, it is characteristic to a certain extent of nearly all cases of prismatic dispersion, the peculiarity of which is the increasing separation of the rays as the wave-length diminishes, so that the red end of the spectrum is relatively much more crowded together than the violet end.

*The diffraction spectrum* (normal spectrum) is produced by means of apparatus, of which that shown in Fig. 3 is typical. The diagram gives only the essential parts, which are the same as those in Fig. 1, with the exception that a reflecting diffraction grating (G) is used instead of a prism. This grating, according to modern practice, would consist of a plate of speculum metal, the surface of which is accurately ground to form a plane mirror, or sometimes a concave mirror with a radius of several feet. Upon this surface are ruled straight equidistant lines to the number of several thousand per centimeter. The process is that described in

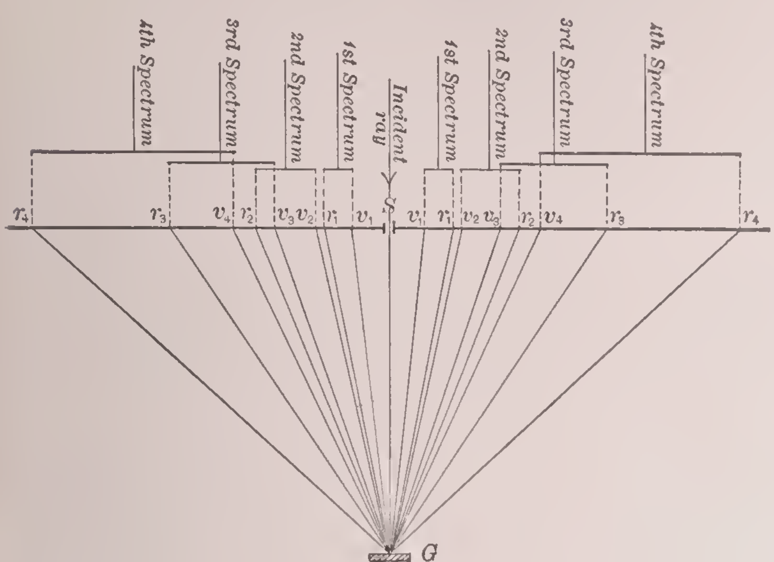



FIG 3

the article RULING-MACHINES (*q. v.*). If monochromatic light from the slit falls upon this ruled surface, it is sent back by reflection from the lines in all directions, in a plane perpendicular to the ruling and to the face of the mirror, and diffraction-bands are formed. These are alternately black and of the color of the light. The law of the position of the colored bands, which are distributed symmetrically with reference to a plane normal to the grating, parallel to the ruling and passing through the slit, is given by the equation

$$\text{Sin } \alpha_n = \frac{n\lambda}{a+b}.$$

In this formula $\alpha_n$ is the angle that the rays which go to form the $n$th band of the series make with the incident ray from the slit, $\lambda$ is the wave-length, while $n$ may be 1, 2, 3, or 4, etc., according to the number of the band which we are considering. The quantity $a + b$ is the distance from the edge of one line upon the grating to the corresponding edge of the next—$a$ being the width of the line, and $b$ the unruled space between it and the next line. The position of the bands with reference to the slit S and the grating G is shown in Fig. 3 ($r_1$ $r_2$ $r_3$, etc.).

If the light which enters the slit be violet instead of red, the diffraction bands will have positions nearer the slit ($v_1$ $v_2$ $v_3$, etc.). If white or other composite light be used overlapping diffraction images of the slit will be produced, and these will be so arranged with reference to each other as to form as a series of spectra on either side of the slit.

If, as in the discussion of the prismatic spectrum, we take $r_1$, etc., to represent the longest visible wave-length, and $v_1$, etc., the shortest, we shall have the intervening spaces in the diagram, viz., $v_1$ - - - $r_1$, $v_2$ - - - $r_2$, $v_3$ - - - $r_3$, etc., occupied by spectra. These are called for convenience spectra of the first, second, third, etc., order. It will be noticed that with the exception of the first and second all the spectra overlap.

The formula given above defines completely the position and character of the spectra produced by a grating. It will be seen, for example, that the distance out from the slit to the position occupied by any given wave-length, measured by the sine of the angle $\alpha$, is proportional to the wave-length. The violet end of the diffraction-spectrum is therefore always nearest the slit. The distribution of wave-lengths throughout the spectrum, moreover, is a uniform one, instead of varying as in prismatic spectra. It is on account of this property that the name *normal spectrum* is applied to a spectrum produced by means of a grating. It is obvious from the formula likewise that sin $\alpha$ for a given wave-length is directly proportional to the number of lines in a centimeter contained upon the grating, so that the dispersion is entirely a question of the fineness of the ruled surface.

*Advantages and Disadvantages of Diffraction-spectra.*—The chief advantage of the diffraction-spectrum lies in the simplicity of the law of distribution of wave-lengths. On this account it affords much the best means for the accurate measurement of wave-lengths. It is also a great advantage to be able to secure any desired degree of dispersion without recourse to the complication and inconvenience arising from the use of a train of prisms. On the other hand, the prismatic spectrum, by equal dispersion, is much more intense, since all the dispersed light goes to the formation of a single spectrum instead of a double series of spectra, and because the losses by reflection, etc., are much less important. Spectra furnished by gratings, moreover, show vagaries in the distribution of intensities, which depend in a complicated manner upon the nature of the ruling. Certain spectra will be very weak or altogether missing, others of abnormal brilliancy. Some spectra will be strong in a certain color and faint in others, etc. The consequence is that diffraction-spectra are ill fitted for use where the question of the relative intensity of the various wave-lengths of a source of light is to be determined.

*Classes of Spectra.*—Thus far those spectra have been considered in which all wave-lengths between the extreme red and the extreme violet are present. Such spectra are produced by the radiation from glowing solids or liquids; they are called *continuous spectra.*

Where the source of light is an incandescent vapor or gas, radiation is confined to one or more definite wave-lengths. Spectral images corresponding to these wave-lengths only are present in the spectrum, which consists of a group of bright lines, each possessing the color due to its particular wave-length. The intervals lying between are black. Such spectra are called *bright-line spectra.*

A third and very important class of spectra consists of those produced by the passage of light (which would otherwise form a continuous spectrum) through an absorbent medium. This medium may be a solid or liquid, or it may be a vapor. In accordance with the law of Kirchhoff, there is, however, a perfectly definite relation between radiation and absorbing power. Each material, in a word, absorbs the precise wave-length or wave-lengths which it is capable of radiating, and in the same proportion. Gases and vapors, therefore, cut out well-defined and perfectly monochromatic lines from the transmitted light, and thus produce what are called *dark-line spectra.* Solids and liquids, on the other hand, absorb selectively and continuously throughout extended regions, and the spectrum of the rays transmitted by them is crossed by dark transverse bands, varying in position and width and also in density and sharpness of definition according to the character of the medium. Frequently the absorption is such as to weaken or destroy one end of the spectrum instead of producing a band.

*Relation of Bright-line and Dark-line Spectra: the Fraunhofer Lines.*—When, in 1817, Fraunhofer made the first application of the narrow slit to the analysis of sunlight, he observed that the solar spectrum was crossed by numerous fine black lines. Repetition of the experiment showed him that these lines were always present, and that they were always in the same positions. Fraunhofer made a map of the spectrum in which he designated some of the lines alphabetically. It is by the letters which he assigned

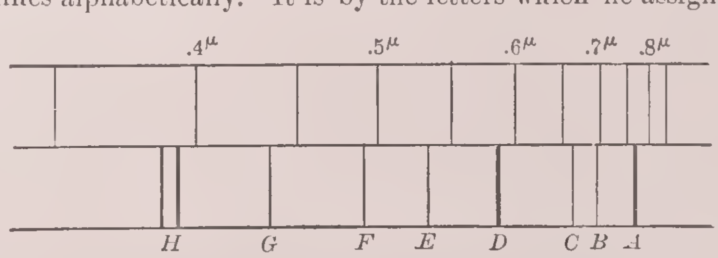



FIG. 4.

to them that they are still known. Fig. 4 shows the positions of a few of the most important Fraunhofer lines in the prismatic spectrum. The wave-lengths are given in the following table:

TABLE I.

Wave-lengths, in millionths of a meter, of the principal Fraunhofer lines. Rowland's values to four places.

| Line. | Wave-length. | Line. | Wave-length. |
|---|---|---|---|
| A | 0·7594μ | E | 0·5270μ |
| B | 0·6867 | F | 0·4861 |
| C | 0·6563 | G | 0·4308 |
| D | 0·5896 ($D_1$)<br>0·5890 ($D_2$) | H | 0·3968 ($H_1$)<br>0·3933 ($H_2$ or K) |

It was nearly half a century after Fraunhofer's observations before the cause of the dark lines in the solar spectrum was determined and their supreme importance in the science of spectroscopy was appreciated. In the meantime the bright-line spectra obtained from the burning vapors of various metals had been described, and finally, about the middle of the century, certain coincidences of position having been noticed, it began to be suspected that there was some connection between the two classes. Finally Kirchhoff and Bunsen in Heidelberg took the matter up, and by means of an exhaustive series of experiments demonstrated that the dark lines of Fraunhofer are produced by absorption, by the sun's atmosphere, and by that of the earth; also that the materials producing absorption in the sun's atmosphere are, in part at least, identical with those which go to form the crust of the earth. The proof is based in part upon the celebrated experiment of the reversal of the sodium lines, which consists essentially in placing in the path of the rays from any incandescent source of light which gives a continuous spectrum a layer of sodium vapor, the temperature of which is lower than that of the source. A favorite method of repeating the experiment for purposes of demonstration is as follows:

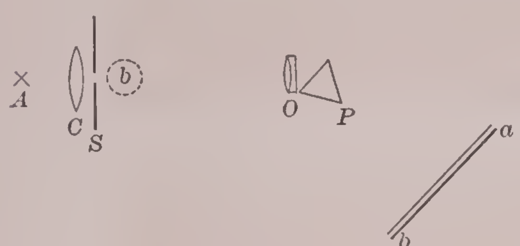


FIG. 5.

In front of an arc-lamp (A, Fig. 5) is placed a condensing lens (C), a vertical slit (S), an object-lens (O), and a prism (P). The lamp A should be tipped back so as give the bright continuous spectrum of the light from the crater of the upper carbon. Before the slit, at *b*, a Bunsen burner is placed, into the flame of which metallic sodium is introduced. The sodium vapor thus produced rises into the path of the ray from A and absorbs light of wave-lengths ·5890 and ·5896, to which rays it is opaque.

In the spectrum upon the screen *a b* two dark lines are formed, but these lie so close together that under ordinary conditions they are merged into a single heavy black band. By slight modifications of the apparatus it is possible to project upon the screen, one above another, spectra containing the bright line due to incandescent sodium, superimposed upon a continuous spectrum, and the artificially produced Fraunhofer line D, and thus to note the precise coincidence in the positions of the two. See Fig. 6.


FIG. 6.

The direct evidence of experiments like the above was supported by measurement of the position of thousands of dark lines in the solar spectrum and of the positions of the thousands of lines obtained by the incandescence of the various chemical elements. The comparison of the two showed the identity of many of the solar lines with those of well-known terrestrial substances. In the cases of metals possessing complicated-line spectra, such as iron, nickel, and calcium, the number of lines in coincidence was so great as to preclude all question of agreement by chance.

A most important example is afforded by the metal iron,

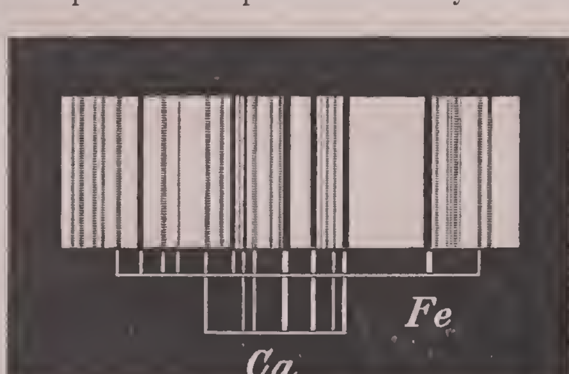


FIG. 7.

in the spectrum of the vapor of which hundreds of lines have been mapped and found to coincide with solar lines.

Kirchhoff and Bunsen explored the entire visible spectrum in the most painstaking and precise manner, measuring the position of thousands of lines in the spectrum of the sun and in those of the different elements. For this purpose they used a spectrometer with a train of four prisms. The results were mapped upon a large scale. Ångström and Thalén made a set of equally careful measurements, and produced maps agreeing well with that of the former observers. By the use of concave gratings and photographic plates Rowland has since been able to obtain absolute values of wave-lengths much more accurate than any hitherto made by the system of hand measurements, while Abney and also Cornu, likewise by photographic methods, have extended the spectrum map to regions lying far beyond the limits of visibility in the direction of the red and of the violet. Fig. 7 shows a small portion of the solar map (in the green), which contains lines due to the vapors of iron and of calcium. The coincidence of these with certain bright lines in the spectra of those metals is also indicated.

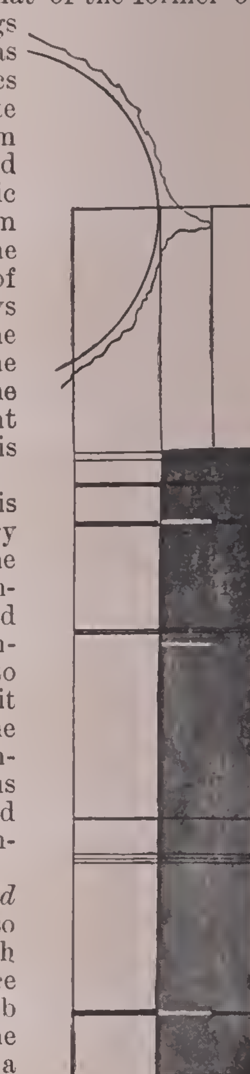
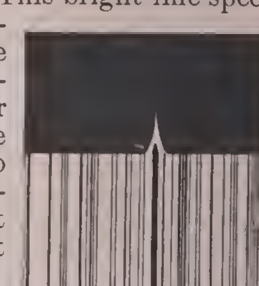


FIG. 8.

The application of spectrum analysis in astronomy has led to extraordinary extensions of our knowledge of the chemical constitution and physical condition of the sun, and even of fixed stars, comets, and nebulæ. The attachment of the spectroscopic eyepiece to the telescope, for example, has made it possible to explore the surface of the sun in detail with reference to its constitution. Only a few of the numerous striking and beautiful results obtained in this field of research can be mentioned here.

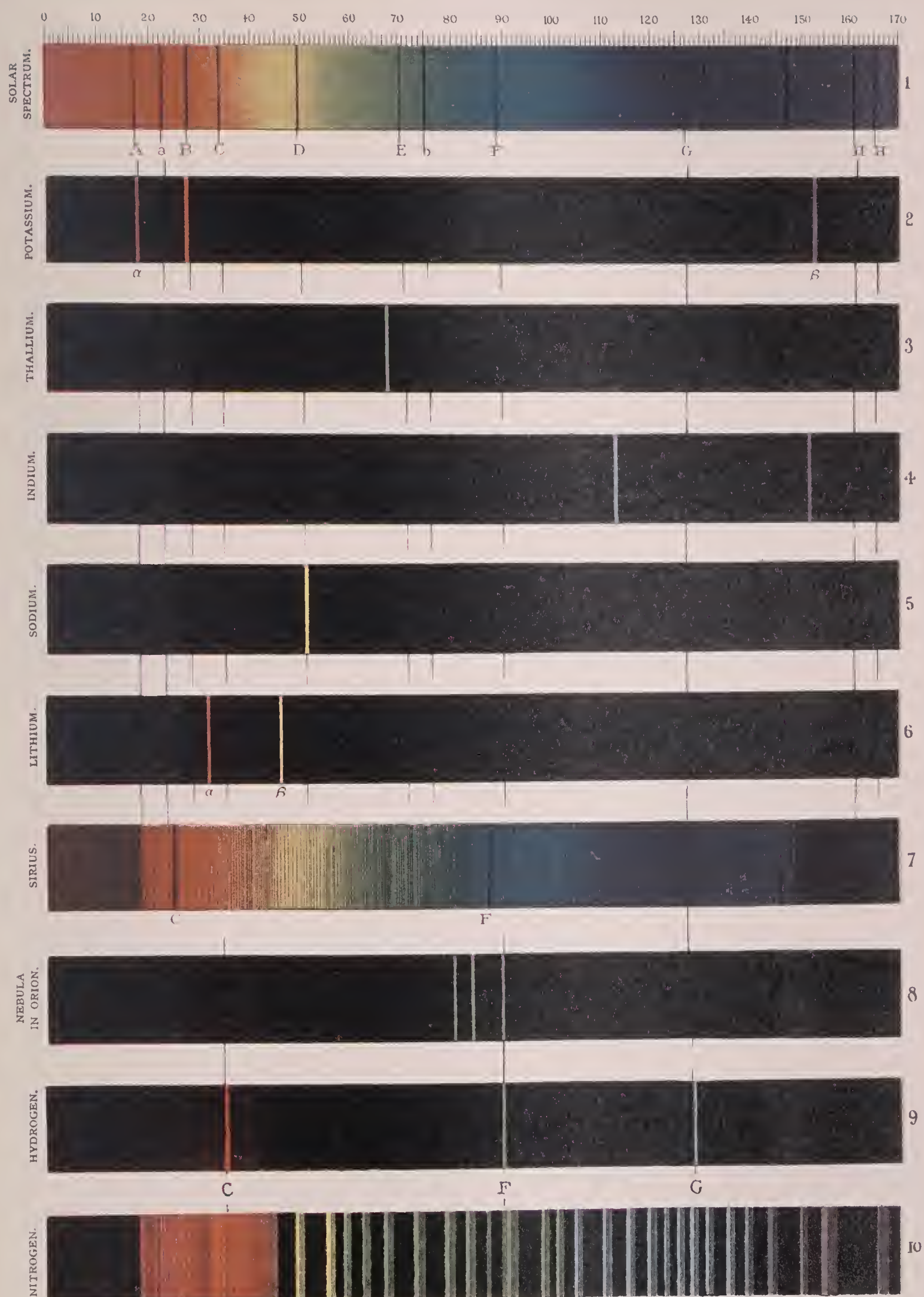
*Spectrum of the Chromosphere and Protuberances.*—If the telescope be so adjusted that the field of view, through the slit of the spectroscopic eyepiece (the slit being perpendicular to the limb of the sun), comprises a portion of the sun's face, the chromosphere, with a protuberance, and the sky lying beyond the limits of the latter, as shown in Fig. 8, a triple spectrum will be formed: (1) The spectrum of the photosphere, consisting of the continuous spectrum of the underlying molten constituents of the body of the sun, crossed by the black lines produced by passage through the cooler gases of the solar atmosphere; (2) the spectrum of the protuberance, which consists of the bright lines of hydrogen corresponding to C and F of Fraunhofer, and a bright line known as $D_3$. Until 1895 it was believed that this line had no counterpart among the lines of terrestrial elements, and it was accordingly ascribed to a hypothetical solar substance to which the name *helium* was given. In that year, however, the chemist Ramsay announced the discovery of the helium line in the spark discharge of a gas obtained from cleveite, a mineral found in Norway. This bright-line spectrum is superimposed upon a faint solar spectrum of the usual character, due to diffused or stray sunlight. (3) Diffused sunlight also fills the remainder of the slit, which otherwise would have for its field the blackness of space, so that beyond the limits of the chromosphere we can still distinguish the faint spectrum to which reference has just been made.


F
FIG. 9.

This method makes it possible to determine the height to which a given constituent of the chromosphere, such as hydrogen, rises above the limb of the sun, the pressures under which it exists, and even the motions which it undergoes.

The hydrogen-line (F), for example, seen through a narrow slit, the field of which extends across the limb of sun into and through the chromosphere, sometimes appears as in Fig. 9, the line being reversed at the limb and then dwindling to a point. This effect is indicative of the diminishing pressure. Frequently the reversed line of the chromosphere is distorted in a manner of which Fig. 10 is typical, and its displacement shows that the glowing gases are moving either

## TABLE OF THE SOLAR AND SOME OTHER SPECTRA.



toward the observer (when the displacement is to the violet) or away from him (when the displacement is toward the red). The same displacement of the lines in the spectra of fixed stars is used in computing the component of their velocity which lies in the line of sight.


Fig. 10.

*The spectra of nebulæ and comets* show for these bodies a gaseous constitution. Instead of a continuous spectrum with absorption lines, we find in the case of the former class two or three bright lines, ascribable to hydrogen and nitrogen. (See Fig. 11.) Comets also show bright bands which correspond in position to the groups of lines which constitute the spark spectrum of the hydrocarbons. See Fig. 12.

*Applications to Chemical Analysis.*—The fact that each metal when vaporized and heated emits light of certain definite wave-lengths affords an important means of detecting its presence. The method is used chiefly for the determination of the alkaline metals and the metals of the alkaline earths, since these almost without exception can be made to give their characteristic colors at the temperature of the Bunsen flame. For such purposes a one-prism spectroscope with an arbitrary scale is commonly used, and the bright lines are mapped with reference to that scale. No accurate determination of wave-lengths is necessary, since the object is simply to recognize the existence of certain well-defined lines, or groups of lines, and to distinguish them from one another. Fig. 13 shows the grouping of lines in the prismatic spectra of the most important of the above-mentioned classes of metals.

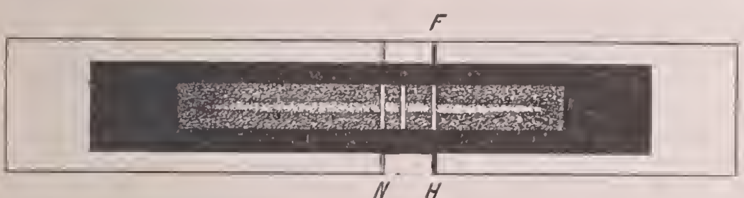



Fig. 11.

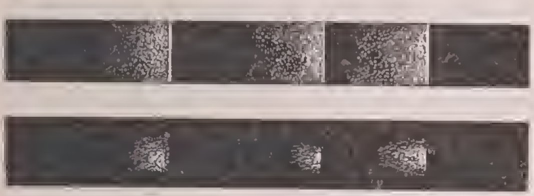


Fig. 12.

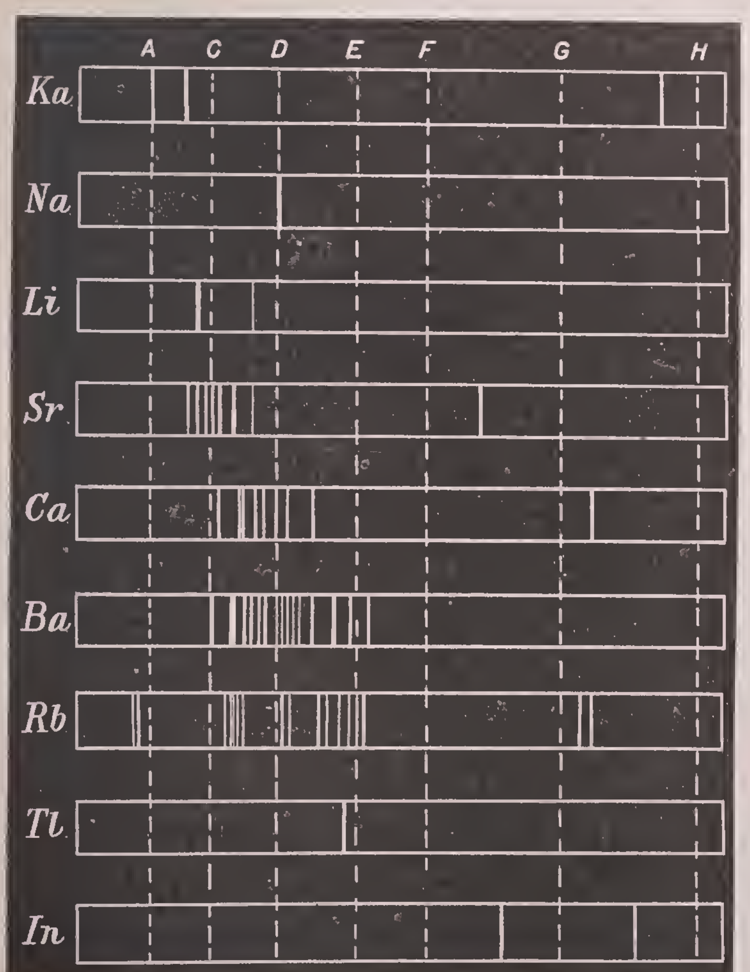



Fig. 13.

Spectrum analysis by means of the bright lines of the elements is a qualitative method of the greatest delicacy.

In the case of the metals easily volatilized in the Bunsen burner it is possible, according to the determinations of Kirchhoff and Bunsen, and of Simmler, of Cappel, and others (see Kayser, *Lehrbuch der Spektral Analyse*, p. 88), to detect the following minute quantities:

TABLE II.

| Metal. | Amount detected, grammes. | Metal. | Amount detected, grammes. |
|---|---|---|---|
| Caesium | $4{\cdot}00\times10^{-8}$ | Strontium | $3{\cdot}33\times10^{-8}$ |
| Rubidium | $1{\cdot}43\times10^{-7}$ | Calcium | $2{\cdot}00\times10^{-8}$ |
| Potassium | $3{\cdot}33\times10^{-7}$ | Manganese | $1{\cdot}2\times10^{-5}$ |
| Sodium | $7{\cdot}16\times10^{-11}$ | Indium | $5{\cdot}00\times10^{-7}$ |
| Lithium | $1{\cdot}66\times10^{-9}$ | Thallium | $2{\cdot}00\times10^{-8}$ |
| Barium | $5{\cdot}00\times10^{-7}$ | Copper | $3{\cdot}5\times10^{-6}$ |

The spectrum of the metals depends to a great extent upon the temperature of the incandescent vapor. Heating does not shift the position of the lines, but it increases their brilliancy and brings into view new ones, which had been too weak to be seen in the spectrum of the cooler vapor. Sodium, for example, which in the Bunsen flame shows only the well-known double line D, has been found by Liveing and Dewar to possess at higher temperatures at least seven other pairs of lines distributed throughout the spectrum from red to violet. A convenient method of getting high-temperature spectra consists in volatilizing the metals in the electric spark. In this way the brilliancy of the spectrum is enhanced, and new metals, too refractory for vaporization at flame-temperatures, are made amenable to the methods of spectrum analysis. The delicacy of the method of the spark-spectrum, in the case of various metals, many of which give no line-spectrum whatever in the Bunsen flame, is given in table III.

TABLE III.

| Metal. | Amount detected, grammes. | Metal. | Amount detected, grammes. |
|---|---|---|---|
| Caesium | $2{\cdot}5\times10^{-7}$ | Cobalt | $6{\cdot}66\times10^{-8}$ |
| Rubidium | $1{\cdot}00\times10^{-6}$ | Nickel | $1{\cdot}66\times10^{-6}$ |
| Potassium | $2{\cdot}5\times10^{-6}$ | Iron | $3{\cdot}84\times10^{-8}$ |
| Lithium | $2{\cdot}5\times10^{-11}$ | Thallium | $1{\cdot}25\times10^{-11}$ |
| Barium | $1{\cdot}11\times10^{-9}$ | Cadmium | $5{\cdot}55\times10^{-8}$ |
| Strontium | $1{\cdot}00\times10^{-11}$ | Lead | $5{\cdot}00\times10^{-8}$ |
| Calcium | $1{\cdot}00\times10^{-10}$ | Bismuth | $1{\cdot}43\times10^{-8}$ |
| Magnesium | $2{\cdot}00\times10^{-9}$ | Copper | $5{\cdot}00\times10^{-8}$ |
| Chromium | $2{\cdot}5\times10^{-10}$ | Silver | $8{\cdot}33\times10^{-8}$ |
| Manganese | $5{\cdot}00\times10^{-9}$ | Mercury | $1{\cdot}00\times10^{-7}$ |
| Zinc | $1{\cdot}66\times10^{-9}$ | Gold | $2{\cdot}50\times10^{-7}$ |
| Indium | $1{\cdot}11\times10^{-8}$ | Tin | $5{\cdot}88\times10^{-8}$ |

*Absorption Phenomena by Transmission through Solids and Liquids.*—Spectrum analysis is not confined to the detection of elements by means of the bright lines of their emission spectra and the corresponding black lines in the spectra of the sun and stars. It makes use also of the selective absorption which light suffers when transmitted through various solids and solutions. In cases in which the absorption is confined to certain definite regions dark bands are formed, the position of which indicates the character of the absorbing medium, while the density and width of the bands enables the experimenter to estimate the strength of the solution with considerable accuracy. Well-known cases are those of chlorophyl and blood, the spectra of which are shown in Fig. 14. Cerium, didymium, and other of the

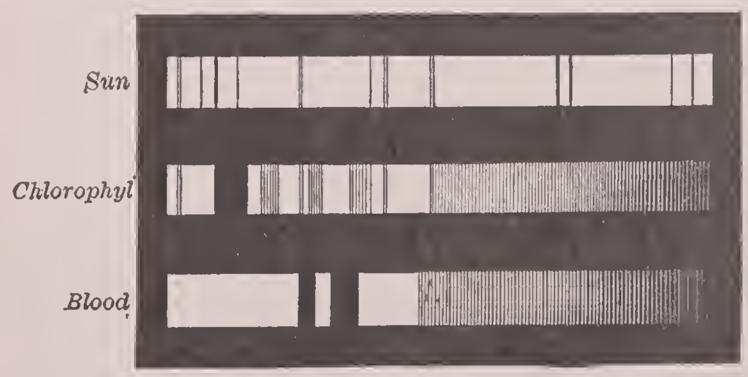



Fig. 14.

rare earths lend themselves peculiarly to this method, on account of the sharpness of their bands. (See Fig. 15.) When

Fig. 15.—Absorption bands due to didymium.

small dispersion is used some of the narrower bands might easily be mistaken for true Fraunhofer lines, but higher dispersion shows them in their true character.

Even when no sharply marked bands are produced a spectrophotometric study of the absorption spectrum often

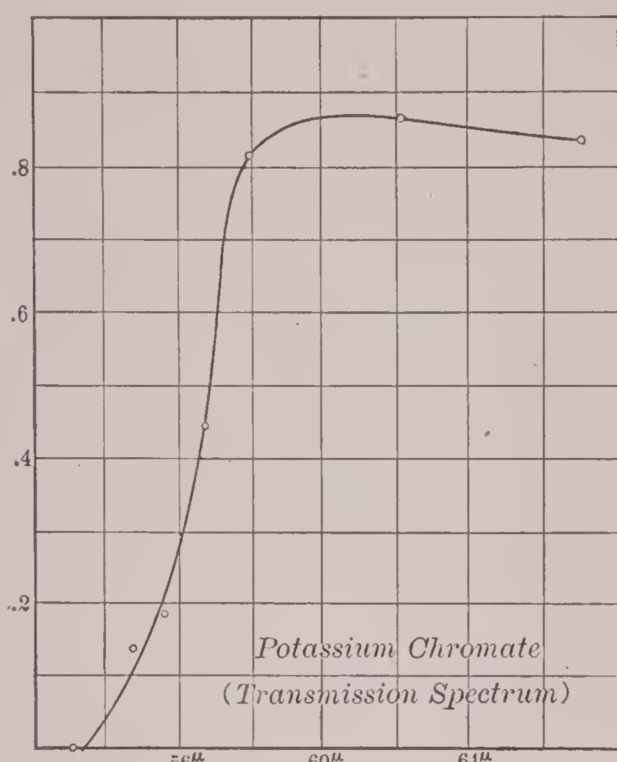



Fig. 16.

affords definite information concerning the character of the transmitting medium. A solution of potassium chromate, for example, submitted to measurement gave the curve of brightness shown in Fig. 16, in which abscissas are wave-lengths and ordinates are percentages of light transmitted. Pigments, viewed by reflected light, give spectra, likewise capable of spectrophotometric analysis and characteristic of the chromatic properties of the material. Figs. 17 *a* and 17 *b* will serve to illustrate this method of expressing or defining the color of a pigment. The curves refer to sulphur, mercuric sulphide, chromic oxide, and artificial ultramarine. Abscissas are wave-lengths and ordinates are intensitives in terms of the intensity of an ideal white substance, which is defined as reflecting all visible wave-lengths as magnesium oxide reflects light of the wave-length ·59μ. For the details of the methods by which these results were obtained, see *Philosophical Magazine* (5), vol. xxxii., p. 405; also vol. xxxiii., p. 19.

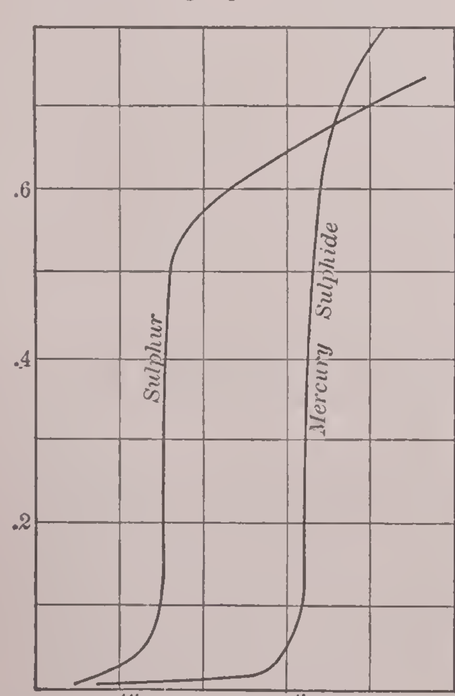



Fig. 17 *a*.

Similarly, by observation of the spectrum of a glowing body at different stages of incandescence and comparison of the same, wave-length by wave-length, with the spectrum of a standard lamp, the development of radiation with rise of temperature can be definitely determined. Fig. 18 shows the results of such an investigation of the spectrum of platinum between 700° C. and 1,000° C. The ordinates are ratios of the brightness of the platinum spectrum to that of the standard lamp, which was an electric glow-lamp maintained as nearly as possible at a temperature of incandescence corresponding to that of a luminous gas-flame. The adjustment was such that the brightness of the platinum spectrum at 1,000°, wave-length ·59μ, was equal to that of the corresponding wave-length in the spectrum of the standard.

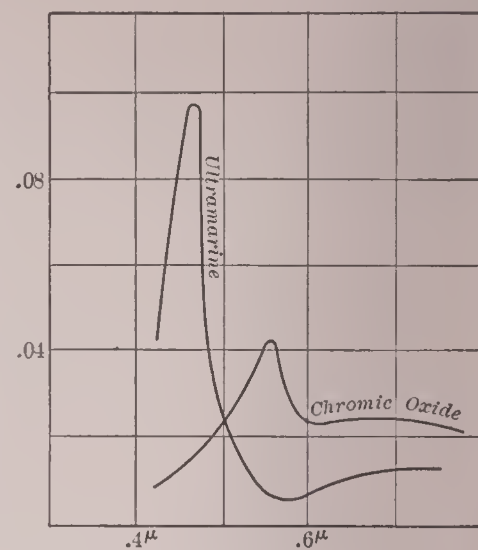



Fig. 17 *b*.

*Invisible Parts of the Spectrum (the Infra-red and Ultra-violet).*—When a spectrum is produced by refraction or diffraction, the only rays capable of affecting the retina lie between wave-lengths ·39μ and ·76μ. Rays of wave-lengths both longer and shorter than the above are present, however, and these constitute the *invisible spectrum.* Waves greater than ·76μ find positions lying beyond the extreme limit of the red. They form what is termed the region of the *infra-red.* Waves shorter than ·39μ are all more strongly refracted than the rays of the visible spectrum. They lie beyond the limits of the violet and constitute the *ultra-violet* spectrum.

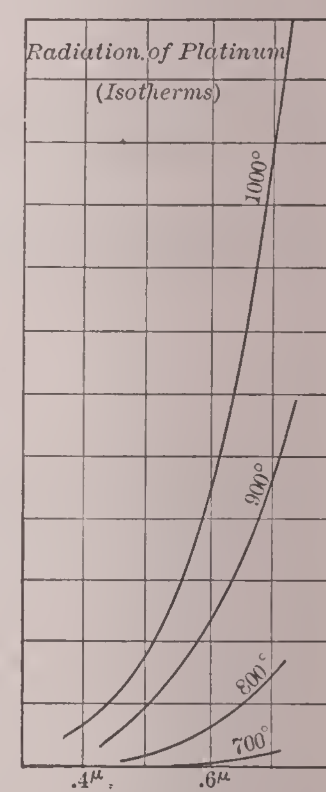



Fig. 18.

In the investigation of these invisible rays indirect methods have to be used. For the infra-red the rays may be allowed to fall upon some surface which becomes luminescent (phosphorescent) under their action. This is the method used by Draper, by Becquerel, and by Lommel and others.

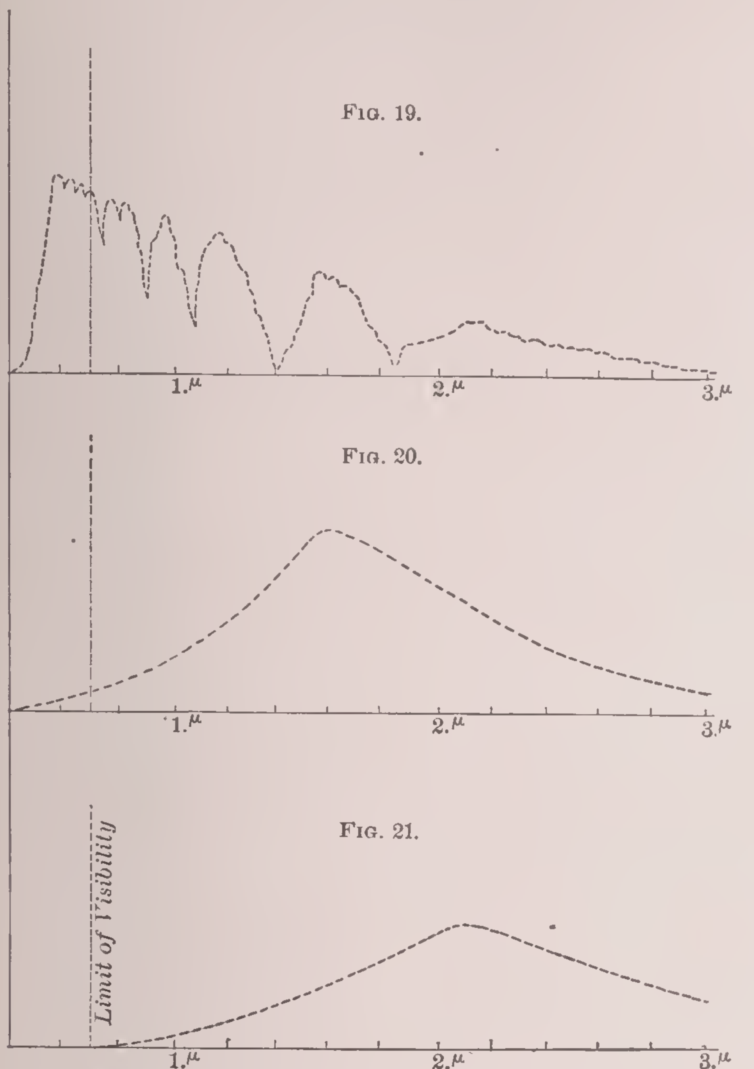
The result of this process is to cause those portions of the luminescent surface upon which the infra-red rays fall to shine, while the other portions remain dark. In this way the intenser portions of the infra-red spectrum can be explored, and if the law of the dispersion apparatus is known they can be mapped.

It is possible also, as has been shown by Abney, to obtain photographic plates which are sensitive to long wave-lengths, and by the use of these to photograph a considerable portion of the infra-red spectrum.

The most complete method of studying the invisible regions beyond the red consists in measuring the intensity of the rays directly by means of their heating effect. For this purpose Fizeau and Foucault used thermometers; Lamansky, Mouton, Dessains, Nichols, and others the linear thermopile; Langley, Ångström, Snow, Paschen, and many other observers the bolometer.

By these various methods it is known that the region of the infra-red is similar to the visible region of the spectrum in nearly every particular, but that it comprises a very much greater range of wave-lengths. While the visible spectrum is all included within about an octave, the bolometer gives evidence of waves more than ten times as long as the longest visible ray. If the spectrum of an incandescent solid be explored by means of thermopile or bolometer, the infra-red spectrum will be found to be continuous, the intensities rising to a maximum in some region, the wave-length of which depends upon the temperature of the source. See Fig. 20, which gives Langley's curve of intensities in the spectrum of a luminous gas-flame.

If the source have a temperature below the red heat an infra-red spectrum will still be found to exist, the intensities of which are all less and the maximum in a region of greater wave-length. The curve of intensities, moreover, will disappear on the side toward the red, before the boundary of the visible spectrum is reached. See Fig. 21.




FIGS. 19, 20, and 21, showing the curves of intensities of sunlight, of gas flame, and of a solid below red heat, respectively.

If the source be sunlight we find its spectrum crossed by dark lines and also by bands due to absorption on the part of the atmosphere of the earth. The curve then appears as in Fig. 19, which is also from measurements by Langley.

If the source be a metallic vapor the bolometer indicates the extension of a bright-line spectrum characteristic of that metal throughout the infra-red. Fig. 22 is a diagram giving the results of bolometric exploration of the spectrum of potassium, made by Snow. Abscissas are wave-lengths and

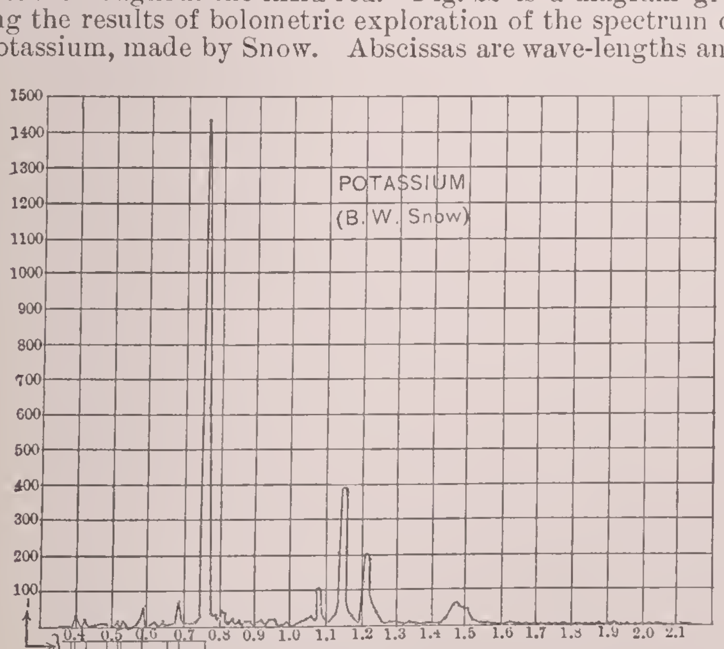



FIG. 22.

ordinates are intensities. It will be seen that there are three bright lines between 1·0μ and 1·3μ, and probably a group of lines, which could not be resolved by means of the bolometer, in the region 1·5μ.

In the ultra-violet region of the spectrum the intensity of radiation is too small to admit of the general use of bolometric measurements. These shorter wave-lengths are, however, readily studied by photography, and they can also be rendered visible by the use of a luminescent (fluorescent) substance, as has been shown by H. Becquerel, Soret, and others. Among the materials which give back visible rays when exposed to the action of the ultra-violet are chlorophyll solution, petroleum, various coal-tar dyes in solution; also uranium-glass and some sorts of fluor-spar. See FLUORESCENCE.

Of the two methods, the photographic is by far the more complete and satisfactory. By means of the sensitive plate and the concave grating, maps giving every detail may be obtained. If the apparatus be of such a character that the rays pass through glass, the spectrum will seem to come to an end in the neighborhood of ·32μ, because glass becomes opaque to still shorter wave-lengths. If quartz lenses be substituted, or if concave mirrors be used instead of lenses, the map can be extended even further beyond the violet.

The results of investigations in the ultra-violet, as in the case of those upon the infra-red of the spectrum, show that no sudden changes take place as we pass beyond the limit of visibility. Sunlight, in the ultra-violet, still shows a continuous spectrum crossed by a multitude of dark lines; glowing vapors, such as those of the electric arc, show groups of lines which to an eye capable of vision in such rays would constitute a bright-line spectrum of the usual type.

See, further, article SPECTROSCOPE; also Schellen, *Spectrum Analysis*; Roscoe, *Lectures on Spectrum Analysis*; and the works of Lockyer, Huggins, Langley, Vogel, K. Ångström, Abney, H. Becquerel, Soret, etc. E. L. NICHOLS.

**Spectrum Analysis**: See SPECTROSCOPE and SPECTRUM.

**Speculation**: See POLITICAL ECONOMY.

**Spec'ulum** [Lat., mirror]: in optics and astronomy, a reflecting surface, usually of metal, though the term has also been frequently applied to unsilvered glass since the introduction of silvered-glass telescopes by Foucault and Steinheil in 1857. See TELESCOPE.

**Spedding**, JAMES: scholar; b. near Bassenthwaite, Cumberland, England, in June, 1808. He studied at Trinity College, Cambridge, of which college he was afterward made an honorary fellow; graduated in 1831. His life-work was the study and exposition of Bacon, begun by a pitiless exposure of Macaulay's showy and inaccurate essay on Bacon, *Evenings with a Reviewer* (privately printed in 1848 and reissued in 1882). His great edition of the *Works of Francis Bacon* was published in 7 vols. in 1857–59. In this he was assisted by R. L. Ellis and D. D. Heath. In 1870–76 he published a *Life and Letters of Francis Bacon*, including all his occasional writings, also in 7 vols.; and in 1878 *Life and Times of Francis Bacon* (2 vols.). Besides his work on Bacon he was the author of *Publishers and Authors* (1867) and *Reviews and Discussions* (1869). D. in London, Mar. 9, 1881. H. A. BEERS.

**Speech**: See LANGUAGE and ACOUSTICS (*The Voice*).

**Speed**, JAMES: lawyer; b. in Jefferson co., Ky., Mar. 11, 1812; graduated at St. Joseph's College 1828; studied law at Transylvania University; began its practice at Louisville 1833; was a member of the Legislature in 1847, State Senator 1861, U. S. Attorney-General Nov., 1864–July, 1866, and in the same year was chosen president of the Philadelphia Loyalists' convention; was Professor of Law in the University of Louisville. D. at Louisville, Ky., June 25, 1887.

**Speed**, JOHN: antiquary; b. at Farrington, Cheshire, England, in 1542; was a tailor in London until late in life, but at the same time was amassing an extensive knowledge of English antiquities, and was enabled by Sir Fulke Greville to publish a costly and valuable series of works. He published anonymously about 1590 a treatise on the *Genealogies of the Scriptures*, afterward prefixed to the first edition of King James's Bible (1611), but his first appearance as an author was in 1608, when he printed fifty-four maps of various counties and cities, and engravings of antiquities of England and Wales, which were incorporated into *The Theatre of the Empire of Great Britain* (folio, 1611). In the same year he published his *History of Great Britain under the Conquests of the Romans, Saxons, Danes, and Normans*. D. in London, July 28, 1629.

**Speedwell**: a plant of the genus *Veronica* of the family *Scrophulariaceæ*. The species are very numerous, comprising annual and perennial herbaceous plants and small shrubs, natives of temperate and cold climates in all parts of the globe, some of them growing in wet ditches or in marshes, others on the driest soils, but all having very beautiful blue, white, or pink flowers. Revised by CHARLES E. BESSEY.

**Speer**, WILLIAM: See the Appendix.

**Speichern**, or **Spichern**: See SAARBRÜCKEN.

**Speier**: See SPEYER.

**Speke**, JOHN HANNING: explorer; b. at Jordans, Somersetshire, England, May 4, 1827; entered the army in 1841; served in India and in the Crimean war; accompanied Capt. Richard F. Burton in the expedition which resulted in the discovery of the great lakes of Central Africa, and afterward was at the head of another expedition (with Capt. Grant) which discovered the connection of the Nile with those lakes. Capt. Speke published a *Journal of the Discovery of the Source of the Nile* (1863), and *What Led to the Discovery of the Source of the Nile* (1864); received gold medals from the geographical societies of France (1860) and England (1861), and from the King of Italy; and was engaged after his second expedition in a bitter controversy with Capt. Burton as to the merits of their respective discoveries. He accidentally shot himself near Bath, Sept. 15, 1864, and died on the same day.

**Spelman**, Sir HENRY: antiquary; b. at Congham, Norfolk, England, in 1562; graduated at Cambridge about 1580; studied law at Lincoln's Inn, but devoted himself chiefly to archæology; was in 1604 high sheriff of Norfolk; was employed by James I. upon important commissions; was knighted about 1612, in which year he withdrew from public business and settled in London; published his treatise *De Non Temerandis Ecclesiis; of the Rights and Respects due to Churches* (1613). D. in London in 1641, and, by special order of Charles I., was buried in Westminster Abbey, near the monument of Camden. Vol. i. of his *Glossarium Archæologicum*, extending to the letter L, was published 1626; vol. ii., completed by his son, Sir John, and by William Dugdale, appeared in 1664, and the whole work was issued in a single folio volume in 1687. Vol. i. of the *Concilia* was issued in 1639: vol. ii., chiefly by Dugdale, in 1664. The *Reliquiæ Spelmannianæ* (Oxford, folio, 1698), with a *Life*, was edited by Bishop Edmund Gibson.—His son, Sir JOHN, was knighted 1641 "in consideration of his father's good services both to Church and state," and was made master of Sutton's Hospital. He edited the *Saxon Psalter* (1641) and a *Life of Alfred the Great* (Lat. trans. 1678; Eng. original edited by Thomas Hearne, 1709). D. at Oxford, July 25, 1643.—EDWARD SPELMAN, a great-grandson of Sir Henry, published an elegant translation of Xenophon's *Anabasis* (1742) and of the *Roman Antiquities* of Dionysius Halicarnassus (4 vols. 4to, 1758). D. in Norfolk in 1767.

**Spelt** [O. Eng. *spelt*, from Lat. *spel'ta*, spelt]: the *Triticum spelta*, probably the *far* of the ancient Romans and the *zea* of the Greeks; a grain somewhat resembling wheat, but distinct from it. It can be grown on poorer soils than those which are required for wheat. It is much raised in parts of Europe, and crops of it are occasionally seen in the U. S., as in Virginia. In quality it is much inferior to wheat. *T. bengalense* is raised in India. Lesser spelt, or St. Peter's corn (*Triticum monococcum*), called also one-grained wheat, is raised to some extent on poor soils in Europe.

**Spelter**: commercial name for pig or block ZINC (*q. v.*).

**Spence**, HENRY D. M.: See the Appendix.

**Spencer**: city; capital of Owen co., Ind.; on the White river, and the Penn. Railroad; 52 miles S. W. of Indianapolis (for location, see map of Indiana, ref. 8–C). It is in an agricultural, stock-raising, and lumbering region; has valuable building-stone quarries, block and cannel coal mines, woolen, flour, saw, and planing mills, machine-shops, and pork-packing house; and contains a State bank with capital of $50,000, a private bank, and two weekly newspapers. Pop. (1880) 1,655; (1890) 1,868; (1900) 2,026.

**Spencer**: town; capital of Clay co., Ia.; on the Little Sioux river, and the Chi., Mil. and St. P. Railway; 80 miles N. W. of Fort Dodge (for location, see map of Iowa, ref. 2–E). It is in an agricultural and stock-raising region, and contains a national bank with capital of $100,000, a State bank with capital of $25,000, 2 private banks, and 3 weekly newspapers. Pop. (1880) 1,392; (1890) 1,813; (1900) 3,095.

**Spencer**: town; Worcester co., Mass.; on the Boston and Albany Railroad; 11 miles S. W. of Worcester, one of the county-seats (for location, see map of Massachusetts, ref. 3–F). It contains a public high school, the Richard Sugden Public Library (founded in 1857), electric railway, a national bank with capital of $150,000, a savings-bank, and three weekly newspapers. The principal industries are the manufacture of shoes and wire. Here, it is claimed, is the largest shoe-factory in the world. Spencer was originally in the grant of Leicester; was made the West Parish of Leicester in 1744; incorporated as a town under its present name in 1753; and its first church was organized in 1744. Pop. (1880) 7,466; (1890) 8,747; (1900) 7,627. EDITOR OF "LEADER."

**Spencer**, HERBERT: philosopher; b. in Derby, England, Apr. 27, 1820; was an only surviving child. His father and grandfather were teachers. Of delicate health in boyhood, he was subjected to little outside pressure, his father, a man of strong character, more than usual breadth of culture, and original views, supervising his early education, but leaving him very much to himself. At the age of thirteen he was sent to study with an uncle, the Rev. Thomas Spencer, a liberal clergyman and a scholar, at that time perpetual curate of Hinton Charterhouse, near Bath. Here he remained three years, carrying on the study of natural history, begun in early childhood under his father's encouragement, and devoting himself to mathematics, where the originality of his mind was strikingly shown by the development of a taste and capacity for working out original problems. He then, too, became familiar with physical and chemical operations, his intellectual bias being strongly in the direction of experimental inquiry and original research. Deciding, in opposition to his uncle's wishes, not to prepare himself for a university career, he returned to Derby, where he was busied for a short time with inventions and miscellaneous study, and, after a brief interval of teaching, in 1837 entered the office of Sir Charles Fox, and began work as a civil engineer. After this he was engaged for several years on railways, devoting his spare time to scientific experiments and studies, and to occasional contributions to *The Civil Engineer and Architect's Journal*. The first indication of his awakening interest in other directions was given in 1842 by the publication in *The Nonconformist* of a series of letters on *The Proper Sphere of Government*. These were reprinted in pamphlet form during the following year, and are interesting as containing, in crude form, the first suggestions of many opinions on social questions afterward so fully developed in his maturer works. Growing discouraged with the prospects of his profession, he presently gave up engineering work and moved to London, where he secured a position on the staff of *The Economist* newspaper, of which in 1848 he became sub-editor. In 1850 he published his first considerable work, *Social Statics*, which was largely a development in more scientific form of the ethical and sociological ideas contained in his letters on government. The work was a treatise on social science, based upon the conception of the evolution of society through the operation of natural laws; and, though Spencer afterward grew dissatisfied with its metaphysical implications, it excited widespread interest at the time on account of its original and advanced views. He then devoted himself to literary work, contributing elaborate articles on a large variety of subjects to the leading English reviews. But though the subject-matter of his work led him into widely diversified fields of knowledge and inquiry, his course of thought was systematic; and the numerous masterly essays which he published from 1852 to 1860 were mainly devoted to the elaboration and application to various important questions of the principle of evolution. These papers reappeared in the U. S. in the collections entitled *Illustrations of Universal Progress*; *Essays, Moral, Political, and Æsthetic*; *Education, Intellectual, Moral, and Physical*; and *Recent Discussions in Science, Philosophy, and Morals.* In 1855 Spencer published a very able and original work entitled *The Principles of Psychology*, pronounced by J. S. Mill to be "the finest example we possess of the psychological method in its full power." In this work (afterward included in his larger treatise on the same subject) the doctrine of evolution was applied to the science of mind. Life is conceived as "the definite combination of heterogeneous changes, both simultaneous and successive, in correspondence with external coexistences and sequences"; and the ground taken is therefore that mental faculties throughout the whole scale of animal life, from lowest to highest, have been developed by experience through the intercourse of organisms with their environment, the principles of variation and heredity being marked out as the causes of the slow modifications which have taken place during vast periods of time. The work was so profound in exposition, and so greatly in advance of the thought of the day, that it produced but little public impression. Spencer had grasped the conception of evolution in its broad relations, and in 1858, while engaged on an essay on the nebular hypothesis, he reached the conclusion that it is a universal process, dependent upon the laws of matter and force, conformed to by all orders of phenomena, and capable of being resolved and formulated. Being the great principle or law of the successive changes of phenomena, involving the unfolding and (on its obverse side and as its necessary corollary) the dissolution of all things, it seemed to offer the basis of a philosophy of nature from the genetic point of view—understanding by the term "philosophy" the completest unification of positive knowledge by universal principles. In other words, the conception of evolution presented itself to him as the basis of a system of thought under which was to be generalized the complete history of the knowable universe, and by virtue of which all branches of scientific knowledge were to be unified by affiliation upon the primal laws underlying them all. Though a rough sketch of the main outlines of the system, as they occurred to him at the time, was mapped out almost immediately, it was not till the following year, 1859 (a year otherwise memorable for the publication of Darwin's *Origin of Species*), that a detailed plan of the various connected works in which these conceptions were to be developed was finally drawn up, and not till 1860 that it was given to the small handful of readers interested in such subjects in the form of a prospectus. This prospectus contained a complete outline of the ten volumes which were to be devoted to the carrying out of the task, and brief comparison of the analysis there given with the works themselves, so far as they have been issued, will show how clearly he must have had the whole vast scheme sketched out in his mind, down to the minutest details, before he set himself to the penning of a single line. To the prosecution of this great enterprise the major part of the energies of his life has from that time forth been devoted, and the *System of Synthetic Philosophy* has been actually brought within measurable distance of completion. Blanks have been left in the sociological divisions, and will probably never be altogether filled up; but save for these lacunæ the work stands in practically finished form. The introductory volume of the series, *First Principles*, was published in 1862, and was concerned with the establishment of those first or foundation principles which, there classed together in their most general and abstract statements, were in subsequent volumes to be worked out through the special phenomena of biology, psychology, sociology, and ethics. The initial task was to define the limits of philosophy, and this is done by the postulation of two categories, the unknowable and the knowable, to the former of which is relegated the absolute, infinite, or unconditioned, and all that pertains thereto, while the latter is seen to include the relative, finite, or conditioned, which alone constitutes the sphere and subject-matter of philosophy properly so called. In this way Spencer aimed to clear the field of his inquiry of what he deemed to be the fruitless speculations of metaphysics, so that his proper work might be coextensive with the sphere of science and strictly conform to its methods. Yet, while confining his attention within the limits of the phenomenal universe, Spencer shows that by the very terms of its cognitions the mind can not escape the consciousness of an unknowable power, of which all phenomena are manifestations, and which remains the ultimate and unresolvable basis of consciousness, though, from the nature of human intelligence, it can be neither grasped nor understood. Covering these preliminary considerations in the space of something over 100 pages, *First Principles* proceeds to deal with the foundations of the scheme; and here the law of evolution is broadly worked out and formulated in terms of matter and motion, or rather in terms of force, into which our conceptions of matter and motion alike are shown to be in the last analysis resolvable. These, as legitimate concepts of science, furnish a proper basis for a superstructure of philosophy. All the "phenomena of the universe," from their great features down to their minutest details, are necessary results of the persistence of force under its forms of matter and motion. This persistence of force gives rise "throughout the universe in general and detail," to unceasing redistributions of matter and motion; and these redistributions constitute evolution "where there is a predominant integration of matter and dissipation of motion," and dissolution "where there is a predominant absorption of motion and disintegration of matter." The rhythm thus set up by these changes and counterchanges "is, so far as we can see, universal and eternal, each alternate phase of the process predominating now in this region of space and now in that, as local conditions determine"; the tendency in that portion of the universe with which we are acquainted being now in the direction of evolution. There is thus reached the famous definition of evolution as "a change from an indefinite, incoherent, homogeneity to a definite, coherent, heterogeneity, accompanying the dissipation of motion and integration of matter" (or, as the earlier statement read, "through continuous differentiations and integrations"). This formula sums up and covers all the processes of development in nature and in mind (in other words, all changes along what we should call the ascending scale as contradistinguished from the descending scale of dissolution), from the unrolling of a planetary system to the sprouting of a wayside flower, and from the genesis of intelligence to the latest variations of social life. These first principles being thus laid down in their broadest and most abstract statements, Spencer proceeded to the task of working them out in greater detail through all the varied phenomena presented by the universe at large. First in order should properly have come the application of such principles to inorganic nature, but this great division was passed over entirely, partly (to quote his own words) because "even without it the scheme is too extensive, and partly because the interpretation of organic nature after the proposed method is of more immediate importance." Spencer therefore at once went to work upon the *Principles of Biology*, which he completed in two volumes in 1867. Here the principles of evolution are traced out through the phenomena of life and the laws of organization, one of the most profound and noteworthy parts being that dealing with the "laws of multiplication," and the inferences to be deduced from them in regard to the "multiplication of the human race" and "human evolution in the future." This leads forward insensibly (since we know intelligence only as a concomitant of organization) into the region of psychology; and in 1872 Spencer published *The Principles of Psychology*, also in two volumes. This new work was based upon the treatise of 1855, but embraced many important modifications and extensions to which he had been led by his subsequent studies. It is an elaborate exposition of mental science grounded on biology and interpenetrated everywhere by the doctrines of evolution; and in it, in the opinion of many good judges, Spencer's powers as a thinker and writer reached their culminating point. The fourth division of the system, *The Principles of Sociology*, outlined to occupy three volumes, was completed in Nov., 1896. The first volume, of great bulk, comprising the *Data* and the *Inductions of Sociology*, and a consideration of domestic relations, was finished in 1876; and this was followed at irregular intervals by parts iv., v., and vi., treating of *Ceremonial Institutions*, *Political Institutions*, and *Ecclesiastical Institutions*, all from the standpoint of evolution. But meanwhile, led by increasing ill health to fear lest persistence in the order sketched out in the original prospectus might result in the final and most important portion of the work—*The Principles of Ethics*—being left untouched altogether, Spencer decided to drop the uncompleted part of the *Sociology*, and to devote what remained of life and energy to carrying his principles forward as far as possible into the region of ethics. As a result of this determination appeared in 1879 the first installment of the proposed *Principles of Morality*, *The Data of Ethics*, which, as the first systematic attempt to place ethical questions upon the new basis of evolution, merits the closest attention. This was followed in 1891 by part iv., on *Justice*, a little work dealing with some of the most important issues at present under discussion; in 1892, by parts iii. and iv., the *Inductions of Ethics*, and the *Ethics of Individual Life*; and in 1893 by parts v. and vi., on negative and positive beneficence: the treatise on morality being thus completed in two volumes. The volumes comprising the *Synthetic Philosophy*, vast as is the labor which they represent, do not exhaust the list of Spencer's works. In 1872 appeared, in the International Scientific Series, his delightful little introductory treatise on *The Study of Sociology*; and in preparation for his work in that subject, he also supervised the publication of the *Descriptive Sociology*—an immense cyclopædia of facts designed to exhibit the characters of human societies of all types and in every stage of development. Eight out of the proposed eighteen parts of this were produced, and then, owing to the enormous expense incurred and the scanty public support, Spencer found himself forced to relinquish the undertaking. The astounding extent of Spencer's life labors becomes all the more marvelous when one considers the impaired health which has for many years past incapacitated him for regular and persistent work. His life has thus necessarily been a very retired and, externally considered, a very uneventful one. He has never married, and has uniformly declined all university honors and invitations to join scientific societies. He visited the U. S. in 1882, remaining from August to November. See POSITIVISM. WILLIAM HENRY HUDSON.

**Spencer**, JESSE AMES, D. D.: educator and author; b. at Hyde Park, N. Y., June 17, 1816; graduated at Columbia College 1837; studied theology at the General Seminary of the Protestant Episcopal Church; was ordained 1840; was rector of St. James's church, Goshen, N. Y., 1840–42; Professor of Latin and of Oriental Languages at Burlington College, New Jersey, 1849–50; editor and secretary of the Episcopal Sunday-school Union and Church Book Society 1851–57; declined the vice-presidency of Troy University 1858; was rector of St. Paul's, Flatbush, L. I., 1863–65, and in 1869–79 was Professor of Greek in the College of the City of New York. He was the author of a volume of religious *Discourses* (1843); *History of the English Reformation* (1846); *The East, Sketches of Travel in Egypt and the Holy Land* (1850); a widely circulated *History of the United States* (4 vols., 1856–69); *Greek Praxis* (1870); and *A Course of English Reading* (1873). Dr. Spencer was editor of *The Young Churchman's Miscellany* (1846–68); of 6 vols. of the Classical Series of Thomas K. Arnold (1846–50); of a *New Testament in Greek* (1847), with notes; *Cæsar's Commentaries* (1848), with notes and a lexicon; of Pycroft's *Course of Reading* (1844); of Archbishop Trench's *Poems* (1856); of a new edition of Prof. Alpheus Crosby's *Anabasis* (1875); and *Origen's Works* (vol. iv. in Ante-Nicene Library, 1885). D. Sept. 2, 1898.

**Spencer**, JOHN, D. D.: b. at Bocton, Kent, England, in 1630; educated at the King's School, Canterbury; graduated at Cambridge about 1650; obtained a fellowship at Corpus Christi College 1655; took orders in the Church of England; became rector of Landbeach, master of Corpus, and archdeacon of Sudbury 1667; prebendary of Ely 1672 and dean of Ely 1677. D. at Cambridge, May 27, 1695. He was the author of *A Discourse concerning Prodigies* (1663; 2d ed. 1665); *Dissertatio de Urim et Thummin* (1669). He is best remembered by his *De Legibus Hebræorum Ritualibus et earum Rationibus* (Cambridge, 1685), a work of great learning which excited much controversy. It maintained that the Hebrew ritual was almost entirely borrowed from the Egyptian—a view previously upheld by Maimonides in his *More Nevochim*, and by Sir John Marsham in his *Canon Chronicus Ægyptiacus*, defended by Bishop Warburton and combated by Witsius, Shuckford, Dr. Woodward, and William Jones of Nayland, but now abandoned. Editions of this work were published at The Hague (1686), and at Leipzig (1705). A new edition, brought out by Dr. Leonard Chappelow (Cambridge, 2 vols., 1727), contained a supplementary book (the fourth) left in MS. by the author, and the whole work, with a memoir and a commentary by C. M. Pfaff, was published at Tübingen (2 vols., 1732).
Revised by S. M. JACKSON.

**Spencer**, JOHN CANFIELD, LL.D.: lawyer; son of Ambrose Spencer (1765–1848), chief justice of the State of New York; b. at Hudson, N. Y., Jan. 8, 1788; graduated at Union College 1806; was private secretary to Gov. Daniel D. Tompkins 1807–08; admitted to the bar at Canandaigua 1809; became master in chancery 1811, judge-advocate-general on the northern frontier 1813, assistant attorney-general for Western New York 1815, member of Congress 1817–19, of the State Assembly 1819–20, being Speaker the latter year; State Senator 1824–28; commissioner to revise the statutes of New York 1829; special attorney-general to prosecute the murderers of William Morgan; was secretary of State and superintendent of common schools 1839–41; Secretary of War under President Tyler from Oct., 1841, to Mar., 1843, when he was transferred to the Treasury Department; resigned the latter post 1844 in consequence of his opposition to the annexation of Texas, and thenceforth devoted himself to the practice of his profession. The organization of the State asylum for idiots and the improvement of the common-school system were largely due to him, and he served on many important State commissions. He edited, with a preface and notes, de Tocqueville's *Democracy in America* (2 vols., New York, 1838), and with John Duer and Benjamin F. Butler a *Revision of the Statutes of New York* (3 vols., Albany, 1846). D. at Albany, N. Y., May 18, 1855.

**Spencer**, JOHN CHARLES, third Earl Spencer, better known as Lord Althorp: statesman; b. May 30, 1782; eldest son of George John, second Earl of Spencer; educated at Harrow and at Trinity College, Cambridge; was elected to Parliament 1804; held office under Fox as Junior Lord of the Treasury from Feb. 11, 1806 to Mar., 1807; sat in Parliament for the county of Northampton from Dec., 1806, till the passage of the Reform Bill 1832, during which long period he was one of the leading members of the opposition; was especially prominent in the attacks upon the financial policy of the Tory administrations; was Chancellor of the Exchequer and ministerial leader of the House of Commons in the reform ministry of Earl Grey 1830–34; succeeded his father as Earl Spencer in Nov., 1834, and soon afterward withdrew from active political life; devoted himself to scientific agriculture; was many years president of the Smithfield Cattle Club; was one of the founders and the first president of the Royal Agricultural Society 1838; was an active member of the Roxburghe Club for reprinting rare books; and vice-chairman of the Society for the Diffusion of Useful Knowledge. D. at Wiseton Hall, Nottinghamshire, Oct. 1, 1845. See Bagehot, *Biographical Studies* (1881), and Myers, *Lord Althorp* (1890). F. M. COLBY.

**Spencer**, JOHN POYNTZ, Earl: statesman; b. at Spencer House, London, Oct. 27, 1835; educated at Harrow and Cambridge; entered Parliament 1857, but succeeded to the peerage in the same year; Lord-Lieutenant of Ireland 1868–74; Lord President of the Council 1880; again Lord-Lieutenant of Ireland 1882–85; for a second time Lord President of the Council in the Gladstone administration 1886; First Lord of the Admiralty in the Gladstone government of 1892.

**Spencer**, SARA (*Andrews*): reformer; b. at Savona, N. Y., Oct. 21, 1837; educated in high and normal schools in St. Louis, Mo.; was a teacher from the age of sixteen till her marriage in 1864 with Henry C. Spencer. They removed to Washington, D. C., where they founded a Spencerian Business College. In 1871–72 Mrs. Spencer defeated attempts to license the "social evil" in Washington. On Apr. 14, 1871, Mrs. Spencer and seventy-two other ladies in Washington were refused the right to register and vote. She brought suit in the D. C. Supreme Court, and Judge Cartter's decision that "women are citizens, but have not the right to vote without local legislation" was reaffirmed by the U. S. Supreme Court in 1874. Mrs. Spencer represented the National Woman's Suffrage Association at the Republican presidential convention in Cincinnati in 1876, addressing the platform committee and the convention; engrossed, signed, and with five other women presented the woman's *Declaration of Rights* at the Centennial celebration in Independence Square, Philadelphia, Pa., July 4, 1876. She was vice-president of the first seven congresses of women 1873–90, representing the District of Columbia; was official delegate from the District to national conference of charities seven years, 1881–88; since the death of her husband in 1891 has been president and proprietor of Spencerian Business College, District of Columbia. She has published *Problems on the Woman Question* (Washington, 1871) and *Thirty Lessons in the English Language* (1873). SUSAN B. ANTHONY.

**Spencer Rifle**: a breech-loading magazine-gun, extensively used as an arm for the Union cavalry during the civil war in the U. S. It is characterized by having in the butt of the stock a magazine holding seven cartridges, which are brought one by one into the chamber by a movement of the trigger-guard as a lever, which at the same time throws out the shell of the exploded cartridge. A new magazine can be inserted whenever the cartridges have been exhausted, or the magazine may be shut off and the rifle used as a single breech-loader. See MAGAZINE-GUNS.

**Spener**, PHILIPP JAKOB: "The Father of Pietism"; b. at Rappoltsweiler, Upper Alsace, Jan. 13, 1635; studied at Strassburg, Tübingen, and Basel, principally theology; became private tutor to the princes Christian and Charles of the Palatinate, and pastor in Strassburg and lecturer in the university in philology and history 1663; was appointed first pastor in 1666 at Frankfort, where he instituted his famous *collegia pietatis* (prayer-meetings), which finally brought him into conflict with the orthodox clergy; became preacher to

the electoral court of Saxony at Dresden in 1686, but lost favor here by reproving the elector (privately) for his vices; was invited in 1695 to Berlin, where he was appointed provost of the Church of St. Nicolai. D. in Berlin, Feb. 5, 1705. He owed his religious views chiefly to English Puritan writers, and neither in his writings nor in his person was there anything of that mysticism and eccentricity which characterized some of his adherents, whose excesses were charged falsely upon him. The Pietism which he developed was quite unlike that developed in Halle and elsewhere, which was formal and lifeless. In opposition to the orthodox theological system of his time, he conceived Christianity principally as a living duty and comfort, not as a science; and, leaving all subtle definitions to others, he simply recommended his hearers to look at the Bible in the light of their own lives, and then to look at their lives in the light of the Bible. The impression he made was both wide and deep. He was the object of virulent and persistent abuse and misrepresentation, but the way he bore these attacks was eloquent testimony to the sincerity and depth of his piety. He was a voluminous writer. Perhaps the best of his works are *Pia, theologische Bedenken* (4 parts, Halle, 1700–02); *Letzte theologische Bedenken* (1711); *Concilia et judicia Theologica Latina* (Frankfort, 1709); *Pia Desideria* (Frankfort, 1675); *Das geistliche Priesterthum* (1677); *Des thätigen Christenthums Nothwendigkeit* (1679); *Evangelische Glaubenslehre* (1688). His *Life* was written by W. Hossbach (2 vols., Berlin, 1828; 3d ed. 1861) and C. A. Wildenhahn (Leipzig, 1842; 2d ed. 1847: Eng. trans. Philadelphia, 1881).
Revised by S. M. JACKSON.

**Spengel**, LEONHARD: Greek scholar; b. in Munich, Germany, Sept. 24, 1803; became privat docent in the university of his native city in 1827, professor at Heidelberg in 1842; recalled to Munich in 1847, where he died Nov. 9, 1880. Spengel's fame rests upon his work in Greek rhetoric, which field he made especially his own. See his *Συναγωγὴ τεχνῶν* (1828), an attempt to reconstruct from extant fragments the systematic development of Greek rhetoric; *Rhetores Græci* (3 vols., new ed. 1893); Aristotle's *Rhetoric* (1844); *Rhetoric* of Anaximenes; *Aristotelische Studien* (4 parts, 1868). He also published, besides many smaller treatises on his favorite subject, an elaborate text edition of Varro's *De Lingua Latina* (new ed. by his son Andreas, 1893). See Bursian's *Biographisches Jahrbuch* (iii., pp. 39–59); W. Christ, *Leonhard Spengel* (1881); Ch. Thurot, *Revue de Philologie* (v. pp. 181–190). ALFRED GUDEMAN.

**Spenser**, EDMUND: poet; b. at East Smithfield, near the Tower, London, England, in 1552. Nothing is known with certainty of his family, but it is almost proved that he was descended from the Spencers of Hurstwood, Lancashire, and was related to the Spencers of Althorp. He was educated at Merchant Taylors' School. He entered as a sizar at Pembroke Hall, Cambridge, May 20, 1569, in which month he contributed a number of sonnets and epigrams to *The Theatre of Worldlings*, a volume printed at London by Dr. John van der Noodt, a Flemish physician; graduated Jan. 16, 1573. In 1576 he left Cambridge without a fellowship and visited his relatives in Lancashire, where he fell in love with a lady supposed to have been Rose Dynley, whose charms he celebrated under the name of Rosalinde in a pastoral poem, *The Shephearde's Calendar*, published anonymously in 1579, the dedication of which to Sir Philip Sidney had been preceded by personal acquaintance in London; printed soon afterward *Three Proper and Wittie Familiar Letters lately passed between two Universitie Men* (1580), being a literary correspondence with his college friend, Gabriel Harvey; obtained in the autumn of 1580, through the influence of Sidney, the post of secretary to the Government under Lord Grey of Wilton, Lord-Lieutenant of Ireland; was probably resident in Dublin from 1582 to 1588, when he resigned his clerkship of decrees; his services were rewarded in 1589 by a grant from the crown of an estate forfeited by the Earl of Desmond, consisting of 3,028 acres of land, including the castle and manor of Kilcolman, near Doneraile, in the county of Cork, where he resided, and where he completed the composition of his *Faerie Queene*; wrote in 1586 his *Astrophel*, a pastoral elegy on the death of Sir Philip Sidney—not published till 1595; was in 1588 appointed clerk of the council of Munster; received in 1589 a memorable visit from Sir Walter Raleigh on his return from the Lisbon expedition; read to Raleigh the first two books of his great poem, which the latter thought "a dish to set before a queen," and accordingly persuaded the poet to accompany him to London. Spenser's reception by Queen Elizabeth appears to have been appreciative, for the publication of the first three books of the *Faerie Queene* in 1590 not only placed him in the front rank of poets, but procured him a pension of £50. In 1590 he also published *Muiopotmos*. During this visit to London Spenser also published in 1591 *Complaints, containing Sundrie Small Poemes of the World's Vanitie* (1591), *The Ruines of Time*, *The Teares of the Muses*, and *Prosopopoia*. His marriage in 1594 to an Elizabeth, whose surname has not been preserved, inspired his beautiful love sonnets entitled *Amoretti* and a magnificent *Epithalamium* (1595), which were shortly followed by *Colin Clout's come Home Again*. In 1596 he published *The Second Part of the Faerie Queene, containing the Fourth, Fifth, and Sixth Bookes*, and *Foure Hymnes* addressed to the Countess of Cumberland; he also presented the queen a MS. dialogue in prose, *A View of the State of Ireland*, not published until 1633. Spenser was appointed in 1598 sheriff of the county of Cork, thus incurring the enmity of the insurgents of "the Earl of Tyrone's rebellion," who toward the close of that year burned his house and plundered his estate, forcing him to fly to England, on which occasion an infant child of the poet is said to have perished in the flames. Reduced to poverty, Spenser passed a few miserable months in London, and died in King Street, Westminster, Jan. 16, 1599. According to Ben Jonson, he "died for lack of bread," after having refused twenty pieces (of gold?) sent him by the Earl of Essex, saying that "he had no time to spend them"; these details are recorded by Drummond of Hawthornden. He was buried in Westminster Abbey, near the tomb of Chaucer, as he had desired, the funeral being at the expense of the Earl of Essex; and a monument in his honor was erected in 1620 by Anne Clifford, Countess of Dorset, afterward Countess of Pembroke. He left two sons, Sylvanus and Peregrine. Hugolin, a son of Peregrine, was outlawed for adhesion to James II., and was living, "very old and unmarried," in 1700. Many editions of Spenser's complete works have appeared, the best being the variorum edition of Henry J. Todd (London, 8 vols., 1805), that of J. Payne Collier (London, 5 vols., 1862), with glossary, notes, and a *Life*, and that of Rev. R. Morris (Globe ed., 1869). These were, however, superseded by a critical edition published by the Rev. A. B. Grosart in 1882, with the assistance of a number of eminent English scholars. G. L. Craik's *Spenser and his Poetry* (3 vols., 1845) is a satisfactory critical work. Dean Church's excellent study on this poet was published in 1879. An edition by Prof. Francis J. Child, of Harvard (1855, 1878), is highly esteemed. Revised by EDMUND GOSSE.

**Speos Artem'idos** [Gr., grotto of Artemis; Arab. *Stabl Antar*, stable of Antar]: an Egyptian rock-hewn temple dedicated to the local deity, the lion-headed goddess Pachet, whom the Greeks identified with Artemis. It was situated just S. of Beni-Hasan (28° N. lat.), on the east side of the Nile. Apparently it was the work of Thothmes III., but under his cartouche there are traces of an earlier name which has been identified by Golenischeff with that of Hatasu. The name of Seti I. is also found. The grotto is cut from the solid rock, and consists of a vestibule, a corridor, and a rectangular chamber with a naos, at the rear of which is a niche for the image of the goddess. In the vestibule only two of the original eight pillars are now standing. The mural texts are nearly all of a religious character, and there are representations of several deities besides Pachet. The whole is considerably dilapidated. C. R. G.

**Spergula**: See SPURREY.

**Spermace'ti, Spermaceti-fat**, or **Cetine** [*spermace'ti* is Mod. Lat.; Lat. *sperma*, sperm + *ce'tus* = Gr. *κῆτος*, whale]: a substance ($C_{32}H_{64}O_4$) which exists ready formed in the cavities of the head of the sperm-whale (*Physeter macrocephalus*), and also in that of some other whales and of *Delphinus edentulus*. It crystallizes out of the sperm oil of the head-cavities after the vital heat is lost, forming a magma or mirole, from which in cold weather the sperm oil is expressed by hydraulic pressure ("cold-drawn sperm oil"), the spermaceti being left behind. It is purified by melting it by steam to separate mechanical impurities, and recrystallizing. It then forms a lustrous, pearly, white mass of eminent crystalline texture, feeling soft and soapy to the touch; does not grease paper if quite freed from oil. If pure, it is without taste or odor, and has a neutral reaction. The natural product, freed from sperm oil by cold alcohol and repeatedly crystallized from hot alcohol or ether, is the cetine of Chevreul, which melts at 120°–128°. It yields by saponification (see FATS) cetyl alcohol and palmitic acid. The ethereal nature of spermaceti was distinctly recognized by Chevreul (*Recherches sur les Corps gras*). Spermaceti was formerly much used in the production of sperm-candles, which are no longer so common as in the prosperous days of the sperm-whale fisheries, the decline of which dates from the general introduction of refined petroleum and paraffin. Spermaceti burns with a bright, clear flame like wax. The standard sperm-candle, which is the common unit of comparison for photometric experiments in Great Britain and the U. S., is taken to burn 120 grains of sperm in an hour, which it rarely does with accuracy. Revised by IRA REMSEN.

**Sper'maphytes** [from Gr. σπέρμα, seed + φυτόν, plant]: another name for the ANTHOPHYTES (*q. v.*).

**Spermatozo'a** [Mod. Lat.; Gr. σπέρμα, seed + ζῷον (plur. ζῷα), animal, living creature]: the male reproductive cells of animals, which by union with the female cell (egg) render the latter able to develop. They consist largely of the cell-nucleus with the addition of other accessory structures to facilitate the union with the egg (impregnation). In shape they vary greatly, but the most common shape recalls the tadpole. In these forms there is a head, composed of the nucleus, followed by a "middle piece," and this in turn by the tail, which may either be thread-like, or may have an undulatory membrane attached to it. Usually the spermatozoa have the power of motion, by means of the vibrations of the tail, but in some forms they are motionless. Recent investigations show that both nucleus and "middle piece" are concerned in impregnation; the tail and analogous structures play no part after the union. J. S. KINGSLEY.

**Sperm Oil**: See OILS and SPERMACETI.

**Spermophile**: any rodent of the genus *Spermophilus*. See PRAIRIE-SQUIRREL.

**Sperm-whale**: See CACHALOT and PHYSETERIDÆ.

**Spessartite**: See GARNET.

**Speusip'pus** (in Gr. Σπεύσιππος): philosopher; b. at Athens about 395 B. C.; a nephew of Plato; received the instruction of his uncle, whom he accompanied to Syracuse, and succeeded as president of the Academy. D. at Athens in 339 B. C. Of his writings nothing is left. J. R. S. S.

**Speyer**, or **Speier**, spī'er: city and railway junction; capital of Rhenish Bavaria, at the junction of the Speyerbach with the Rhine (see map of German Empire, ref. 6–D). It has some sugar-refineries and manufactures of vinegar and tobacco, and carries on an active trade in grain, timber, and wine on the Rhine. It is one of the oldest cities of Germany, and in the Middle Ages the German emperors often resided and held their diets here. Nevertheless, it has only one monumental building, the cathedral, erected in the eleventh century, thoroughly restored in 1858, and one of the finest church buildings of Germany. The other great edifices Speyer once possessed were destroyed by the French, who twice conquered and devastated the city. Pop. (1895) 19,045. Revised by M. W. HARRINGTON.

**Spezia**, spăt'si-ă̈a: town; in the province of Genoa, Italy; beautifully situated on a gulf of the same name in lat. 44° 7' N., lon. 9° 48' E. (see map of Italy, ref. 4–C). The old walls and gates of Spezia have been mostly demolished in the course of the changes necessitated by the rapid growth of the town consequent upon the construction of the naval arsenal. The town is the chief naval station of Italy and is defended by formidable batteries; it has extensive shipbuilding yards, docks, etc., a foundry, and manufactures of sail-cloth, white lead, cables, and leather. It is the seat of a school of navigation, and is much frequented as a seaside resort. Pop. about 19,860.

**Spezzia**, spet'si-ă̈a: an island at the entrance of the Gulf of Nauplia, Greece; has a fine harbor; became distinguished in the Greek revolution (1821–29). The inhabitants are mostly engaged in commerce and navigation. Area, 26 sq. miles. Pop. (1890) 5,192. E. A. G.

**Sphag'num** [Mod. Lat., from Gr. σφάγνος, a kind of moss]: a large and interesting genus of mosses, many species of which grow in the U. S., mainly in bogs, forming deep, spongy masses, almost always damp. They are called peat-mosses, being the principal ingredient in pure peat. See MOSSWORTS. Revised by CHARLES E. BESSEY.

**Spheg'idæ** [Mod. Lat., named irregularly from *Sphex*, the typical genus, from Gr. σφήξ, σφηκός, wasp]: a family of hymenopterous insects, including the so-called sand-wasps and mud-wasps. See HYMENOPTERA.

**Sphenis'cidæ**: See PENGUIN.

**Sphen'odon**: See HATTERIA.

**Sphenoid Bone** [*sphenoid* is from Gr. σφήν, wedge + suffix *-oid*, like]: a bone of the skull, situated in man at the anterior part of the base. It has been likened in shape to a bat with open wings. It consists of a body, four wings, two greater and two less, and the two pterygoid processes. The body is quadrilateral, and hollowed out into a mere shell. This body is conceived to represent the centrum of the third cephalic vertebra (constituting the posterior portion of the sphenoid), joined to the centrum of the second vertebra (the anterior portion). The two greater wings are the neurapophyses of the third vertebra, and the two lesser wings are neurapophyses of the second vertebra. The sphenoid is exceedingly complicated and irregular in its outlines. It is developed from ten centers. It is usually joined anteriorly in the adult to the two sphenoidal spongy bones (a pair of thin, curved irregular plates). Posteriorly, it becomes continuously united to the occipital bone. It articulates with all the bones of the skull and with five of those of the face.

**Sphere** [(readapted to Latin) < M. Eng. *spere*, viâ O. Fr. from Lat. *sphæra* = Gr. σφαῖρα, ball, sphere]: a surface all of whose points are equally distant from a point within called the *center*. It may be generated by a semicircle revolving about its diameter as an axis. Any line from the center to a point of the surface is a *radius*, and any line drawn through the center and limited by the surface is a *diameter*; all radii of the same sphere are equal; also all diameters of the same sphere are equal. Every plane section of a sphere is a circle; if the plane passes through the center, the section is called a *great circle*; if it does not pass through the center, the section is called a *small circle*; the radius of a great circle is equal to that of the sphere; the radius of a small circles may have any value from the radius of the sphere to 0, in which case the cutting plane merges into a tangent plane. The surface of a sphere is equal to four great circles, or it is equal to the circumference of a great circle multiplied by its diameter. The surface of a zone, viz., the portion of surface included between two parallel planes, is equal to the circumference of a great circle multiplied by the altitude of the zone. The volume of a sphere is equal to its surface multiplied by one-third of its radius. The volume of a spherical sector is equal to the zone which forms its base multiplied by one-third of the radius of the sphere.

In analysis, the surface of a sphere is a surface of the second order, whose equation in rectangular Cartesian coordinates is of the form

$$(x-\alpha)^2+(y-\beta)^2+(z-\gamma)^2=R^2,$$

in which $\alpha, \beta$, and $\gamma$ are the co-ordinates of the center, and $R$ is the radius of the sphere. Revised by S. NEWCOMB.

**Spherical Trigonometry**: See TRIGONOMETRY.

**Sphe'roid** [from Gr. σφαῖρα, sphere + suffix *-oid*, like]: a surface generated by an ellipse revolving about one of its principal axes. If the ellipse revolves about its conjugate axis, it generates a surface resembling a flattened sphere called an *oblate* spheroid; if it revolves about its transverse axis, it generates an elongated surface called a *prolate* spheroid. The surface of the earth is very approximately an oblate spheroid.

**Spheroidal State**: See HEAT and LIQUIDS.

**Spherom'eter**: an instrument for measuring the radius of a sphere when only a portion of the spherical surface, as, for instance, a lens, is given. The usual form consists of a vertical screw turning in a socket, which is equidistant from three supporting legs with sharp steel points. Above the sockets the screw has a graduated circular head. The points of the legs are brought in contact with the spherical surface, and the screw is turned until its extremity also touches it. This process is repeated with a plane. Thus the distance between the center of the circle through the ends of the legs and its pole on the sphere is obtained, from which the radius of the sphere can be calculated. R. A. R.

**Sphincter** [Mod. Lat., from Gr. σφιγκτήρ, anything which binds tight, deriv. of σφίγγειν, compress, squeeze, bind tight]: in anatomy, a muscle the fibers of which, generally circular, surround some passage in the animal organism, closing the passage, in opposition to certain other muscles called dilators. Some of the sphincters are composed of striped fiber, some of unstriped, and some of both combined. The eyes, pupils, mouth, rectum, vagina, bladder, and urethra are the most important passages which are provided with sphincters; but there are numerous other sets of circular fibers which have more or less of the action of sphincter muscles.

**Sphin′gidæ**: a family of moths including the hawk-moths. See HAWK-MOTH and LEPIDOPTERA.

**Sphinx** [Lat. = Gr. σφίγξ, σφιγγός]: in Grecian mythology and art, a malevolent being, usually represented as having the head of a woman, the breast, feet, and claws of a lion, the tail of a serpent, and the wings of a bird. It was also represented as having the fore part of a lion, the body of a man, the claws of a vulture, and the wings of an eagle. It was reputed to have originated in Ethiopia. In this latter point there may be an historical reminiscence, but in respect to the features which were combined to form the Greek sphinx there are few items of similarity with the Egyptian prototype. The Egyptian sphinx proper is composed of the head of a man and the body, legs, feet, and tail of a lion, but it was represented as destitute of wings, except in the period when Greek influence had come to be felt, and its artistic designs to be copied. In Egyptian symbolism the sphinx was the guardian of temples and tombs, the incorporation of Rā-Harmachis. The face, however, was sculptured presumably to represent the reigning Pharaoh. It was the form assumed by Rā and Horus when opposed to their enemies, and it was supposed properly to be a quadruped of the desert. Similar figures are frequent in which the human head is replaced by that of the ram (criosphinx) or of the hawk (hieracosphinx); but when applied to these composites the name sphinx is a misnomer, as they are merely variations in the forms given to the deities to whom these animals were sacred. The ram-headed figure and the real sphinx (androsphinx) were, however, used for similar purposes, as they alternate in the "avenues of sphinxes" which mark the passageways from the Nile to the temples. Used thus they were supposed to ward off evil from the dwellings of the gods and of their sacred animals.

There are few, if any, specimens of this style of sculpture from the old kingdom; from the twelfth dynasty there are several, and during the remainder of Egyptian history it was a favorite device. The so-called Hyksos sphinxes from Tanis are of a different type from those found in other parts of Egypt, and also from some other examples found even in Tanis itself. Their bodies are shorter, more sinewy and powerful, and the human heads are also of a different type, with high cheek-bones, broad faces, and powerful features. They are also adorned with manes and shaggy breasts. Several theories have been advanced to account for the variations. It was at first supposed that they were genuine Hyksos remains, produced by foreign artists settled in Tanis; but against this is the fact that the name of Apepi, the Hyksos, is merely scratched upon the shoulder, and does not occupy the place of honor—that it resembles a graffito rather than an inscription. The main argument rests upon the un-Egyptian cast of feature shown. Mariette proposed this view, and it has heretofore been generally accepted. It has also been suggested that they are productions of a local Egyptian school of sculpture not under the ordinary canons of Egyptian art. Meyer holds that they are memorials of an invading race, which apparently gained the upper hand in Egypt between the ninth and tenth dynasties, of which Khyan is the representative. (See Petrie, *History of Egypt*, i., p. 117 ff.) Golenischeff considers that they were memorials of Amenemha III. of the twelfth dynasty (*Recueil de Travaux*, xv., 131), to whom they bear a striking resemblance. The whole subject, however, is involved in much doubt.

The date of the Great Sphinx of Gizeh, located about half a mile S. E. of the Great Pyramid, is absolutely unknown (see illustration in the article EGYPTOLOGY). It has been assigned to prehistoric times, to the age of Cheops (Khufu), and Khafra of the fourth dynasty, and even to Thothmes IV., but of proof there is none. Fundamental to the whole discussion are two facts—no dated sphinxes earlier than the twelfth dynasty can be proved, and the Egyptian inscriptions of the Old Kingdom do not contain the sphinx-hieroglyphic sign at all, as do those of later periods. The assignment to a period antedating the fourth dynasty rests upon an inscription found in a neighboring temple, which purported to be from the fourth dynasty, but which was really composed in the twenty-first. It alleges that at the earlier date the sphinx was in need of repairs, but internal evidence points to the probable conclusion that the story is entirely unhistorical. The assignment to Khafra was based upon the fact that a statue of that king was found in the immediate neighborhood. On a pillar in the small temple, between the paws of the figure, was found a tablet of Thothmes IV., in which he is understood to record a dream in which Rā-Harmachis, whose emblem the sphinx was, appeared to him and promised him long life and prosperity if he would clear the figure from the desert sand that had encroached upon it, and repair it. The question of age promises to remain a riddle, and the assignment of it to the time of the Heracleopolite dynasties (ninth and tenth) is only a guess which has something in its favor. It is certain that it was uncovered twice in ancient times, once under Thothmes IV. and once under Ramses II., but little else is known. Curiously enough, it is not mentioned by Herodotus, though it finds place in other ancient writings. In modern times it has been thrice cleared, by Caviglia, Mariette, and Maspero. When uncovered it was found to be hewn out of the native rock, the head having been carved with great care, but the body left comparatively rough. Breaks or inequalities in the stone were patched with rough masonry, apparently of the Roman period. The whole figure faces eastward, and is about 150 feet long. The top of the head is about 66 feet above the pavement between the paws. The paws are 50 feet long, the head 30 feet long and nearly 14 feet broad. The face was originally colored red, but all traces of the tint have disappeared. It is supposed to have been veneered, in part, at least, with a limestone covering. The face is much damaged and the nose and beard have disappeared. This defacement was largely due to the fact that the Mamelukes used it for a target. The mouth is broad and pleasing, and the face has a benign aspect. It is quite probable that it originally represented the face of the Pharaoh by whom it was cut.

Between the paws of the sphinx is a stone platform approached by a flight of steps, and close to the breast is a small open temple, which is divided into two parts. Three pillars form the rear, and on the central one was the tablet of Thothmes IV., dated from his first year. Another temple is near at hand, which has the general appearance of a tomb or mastaba, and it has been supposed that the sphinx was regarded as the guardian of this building and its contents. CHARLES R. GILLETT.

**Sphinx-caterpillar**: See HAWK-MOTH.

**Sphyg′mograph** [Gr. σφυγμός, pulse, heart-beat + γράφειν, write]: an instrument for measuring and recording the shape, frequency, and force of the blood-wave in an artery. It consists of a series of delicate levers set in motion by the pulse-beat, and of a moving surface of paper, on which are recorded the results of the measurement. There are several forms of sphygmograph. They simply amplify on the record the successive changes in the caliber of the blood-vessel. In diseased conditions of the heart the records have a diagnostic value. See RECORDING APPARATUS, PSYCHOLOGICAL, in the Appendix.

**Spice** [M. Eng. *spice*, *spece*, from O. Fr. *espice*, *espece* (> Fr. *épice*): Ital. *spezie* < Lat. **specia*, *species*, appearance, kind, wares, goods, spices]: certain aromatic seeds, barks, roots, dried fruits, etc., used in cookery for their flavoring qualities, and in medicine as stimulants and carminatives. Such are cloves, ginger, allspice, nutmeg, pepper, mace, capsicum, cinnamon, cassia, vanilla, etc. Besides the above, which are extensively exported from tropical countries, and especially from the East, there are others now nearly forgotten, such as cassamunar, zerumbet, zedoary, culilawan, and the so-called clove-bark. These have nearly disappeared from general commerce—some because they are inferior in quality, and others on account of their limited supply. Most of the spices are natives of the Old World, but a few are American, and nearly all the important ones are now generally naturalized throughout the tropical world.

**Spice Bush**: See FEVER BUSH.

**Spice Islands**: See MOLUCCAS.

**Spichern**, or **Speichern**: See SAARBRÜCKEN.

**Spider-crab**: See CRAB.

**Spiders** [M. Eng. *spither*, or *spiþre* < O. Eng. **spīdre* for **spin-þer*; deriv. of verb *spinnan*, to spin]: an order of arachnid animals, the *Araneida*. The chief characters which distinguish them from other groups are the possession of a body divided into two regions, cephalothorax and abdomen, both without distinct joints, and the latter, which is joined to the former by a slender stalk, bearing spinning mammillæ on the hinder end. The cephalothorax bears four pairs of legs and two pairs of smaller appendages, the first of which are the poison-jaws, while the second are curiously modified in the male for reproductive purposes. There are usually eight eyes (sometimes six or fewer) upon the front of the cephalothorax. Respiration is accomplished by lungs or lungs and tracheæ. When lungs alone are present there are two pairs of these organs on the under side of the abdomen. In other forms there is a single pair of lungs, the other pair being replaced by air-tubes like those of true insects.

Orb web spider, *Epeira insularis*.

Spiders are carnivorous, and live upon other insects which they kill by the poison forced through the poison-jaws. They do not eat the prey, but merely suck its juices. Some spiders hunt their prey, jumping upon it like a miniature tiger, but the majority form webs of silken threads covered with a viscid substance. The shape and character of these webs varies exceedingly. In general it may be said that the spider has a lair where he can recognize any vibration of the web, and whence he can rush out to further entangle the prey. The web is secreted by glands inside the body, and as it comes in contact with the air in its passage through the spinning organs it hardens into the familiar thread, which in reality is a cable formed of a number of smaller fibers. Besides its use in forming webs the silk is employed in making nests, as a means of flying, and for the formation of cocoons to contain the eggs. "The males are smaller than the females, and their approaches to the latter are made with extreme caution, as they run the risk of being devoured; extending their pedipalps, they deposit the spermatophores in the female genital aperture and betake themselves to flight" (*Huxley*). In their habits spiders are among the most interesting of animals, well repaying observation. Besides the European works of Thorell and Semon, the student should consult papers by Emerton, *Trans. Connecticut Acad. Science* (1882–94); Peckham, *Trans. Wisconsin Acad. Science* (1888); and McCook, *American Spiders* (3 vols., Philadelphia, 1889–94). J. S. Kingsley.

**Spie'gel**, Friedrich: Orientalist; b. at Kitzingen, near Würzburg, Bavaria, July 11, 1820; studied Oriental languages at Erlangen, Leipzig, and Bonn 1838–42, and at Copenhagen and Oxford 1842–47, and in 1849 was appointed Professor of Oriental Languages at the University of Erlangen. Besides editions of various Persian works and grammars of the Old Persian and Old Bactrian languages, he published *Einleitung in die traditionellen Schriften der Parsen* (2 vols., Leipzig, 1856–60); *Die Altpersischen Keilinschriften* (1862; 2d ed. 1881); *Eran, das Land zwischen Indus und Tigris* (1863); *Eranische Alterthumskunde* (3 vols., Leipzig, 1871–78); *Vergleichende Grammatik der alteranischen Sprachen* (1882); *Die arische Periode und ihre Zustände* (1887).

**Spiel'hagen**, Friedrich: novelist; b. at Magdeburg, Germany, Feb. 24, 1829; studied jurisprudence, and afterward philosophy, philology, and literature at Berlin, Bonn, and Greifswald; taught for some time at the university at Leipzig, and finally devoted himself entirely to literary pursuits. In 1859 he removed from Leipzig to Hanover, where he became literary editor of the *Zeitung für Norddeutschland*; but in 1862 he took up his permanent residence in Berlin. Spielhagen has successfully aspired to treat the great questions of the day in a series of novels distinguished by their artistic composition, their elegant style, and their philosophic thought. The most important of these novels, many of which have passed through numerous editions, are *Problematische Naturen* (1860); *Durch Nacht zum Licht* (1861); *Die von Hohenstein* (1863); *In Reih und Glied* (1866); *Hammer und Amboss* (1869); *Sturmflut* (1877); *Quisisana* (1880); *Angela* (1881); *Was soll das werden* (1886); *Noblesse oblige* (1888); *Der neue Pharao* (1889). In his excellent book *Beiträge zur Theorie und Technik des Romans* (1883), Spielhagen attempts to fix the æsthetic laws which govern the art of novel-writing, and in his autobiography, *Finder und Erfinder* (1890), he gives a charming account of the influences which conspired to make him a novel-writer. An edition of selected novels appeared in 1889–92, comprising twenty-three volumes. Julius Goebel.

**Spiers**, Alexander, Ph. D.: lexicographer; b. at Gosport, England, in 1807; graduated at the Universities of Paris and Giessen; settled at Paris 1829; was Professor of English successively at the School of Commerce, at the School of Public Works (Ponts et Chaussées), at the Lycée Bonaparte (1833), and at the University of France; became inspector of colleges; received from Napoleon III. in 1869 the cross of the Legion of Honor in acknowledgment of the value of his series of English grammars, and especially of his standard French-English and English-French *Dictionary* (Paris and London, 2 vols., 1846–49), of which two editions appeared in the U. S.—one edited by G. P. Quackenbos (New York, 1852), the other by J. L. Jewett (1856). D. at Passy, near Paris, France, Aug. 26, 1869.

**Spike** [from Lat. *spi'ca*, point, spike, ear of corn, tuft or head of a plant]: in botany, a flower-cluster, of the centripetal or indeterminate order, in which sessile flowers are arranged along an axis. The spadix and ament are varieties of the spike. The ears of wheat and rye are familiar instances of the spike, which in some instances is compound—that is, contains many sessile spikelets. When the flowers are stalked instead of sessile, the spike becomes a raceme.

**Spikenard**, or **Nard** [*spikenard* is *spike* (see Spike) + *nard* < O. Eng. *nard*, from Lat. *nar'dus* = Gr. νάρδος; cf. Heb. *nērd*, Pers. *nard*]: (1) in the East the *Nardostachys jatamansi*, a valerianaceous plant of India. Its strong odor is disagreeable to most persons of European and American birth, but it is considered very precious in the East. Its medicinal properties are precisely those of valerian. (2) Roots of various species of valerian are exported from Europe to the Levant under the name of Frankish nard, Celtic nard, and mountain nard. Cretan nard is also the root of a valerian. These are much used in the East as substitutes for the true spikenard. (3) In England the fragrant oil of *Andropogon nardus*, an East Indian grass, is called oil of spikenard. It is used in perfumery. (4) In the U. S. the name spikenard is given to *Aralia racemosa*, and the *A. nudicaulis*, or false sarsaparilla, is called small spikenard. They have each a limited use in domestic medicine.

**Spike, Oil of**: the volatile oil of the *Lavandula spica*, the broad-leaf lavender of Europe. It has an odor much like that of oil of turpentine. It is used by artists in preparing their varnishes, and by veterinarians as a horse medicine. Much of the commercial oil of spike is an entirely factitious mixture, of which oil of turpentine is the basis.

**Spinach**, or **Spinage**: the *Spinacia oleracea*, a chenopodiaceous Old World herb, much cultivated in nearly all parts of the world as a potherb, especially for use in the spring. There are about twenty varieties grown in the U. S. Other plants of this and of other genera having similar uses are locally called by this name.

**Spinal Caries**, or **Potts's Disease of the Spine**: an inflammatory condition of the vertebræ, a spondylitis, destructive in its nature, usually tuberculous in character, and slow in its course. A slight injury is often sufficient to awaken the process in an individual predisposed to struma. Gradual disintegration of the bodies of one or more vertebræ takes place with subsequent bending, which produces a kyphosis or sharp projection backward. The early symptoms are colicky pains in the abdomen (often mistaken for indigestion), reflex pains in the limbs, and a peculiar rigidity of the back in walking and stooping. If the disease is situated in the cervical or upper dorsal regions, an irritative cough is often among the earliest symptoms.

The name Potts's disease was given to this affection from the fact that Dr. Percival Potts, in 1779, was the first physician to describe accurately this special condition of the bones which gives rise to the hunch-back deformity. That this disease existed in prehistoric times is evidenced by the specimens in the Peabody Museum at Cambridge, Mass.

The treatment consists in keeping the diseased bones perfectly at rest until nature throws a bony bridge across the diseased gap and anchyloses the spine. This result may be accomplished by placing the patient continuously in the recumbent posture, or by the application of a steel support, a hard leather or rigid jacket, plaster-of-Paris splint, or other device. The disease is necessarily long and tedious, its course often extending over many years. Abscesses frequently form in the back or groin, more commonly in the latter situation. The latter condition is known as a psoas abscess, from the fact that the pus follows the sheath of the psoas muscle. When the pus seeks exit in the back, the process constitutes a lumbar abscess.

Paralysis of the lower limbs occasionally results, which though tedious is usually curable, provided extension and fixation are rigidly enforced. Laminectomy is rarely required. See CARIES.

DE FOREST WILLARD.

**Spinal Column** [*spinal* is from Lat. *spina'lis*, deriv. of *spi'na*, back-bone, liter., thorn, spine. So called from the shape of a vertebra]: the back-bone, the composite bony column of the back of vertebrated animals which affords attachments, direct or indirect, for the ribs and other bony parts, and for the numerous groups of voluntary muscles. In man it is a flexible column of thirty-three vertebræ united by ligaments, with interposed cartilaginous cushions. The column is from 2 to 2½ feet in length, and viewed laterally presents marked curves, which add to the grace and free movements of the trunk. (Fig. 1.) The column is divided into regions—the *cervical*, *dorsal*, *lumbar*, and *pelvic*—corresponding to the neck, chest, abdomen, and pelvis. The vertebræ, excepting in the pelvic region, rotate freely and flex both antero-posteriorly and laterally. A single vertebra (Fig. 2) consists of the *body*, which unites it to other vertebræ, and a bony ring which incloses the vertebral foramen or vertebral canal, protecting the spinal cord; this ring has articular and spinous processes for attachment of ribs, ligaments, and muscles.

FIG. 1.—Lateral view of spine.

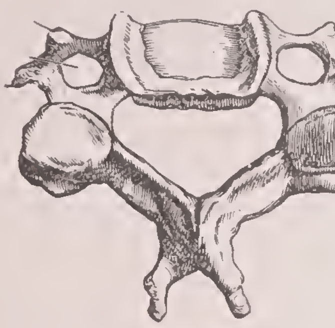


FIG. 2.—A vertebra.

Revised by W. PEPPER.

**Spinal Cord**: See MEDULLA SPINALIS.

**Spinal Curvatures**: three kinds—(1) rachitic curvature; (2) lateral curvature; (3) angular curvature. The curvature of rickets (rachitis) is usually a simple exaggeration of the normal curves of the spine—convexity or kyphosis in the dorsal, and concavity or lordosis in the lumbar region; occasionally there is a lateral bending (scoliosis), but unaccompanied with the rotation of true lateral curvature. Lateral curvature is a deviation of the spinal column at one or several points from the position which it occupies in health in the median line of the back, accompanied by marked rotation of the bodies of the vertebræ around the axis of the spinal column, which is thus much more distorted in front than behind. It occurs in children, in young, imperfectly developed, feeble, and growing adults, more especially women, and less often in men. The spine normally occupies the middle of the back, with a slight convexity to the right in the dorsal region; in this central position it is acted upon by many forces—the weight of the head and trunk, the lateral traction of the arms in all physical efforts, of the thoracic and abdominal muscles in breathing—and beneath has a divided support of the two lower extremities through the intervention of the pelvis. A lateral curvature may develop connected with any one of these forces; when the tissues are poorly nourished the spine may yield to the weight it supports. Habitual use of one arm to the exclusion of the other may cause deviation of the spine, cervico-dorsal, to the stronger side—a common occurrence in weakly children at school, housemaids, and in some confining mechanical vocations. Disease of one lung, as phthisis, chronic pneumonia, pleuritic adhesions and chest-contraction, by limiting respiratory movement on one side, often causes dorsal curvature to the more active side. Shortening of one limb, hip-joint disease, persistent limping from any cause, by tilting the pelvis throws the spine out of center and develops lumbar curvature. Whenever a curvature is thus primarily established, a secondary curvature develops at another part of the vertebral column, and to the opposite side, and thus the erect position of the body is maintained. The affected spine, viewed anteriorly or posteriorly, presents a double curvature, a tortuous line whose upper and lower ends can be connected by a vertical straight line, representing the component of all the forces, weight, etc., which the spine sustains. Occasionally there are four curves, two in the dorsal and two in the lumbar region.

Lateral curvature, if of long standing, may so modify the size and conformation of the lung, so change the nutrition and structure of the intervertebral cartilages and the muscular volume of the two sides of the body, that cure is impossible or incomplete. More often it is curable by correcting bad habits, as favoring one side in standing, sitting, or sleeping, by resort to light gymnastics and special passive movements, and by the use of apparatus which removes weight from the spine and applies pressure or traction to counteract the curves. Great advantage may, in early cases, be derived from dividing the period during which the body is erect, by lying flat on the back, without a pillow and on a hard mattress, for at least an hour in the mid part of the day. General tonic treatment, cod-liver oil, and phosphates, out-of-door life, warm clothing, stimulating baths, and regulated diet are indicated in all cases.

Angular curvature, or SPINAL CARIES (*q. v.*), is of more serious nature. It may be followed by paralysis of the lower extremities, due to pressure on or inflammation of the spinal cord, but paralysis and abscess do not usually coexist in the same cases. Revised by JOHN ASHHURST, Jr.

**Spinal Diseases**: See MENINGITIS and SPINAL CURVATURES.

**Spindler**, KARL: novelist; b. at Breslau, Prussian Silesia, Oct. 16, 1796: educated at Strassburg, afterward at Augsburg; was connected for some time with a company of strolling actors; published in 1824 his first novel, *Eugen von Kronstein* (2 vols.); chose literature for his occupation; lived at Hanau, Stuttgart, Munich, and finally at Baden-Baden. D. at Freiersbach, Baden, July 12, 1855. The best of his novels are *Der Bastard* (3 vols., 1826); *Der Jude* (4 vols., 1827); *Der Jesuit* (3 vols., 1829); and especially *Der Invalide* (1831). The latter story is an excellent specimen of the early historical novel in Germany, giving a picture of the French Revolution and the subsequent *rôle* of Napoleon which has not yet been surpassed in fiction. Many of his minor novels were published in a periodical, *Vergissmeinnicht*, which he edited after 1831. A collected edition of his works appeared in 102 vols. at Stuttgart from 1831 to 1854.

Revised by JULIUS GOEBEL.

**Spindle-tree, Staff-tree**, or **Bittersweet Family**: the *Celastraceæ*; a small family containing 300 species of discifloral, choripetalous, dicotyledonous shrubs and trees. The perianth is 4- to 5-merous, and the compound, superior ovary three to five celled, with two ovules in each cell. The species are widely distributed in temperate and tropical climates, eighteen of which occur in North America. The climbing bittersweet (*Celastrus scandens*) is one of the prettiest woody climbers of the U. S., especially in the winter, when its red-arilled seeds remain long in conspicuous clusters. The genus *Euonymus* includes the spindle-trees proper. *E. atropurpureus* is the ornamental shrub known in the U. S. as the WAHOO (*q. v.*), or burning-bush. CHARLES E. BESSEY.

**Spine**: See SPINAL COLUMN.

**Spinel** (Fr. *spinelle*): a mineral, essentially a compound of alumina and magnesia, but with variations and admixtures that give rise to a great variety of colors and tints. It crystallizes in regular octahedrons, sometimes of large size in the black and opaque kinds. The transparent spinels make beautiful gems, especially the deep-red, flame-red, and carmine-colored stones, which are known as ruby spinels, and command high prices, from one-eighth to one-half that of diamonds, the finest having often been erroneously sold for true rubies. The pink variety is known as balas-ruby or rubicelle, the blue sapphire spinel, the green chlorospinel, the purple almandine spinel. They are also blue, green, yellow, and purple, and even white. The so-called Black Prince's ruby in the English crown is a spinel. The best spinel gems are from Ceylon, Burma, and Siam. G. F. KUNZ.

**Spinel'lo di Luca Spinelli**, called SPINELLO ARETINO: painter; b. at Arezzo, Italy, about 1333. He was the pupil of

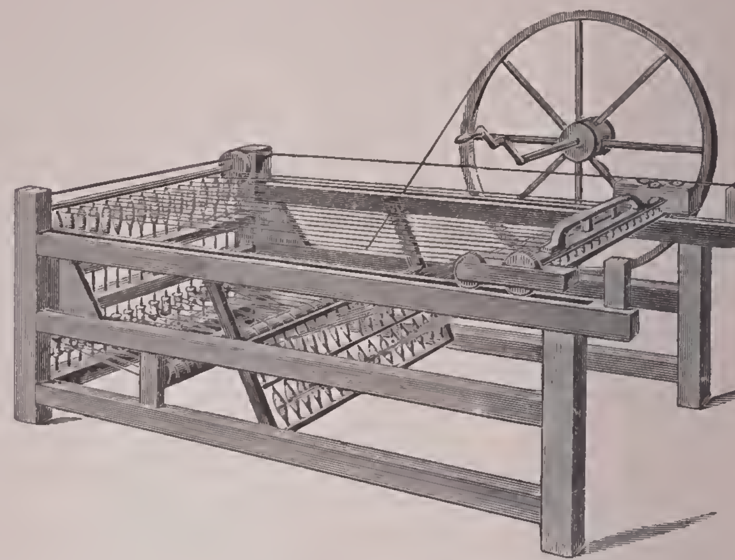
Jacopo di Casentino, and at the age of twenty surpassed his master. It is supposed that in 1347 he was assisting his master to decorate the Church of Santa Maria Novella in Florence with frescoes representing the Virgin and St. Anthony. Of these little remains. Some scenes from the life of St. Benedict, by Spinello, at San Miniato, near Florence, are still in good preservation. These were painted in 1384, when Spinello took refuge in Florence after the sack of Arezzo. Before this date he had decorated many churches in his native city; in San Francesco an *Annunciation* still exists in the chapel of St. Michael. He painted a fantastic composition of the archangel driving Lucifer from heaven, a fragment of which fresco is in the National Gallery, London. This composition was afterward repeated by him for the guild of St. Angelo. In 1361 Spinello painted a panel for the abbey of the Camaldolesi, in the Casentino. The side-frescoes for the altar of Monte Oliveto Maggiore of Chiusi are to be seen in the Ramboux collection at Cologne. In 1387 Spinello was invited to Pisa to work in the Campo Santo there, and painted pictures considered his masterpieces, but now nearly destroyed. He left Pisa on account of political disturbances, and after a year in Florence he returned to Arezzo about 1394. Here he worked, decorating many churches with frescoes till 1405, when he went with his son and assistant, Parri, to Sienna, to paint the series of frescoes still preserved in the town-hall of that city. The last that is heard of him in Sienna is in 1408, after which he returned to his birthplace, where he died in Mar., 1410. For further information, see Vasari (Le Monneer), vol. ii., and Kugler's *Handbook* (1887). W. J. S.

**Spinet**: a musical instrument, stringed and provided with a keyboard; one of the forerunners of the piano, but much weaker, and entirely out of fashion.

**Spinner**, Francis Elias: financier; b. at German Flats (now Mohawk), Herkimer co., N. Y., Jan. 21, 1802; son of a German clergyman; was successively apprentice to a confectioner at Albany and to a saddle and harness maker at Amsterdam, N. Y.; became in 1824 a merchant at Herkimer; was deputy sheriff of Herkimer County 1829–34, and sheriff 1835–37; served in the militia and became major-general; was for twenty years connected with a bank at Mohawk, N. Y., and became its president; was auditor and deputy naval officer of the port of New York 1845–49; Democratic member of the Thirty-fourth Congress 1855–57; was an original member of the Republican party, and re-elected by it to Congress by 9,000 majority in 1856, and again by a similar majority in 1858; was chairman of the committee on accounts 1859–61; was appointed by President Lincoln, on the recommendation of Secretary Chase, to the post of treasurer of the U. S. Mar., 1861; and held the office until July, 1875. During this period his name was a synonym for official integrity, and his curious signature on the "greenbacks" became more familiar in the U. S. than the autograph of any other living man. He was defeated in 1875 as Republican candidate for comptroller of the State of New York. D. at Jacksonville, Fla., Dec. 31, 1890.

**Spinning**: the art of producing from vegetable or animal fibers an even and compact thread suitable for sewing or weaving. It is one of the most ancient of industries, and is still practiced in many parts of the globe by the spindle and distaff in the same manner that the process is pictured on Egyptian monuments. The distaff, held in the left hand, was a simple stick around which the fiber was loosely coiled; the spindle was a species of top which was set in motion by a twirl of the hand, and by combining its rotary motion with a gradual movement away from the spinner, who equalized the size of the fiber by passing it between the finger and thumb of the right hand until the motion of the spindle was exhausted, when the thread was wound around it, and the process was repeated. The first and most obvious improvement consisted in placing the spindle in a frame and making it revolve by mechanical action of the hand or foot in connection with a wheel and treadle. This constituted the spinning-wheel, which, notwithstanding its simplicity, can not be traced further back than 1530. Modern invention has added little to this implement, the chief improvement being a bobbin for winding the yarn by a motion separate from that of the spindle. See Cotton Manufactures.

**Spinning-jenny**: the earliest form of spinning-machine in which more than one thread was spun at a time. Cotton, in the course of manufacture, is reduced from the state of the fleecy roll called carding into the state of spun thread by repeated though similar operations. The first draws out the carding and gives it a very slight twist, so as to make it into a loose thread about the thickness of a candle-wick, in which state it is called a roving or slubbin. The subsequent processes draw out the roving much finer, and


The spinning-jenny.

at length reduce it into yarn. The spinning-jenny, invented about 1764 by James Hargreaves (*q. v.*), was not, like Arkwright's spinning-frame (1769), capable of being applied to the preparation of the roving itself. In 1779 Samuel Crompton completed his invention of the mule, which combined in one machine the principles of both the jenny and the frame, and by which the jenny was ultimately superseded. See Cotton Manufactures.

The person operating the jenny turned the wheel with the right hand and with the left drew out from the slubbin-box the rovings, which were twisted by the turn of the wheel. Next a piece of wood, lifted up by the toe, let down a wire, which so pressed out the threads that they wound regularly upon bobbins placed in the spindles. The number of spindles in the jenny was at first eight; when the patent was obtained it was sixteen. It soon came to be twenty or thirty, and as many as 120 have been used. The introduction of the spinning-jenny met with great opposition. In 1779 a mob destroyed the jennies for several miles around Blackburn, and with them all the carding-engines, spinning-frames, and every machine turned by water or horses. The spinning industry was driven from Blackburn to Manchester and other places. Nevertheless, the jenny and the frame revolutionized the cotton manufacture. William Kent.

**Spi'nola**, Ambrosio, Marquis de: soldier in the service of Spain; b. in Genoa, Italy, about 1571, son of a wealthy Levant merchant and of a princess of Salerno; took service at an early age under his brother, an admiral in the Spanish navy; participated in the war against the Dutch and English 1588; raised and equipped at his own expense in Spain a numerous corps of veterans, at whose head he proceeded to the Spanish Netherlands 1602; was instrumental in rescuing the Archduke Albert from the superior forces of Prince Maurice of Nassau; became chief commander of the Spanish armies in Flanders 1603; and in the fall of that year took command of the forces around Ostend, which had been besieged for two years. The city capitulated in Sept., 1604. He conducted the war with great ability, but varying success, until the truce of twelve years (1609), which he favored; commanded in the interval the Spanish forces in Germany; took Aix-la-Chapelle, Wesel, and Jülich 1622; was repulsed from Bergen-op-Zoom 1623; captured Breda after a protracted siege 1625; was subsequently commander of the Spanish army in Italy, and captured the city of Casale, Piedmont, but died while pressing the siege of the citadel, Sept. 25, 1630. His death is said to have been hastened by his chagrin at the ingratitude of the Spanish Government in disregarding his pecuniary claims.

**Spinoylic Acid**: See Salicylic Acid.

**Spino'za**, (Baruch) Benedict: philosopher; b. at Amsterdam, Holland, Nov. 24, 1632; a member of the Spanish-Portuguese Jewish community at that place, then the chief seat of European Judaism. His father, who was a trader, noticing the extraordinary faculties of the son, gave him a good education. Accordingly, he entered upon the customary path of a Jewish scholar, passing through all the steps of the ordinary rabbinistic school, from the elements of Hebrew to the holy writings of the Old Testament, thence to the Talmud, the Jewish commentaries, and the scholastic writers of the Middle Ages. Jewish literature led him, through the literature of the scholastics, wherein the Cabbalistic doctrine played so prominent a part, gradually to the portals of the then developing modern views of the school of Descartes. In short, the rabbi Spinoza became a skeptic, even as Descartes, the scholar of the Jesuits, had become a skeptic before him. Descartes, however, was enabled to fall back upon Christianity for salvation from skepticism. This Spinoza could not do. Cut loose from Judaism, unable or perhaps traditionally so opposed to it that he did not feel any way inclined to accept Christianity, he was left without any support or guidance. The Jewish God, as the cause and creator of the universe, he had discarded; the Christian conception of God, as the moral harmony and order of the universe, was utterly repugnant to his originally Jewish mind; and thus he had no other recourse left than the so-called pantheism of Substantiality. This rupture with Jewish theology brought about a dispute between him and his rabbinistic teachers, which finally led to his expulsion from the synagogue at Amsterdam (July, 1656). Spinoza wrote a protest against the anathema pronounced against him, but otherwise paid little attention to it. He simply changed his name from *Baruch* to *Benedict* Spinoza, by which last name he is generally known, and when he discovered that he was still persecuted by both the orthodox Jews and orthodox Christians of Amsterdam, he retired to the country-house of a friend in the vicinity of Amsterdam, a member of one of the persecuted sects of Protestants of that time, with whom he lived in deep seclusion from 1656 to 1661. He subsequently accompanied him to Rynsburg, where he remained till 1664, in May of which year he removed to Voorburg, where he remained in the house of the painter Tydenau till 1669. He then, at the entreaty of his friends, removed in 1671 to Scheveningen, near The Hague, where he remained till his death on Feb. 21. 1677. In personal appearance Spinoza was of middle height; his features were regular and well formed, complexion dark, hair curly and black, long black eyelashes, and, as Leibnitz remarks, "with somewhat of the Spanish in his face." To earn his livelihood he learned to grind optical glasses, and also the art of painting. His mode of living was throughout extremely frugal and secluded. He never married.

The ground of the extraordinary interest taken in Spinoza is to be found in the pantheistic view of the universe which he has carried out in the completest of extant forms in his *Ethics*. Hence none of the other works of Spinoza claim special notice. Interesting as they may be in connection with the *Ethics*, they have no intrinsic merit of their own. All his few published minor works, as well as his published correspondence, have their central point in the *Ethics*. Students of Spinoza are here referred, first, to the remarks of Goethe concerning Spinoza's philosophical system; second, to the remarks of G. E. Lessing; and, in this connection, third, to the essays of Jacobi on Spinoza and Lessing. Fichte's works are also full of references to Spinoza. Spinoza's view of the universe may be very concisely described as follows: Adopting the category of substantiality, he altogether abandoned the Jewish conception of a First Cause—a self-conscious Jehovah calling the world into existence by his mere word—and adopted in its place the Oriental notion of an unconscious substance of the universe as a whole, of which all the separate phenomena of that universe—stars, heaven, earth, mankind, animals, plants, and minerals—were but so many attributes. In his scheme there were therefore no God, no Freedom, no Immortality. Whenever he uses the word "God," it is to be interpreted as equivalent to the word "nature" or "universal substance"; when he uses the word "freedom," it is to be understood as the equivalent of "necessity"; and his conception of the word "immortality" means simply that the human soul, after death of the body, will merge again into the infinite substance, wherein no self-consciousness can possibly exist. His God is therefore no God, in the ordinary acceptance of the term; his freedom, no freedom; his immortality, the very reverse of what men mean when they lay claim to being immortal.

To understand thoroughly the style of the *Ethics*, it must always be kept in mind that Spinoza was a Jew, and that the Jewish tendency of mind betrays itself not only in the subject-matter under discussion, but also and equally in its mode of utterance. The style of all Jewish writers is abrupt, disregarding transition, and loving above everything parallelisms, as every chapter of the Bible shows. This explains, although seemingly in a paradoxical way, why Spinoza chose what he calls the "geometrical or mathematical" method for his chief work. The opening sentences are as disjointed as the opening propositions of Euclid; the first does not involve the second, nor the second the third, etc.; and none are proven, nor is there any attempt in the whole book to prove any of them. Hence the very fundamental principles of philosophy, about which alone there is any dispute, are at the beginning of the work laid down as axioms; and, what is equally objectionable, at the beginning of each new part of the *Ethics*, of which there are four parts, new axioms are introduced in the same arbitrary, abrupt manner. That the word freedom had no significance to him in its current meaning is abundantly evident from the following extracts that occur in his letters, wherein he is usually a little more outspoken than in his very guardedly worded published works. Taking the example of a stone thrown by some hand, and hence impelled by an external cause: "Now conceive, further, that the stone as it proceeds in its motion thinks and knows that it is striving, so far as in it lies, to continue in motion; then, inasmuch as it is conscious only of its endeavor, and in nowise indifferent, it will believe itself to be most free, and to persevere in its motion from no other cause than that it wills to do so. *And this is precisely that human freedom of which all men boast themselves possessed, but which consists of this alone—that men are conscious of their desires, and ignorant of the causes by which these are determined.*" To remove the last objection, that we might be free at least in thinking, Spinoza adds: "Your friend, however, affirms that we can use our reason with perfect freedom. . . . 'Who,' he asks, 'without a contradiction of his proper consciousness, can deny that he is free to think his thoughts, to write what he pleases, or to leave writing alone?' . . . I, for my part, and that I may not contradict my consciousness—that is, that I may not contradict reason and experience, and yield to ignorance and prejudice—*deny that I possess any absolute power of thinking, and that at pleasure I can will, or not will, to do this or that—to write, for example.*" The same criticism applies to his doctrine of immortality. There are numerous Latin and German editions of the *Ethics*, and of most of the other of Spinoza's works. English translations and expositions of his works are as follows: *Benedict de Spinoza, his Life, Correspondence, and Ethics*, by R. Willis, M. D. (London, 1870); *The Ethics of Benedict de Spinoza* (anon.) (New York, 1876); *Spinoza, his Life and Philosophy*, by Frederick Pollock (London, 1880); *A Study of Spinoza*, by James Martineau (London, 1882); *The Chief Works of Benedict de Spinoza* (2 vols., Bohn's Library, London, 1883); *Ethics*, translated by W. H. White and Amelia H. Stirling (1894). It includes all his correspondence, a very valuable feature. In German, Kuno Fischer's *Geschichte der neuern Philosophie* (vol. i., part 2) is devoted entirely to Spinoza and his antecedents, and is the most satisfactory work extant on this subject.
Revised by W. T. HARRIS.

**Spiræ'a** [Mod. Lat., from Lat. *spiræ'a* = Gr. σπειραία, meadowsweet, deriv. of σπεῖρα, coil, spire. So called from the shape of its follicles]: a genus of herbs and shrubs of the family *Rosaceæ*, including numerous species, such as hardhack (*S. tomentosa*), queen-of-the-prairie (*S. lobata*), and several other American, besides numerous Old World species, many of them very fine in garden-culture. Some species of *Astilbe* (family *Saxifragaceæ*), having somewhat the aspect of *Spiræa*, are cultivated under this name, incorrectly bestowed.
Revised by CHARLES E. BESSEY.

**Spiral** [from Lat. *spira'lis*, spiral, deriv. of *spi'ra* = Gr. σπεῖρα, coil, spire]: a curve that may be generated by a point moving along a straight line in accordance with a fixed law, while the line revolves uniformly about one of its points, always remaining in the same plane. The portion generated during one revolution of the line is called a *spire*; the fixed point is the *pole*; and the distance from the pole to any point of the curve is the *radius-vector*. If we take any position of the revolving line as the initial radius, and denote the angle through which the line has revolved by $\theta$, and the corresponding value of the radius-vector by $r$, the equation of any spiral may be written $r = f(\theta)$. The most interesting spirals are the spiral of Archimedes and the logarithmic spiral. The former is determined by the law that the radius vector increases uniformly as it revolves, so that the successive spires intersect it at equidistant points along its length.

In the logarithmic spiral the logarithm of the radius-vector increases uniformly, and the radius-vector itself increases by a constant ratio for every equal increment of the angle of revolution. Thus the distances of the points of intersection from the pole form a geometric progression. At every point of this curve the tangent makes a constant angle with the radius-vector. On the inner side the curve continually approaches the pole, which it only reaches after an infinite number of convolutions. The RHUMB (*q. v.*) is a similar curve on the surface of a sphere. Revised by S. NEWCOMB.

**Spiral Ducts** or **Spiral Vessels**: See HISTOLOGY, VEGETABLE.

**Spirants** [from Lat. *spi'rans*, partic. of *spira're*, to breathe]: in phonetics, a class of consonants produced by a friction of the current of breath against the walls of the narrowed organs of the mouth. They are also called fricatives (Germ. *Reibelaute*, *Dauerlaute*, *Schleifer*). Such are *s*, *z*, *sh*, *zh*. *f*, *v*, þ, ð, *ch* (in Germ. *ich*, *ach*), ʒ, and to some extent *r* and *l*. They are distinguished from explosives or stops, *p*, *t*, *k*, etc., by being continuous and not momentary. See CONSONANT. BENJ. IDE WHEELER.

**Spire**, or **Spires**: English name of SPEYER (*q. v.*).

**Spirillum**: See BACTERIOLOGY.

**Spirit-duck**: a common North American duck (*Charitonetta albeola*). The male has the head very puffy and iridescent, hence the name bufflehead. It is an expert diver.

**Spiritism**: See ANIMISM and RELIGION, COMPARATIVE.

**Spirit-level**: See LEVELS AND LEVELING and HYPSOMETRY.

**Spirit-plant**: the HOLY GHOST FLOWER (*q. v.*).

**Spirit-rapping**: See SPIRITUALISM.

**Spiritualism** [from Late Lat. *spiritua'lis*, spiritual, of a spirit, deriv. of Lat. *spi'ritus*, breath, life, spirit, soul (in Late Lat.) ghost, deriv. of *spira're*, breathe]: the creed of those who believe in the communication of the spirits of the dead with the living, usually through the agency of peculiarly constituted persons called mediums, and also in certain physical phenomena, transcending ordinary natural laws, believed to accompany frequently such spiritual communication, and attributed either to the direct action of spirits, or to some force developed by the medium's own personality.

*Revival of Spiritualism.*—The elements of the spiritualistic creed are not in themselves new, but are traceable severally to a high antiquity among different races and in widely separated localities, and have usually been associated with some form of religion; they have been revived, though not of conscious purpose, and gathered into one body of beliefs by a movement having its origin as the result of certain incidents which took place at Hydesville, a small town in the State of New York, in 1848.

In March of that year rapping sounds were heard, apparently proceeding from the furniture, walls, and ceilings, of a house in Hydesville, belonging to a family of German descent named originally Voss, a name anglicized into Fox. It was found that these sounds were always perceived in the presence of one or both of the young daughters of Mr. Fox, and that a code of communication could be established by which conversation was carried on with the intelligence supposed to produce them. It was said that in this way evidence was obtained concerning a murder believed to have been committed in the house some time before, and the sounds purported to come from the spirit of the murdered man. Many years after, in 1888, Mrs. Kane (Margaretta Fox) came before the public with a confession that she and her sister had made the sounds with their toes; but before her death she repudiated this confession.

*Noted Mediums.*—The reported phenomena at the time excited widespread attention in the U. S. and led to the formation of numerous circles of experimenters, where rappings of a similar kind were produced, and supposed communication with the spirits of the dead was established. To the spirit-rappings were added other phenomena, such as table-turning, automatic writing, trance-speaking, etc.; and the persons who developed them received the name of mediums. Mediums, according to the spiritualistic view, are endowed with a special faculty enabling them to be the agents of the communications and other manifestations of spirits. Some show evidence of this gift in early youth, and others gradually develop it in later years. The first medium, after the Fox sisters, was Andrew Jackson Davis, who attracted notice in 1845 as a clairvoyant and later as a trance-speaker. Judge Edmonds, a well-known lawyer of New York, may also be mentioned; he began an investigation of the subject, became convinced that he was himself in communication with spirits, and wrote an elaborate work on spiritualism. Mrs. Hayden, another native of the U. S., went to England in 1852, and her séances there started the spiritualistic movement which eventually spread over all Europe. In 1855 the celebrated Daniel D. Home also went to England, and later to the Continent. With Home spiritualism reached its highest development, and private and professional séances were established in almost every European town.

Home overshadowed all contemporary mediums, and gained adherents to spiritualism from every intellectual and social class. He was, according to numerous witnesses, equally successful in receiving spiritual communications and in producing physical phenomena, which were witnessed and often severely tested by competent observers. Notable experiments in testing Home's powers were made by William Crookes, by means of apparatus of his own construction, with successful results.

Some years later Slade, and also Eglinton, attracted much attention in Europe by their so-called psychography, or spirit-writing (usually produced on slates), which led to interminable discussion in the press occupied with such matters. The spiritualists attributed this psychography to the spirits, and the non-spiritualists asserted it to be due to conjuring. Slade also gave séances for a variety of spiritualistic phenomena, and achieved special notoriety from a series of sittings with Prof. Zöllner, of Leipzig, who, in *Transcendental Physics*, recorded his belief that the phenomena he had witnessed were due to intelligent "fourth-dimensional" beings.

One of the most noted mediums in England was the Rev. William Stainton Moses, who died in 1892. A full account of his experiences has been published in the *Proceedings* of the Society for Psychical Research. He claimed to receive communications from spirits, both of those recently departed and of personages belonging to remote generations. The list of his physical phenomena, according to his own account and the evidence recorded by the witnesses at his séances, comprised most of those produced by Home and other manifestations as remarkable. Mr. Moses was for several years editor of *Light*, a London spiritualistic periodical, and was, besides, a busy clergyman and school-master of high reputation, and in no sense a professional medium.

In 1892 a series of sittings under unusually stringent if not perfect conditions was held by a committee of Italian savants, among others Schiaparelli, director of the Observatory of Milan, Profs. Gerosa and Brofferio, with a Neapolitan medium, Madame Eusapia Palladino, with the result that several of this committee were convinced of the supernormal character of the phenomena observed, while the others, if not quite convinced, were unable to offer any satisfactory explanation of what they had seen. The phenomena consisted in alterations in the weight of the medium, raps, moving of furniture, and materialization of hands. The séances of Madame Palladino have attracted much attention in Italy, and are remarkable for having influenced the thought of numerous persons of high intellectual standing.

*Spiritual Communications.*—Spiritualistic communications or messages are received through the automatic writing with pencil or planchette, or trance-speaking of the medium when under spirit-control; by direct writing of the spirits on paper or slates with pencil or chalk; by precipitated writing—that is, writing supposed to be produced on paper without visible means; by table-turning, either with or without contact of the medium, and interpreted by a conventional code; and by raps on the furniture or walls of a room, made intelligible by a code as in table-turning. These communications are supposed to have two objects—one is to convey proof of the survival of the dead, the other to instruct in moral and philosophical knowledge. They are acknowledged by spiritualists to vary greatly in character and in value. Some are merely the expression of the ideas and opinions of the medium himself or of the sitters; some are trivial or false, and are attributed to a low order of mischievous spirits: others, however, it is asserted, are genuine and imply a knowledge of events or of facts beyond the range of the medium or of the inquirers, and proving their supernormal origin.

*Physical Phenomena.*—The principal so-called physical phenomena of spiritualism are lights, musical sounds, as of invisible instruments played on or playing of real instruments by invisible or materialized hands; moving of furniture and other heavy objects; the passage of matter through matter, as bringing flowers or other material objects into closed rooms; materializations of hands or other parts of the body or of complete human figures; spirit-photography; and, finally, phenomena immediately affecting the medium, such as levitation or floating in the air without visible support, the elongation or shortening of his body, and fire-tests, when the medium handles live coals and gives them to others to handle without injury, phenomena for which Home was especially renowned.

The object of these phenomena is considered by spiritualists to be the attestation of the genuineness of the communication, and they bear to spiritualistic belief much the same relation that miracles do to revealed religion. Phenomena of undignified character, like the corresponding communications, are attributed to the lower orders of spiritual beings. All these phenomena do not occur at all séances or with all mediums, and the latter are often classified according to the predominant character of their special "development." Thus there are writing mediums, trance mediums, materializing mediums, etc. A few, such as Home and Stainton Moses, seem to have been equally successful in every variety of manifestation.

*Non-spiritualistic Evidence for "Phenomena."*—Count Agénor de Gasparin carried out an elaborate series of experiments in moving tables without contact, a full account of which he published under the title *Des Tables Tournantes*. His circle consisted of himself and his family and a few skeptical witnesses whom he admitted to his séances. The experiments were made in full light, the members of the circle joining hands and concentrating their will upon the object to be moved, a condition considered by de Gasparin to be essential to success. De Gasparin, scouted the idea of the intervention of spirits in the movements he describes, and attributed them to a mental force capable of acting upon matter without the agency of muscular action. *Des Tables Tournantes* is a body of evidence very carefully recorded, and deserves attentive consideration in connection with the study of these obscure and disputed phenomena. Prof. Barrett and others have also placed on record experiences in various phenomena usually called spiritualistic, but in their case not produced in the presence of professional mediums, where, too, the hypothesis of fraud seemed to be a difficult one.

*Theories of Apparitions and Materialized Spirits.*—A typical belief is that of Allan Kardec, who asserts that the human personality consists of the body, the soul or spirit, and a spiritual body ("périsprit") of a rarefied material, and that after death the spirit can manifest itself to the senses through the périsprit, which by some force of the will or through the agency of the medium becomes visible like vapor condensed under certain atmospheric conditions.

Another theory of the materialization of spirits is that the spirit draws from the medium certain emanations by which it can make itself wholly or in part visible in a temporary reduplication of the medium's body. While materialized the spirit remains in close rapport with the medium, and at the end of the séance or on any sudden disturbance repercussion takes place—that is, the materialized body at once withdraws into the organism of the medium.

*Exposures of Fraud.*—Spiritualists acknowledge that many exposures of fraud in mediums have been made. They assert, however, that such fraud is to be expected occasionally in professional mediums, since their living depends upon the production of phenomena and the necessary power is very uncertain. They also say that the trickery is generally of a rather simple kind, and that the genuine phenomena are unmistakable and not to be so explained, and that therefore occasional trickery does not necessarily prove habitual bad faith on the part of a medium.

Spiritualists further contend that numerous exposures have been only apparent, and that much injustice has been done. This view is founded on the theory of repercussion, namely, that the materialized form when disturbed disappears, thus leaving the medium in the exposer's grasp and creating the impression that the medium has himself impersonated the spirit-form.

*Relation of Spiritualism to Religion.*—Spiritualism is not an independent religion, but its manifestations are regarded by spiritualists as corroborating those ethical teachings of Christ in which all the sects of the Christian religion substantially agree. It does not modify in any specific manner the creeds or dogmas of Christian sects, and among spiritualists are to be found persons of every shade of belief from Roman Catholic to Unitarian. To this general statement one important exception may be noted. There is in France a large class of spiritualists who believe that the existence of the soul is one of alternate spirit-life and reincarnation.

The main points of spiritualistic belief, then, as it touches religion are that at death the character undergoes no sudden change, but retains the impress of the actions and thoughts of the earthly life; that the soul enters upon a course of steady progress toward improvement; that there are in the other life occupations and interests as in this world; that all work together for the attainment of the perfect life; and that happiness depends upon the degree of moral advancement.

In 1900 there were 334 spiritualistic organizations in the U. S., with 45,030 members.

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THOMAS C. FELTON.

**Spirochæ'tæ**: See BACTERIOLOGY.

**Spir'ula** [Mod. Lat., dimin. of Lat. *spi'ra*, coil]: a genus of ten-armed dibranchiate cephalopods, of which there are three species, found in most warm seas. They constitute a family, *Spirulidæ*, which has interesting relations to the nautilus and the ammonites. The extremely delicate, nacreous, chambered shell is especially common on the New Zealand shores, but the animal itself is very rarely seen in a perfect condition. Revised by D. S. JORDAN.

**Spit'head**: a roadstead off Portsmouth, England, being the eastern portion of the sea-channel separating the Isle of Wight from the English mainland. (See PORTSMOUTH.) Its security as an anchorage, being protected from all winds except those from the S. E., its contiguity to the great naval establishment at Portsmouth, and its proximity to the coasts of the Continent make it a favorite rendezvous of the British navy. Spithead has been strongly fortified since 1864. Besides the works on the Isle of Wight and on the mainland there are five iron-plated works, built from the bottom, which are among the most remarkable specimens of modern iron-plated fortification.

**Spitzberg'en**: Arctic archipelago; 400 miles N. of North Cape of Norway; between 76° 30′ and 80° 30′ N. lat., and 10° and 30° E. lon.; consisting of West Spitzbergen, Northeast Land, Stans Foreland, King Charles Land, Prince Charles Foreland, and many smaller islands. Area, 27,000 sq. miles, with no permanent inhabitants. The islands are mountainous, the peaks often rising between 4,000 and 5,000 feet, and mostly covered with perpetual snow and ice. Only along the shore between the ocean and the mountains are in some places found patches of land, where during the two summer months, when the thermometer rises 10° F. above the freezing-point, the snow melts and a few herbs appear. The mountains contain granite, marble, and coal. Bears, reindeer, and foxes are found, and innumerable whales, seals, and sea-fowl gather along the shores. The islands were discovered in 1553, and visited in 1596 by the Dutch navigator Barentz while seeking a northeast passage to India. The group forms occasionally the base of operations for Arctic expeditions. Revised by M. W. HARRINGTON.

**Spitz Dog** [used as transl. of Germ. *spitzhund*]: the Pomeranian dog, a small variety which is thought to be a cross between some of the Arctic wolf-dogs and the Arctic fox, like the Esquimaux, Siberian, Lapland, and Iceland dogs, to which, though much smaller, it has a marked resemblance. It is characterized by short and erect ears, a pointed muzzle, a curved bushy tail, and long hair, usually pure white, but sometimes cream-color or even deep black. It is brisk in its movements, useful as a watch-dog, somewhat snappish, handsome, quick of apprehension, and a favorite lapdog in Europe and the U. S.

**Spitzka**, EDWARD CHARLES, M. D.: neurologist; b. in New York Nov. 10, 1852; M. D., University of City of New York, 1873; studied University of Leipzig 1873; University of Vienna 1874; Assistant Professor of Embryology at Vienna 1874–75; Professor of Medical Jurisprudence, New York Post Graduate Medical School, 1881–82; Professor of Neurology there 1882–84; consulting neurologist St. Mark's Hospital and Northeastern Dispensary; vice-president International Medical Congress at Washington 1887; honorary president Pan-American Medical Congress 1893; author of *Insanity, its Classification, Diagnosis, and Treatment*; articles on *Organic Brain* and *Spinal Cord Diseases* in Pepper's *System of Medicine*; *The Architecture and Mechanism of the Brain* in Wood's *Handbook of Medicine*; *Insanity in Children* in Keating's *Cyclopædia*; and numerous professional essays. C. H. THURBER.

**Spleen** [from Lat. *splen* = Gr. *σπλήν*; cf. Lat. *lien*: Sanskr. *plīhán-*, spleen]; the largest of the ductless glands of the body. In man, it is situated in the left hypochondriac region, its outer convex surface corresponding with the ninth, tenth, and eleventh ribs, from which it is separated by the descending muscular attachments of the diaphragm; its inner concave surface adjoins the great pouch of the stomach. It also comes near to the pancreas, left kidney, left lobe of the liver, and arch of the colon. It is held in position by a peritoneal reflection from the diaphragm, called the suspensory ligament. It is even more directly related to these adjacent viscera by its blood-supply, the splenic artery being the largest branch of the cœliac axis, the trunk which gives off the nutrient vessels of the stomach, liver, and parts of the small intestine. The variable size and gross and minute structure of the spleen indicate that it is a great vascular reservoir. In health it is 5 inches long, 3 to 4 thick, and 1 to 1½ in breadth, and weighs 7 oz.; it is larger immediately after eating, and in malarial and certain other diseases may weigh 15 or 20 lb., and occupy the abdomen down to the pelvic bones. The fibrous capsule of the spleen is very elastic; it is reflected inward on the vessels as they subdivide, thus forming a system of ramifying partitions, which constitutes the fibrous framework of the spleen. The interspaces of this structure are occupied by the substance of the spleen, a soft, pulpy mass of dark, reddish-brown color, consisting of granular matter, red and white blood-cells, and the Malpighian corpuscles—masses of lymphoid cells closely packed about the terminal arterioles.

The functions of the spleen are not definitely known, but it is certainly the birthplace of both white and red blood-corpuscles. It is active also in the destruction of red corpuscles, but less so than was formerly supposed. It is not an indispensable organ, for it has been removed in animals and men with no serious or marked result. The spleen is frequently congested in the course of infectious diseases, such as typhoid fever, malaria, typhus fever, and the like, and is often permanently enlarged by repeated congestions, infiltration, and hypertrophy of its tissue. There may be supernumerary spleens. The spleen is liable to rupture and fissure from external violence. See HISTOLOGY.

Revised by W. PEPPER.

**Splint**: a bony growth, generally upon the inside of the fore leg of the horse, below the knee. In young horses it is usually caused by overwork. Rest, poulticing, and packing with cold wet compresses are recommended for the early stages. At a later stage, iodine, mercurial ointment, blisters, and the actual cautery may be usefully employed, but not till the inflammation is gone. If the tendons are interfered with, veterinary surgeons sometimes remove the splint.

**Splint**: in surgery, a piece of wood, leather, pasteboard, gutta-percha, metal, or other material employed to prevent displacement of the fractured ends of bones or for other analogous purposes. In many cases surgeons use bandages stiffened with gypsum, starch, dextrine, or gum-arabic in the place, and a very great number of splints have been devised for special purposes in surgery. See FRACTURE.

**Splü'gen**: a mountain-pass of the Alps leading from the Swiss canton of the Grisons into Italy over an elevation of 6,946 feet. On the Italian side it is covered at many places with galleries of solid masonry to protect travelers from avalanches. These galleries were built by the Austrian Government, and finished in 1834.

**Spofford**, AINSWORTH RAND, LL. D.: librarian; b. at Gilmanton, N. H., Sept. 12, 1825; received a classical education by private tuition; was employed in publishing and editing; became principal librarian of Congress 1865, and first assistant 1897; is member of many historical and philosophical societies; has written much for the press on historical topics. He has published *Catalogues of the Library of Congress*; *The American Almanac and Treasury of Facts* (1878–89); *The Library of Choice Literature* (1881); *Library of Historic Characters and Famous Events* (1894); and other works. During his tenure of the office of librarian the national collection grew from 90,000 to over 700,000 volumes, and the change in the law of copyright was effected by which all copyrights are entered and all facts regarding literary property verified at one central office at the Library of Congress, Washington, D. C., instead of being scattered, as was the case prior to 1870, in the offices of the district clerks throughout the country.

**Spofford**, HARRIET ELIZABETH (*Prescott*): poet and story-writer; b. at Calais, Me., Apr. 3, 1835; removed at the age of fourteen to Newburyport, Mass.; attended school at Derry, N. H., and early began writing stories for the magazines; married in 1865 Richard S. Spofford, a lawyer of Boston, and subsequently resided at Amesbury, Mass. Among her publications are *Sir Rohan's Ghost* (1859); *The Amber Gods, and other Stories* (1863); *Azarian* (1864); *New England Legends* (1871); *A Thief in the Night* (1872); *Art Decoration applied to Furniture* (1881); *The Marquis of Carabas* (1882); *Poems* (1882); *Hester Stanley at St. Mark's* (1883); *Ballads about Authors* (1887); and *A Scarlet Poppy* (1894). Revised by H. A. BEERS.

**Spohr**, LUDWIG: composer; b. at Brunswick, Germany, Apr. 5, 1784. His father was a physician. He was early noticed by the Duke of Brunswick, placed on the civil list, and furnished with means for study and travel. His masters on the violin were Maurer and Eck; visited Russia; in 1804 began his professional career in Germany; was concert conductor under the Duke of Saxe-Coburg-Gotha; in 1813 was in Vienna, in 1816 in Italy, in 1817 in Frankfort and London. A residence of some years in Dresden followed, and continued till he was called to the office of chapel-master at Cassel. D. Oct. 22, 1859. Spohr was possessed of fine sensibility and immense activity. Skillful in construction, elaborate in finish, a master of harmony and instrumentation, poetic in sentiment, imaginative, sympathetic, he ranks with the great, although not the greatest, composers. He was the violinist *par excellence* of his day. His book of instruction for the violin is a standard work. He composed in nearly every style—duos, quartettes, quintettes, sonatas, variations, overtures, cantatas, nine symphonies, five or six operas, several oratorios, songs with pianoforte accompaniments. His most famous pieces are the symphony *The Consecration of Tones* and the oratorio *The Last Judgment*, which is rather a collection of musical gems than an evenly developed structure. A vein of mournful tenderness pervading his compositions suggests monotony and mannerism. A critic has said that "if all the works of Spohr could be destroyed except one specimen in each class of composition, it would be of advantage to his reputation."

Revised by DUDLEY BUCK.

**Spoils System**: in politics, the system of bestowing public offices upon members of the party in power as rewards for political services. See CIVIL SERVICE AND CIVIL SERVICE REFORM.

**Spokane'**: city; capital of Spokane co., Wash.; on the Spokane river, and the Gt. Northern, the N. Pac., the Or. Railway and Nav. Co., and the Spokane Falls and N. railways, the Central Washington R. R., the Kootenai Valley R. R., the Spokane and Idaho R. R., and the Spokane and Palouse R. R.; about 15 miles W. of the boundary-line between Washington and Idaho (for location, see map of Washington, ref. 3–J). It is at the falls of Spokane river, and has a very picturesque location. The business portion is built about the falls, with broad streets running N. and S. and E. and W., and some of the residence districts are on higher ground. The streets are lighted by electricity, and the view from the hill, S. of the city, is at night particularly striking. The more important buildings are the city-hall, of brick and granite; the opera-house, seating 1,500; and the county court-house. The city has an excellent system of drainage and of water-works. The business streets are paved with asphalt.

*Churches and Schools.*—Spokane is the seat of a bishopric in the Protestant Episcopal Church, and the Jesuits have two or three church buildings, several parochial schools, and a college—Gonzaga College. The Jesuit missionaries came to Spokane when it was a mere village, and acquired an extensive tract of land, now within the city limits, by which their college has become well endowed, and it is now one of the finest educational institutions in the Northwest. The city has 16 public-school buildings, including a high-school building, ranging in cost from $15,000 to $100,000. One hundred and forty-eight teachers are employed, and there is a daily attendance of 6,233 pupils. The Sisters of the Sacred Heart maintain a hospital and an orphan home, and the Protestant women have established a Home for the Friendless, and a Protestant hospital (St. Luke's).

*Finances and Banking.*—In 1900 the city had a property valuation of $19,500,000 and a bonded debt of $1,320,000. The receipts from all sources are about $400.000 per annum and expenditures something less. The tax levy is 11 mills. There are four national banks with combined capital of $850,000 and surplus of $362,000. Bank deposits $4.948.775.

*Business Interests.*—The river is not only a source of abundant and superior water-supply, but it has a series of falls over a distance of half a mile as it passes through the city, from which power is obtained to operate about 36 miles of electric street-railway, many mills and factories, an electric-lighting plant, printing-presses, elevators, and small machinery generally. This admirable water-power has made Spokane an important center for the manufacture of flour. The output of the mills for 1900 was 357,080 barrels, mostly exported to Japan and China. Four breweries have an annual output of 55,000 barrels.

*History.*—In 1879 the site of Spokane was occupied by an Indian trading-store and a sawmill. The Northern Pacific Railroad was completed as far as Spokane in 1884, and from that time the place had a rapid growth. It became the chief supply-point for numerous mines of gold and silver in Washington, Idaho, and British Columbia, and a very rich agricultural region to the S. When at the height of its prosperity, in Aug., 1890, it was almost wholly destroyed by fire, the burnt area covering about 60 acres. More than $6.000.000 was invested in business blocks within two years. During the same period there was a rapid concentration of railways here. The Union Pacific was the second transcontinental line to arrive, and the Great Northern came in 1892. The main lines built numerous branches in all directions from the city, and the Spokane and Northern, an independent road, was built into British Columbia. At the close of 1892 Spokane had eight railways, and had become one of the most important railway centers of the Pacific coast. In the winter of 1894–95 its citizens gave 1,000 acres of land adjoining the city to the U. S. Government in consideration of the establishment thereon of a large military post, and Congress passed a law in Jan., 1895, creating the post, Fort Wright. Pop. (1880) 350; (1890) 19.992; (1900) 36.848. EDITOR OF "SPOKESMAN-REVIEW."

**Spole'to** (anc. *Spole'tium*): town: in the province of Perugia, Italy; about 60 miles N. N. E. of Rome, on a slight elevation, the crater of an extinct volcano (see map of Italy, ref. 5–E). The old castle, whose foundations date from the time of Theodoric, stands on a height above the town, from which it is separated by a chasm-like valley spanned by a bridge 670 feet long and 280 feet high, originally Roman, but rebuilt, probably in the tenth century, and now serving as an aqueduct as well as bridge. The old Roman arched gateway, known as the Porta della Fuga, is, according to Livy, a monument of Hannibal's time. The grand Palazzo Comunale has a tower of the eleventh century. Pop. 7,690.

**Spondias**: See HOG-PLUM.

**Sponge-fisheries**: those industries which consist in gathering the sponge of commerce, which is the fibrous, horny framework remaining when the fleshy matter has been washed away from one of the *Ceratospongia*. The softness, and consequent value, of a sponge depends on the fineness and elasticity of the fibers, and this varies, even in the same species, according to the conditions under which the sponge has lived. The best sponges grow in clear, quiet water, from 150 to 200 feet deep, those found where the water is shallow or turbid being coarser in texture. The principal commercial sponges are *Spongia officinalis*, which includes the toilet-sponges and Turkey sponges of the Mediterranean and the glove-sponge of Florida and the Bahamas; *Spongia equina*, containing the horse-sponge of the Mediterranean and the sheep's-wool-sponge, velvet-sponge, and the grass-sponge of American waters; *Spongia agaricina*, comprising the zimocca of the Mediterranean and the yellow and hard-head sponges of America. There are numerous varieties of these species, while commercially from fifteen to twenty-five grades are recognized. These range in value from twenty-five cents to $50 per pound, the fine Turkey sponges being the most expensive. The greater portion of the sponges of commerce, as well as the best qualities, come from the Mediterranean and Adriatic, along the line of coast extending from Ceuta, on the northern coast of Africa, to Trieste. Some sponges are also taken in the Red Sea, and large quantities, mostly of the coarser varieties, in Florida and the Bahamas. Good sponges also occur off the Australian coast and at other points in the Pacific, but as yet they have been gathered only for local use.

*Methods of Gathering Sponges.*—Sponge-fisheries are mostly carried on from small rowboats, and where larger craft—ranging from 5 to 50 tons—are employed they are used to transport the boats to the fishing-grounds and to market the catch. The greater portion of the sponges are wrenched from the bottom by a spear with four or five prongs; but, owing to the weight of the handle, this implement can be used only in water under 40 feet deep; beyond that depth divers are employed, or in some localities a dredge. In connection with the spear a water-glass is commonly used, this being a tube of wood or metal 3 or 4 feet long, with an end of plain glass. When this is lowered into the water the bottom can be seen through it plainly. In some localities in the Mediterranean the primitive method is followed of tossing a stone dipped in oil ahead of the boat. There are some variations in the process of preparing sponges for market, but in the main it is as follows: After the sponge has been taken from the sea it is exposed to the air until decomposition sets in, and is then beaten with a stick or trodden under foot in water till the soft parts are removed. In Florida the practice is to place the sponges in pens, where the animal matter decomposes, and is washed out by the tide. After cleaning, the sponges are bleached, dried, and baled. The annual import of sponges into Great Britain is about $1,000,000. The Florida sponge-fishery for 1890 amounted to 366,772 lb., worth $438,682. Successful experiments have been made in cultivating sponges, but as yet the work has not been carried on on a large scale. Fresh sponges are cut into pieces about an inch square, care being taken to injure the outer skin as little as possible. The cuttings are skewered on bamboo rods, each rod bearing three pieces, and these are attached to boards and sunk in favorable localities. The drawback to sponge-culture is the fact that it requires from three to seven years for a sponge to attain a marketable size; on the other hand, small or ill-shaped sponges, which would otherwise be of little or no use, can be used in this way. F. A. LUCAS.

**Sponges** [from O. Fr. *esponge* > Fr. *éponge* : Ital. *spunga* : Span. *esponja* < Lat. *spongia* = Gr. *σπογγιά, σπόγγος*]: the members of the group *Spongida* or *Porifera* of zoölogists. The sponges are animals of remarkably uniform structure, although varying greatly in appearance. In all forms three layers may be distinguished: (1) a flattened layer of epithelial cells (ectoderm) covering the outer surface; (2) a digestive layer (entoderm) of columnar cells, each with its free end surrounded by a delicate collar, from which projects a whip-like flagellum; and (3) between these two a third layer (mesoderm), in which the skeletal elements and the reproductive cells arise. In the simplest sponges these layers are arranged in the form of a cup, the hollow or cloaca being lined with entoderm, the outer surface covered by ectoderm, the mesoderm being between the two. In other forms the arrangement becomes more complicated. All over the outer surface are minute openings or pores which communicate with canals, and through these water enters the mass of the sponge. In this the canals branch and supply large numbers of chambers (*ampullæ*) lined with entoderm, and from these ampullæ the water is collected into excurrent canals and transported through the cloaca to the exterior. In any common sponge the general course of these canals

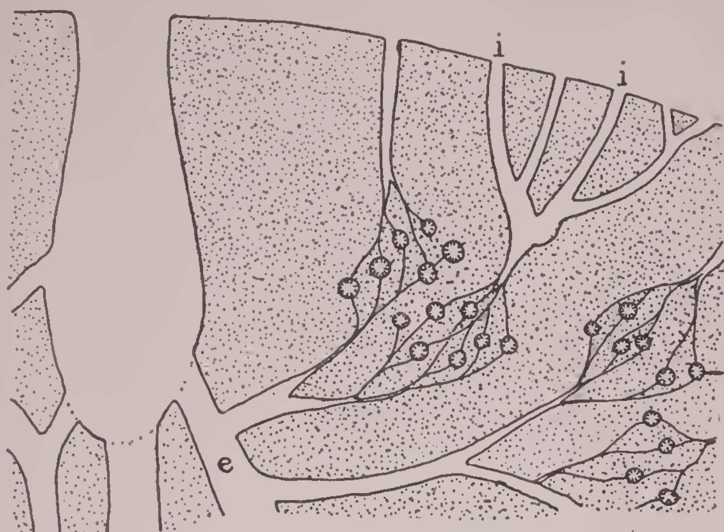


Fig. 1.—Diagram of a part of a sponge showing the pores and incurrent canals, *i*, communicating with the ampullæ, *a*; and the excurrent canals, *e*, leading from the ampullæ to the cloaca.

can be traced among the fibers. (See Fig. 2.) In these forms the digestive layer is restricted to the ampullæ, while the ectoderm lines all the canals. Nourishment is obtained from minute particles drawn in with the water which is constantly passing through the body.

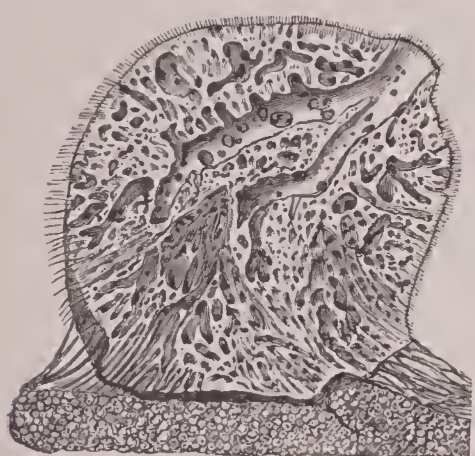

Fig. 2.—Section of a sponge (*Tethya*) showing the cloaca and the canal system in outline.

In some sponges no skeleton occurs, but in the majority some framework is necessary to support the weight of the flesh. The skeletal elements are of two kinds, spicules and fibers, and these are greatly different, both in appearance and in origin. The spicules are extremely regular, although they vary greatly among different sponges. Each spicule is the product of a single cell, and is formed on the outer surface of the secreting body. These spicules are of two kinds; in the one they are composed of calcium carbonate, in the other

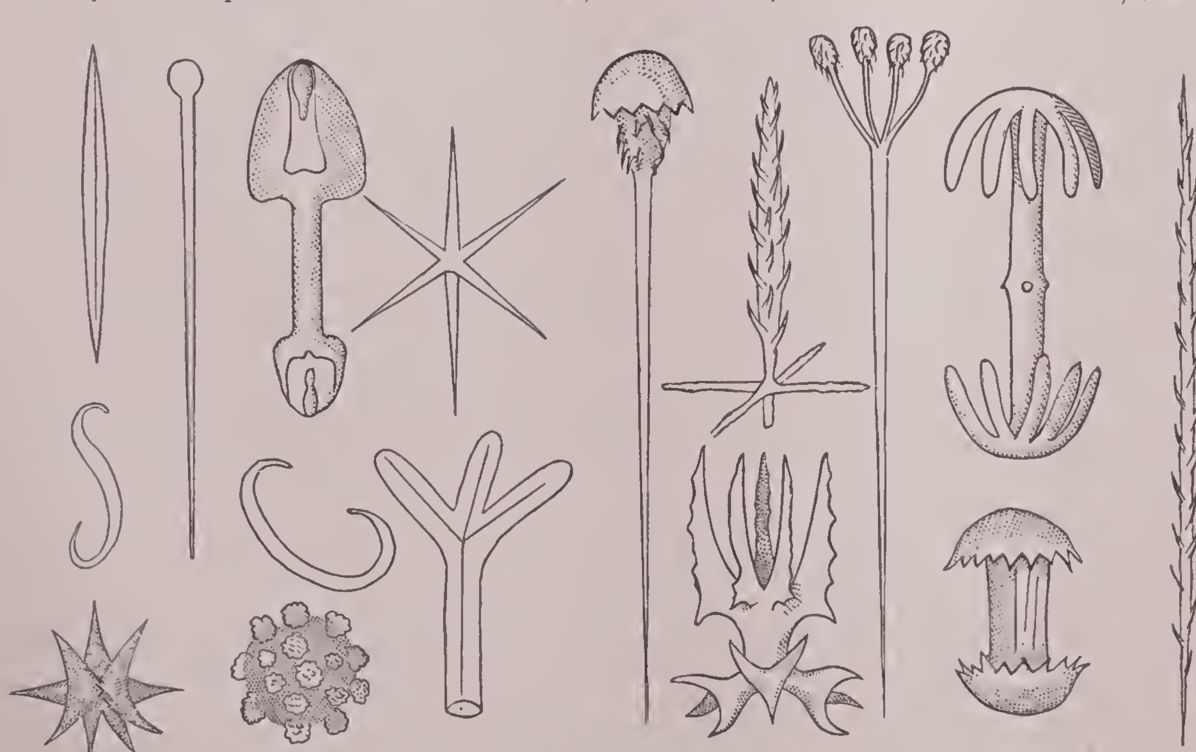

Fig. 3.—Different kinds of sponge spicules, enlarged.

of silica; and upon this chemical basis sponges are divided into two classes. Fibers and siliceous spicules may occur in the same sponge. The fibers form a continuous network, and are the result of secretion from the ends of numerous cells. Chemically they consist of a peculiar organic sub-

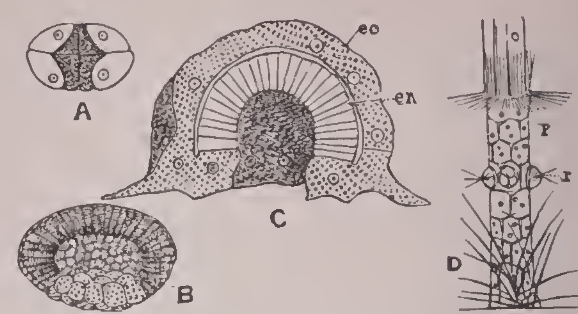


Fig. 4.—Development of a calcareous sponge (after F. E. Schulze): A, early segmentation of egg; B, blastosphere stage (close of segmentation); C, gastrula after fixation; D, young sponge after formation of spicules; *ec*, ectoderm; *en*, endoderm; *p*, incurrent pores; *o*, ostiole; *r*, radial tubes.

stance known as spongin. When spicules and fibers occur in the same sponge the spicules are imbedded in the fibers.

In the mesoderm (the layer which forms the skeletal elements) are the reproductive elements. These consist of eggs and sperm-cells, and it is only after the union of these two that the egg will develop. In the process of development the egg segments (see Embryology), and then, in the forms most studied, one side of the egg pushes into the other, thus giving rise to the embryo known as a gastrula, in which ectoderm and entoderm are differentiated. The gastrula becomes fixed to some solid body, and pores break through the wall, forming the beginning of the incurrent-canal system. Later the excurrent opening or ostiole is formed, and all subsequent changes are the result of partial division or budding from this larva. The skeleton arises early, and in its future growth keeps pace with the general growth of the sponge.

Fig. 5.—*Leucosolenia*, one of the calcareous sponges, and three of its spicules, enlarged.

Various systems of classification of sponges have been advanced. The best seems to be that which divides the group or branch into two classes, *Calcarea* and *Silicea*. The *Calcarea* (those with calcareous spicules) are all small, marine, and without any economic importance. According to the complication of structure they are subdivided into three orders. Fig. 5 is an illustration of one of the simplest forms.

The great majority of sponges belong to the *Silicea*, in which spicules, when present, are siliceous in character. Some forms, however, are degenerate, and have lost the spicules, while in a few, which form their incrusting sheets, all skeletal structures are absent. Three orders of *Silicea* may be recognized. In the first, or *Hexactinellidæ*, the spicules are six-rayed, and the resulting skeleton is extremely regular. These forms occur as fossils and in the deeper parts of the ocean, and include the "glass-rope sponges" and that beautiful form termed the "Venus's flower-

basket sponge." In the second order, *Lithospongiæ*, the spicules are never united by horny fibers. Here belong the large sponges known as "Neptune's-cup," and from this group have apparently come those forms without skeleton. The last division, the *Cornacuspongiæ*, have horny fibers, while spicules may or may not be present. In this group belong the only fresh-water sponges, several species of which inhabit the rivers and ponds of the U. S. The decay of these frequently injures the water-supply of cities. To this same group also belong the sponges of commerce. For the preparation, etc., see SPONGE-FISHERIES. The literature of the sponges embraces nearly 2,000 titles. The list to 1886 can be found in Lendenfeld, *Systematic Position and Classification of Sponges* in *Proc. Zoöt. Soc. London* (1886). Important later papers are Vosmaer, *Porifera*, in Bronn's *Klassen und Ordnungen des Thierreichs* (1887); Schulze, *Hexactinellids*, in vol. xxi. of *Zoölogy* of Challenger voyage.
J. S. KINGSLEY.

**Sponsors** [from Lat. *spon'sor*, promiser, surety, (in Late Lat.) sponsor, deriv. of *sponde're*, *sponsum*, promise solemnly; cf. Gr. σπένδειν, make a libation to the gods]: in general, those who in any way become surety for another; specifically, one who at the baptism of an infant promises in its name that it shall lead a Christian life: a godfather or godmother. The sponsors also bind themselves to see to it that the child shall receive Christian training. Usually, in the Roman Church, there are two sponsors, a man and a woman, and the relation of godfather or godmother and godchild is held to be a real one, precisely as though it were one of consanguinity. The rule of the Church of England calls for three sponsors, two of whom are of the same sex as the godchild, and no impediment to marriage is created by this relation; the present Anglican rule also permits parents to act as sponsors.

**Spontane'ity** [Mediæv. Lat. *spontaneitas*]: a term used in philosophy to express self-origination. It is sometimes confounded with freedom. Freedom involves not only spontaneity, but also conformity to law or consistency with itself. Mere spontaneity may contradict each act by its successor, and thus its entire series may reduce to zero, thus preventing its realization by external acts. The existence of spontaneity is denied by strict necessitarians, who think all events under the form of causality, making each effect to flow from an external cause; but an examination of the presuppositions of necessity discovers that the ultimate cause—the "totality of conditions"—must be self-determining or spontaneous. Everything that happens must ultimately flow from a spontaneous activity. This spontaneity—all spontaneity—likewise can be shown to be personal will or else dependent on it in the last analysis. Cousin laid much stress in his philosophy upon the spontaineity of reason as contradistinguished from its reflective activity. While reflection depends on the arbitrary will of the individual, and is subject to error, the spontaneous original activity of reason is above reflection and arbitrariness, and not liable to error. Such a theory of reason was applied to the support of *a priori* ideas upon which the eclectic system was built. Schelling's "intellectual intuition" and Reid's "common sense" were used much in the same way; also, "intuition of the reason," which cognizes *a priori* ideas, according to many contemporary philosophers, corresponds to Cousin's "spontaneity." It is noteworthy that Fichte regarded the philosophic perception of the principles of the true science of knowledge to be a higher order of reflection—as it were, a third intention of the mind (see PHILOSOPHY), whereas Cousin would make it a first intention.
WILLIAM T. HARRIS.

**Sponta'neous Combustion**: combustion which takes place without the application of heat or other means specially designed to promote that end. Lucifer matches have ignited when exposed to the sun's rays, and phosphorus, when in a dry state, has often taken fire at the touch of the hand, on account of its affinity for oxygen. In fact, it is this same readiness to combine with oxygen which causes spontaneous combustion in the case of other bodies, so that anything which will increase it will increase the tendency to such combustion. Mechanical division increases it greatly, by affording a larger surface to the action of oxygen, and by lessening the conducting powers of the bodies acted on. If the oxides of nickel, cobalt, or iron are reduced by hydrogen below a red heat, the resulting finely divided metals take fire when poured into the air; but if heated too highly, they become agglomerated and lose the property, unless some finely divided powder is present to keep them porous, such as alumina precipitated with the metallic oxides. Freshly burned charcoal is liable to take fire, owing probably to condensation of oxygen in its pores; on this account it is not ground for making gunpowder until it has been kept for a time. Recently expressed fixed oils absorb oxygen and give out carbon and hydrogen; the temperature of heaps of rags, tow, sawdust, and similar bodies soaked with oil, grease, turpentine, varnishes, etc., will rise on this account, and the low conducting power of such materials helps the process, until very often the mass takes fire. Serious conflagrations have resulted from this cause. Bituminous coal, especially when containing much pyrites, is liable to spontaneous combustion, when moistened with water. Moisture aids spontaneous combustion also in the cases where piles of damp hay or freshly mown grass have taken fire. Barns have probably been burned in this way. Strong nitric acid will act on straw, hay, and such bodies so as to render them spontaneously combustible. Some gases ignite spontaneously, as phosphuretted hydrogen. The illuminating oil distilled from petroleum sometimes gives off gases that inflame spontaneously before it is refined in the "agitator." There are also spontaneously combustible liquids, of which cacodyl is an example. (See PYROPHORI). There are a number of alleged cases of spontaneous combustion of the human body, but there is hardly an instance which admits of no other explanation. Liebig considered that the dead body of a fat man, who had been saturated with alcohol, might possibly burn, but that in no circumstances could a body, in which the blood is circulating, take fire.
Revised by R. A. ROBERTS.

**Spontaneous Generation**: See GENERATION, SPONTANEOUS.

**Spoonbill**: any one of five or six species of wading birds closely related to the ibises, and remarkable for their spoon-shaped bills. The family *Ptatateidæ* to which they belong has been divided into two genera: *Ajaja*, in which the lower portion of the trachea is simple, and *Platatea* in which it is convoluted. The roseate spoonbill (*Ajaja ajaja*) of tropical and sub-tropical America, the sole representative of the first-named genus, is from 30 to 36 inches long; the back, wings, and under parts are of a delicate rose color; the lower neck, smaller wing-coverts, and tail-coverts of a rich carmine hue; legs darker. The bill and bald head are varied with tints of green, yellow, and black. This bird occurs in the southern parts of the U. S., but is yearly growing scarcer as it is much sought after. The birds of the genus *Platalea*

European spoonbill (*Platalea leucorodia*).

are mostly white, and are found in Europe, Asia, and Australia. *Platalea leucorodia*, the only species found in Europe, was formerly in some demand for the table. In the U. S. the name spoonbill is often applied to the SHOVELER (*q. v.*). The spoonbill sandpiper is *Eurynorhynchus pygmæus*, of Northeastern Asia, occurring occasionally in Alaska.
F. A. LUCAS.

**Spooner**, SHEARJASHUB, M. D.: author; b. at Brandon, Vt., in 1809; graduated at Middlebury College 1830, and at New York College of Physicians and Surgeons 1835; was a dentist in New York. He was the author of several professional treatises, of *Anecdotes of Painters, Engravers, etc.* (3 vols., 1853), and of a *Biographical and Critical Dictionary* *of Painters, Engravers, Sculptors, and Architects* (1853; new ed., 2 vols., 1865), containing notices of 12,000 artists. D. at Plainfield, N. J., in Mar., 1859.

**Sporades**, spor'ă-deez [= Lat. = Gr. Σποράδες (sc. νῆσοι, islands), liter., fem. plur. of adj. σποράς, σποράδος, scattered, deriv. of σπείρειν, scatter]: those islands in the Grecian Archipelago which are not included in the group of the Cyclades. In a restricted and more accurate sense it includes only the islands near the west coast of Asia Minor between Samos and Rhodes. The more important are Samos, Nicaria, Patmos, Kalymno, Cos, Syme, Telos, Scarpanto, and Rhodes. All belong to the Ottoman empire and are comprised in the vilayet of the Archipelago. The cluster of islands N. of Negropont is sometimes called the Northern Sporades. Scyros, Scopelos, Sciathos, and Halonnesos are the chief. They belong to Greece. E. A. GROSVENOR.

**Spore** [from Gr. σπόρος, sowing, seed, deriv. of σπείρειν, scatter, sow]: in botany, a "single cell which becomes free and is capable of developing into a new plant" (*de Bary*). Sachs attempted to limit the term by defining a spore as "a reproductive cell produced directly or indirectly by an act of fertilization," reserving the term gonidium for those reproductive cells which are produced without any previous act of fertilization. Bennett and Murray, on the contrary, apply the term to "any cell produced by ordinary processes of vegetation, and not directly by a union of sexual elements, which becomes detached for the purpose of direct vegetative propagation." Adopting de Bary's definition, spores in Sachs's sense are sexually produced, or briefly sexual spores, while those of Bennett and Murray are asexual spores.

Many kinds of spores are distinguished by botanists, only the more common of which are noticed here. *Æcidiospores* are cells formed by abstriction in the "cluster-cup" stage of a rust. (See RUSTS.) *Ascospores* are spores formed by internal division of the protoplasm of a cell, termed an ascus. (See ASCOMYCETES.) *Auxospores* are the larger cells occurring in the life-history of diatoms, each the starting-point of a new series of divisions. *Basidiospores* are cells formed by pullulation and abstriction from a cell termed a basidium. (See BASIDIOMYCETES.) *Carpospores* are spores formed in a sporocarp, e. g. in liverworts and mosses. *Chlamydospores* are thick-walled spores formed singly and asexually in the cells of various simple algæ and moulds. *Conidiospores*, *conidia*, or *gonidia* are cells formed asexually, usually by abstriction of a little-modified hypha. *Macrospores*, in pteridophytes, are the large spores which upon germination form prothallia-bearing female organs. In anthophytes the embryo-sac is the homologue of the macrospore. *Microspores*, in pteridophytes, are the small spores which upon germination form minute prothallia-bearing antherids. In anthophytes the pollen-cell (pollen-spore) is the homologue of the microspore. *Oöspores* are cells produced by the fertilization of oöspheres by antherids. When thick-walled they are often called *resting-spores*. A *sporidesm* is a compound spore, or a spore-cluster; each spore in such a structure is known as a *merispore*. A *sporidium* is a small spore abjointed on a promycelium. *Stylospores* are stalked spores; the term is sometimes restricted to those formed in pycnidia. *Teleutospores* are the spores, one to many, formed in the tightly fitting asci of the *Uredineæ*; the term is commonly applied to the asci with their contents. *Tetraspores*, in the red seaweeds (*Florideæ*), are the spores formed in tetrads by the fission of a mother-cell. *Uredospores* are the stylospores of the *Uredineæ*. *Zoöspores* are motile spores, always aquatic. *Zygospores* are cells produced by the union of similar cells; known also as *resting-spores*. See FUNGI. CHARLES E. BESSEY.

**Sporozo'a** [from Gr. σπόρος, seed + ζῷον, animal]: a class of protozoans the members of which are parasitic in all stages of their existence. They lack all special organs of locomotion, and reproduce by the conversion of the protoplasm of the cell into minute particles or spores, which, frequently passing through an amœba-like stage, develop into the adults. Four sub-classes are recognized: GREGARINIDA (*q. v.*), *Amœbosporida*, *Sarcosporida*, and *Myxosporida*, of which only the first contains many species. By many writers the disease known as cancer (*carcinoma*) is regarded as the result of parasitism of sporozoans in the body. J. S. K.

**Sports**: in general, diversions of the field or of the turf; in a special sense, contests between athletes. Apparently the earliest competitive athletic sports were those of Greece and Rome, from 1,000 to 2,000 years B. C., though the name athletic is of recent application and in its Greek origin referred only to those who competed for prizes in public games, thus separating into a distinct class the ἀγωνισταί, who exercised and competed with each other for pleasure or improvement. In earliest times the best citizens competed at the Olympian, Pythian, Nemean, Isthmian, and Panathenæan games, and highest honors were paid to the winners, but a professionalism very similar to that of these times appeared, and the dignity given to the contests was lost. The events open to competition were foot-racing, leaping, throwing the discus, wrestling, boxing, and the pancratium, a combination of boxing and wrestling, and, separate from these, chariot-racing.

When the Romans invaded Britain they brought with them the games of the soldiery, such as jumping, running, hunting, swimming, and combats on horseback. With the advent of the Saxons came skating, hawking, and wrestling, and in the Norman era were introduced the more accomplished arts of the tourney and joust. In the seventeenth century cards, dice, hawking, following the hounds in chase, football, bowling, quoits, wrestling, fencing, shovelboard, shuttlecock, and billiards were of prevalent interest. Bull and bear baiting and cock-fighting came in the eighteenth century, and were popular with people of both sexes. It is interesting to note the revival of football in the eighteenth century, it having been a sport of so much prominence in the early part of the fourteenth century. It was prohibited in England in 1349 because it interfered with the other sports. Falconry, or hawking, has almost disappeared from England, its place being largely taken by fox-hunting. Fox-hunting, so called, is popular in some parts of the U. S., where often the presence of a fox is made unnecessary by dragging a bag of anise seed, which leaves a scent in its trail, over the ground where the hunt (?) is to take place. The hounds follow this scent readily.

Wrestling, boxing, and pedestrianism have been popular for centuries, but it was not until well along into the nineteenth century that the interest in athletic sports developed into a passion.

The schools and colleges of Great Britain early took active part in organizing athletic clubs. In 1837 the Rugby Crick Run was founded, and Mar. 27, 1858, an annual steeplechase was inaugurated, both at Rugby, and the School Hunt was started at Shrewsbury in 1842.

Oxford and Cambridge met at Christ Church Cricket-grounds, Oxford, Mar. 5. 1864, for the first inter-'varsity athletic competition. The events were running 100 yards, 440 yards, and 1 mile; jumping, both for height and distance; hurdling, 120 and 200 yards, and steeplechasing. Each of the competing teams won four of the events.

The first important athletic meeting held in London was that of the Civil Service Athletic Sports at Walham Green, on Apr. 22 and 23, 1864. In 1863 the Mincing Lane Athletic Club was formed, which in 1866 became the now famous London Athletic Club.

From about 1861 the development and spread of athletics all over the civilized world has been prodigious. Since the civil war the U. S. has kept pace with Great Britain, and scarcely a city of 20,000 inhabitants can be found in North America or Great Britain which has not at least one flourishing club for the promotion of general athletics. In Germany and France the same interest is noticeable, and it has developed in a large degree all over Europe, Australia, and the British colonies.

Since 1880 athletics has become a most important feature of scholastic life throughout the U. S., and seems to be substituting itself for the lawlessness exhibited by students in class rushes and hazing affairs. In many institutions of learning the encroachment of organized sports upon purely scholastic occupations has caused some of the governing bodies to place practically prohibitory restrictions on some of the games, most notably upon football.

*Professionalism* has played a most important part in general athletics, and that part has not in all respects been good, so that very carefully prepared definitions of an amateur have been adopted by practically all amateur clubs in the U. S., Great Britain, Canada, and France, and competitors at the amateur meets are obliged to qualify in accordance with their terms.

In the eastern part of the U. S. the definition of an amateur, as adopted by the Amateur Athletic Union, is generally accepted, and is as follows:

"One who has not entered in an open competition; or for either a stake, public or admission money or entrance-fee; or under a fictitious name; or has not competed with or against a professional for any prize or where admission-fee is charged; or who has not instructed, pursued, or assisted in the pursuit of athletic exercises as a means of livelihood, or for gain or any emolument; or whose membership of any athletic club of any kind was not brought about or does not continue because of any mutual understanding, express or implied, whereby his becoming or continuing a member of such club would be of any pecuniary benefit to him whatever, direct or indirect, and who shall in other and all respects conform to the rules and regulations of this organization.

"*Definition of a Novice.*—The sports over which the A. A. U. claims jurisdiction shall be divided into the following classes: Baseball, billiards, bowling, boxing, fencing, football, gymnastics, hurdle-racing, jumping, lacrosse, lawn-tennis, pole-leaping, putting shot, quoits, racquets, rowing, running, sculling, skating, swimming, throwing the hammer, tug of war, walking, and wrestling. An athlete shall be held to be a novice in each of these twenty-four classes until he shall have won a prize in competition in that class open to the members of two or more clubs. The winning of such a prize shall prevent his future competition as a novice in that class, although his entry may have been made before he lost his standing as a novice."

The English Amateur Association has adopted the following definition:

"An amateur is any person who has never engaged in, nor assisted in, nor taught any recognized athletic exercise for money, or who has never, either in public or in private, raced or exhibited his skill for a public or for a private stake, or other remuneration, or for a purse or for gate-money, and never backed or allowed himself to be backed either in a public or private race.

"A novice is one who has never won a prize in a similar class of competition—i. e. winning a prize for walking would not disqualify for running, and *vice versa*; but winning a prize for running any distance would disqualify for running. This rule does not apply to school and boys' races."

The Pacific Coast Association is somewhat more liberal in its definition, as are the associations of Canada and France.

Professionals are found in nearly all branches of sport, and while they undoubtedly raise the standard of the sports in that they make the records high, it is a fair question if it would not be better if amateur effort alone set the mark for amateur competitors. Pedestrianism, which was popular with professionals a few years ago, is fast disappearing from all competitions. Walking-matches are no longer popular, and largely because of the difficulty of differentiating a walk from a run. Archery, which was and still is popular in Great Britain, has never been very popular in the U. S. The same may be said of the game of cricket, its place being largely taken by baseball.

Meets of Scottish and Irish clubs are held annually wherever Scotchmen or Irishmen are to be found. The Irish games are very similar to those held throughout the U. S., but the Scotch offer variety in tossing the caber—a log 16 feet long with a diameter of 11 inches at one end and 5 at the other—quoit-pitching, and a sword and hornpipe dance. A Scottish winter game called curling is becoming deservedly popular in North America, especially in Canada.

Most of the popular interest in general athletics in the U. S. gathers about the annual meets of the metropolitan and intercollegiate clubs. The records of these meets are annually published in the principal newspapers, and in several almanacs and sporting annuals.

Fishing and hunting will always be popular with sportsmen, and nowhere are better opportunities afforded than in the U. S. and Canada. Stringent game-laws have been passed in most of the States, so that the wanton destruction of game—as evidenced by the entire destruction of the buffalo, and of the pigeon-roosts in Ohio, and of the salmon in many of the Eastern rivers—is no longer possible. The U. S. Fish Commission is restocking lakes and rivers with game fish, and game protective associations are seeing that game-laws are enforced.

For extended accounts of various sports, see BASEBALL, CRICKET, CURLING, FOOTBALL, GOLF, LACROSSE, LAWN-TENNIS, ROWING, WRESTLING, YACHTS AND YACHTING, etc.

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**Sports, Book of**: a proclamation by James I. of Great Britain, issued in 1618, setting forth certain games which might lawfully be indulged in on Sundays after church service. Among the sports allowed were "dancing, archery, leaping, vaulting, May-games, Whitsun-ales, morris-dances, and the setting up of May-poles." It was designed to prevent unlawful interference by Puritanical magistrates with popular recreations. Bear-baiting, bull-baiting, bowling, and "interludes" were forbidden on Sundays. Charles I. reissued the proclamation in 1633. In 1644 the Long Parliament directed that all copies of the *Book of Sports* be burned by the common hangman. In both instances the publication of the *Book of Sports* gave rise to intense excitement, and aroused the strongest opposition among the Puritans. See Govett, *The King's Book of Sports* (1890).

**Spots, Solar**: See SUN.

**Spotswood**, ALEXANDER: governor of Virginia; b. at Tangier, Africa, 1676; was deputy quartermaster-general under the Duke of Marlborough; went to Virginia as governor 1710, and held office until removed in 1722; deputy postmaster-general 1730–39; was the pioneer of iron-manufacturing in Virginia; was originator of an act improving the staple of tobacco, and making tobacco-notes a medium of common exchange; lent great aid to William and Mary College; was made major-general 1740 and placed in command of an expedition to the West Indies; died at Annapolis, Md., June 7, 1740, before the embarkation took place.

**Spotswood**, or **Spottiswood**, JOHN: prelate and historical writer; b. in Scotland in 1565; was educated at Glasgow, and in 1601 went to France as chaplain to the Scottish ambassador. He accompanied James VI. to London in 1603, and in the same year was made Archbishop of Glasgow and a member of the privy council for Scotland; in 1615 was made Archbishop of St. Andrews and Primate of Scotland. Through his influence the Perth Assembly sanctioned the Five Articles (1618). In 1633 he crowned Charles I. at Holyrood, and in 1625 became chancellor of Scotland. He drew great obloquy on himself for the part he took in the examination of John Ogilvie, a Jesuit priest who was apprehended at Glasgow and hanged for refusing to disown the temporal power of the pope, and in the prosecution of Lord Balmerino, who was condemned to death for the crime of "lease-making" (verbal sedition), and pardoned only after a long imprisonment, Spotswood, his personal enemy, taking an active part in the proceedings. In 1637 he endeavored to introduce the new liturgy and book of canons into Scotland, urged on by the king and Laud, and, as is said, contrary to his own wish. Removed from the chancellorship by King Charles, deposed from his bishopric by the assembly convened at Glasgow in Nov., 1638, excommunicated, and declared infamous, he fled to London, where he died Nov. 26, 1639. He wrote a *History of the Church of Scotland* (published in 1625), the greater part of which treats of the history of his own times. Among his other writings is a Latin treatise (*Refutatio Libelli de Regimine Ecclesiæ Scoticanæ*), written in answer to a tract of Calderwood's, published in 1620. His *Life* was written by Bishop Duppa and by Bishop Russell, the latter prefixed to the Spottiswood Society edition of his *History of the Church of Scotland*.

**Spottsylvania Court-house, Battles at**: See WILDERNESS.

**Sprague**: town; Lincoln co., Wash.; located on the Northern Pac. Railroad, 42 miles S. W. of Spokane (for location, see map of Washington, ref. 4–J). It is in an agricultural and stock-raising region, is the trade-center of the Big Bend country, and contains railway machine-shops and car-works that cost $250,000, a national bank with capital of $50,000, and a daily and three weekly newspapers. Pop. (1890) 1,689; (1900) 695.

**Sprague**, CHARLES: poet; b. in Boston, Mass., Oct. 26, 1791; educated at the Franklin School, Boston. He entered mercantile life at the age of thirteen and was cashier of the Globe Bank from 1825 to 1865. He wrote prize prologues for the opening of theaters and delivered Φ. Β. Κ. poems, centennial and anniversary odes, and other occasional pieces, the best known of which is his *Shakspeare Ode*, recited at the Boston theater in 1823. A collected edition of his writings in verse and prose was published in Boston in 1841 (revised editions in 1850, 1855, and 1876). D. in Boston, Jan. 14, 1875. H. A. BEERS.

**Sprague**, WILLIAM BUELL, D. D., LL. D.: clergyman and annalist; b. at Andover, Conn., Oct. 16, 1795; graduated at Yale College 1815; studied at Princeton Theological Seminary 1816–19; was colleague with Dr. Lathrop over the Congregational church of West Springfield, Mass., 1819–21, and pastor 1821–29; pastor of the Second Presbyterian church of Albany, N. Y., 1829–69; visited Europe in 1828 and 1836; engaged exclusively in literary work at Flushing, L. I., 1869–76. D. at Flushing, L. I., May 7, 1876. Dr. Sprague was a preacher and public speaker of special eminence; made a collection of autographs (nearly 100,000 in number) and religious pamphlets, presenting the latter to the New York State Library; won the title biographer of the Church by his most important publication, begun in his fifty-seventh year, *Annals of the American Pulpit*, sketches of the most prominent clergymen of all denominations from the earliest dates to 1855 (10 vols., New York, 1857–76); and among other works *Letters to a Daughter* (New York, 1822; republished under the title *The Daughter's Own Book*); *Letters from Europe* (1828); *Lectures on Revivals* (1832); *True Christianity and other Systems* (1837); *Life of Rev. Edward Dorr Griffin, D. D.* (1838); *Letters to Young Men* (1845); *Women of the Bible* (1850); *Visits to European Celebrities* (1855); and *Life of Rev. Jedidiah Morse* (1874). C. K. HOYT.

**Sprain**, or **Subluxation** [*sprain* is deriv. of *sprain* (verb), from O. Fr. *espreindre* > Fr. *épreindre*, press, wring < Lat. *expri'mere*, press out; *ex*, out + *pri'mere*, press. *Subluxation* is from *sub-*, partially + *luxation*, from Lat. *luxa're*, dislocate]: a stretching or wrenching of the non-osseous parts of a joint, without displacement of the bones, and either with or without lesion of ligaments or tendons. Severe sprains are sometimes as serious and lasting in their effects as dislocations, especially on account of the liability of the patient to attempt to use the part before the inflammation has wholly subsided. Perfect rest, cold or sometimes hot lotions (if the latter be more agreeable to the patient), accompanied by the use of splints for mechanical support and of opiates for the relief of pain, are required in the treatment. Revised by W. PEPPER.

**Sprat**, or **Garvie**: the *Harengulus sprattus*, a little herring of the European seas. Sprats are spiced, salted, dried, and potted in many ways, and are very good when fresh, but are generally eaten only by the poorer classes. The French preserve great quantities of small sprats and sell them for sardines. Great quantities are also used for fertilizing land. The sprat is seldom over 6 inches long. See WHITEBAIT.

**Sprecher**, SAMUEL, D. D., LL. D.: theologian; b. near Williamsport, Md., Dec. 28, 1810; studied in Pennsylvania College and Theological Seminary, Gettysburg, Pa.; pastor at Harrisburg, Pa., 1836–39; principal of Emmaus Institute, Middletown, Pa., 1839–42; pastor Martinsburg, Va., 1842–43, and Chambersburg, Pa., 1843–49; president of Wittenberg Theological Seminary Springfield, O., 1849–74. He combined with it until 1884 the chair of Systematic Theology. Removing to the Pacific coast, he filled for a time the presidency of the college at San Diego, Cal. Dr. Sprecher's chief book is his *Groundwork of a System of Lutheran Theology* (Philadelphia, 1879). H. E. JACOBS.

**Spree**, sprā: a river of Prussia; rises in the kingdom of Saxony, passes through Berlin, and joins the Havel at Spandau, after a course of 220 miles. At Leibsch it becomes navigable for small craft, and considerable traffic is carried on along its whole course.

**Sprengel**, HERMANN JOHANN PHILIPP, Ph. D., F. R. S.: chemist; b. at Schillerslage, Hanover, Germany, in 1834; studied at the Universities of Göttingen and Heidelberg, from the latter of which he took his degree in 1858 with the highest honor; moved to England 1859; discovered and described in *The Journal of the Chemical Society*, 1865, the method of producing vacua by the fall of water or mercury in tubes. He first drew attention to picrid acid, which he suggested as a detonating charge for shells; and was the first who described and patented in England a number of so-called safety-explosives, among which are hellhoffite, oxonite, panclastite, rackarock, etc. Hellhoffite and rackarock were used by Gen. John Newton in blowing up Flood Rock at Hell Gate. C. H. THURBER.

**Sprengel's Air-pump**: See PNEUMATICS.

**Sprenger**, ALOYS: Orientalist; b. at Nassereut, Tyrol, Sept. 3, 1813; educated at Innsbruck and Vienna (1832); went to London (1836) to assist the Earl of Munster in his work, *The Military Sciences of the Mohammedan Nations*; then to Calcutta (1843) and became (1845) president of the College of Delhi, where he introduced European methods of teaching, established a lithographic press, and issued a penny magazine, *Kiran Alsadain*; was assistant resident at Lucknow (1848), where he catalogued the royal library; examiner at the College of Fort William (1850); head of the Calcutta and Hugli Mohammedan Schools; Government interpreter and secretary of the Asiatic Society of Bengal. He was pensioned in 1857, returned to Europe, and became Professor of Oriental Languages at Berne. D. Dec. 19, 1893, at Heidelberg, to which place he had retired. His most important work is *Das Leben und die Lehre des Mohammed* (Berlin, 1861–65, 3 vols.), the most comprehensive life of the prophet by a European, but written too much from the point of view of a physician. Of his *Bibliotheca Indica*, which he published in conjunction with other scholars, may be mentioned: *Dictionary of the Technical Terms used in the Sciences of the Mussulmans* (Calcutta, 1854); *Ibn Hajar's Dictionary of Persons who knew Mohammed* (1856); *Soyuti's Itkân* (1856), etc. He also published *Otby's History of Mahmud of Ghaznah* (Delhi, 1847); *Masudî's Meadows of Gold* (London, 1849); *Die Alte Geographie Arabiens* (Bern, 1875). RICHARD GOTTHEIL.

**Spring** [liter., origin, source, beginning, time of beginning (cf. *dayspring*), deriv. of *spring*, to arise, take birth, rise, or origin]: the season of the year which follows winter and precedes summer. In the temperate regions of the northern hemisphere it includes, in a vague and indefinite way, the months of February, March, and April (as in Great Britain), or March, April, and May (as in North America); astronomically, it would extend from Mar. 21 to June 21. In the temperate regions of the southern hemisphere the spring months are September, October, and November. In the tropical regions there is strictly neither spring nor autumn, but only two seasons, the wet and the dry; in the polar regions, only two seasons, summer and winter.

**Spring**, GARDINER, D. D., LL. D.: clergyman; b. at Newburyport, Mass., Feb. 24, 1785; was valedictorian at Yale College 1805; studied law and taught in New Haven 1805–06; established an English school and taught in Bermuda 1806–08; admitted to the bar 1808; studied theology at Andover Theological Seminary 1809–10; and was pastor of the Brick church (Presbyterian), New York, 1810–73. D. in New York, Aug. 18, 1873. Many of his publications have passed through several editions, and have been reprinted and translated in Europe. They include *Essays on the Distinguishing Traits of Christian Character* (New York, 1813); *Memoir of Rev. Samuel J. Mills* (1820); *Fragments from the Study of a Pastor* (1838); *Obligations of the World to the Bible* (1839); *The Attractions of the Cross* (1846); *The Bible not of Man* (1847); *Discourses to Seamen* (1847); *The Power of the Pulpit* (1848); *The Mercy-seat* (1850); *First Things* (2 vols., 1851); *Contrast between Good and Bad Men* (2 vols., 1855); *Pulpit Ministration* (2 vols., 1864); and his autobiography, *Personal Reminiscences of the Life and Times of Gardiner Spring* (2 vols., 1866). The *Memorial Discourse*, by Rev. John O. Murray, D. D., has been published (New York, 1873). C. K. HOYT.

**Spring**, LEVERETT WILSON, A. M., D. D.; teacher and author; b. at Grafton, Vt., Jan. 5, 1840; graduated at Williams College 1863, at Hartford Theological Seminary 1866; pastor of Rollstone Congregational church, Fitchburg, Mass., 1868–75; pastor of Plymouth church, Lawrence, Kan., 1876–81; Professor of English Literature, University of Kansas, 1881–86; Morris Professor of Rhetoric at Williams College since 1886; author of *Kansas* (in the American Commonwealth Series); *Mark Hopkins, Teacher* (1885). C. H. T.

**Spring-bok** [Dutch for spring-buck, so called from its habit of leaping when alarmed]: a very beautiful, active, and graceful antelope of South Africa, the *Gazella euchore*. It goes in immense herds upon the plains. Its flesh is in some estimation as food, and the hides are much sought for by tanners. This timid creature, when taken in hand young, becomes very tame and sportive.

**Spring City**: borough; Chester co., Pa.; on the Schuylkill river, the Schuylkill Canal, and the Penn. Railroad; opposite Rogersford, 32 miles N. of Philadelphia (for location, see map of Pennsylvania, ref. 6–I). It has manufactories of wood-pulp, stoves, glass, stove-moulders' facing, fire-brick, tile, paper, sash, and lumber, a national bank with capital of $200,000, and a weekly newspaper. Pop. (1880) 1,112; (1890) 1,797; (1900) 2,566.

**Springer**: a name given by sportsmen to several varieties of the hunting spaniel, used for starting birds from bushy coverts. The Clumber, Sussex, and Norfolk breeds are the best. The springer should weigh from 14 to 40 lb., and should have a good coat, a feathery tail, carried low, and an active, graceful style of work. The Clumber is especially liked, because it gives no tongue while at its duty.

**Springfield**: city; capital of the State of Illinois and of Sangamon County; on the Balt. and Ohio S. W., the Chi. and Alt., the Chi., Peoria and St. L., the Ill. Cent., and the Wabash railways; 3 miles S. of the Sangamon river, and 185 miles S. W. of Chicago (for location, see map of Illinois, ref. 6–D). It lies on the western border of an undulating prairie stretching from near the river to the timbered lands that line its tributaries on the S. The original city was 2 miles square, surrounded by an avenue 80 feet wide. It now contains 5·84 sq. miles, and is of irregular outline, the greatest length north and south being approximately 4 miles, and east and west 3 miles. The streets and avenues intersect each other at right angles, and the residence portions are ornamented with shade-trees and grass-plots. The city is lighted by electricity; has excellent water-works, with a $60,000 pumping plant with a daily capacity of 12,000,000 gallons; a complete system of sewerage; 7 fire companies; a municipal light plant; 7 seven lines of electric street-railway with 20 miles of track; 366 acres of improved park lands, with connecting boulevards, and 29 miles of paved streets, mostly of vitrified brick.

*Public Buildings.*—The most conspicuous of the public buildings are the State-house, the U. S. court-house and post-office, the county court-house, the Governor's mansion, the State arsenal, the city-hall, and the public library. The Capitol, completed in 1887, stands in a park of about 8 acres. The ground-plan is in the form of a huge cross, and the superstructure is of the modern classic style of

State-house, Springfield, Ill.

architecture. The extreme length from N. to S., including the northern portico, is 379 feet, and the extreme width from E. to W., including the eastern portico, is 286 feet. The exterior walls are of dressed Joliet limestone, and the large and lofty porticoes of sandstone, supported by columns of polished gray granite. The edifice is three full stories in height, with a mansard roof and two turrets. Over the center rises a stately dome, surmounted by a lantern and iron flagstaff, reaching a total altitude of 364 feet. The whole cost of the building was over $4,000,000. The county court-house (formerly the old State-house), the corner-stone of which was laid July 4, 1837, occupies the center of the public square in the heart of the city. It is a massive structure, built of solid limestone in the form of a rectangle, being longest from E. to W. The original edifice was two stories high, with a basement, and surmounted by a handsome dome. The total cost was $240,000. In 1900 the building was raised bodily, a ground-floor story added, the interior remodeled after modern plans, a new dome built, and other improvements made at a cost of nearly $150,000. The U. S. court-house and post-office stands on the Government block at the intersection of Sixth and Monroe Streets. It is built of Nauvoo stone, three stories high, and was completed in 1868 at a cost of $320,000. The interior was remodeled in 1900 to meet the increased requirements of the post-office department. The Governor's mansion and grounds occupy

The Lincoln residence, Springfield, Ill. (belongs to the State).

an entire block in the southern part of the city. The mansion is a fine and imposing brick structure. It, too, was remodeled and modernized recently at a cost of $40,000. The city-hall is built of cream-colored brick with stone trimmings, and is four stories high.

*The Lincoln Monument.*—Among the chief historical attractions of Springfield are the Lincoln residence and the Lincoln national monument. The latter stands in Oak Ridge Cemetery, about 1½ miles N. of the new State-house. This mausoleum contains the remains of President Lincoln, his wife, two of his children, and one grandson. It was designed by Larkin G. Mead, of Vermont, and was built by William D. Richardson, of Springfield, Ill. The exterior walls of the terrace, pedestal, and shaft are faced with Massachusetts gray granite, and the total height of the monument, which originally was 98 ft. 5 in., now is 120 ft. 2 in. It was dedicated Oct. 15, 1874. The whole cost, including the statue of Lincoln and four groups of bronze statuary, was about $325,000. In 1900 the monument was taken down and rebuilt upon a foundation extending to the solid rock at the base of Monument Hill. The reconstructed monument is identical in outline with the original except that the shaft is greatly increased in altitude.

The Lincoln home is owned by the State and is maintained as it was when the President's family left it, with as much as possible of the furnishings intact. A custodian, appointed by the Governor, has charge of the premises, which are open to visitors daily.

*Churches and Schools.*—The churches and mission chapels of the city and suburbs number 48, classified as follows: 4 Protestant Episcopal, 6 Roman Catholic, 4 Lutheran, 7 Baptist, 8 Methodist Episcopal, 6 Presbyterian, 3 Congregational, 2 Christian, 2 Hebrew, 1 United Brethren, 1 Seventh-day Advent, 1 Church of Christ (Scientist), 1 Evangelist, 1 Volunteers of America, and 1 Salvation Army barracks. The public schools consist of a new central high school, built in 1897 at a cost of $100,000, and 21 graded schools. The money expended for public-school purposes in the fiscal year ending Aug. 31, 1901, was $124,814.50. Besides the public schools there are Concordia College (Lutheran), the Bettie Stuart Institute, St. Agatha's School, the Ursuline Convent, the Convent of Our Lady of the Sacred Heart, SS. Peter and Paul's Convent, 7 parochial schools, and 2 business colleges. Among the charitable institutions are the Home of the Friendless, the Home for Aged Women, the Colored Old Folks' Home, the Orphanage of the Holy Child (Episcopal), and the Springfield Associated Charities, maintained by the churches and citizens generally; also four hospitals—St. John's, the Springfield, the Wabash Railway, and the Prince Sanitarium.

*Libraries.*—The free public library is claimed to be the largest in the United States in proportion to the size of the city, containing, in January, 1901, over 45,400 volumes. In addition, the city has the Illinois State library of 55,000 volumes, the Illinois State Historical library of 3,500 volumes, and the Supreme Court library of 18,000 volumes.

Near the city is Camp Lincoln, the permanent training-grounds of the Illinois National Guard, with rifle-range, a State arsenal, and headquarters of the Second brigade.

*Finances and Banking.*—The gross receipts of the corporation for city purposes for the fiscal year ending Feb. 28, 1901, were $456,899.85; the bonded debt on Mar. 1, 1901, was $898,700; and the estimated value of city property $1,747,050. In 1901 there were 5 national banks with combined capital of $1,450,000, 1 State bank with capital of $300,000, and 1 loan and trust company with capital of $100,000. There are also 9 building and loan associations, all serial, with 3,672 shareholders and 37,151 shares in force.

*Business Interests.*—The census of 1890 showed 374 manufacturing establishments (representing 63 industries), with a combined capital of $3,641,415, employing 3,269 persons, paying $1,746,228 for wages and $3,789,139 for materials, and turning out products valued at $6,562,070. The principal industries, according to capital invested, were those connected with the building trades, 102 establishments, $558,573 capital; printing and publishing, 12 establishments, $261,031 capital; textiles, $257,215 capital; foundry and machine-shop products, $202,837; planing-mills, $58,500 capital. The city is also an important coal-mining center.

*History.*—Springfield was settled in 1819 and platted in 1823, when it became the county-seat. It was incorporated as a town Apr. 2, 1832, and as a city Apr. 6, 1840. By acts of 1837 it was made the permanent seat of the State government, and the first session of the Legislature held here was convened Dec. 9, 1839. Pop. (1880) 19,743; (1890) 24,963; (1900) 34,159. S. LEIGH CALL.

**Springfield**: city; port of delivery; county-seat of Hampden co., Mass.; on the Connecticut river, and the Boston and Albany, the Boston and Maine, and the N. Y., N. H. and Hart. railways; 99 miles W. by S. of Boston, and 138 miles N. N. E. of New York (for location, see map of Massachusetts, ref. 3–E). The city is beautifully situated, is laid out with wide streets, adorned with fine shade-trees, and is noted for the variety and taste of its private dwellings and the beauty of its churches and public buildings. There are two parks—Forest, comprising 463 acres, laid out with ponds, carriage roads, and promenades, and Hampden, containing about 60 acres, famous for its horse-races and cycling tournaments. The steam-railways entering the city use a union dépôt erected in 1889 at a cost of $500,000. A street-railway connects the extreme sections of the city and offers communication north to Northampton, west to Westfield, south to Warehouse Point, Ct., and east to Palmer.

*Churches and Schools.*—Springfield has 46 churches, of which 12 are Congregational, 7 Methodist Episcopal, 5 Roman Catholic (also a mission), 7 Baptist, 2 Union, 2 Protestant Episcopalian, 2 Lutheran, and 1 each Unitarian, Universalist, Advent, Swedenborgian, Presbyterian, Jewish, and Spiritualist. The public-school system comprises 2 high schools and 10 grammar, 16 primary, 5 ungraded, 8 evening, 9 kindergarten, 1 manual-training, 3 cooking and 2 drawing schools, located in 33 buildings, and having 323 teachers and over 9,300 pupils. Various parochial schools have about 1,400 pupils, and private schools about 100. The city also contains a French-American (Protestant) college, Bible Normal College, and the International Y. M. C. A. School. The Public Library and museum buildings are among the finest in the city, including besides a library of over 100,000 volumes, with a free reading-room, art and science museums, each in a handsome building of its own.

*Finances and Banking.*—The city has an assessed property valuation of over $72,000,000 and a funded debt of $2,727,100, of which $1,500,000 is water debt; deducting sinking funds, the net debt is (1900) $2,131,818. The receipts and expenditures are nearly equal, and are more than $2,100,000. In 1900 there were 10 national banks with combined capital of $3,300,000, 3 savings-banks with aggregate deposits of $25,199,103, a co-operative bank with assets of $500,000, 2 safe-deposit companies, with a combined capital of $600,000, a bank clearing-house, which in 1900 cleared over $68,000,000, and 4 insurance companies.

*Business Interests.*—The census returns of 1895 showed 574 manufacturing establishments (representing 107 industries), with a combined capital of $10,540,680, employing 7,703 persons, paying $3,804,763 for wages and $8,436,384 for materials, and turning out products valued at $16,569,228. The city has a great variety of skilled industries, extensive manufactories of railway-cars, pistols, sporting-arms, cotton and woolen goods, paper, envelopes, paper boxes, and collars, toys, needles, watches, buttons, skates, machinery, knit goods, confectionery, corrugated iron, paints and chemicals, sewing-machines, etc. The U. S. armory is located here and gives employment to about 1,000 men. Large additions have been made to the shops and machinery, and the output of rifles is 1,500 a week. The arsenal is 200 by 70 feet, and accommodates 300,000 stand of arms. The U. S. Government building, completed in 1891 at a cost of about $150,000, contains the post-office and the customs-office. The value of the imports for the year ending June 30, 1900, was $88,693, and for the 9 months ending Mar. 30, 1901, $81,531, and the duty collected in the year ending June, 1900, $40,958. The city has a flourishing board of trade. There are 4 daily, 9 weekly, 1 monthly, 1 semi-monthly, and 2 Sunday periodicals.

*History.*—Springfield was settled in 1636 by emigrants from Roxbury under the leadership of William Pynchon, and was first called Agawam, the Indian name for a portion of the territory occupied. West Springfield, Chicopee, and several of the neighboring towns were then included in its boundaries. In 1640 the name of the settlement was changed to Springfield in compliment to Mr. Pynchon, whose country residence in England bore that name. In 1675, during King Philip's war, the town was burned by the Indians. During Shays's rebellion in 1787 the U. S. arsenal was attacked, but the insurgents were dispersed by the State militia. Pop. (1880) 33,340; (1890) 44,179; (1900) 62,059. Revised by EDITOR OF "REPUBLICAN."

**Springfield**: city; capital of Greene co., Mo.; on the St. L. and San Fran., and the Kan. City, Ft. Scott and Memphis railways; 130 miles S. of Jefferson City, the State capital, and 240 miles W. S. W. of St. Louis (for location, see map of Missouri, ref. 7–F). It is on one of the highest plateaus of the Ozark Mountains, 1,450 feet above sea-level, is built in a grove of forest-trees with prairies on three sides, and is in an agricultural and lead and zinc mining region. The streets cross at right angles and are from 60 to 80 feet in width; many are macadamized or paved with brick. The city is lighted by gas and electricity, and has electric street-railways, improved water-works and sewerage, and two public parks. There is a U. S. Government building which cost with grounds $150,000, and contains the post-office, land-office, Federal courts, internal-revenue office, and signal-service quarters. Immediately S. of the city is a National Cemetery, containing the remains of more than 2,000 Union and Confederate soldiers.

*Churches and Schools.*—There are about 40 churches, a high school with building and ground that cost $50,000, a commodious central building, and 9 ward schools, with 65 teachers and more than 6,000 enrolled pupils. A normal school with accommodations for 2,000 pupils was opened in 1893. There are also 3 Roman Catholic parochial schools and 2 private kindergartens. For higher instruction there are Drury College (Congregational, chartered in 1873), a Roman Catholic college; and several academies. Springfield has a circulating library, and 3 daily and 6 weekly newspapers.

*Finance and Banking.*—In 1894 the city revenue was $89,753; expenditures, $80,962; bonded debt, $188,800; and assessed property valuation, $7,790,923. There were 5 State banks, a national bank, a private bank, with aggregate capital of $725,000 and deposits of $1,890,000, and 4 loan and trust companies.

*Business Interests.*—The city has a large jobbing trade, embracing the chief lines of merchandise, and covering principally Southwestern Missouri and Northwestern Arkansas. The industrial establishments comprise railway-car and repair shops, the largest wagon-factory in the State, 4 candy-factories, 4 roller flour-mills, 3 tobacco-factories, 2 iron-foundries, a furniture-factory, a cooperage, and a stove-factory. Pop. (1880) 6,522; (1890) 21,850; (1900) 23,267.

JOHN B. WADDILL.

**Springfield**: city; capital of Clark co., O.; on the Mad river, Lagonda creek, the Cleve., Cin., Chi. and St. L., the Erie, the Ohio S., and the Pitts., Cin., Chi. and St. L. railways; 45 miles W. of Columbus, and 80 miles N. E. of Cincinnati (for location, see map of Ohio, ref. 5–D). Connected with Dayton and Urbana by electric lines. It is in an agricultural region, but best known for its extensive manufactures. The city has gas and electric-light plants, water-works, sewers, and street-railways, and obtains some power for manufacturing purposes from the river and creek. Water for domestic use is supplied from springs. Natural gas for fuel is piped from other territory and extensively used. The public buildings include a city-hall (costing $225,000), U. S. Government building (costing $115,000), a free library presented to the city by B. H. Warder (costing $100,000), and a city hospital.

In the suburbs of the city are located the Ohio Masonic

Home, which cost $150,000 and has 145 inmates (97 adults and 48 children); the Ohio Pythian Home, nearly completed, which will cost when finished $120,000, and now provides for 138 children. Also the Ohio Odd Fellows' Home, which cost $100,000 and has now 175 inmates (125 children and 50 adults).

There are nearly 50 churches and other places of worship, 16 public-school buildings, public-school property valued at over $250,000, high school, seminary, 4 Catholic schools, 2 kindergartens, a business college, 2 colleges of shorthand, 4 dailies and 13 other periodicals.

It is the seat of Wittenberg College (Lutheran, chartered in 1845), which in 1900 had 21 instructors, 405 students of both sexes, and 19,000 volumes in its general and society libraries, and has graduated 700 students since its opening.

The manufactures include mowers and reapers, grain-drills, grain-separators, lawn-mower and reaper knives, lawn-mowers, stationary and portable steam-engines, turbine water-wheels, hay-rakes, hay-tedders, bicycles, machine tools, rubber tires, warm-air furnaces, stoves, piano-plates and piano hardware, shoes, shipping-tags, metallic caskets, grave-vaults, coffins, gas and gasoline engines, emery-wheels, metal wheels, water-purifiers, ensilaged feed and cane cutters, corn-planters and corn-harvesters, paper-mill machinery, pumps, road-rollers, leather, and proprietary medicine. One of the great industries of the city is flowering plants, there being eight large establishments that issue catalogues and do a large mail-order and wholesale business.

The city had in 1900 an assessed valuation of $17,894,095, and a net debt of $728,644. There are 5 national banks with a combined capital of $1,000,000 and a surplus of $300,000, and 1 savings-bank, and 3 building and loan associations, with 1,664 shareholders, and 6,472 shares. Pop. (1890) 31,895; (1900) 38,253. R. S. THOMPSON.

**Springfield**: town; capital of Robertson co., Tenn.; on the Louisv. and Nashv. Railroad; 30 miles N. W. of Nashville (for location, see map of Tennessee, ref. 5–E). It is in an agricultural and stock-raising region; is engaged in growing tobacco, corn, wheat, and grass; and contains flour-mills, sawmills, brick-works, a tannery, a national bank with capital of $60,000, a State bank with capital of $50,000, and 2 weekly papers. Pop. (1890) 1,372; (1900) 1,732.

**Springs**: fountains or streams of water flowing out of the earth and fed by rains on higher lands, frequently at some distance. As the water of springs often flows through subterranean channels which are beyond the reach of changes in surface temperature, it is little affected by the seasons, and is often maintained at about the average annual temperature of the locality. When it emanates from a deeper source it is sometimes highly heated, producing THERMAL SPRINGS (*q. v.*). When, as is often the case, the water is impregnated with chemical substances, such springs are called mineral springs. See WATER and MINERAL WATERS.

**Spring Valley**: city; Bureau co., Ill.; on the Burlington Route, the Chi. and N. W., and the Chi., Rock Is. and Pac. railways; 100 miles S. W. of Chicago (for location of county, see map of Illinois, ref. 3–E). It is in a coal-mining region, has important manufacturing interests, and contains a national bank with capital of $50,000 and two weekly newspapers. Pop. (1890) 3,837; (1900) 6,214.

**Springville**: village; Erie co., N. Y.; on the Buffalo, Rochester and Pitts. Railway; 30 miles S. of Buffalo (for location, see map of New York, ref. 5–C). It contains the headquarters of the Springville cheese-factory combination, which uses the milk of 8,000 cows daily and produces 2,000,000 lb. of cheese annually. There are 9 churches, an endowed academy and union free school, public library, 2 parks, soldiers' monument, natural gas-supply for fuel, electric light and power plant, excellent water-system, numerous manufactories, a national bank with capital of $50,000, a private bank, and 2 weekly newspapers. Pop. (1880) 1,227; (1890) 1,883; (1900) 1,992. EDITOR OF "JOURNAL AND HERALD."

**Springville**: city (founded in 1850); Utah co., Utah; on the Rio Grande W. and the U. Pac. railways; 6 miles S. of Provo, the county-seat, and 50 S. by E. of Salt Lake City (for location, see map of Utah, ref. 4–M). It is in a beautiful valley near the east end of Utah Lake; has abundant water-power, and is engaged in farming, stock-raising, and manufacturing. There are 5 district schoolhouses, an academy, a Mormon and a Presbyterian church, a State bank with capital of $50,000, and a weekly newspaper. Pop. (1890) 2,849; (1900) 3,422. EDITOR OF "INDEPENDENT."

**Spruce** [from M. Eng. *spruce*, variant of *Pruse*, Prussia, the tree being first known as a native of Prussia]: any one of several trees of the genus *Picea*, in the U. S. especially *P. nigra*, black or double spruce, and *P. alba*, white or single spruce. Both of these afford much useful timber, superior to that of hemlock, but inferior to the best pine. There are also several trees called spruce on the Pacific coast. (See also FIR and PINE.) The so-called Norway spruce, *P. excelsa*, very widely planted, is a noble forest-tree of the north of Europe. The native spruces of the U. S. afford a resinous substance called spruce-gum, much used as a masticatory. The tops are often brewed to make a pleasant drink called spruce-beer. It is made by adding the essence of spruce to water in which sugar or treacle has been dissolved, in the proportion of about 4 oz. of essence to 10 lb. of sugar or three parts of treacle, and 10 or 11 gal. of water, with about half a pint of yeast. Revised by L. H. BAILEY.

**Spuller**, spü'lār', EUGÈNE: publicist and politician; b. at Seurre, Côte-d'Or, France, Dec. 8, 1835; studied law, and was admitted to the bar in Paris, but abandoned the legal profession to devote himself to journalism and politics. Took part in the formation of Gambetta's journal, *La République Française*, and afterward became its editor-in-chief, but resigned after his election to the Chamber in 1876. In the Chamber he was active on several important commissions, concerning himself especially with questions relating to education and foreign affairs. He was Under-Secretary for Foreign Affairs in the short-lived cabinet of Gambetta 1881–82, Minister of Public Instruction in the cabinet of Rouvier 1887, and Minister of Foreign Affairs in that of Tirard 1889–90. He was elected to the Senate Apr. 24, 1892. D. at Dijon, July 23, 1896. Among his writings are *Petite histoire du second Empire, utile à lire avant le Plébiscite* (1870); *Ignace de Loyola et la Compagnie de Jésus* (1876); *Michelet, sa vie et ses œuvres* (1876); *Conférences populaires* (1879 and 1881); *Figures disparues* (1886); and *Au ministère de l'instruction publique* (1889). F. M. C.

**Spur**: See ERGOT.

**Spurge**: See EUPHORBIA.

**Spurgeon**, CHARLES HADDON: preacher and writer; b. at Kelvedon, Essex, England, June 19, 1834, the son of an Independent preacher; was educated at Colchester; became usher of a school at Newmarket, but, embracing Baptist views, joined a congregation of that denomination in Cambridge; became a tract-distributer and village preacher, and at the age of eighteen minister of a small chapel at Waterbeach, where he soon became noted for his zeal and eloquence. He went to London in 1853, where he at once attracted audiences so numerous that the congregation was compelled to remove first to Exeter Hall, and thence to the still larger Surrey Hall. In 1861 an immense chapel, called the Tabernacle, was built for him in Newington Butts, London, where he afterward preached. Nearly 20,000 persons were admitted to his church, and thirty-six other chapels were opened in London, the ministers of which were trained at a college founded and directed by him. His sermons were printed weekly, and from them thirty-seven volumes were made up. He also published *The Saint and his Saviour* (1857); a *Commentary on the Psalms* (7 vols., 1865–80); *Gleanings among the Sheaves* (1868); *John Ploughman's Talk* (1868); *Evening by Evening* and *Readings for the Closet* (1869); *Feathers for Arrows* (1870); *Types and Emblems* and *Lectures to my Students* (1875); *Storm Signals* (1886); *Messages to the Multitude* (1892), and other works. In 1867 he laid the foundation of an orphanage at Stockwell established by his congregation, and in 1865 became editor of a journal, *The Sword and the Trowel*. D. at Menton, France, Jan. 31, 1892. See the *Life* by Shindler (1892).—His son, THOMAS SPURGEON, was elected pastor of the Tabernacle in 1894. Revised by W. H. WHITSITT.

**Spurgeworts**: the *Euphorbiaceæ*; a family of about 3,000 species of dicotyledonous herbs, shrubs, and trees, for the most part natives of the tropics, but with many representatives in all regions. The flowers are often monœcious or diœcious, and the perianth is generally small. The ovary is usually tricarpellary, with one or two anatropous ovules in each cell. The stamens are generally numerous, and are commonly clustered and branched. Nearly all species have well-developed laticiferous tubes in their stems and leaves containing a milky fluid (latex). They are much-modified relatives of the mallows, with which they should be associated in spite of their usually apetalous structure.

More than 200 are North American, fully one-half belonging to the genus *Euphorbia*, commonly represented by *E. maculata*, *E. nutans*, both prostrate spreading species, and *E. corollata*, an erect, white-flowered, weedy herb.

Economically the family is of great importance; medicines are supplied by species of *Croton*, *Euphorbia*, *Jatropha*, *Joannesia*, *Mercurialis*, *Ricinus*, *Stillingia*, etc.; caoutchouc by the latex of *Hevea*, *Mabea*, *Manihot*, and *Sapium*; food by species of *Manihot*, slender plants of the tropics, with large starchy roots, the product being known as tapioca and cassava. The box-tree (*Buxus sempervirens*) is ornamental, and its wood (box-wood) is most useful, especially for engravers' purposes. Many species are grown in conservatories, some of them resembling cactuses in their succulent, leafless stems. CHARLES E. BESSEY.

**Spurrey**: any plant of either of the genera *Spergula* and *Tissa* (*Spergularia*), belonging to the family *Caryophyllaceæ*. *Spergula arvensis*, well known to farmers of Europe and North America as a weed, is profitably cultivated in the Low Countries and Germany as a forage-plant, and its seeds yield a valuable oil and oil-cake. *S. pilifera*, a dwarf alpine plant, has been recommended as a lawn-plant in proper climates, being handsomer than grass and requiring much less care. Revised by CHARLES E. BESSEY.

**Spur-winged Goose**: the *Plectropterus gambensis*; a goose deriving its popular name from the strong tubercle, or blunt spur, on the bend of the wing, formed by the projecting wrist-bone (radiale). The body is slender, neck and legs long; there is an excrescence at the base of the beak. The bird is about 3 feet long; chin, throat, center of breast, under side, and scapulars white, rest of plumage greenish black. It is found in Central and South Africa. F. A. L.

**Spurzheim**, spoorts'hīm, KASPAR: phrenologist; b. at Longwich, near Treves, Rhenish Prussia, Dec. 31, 1776; studied medicine at Treves and Vienna, and became a zealous disciple of Dr. Gall, whom he accompanied on his travels in Germany and France, and assisted in popularizing his phrenological doctrines by lecturing, newspaper articles, etc. In 1813 he separated from Gall, and undertook the introduction of the new doctrines in England, where he resided from 1814 to 1817, and from 1825 to 1828, and gave very popular lectures. From 1817 to 1825 he lived in Paris. In 1832 he removed to the U. S., and had just begun to excite interest when he died in Boston, Nov. 10, 1832. Among his writings are *The Physiognomical System of Drs. Gall and Spurzheim* (London, 1815); *Outlines of the Physiognomical System* (1815); *Sur la Folie* (Paris, 1818); *Essai philosophique sur la Nature morale et intellectuelle de l'Homme* (1820); *A View of the Elementary Principles of Education* (1821). See the memoir by Carmichael (1833).

**Sputum**: in pathology, the substance expectorated from the lungs. See EXPECTORATION.

**Spuyten Duyvil** (spī ten-dī'vil) **Creek** [probably from the Dutch *Spuyt den Duyvil*, in spite of the devil]: the channel connecting the Hudson river with the Harlem river, and thence with the East river, on Long Island Sound. The creek forms the northern boundary of Manhattan Island.

**Spy** [deriv. of *spy* (verb), from O. Fr. *espier* (> Fr. *épier*), from O. H. Germ. *spehōn* > Mod. Germ. *spähen* < Teuton. *speh-*: Lat. *spe'cere*, look at, view]: in the laws of war, a person who goes in disguise or under false pretenses within the lines or territory of a belligerent to observe his strength and obtain information concerning his works and movements for the purpose of communicating the same to the enemy. The rules of warfare among all modern civilized nations permit the infliction of the death penalty upon spies taken in disguise within the enemy's lines. The employment of spies, however, is considered a kind of deceit allowable by the rules of war, and, notwithstanding the ignominious method of inflicting death (usually by hanging), it has not infrequently happened that men of high honor have undertaken the office. Two of the most notable instances in all history are those of Capt. Nathan Hale and Maj. André during the Revolutionary war.

Because of the treachery involved in acting as a spy all authorities are agreed that although a sovereign may hold out an inducement or the temptation of a reward to persons to engage in such service, yet the service can not be required of subjects, except, perhaps, in some singular case of the last importance. In Great Britain by the Naval Discipline Act (29 and 30 Vict., c. 109, § 6) spies can be tried by a naval court martial, and shall suffer death or other punishment. In the U. S. the instructions for the government of the armies of the U. S. in the field provides (General Orders No. 100, sec. v., § 88) that "the spy is punishable with death by hanging by the neck, whether or not he succeed in obtaining the information or in conveying it to the enemy."

Exactly what acts shall bring a person within the definition of a spy is not definitely determined, nor when he ceases to be a spy after once having had that character. In the Franco-German war of 1870 the Germans claimed that persons crossing their lines in balloons were spies; but this is not in accordance with the treatment of the subject of spies in the rules proposed at the Conference of Brussels in 1874 (Project of an International Declaration concerning the Law and Custom of War, Arts. 19–22), which expresses the opinion generally accepted among the nations of Europe. See Vattel's *Law of Nations*; Kent's *Commentaries*; and Halleck's *International Law*. F. STURGES ALLEN.

**Squali** [Mod. Lat., from plur. of Lat. *squa'lus*, a kind of sea-fish]: See SHARK.

**Squalls**: bursts of wind, usually of brief duration, and when accompanied with the proper precipitation called rain-squalls or snow-squalls. They are of many varieties as to origin. One of the commonest is the falling wind which descends on the water from mountainous coasts. On the northwest coast of Lake Superior they descend from the bluffs and low mountains only a few hundred feet high, yet with such violence and suddenness in calm, warm weather, and in the heat of the day, that they are very dangerous to sailing-vessels. In the Aleutian islands they often descend the mountains behind a head of white wool-like fog, and are therefore called "woollies." The papagayos of Lakes Nicaragua and Managua, and of the Papagayo Bight on the west coast of Nicaragua and Costa Rica, are of the same character, but of longer duration. They usually fall on the ocean at from 10 to 20 miles from land, and the navigator must keep within 10 or beyond 40 miles from shore if he wishes to escape them. Of the same character also are the nevados, a falling diurnal wind in Ecuador and Peru, when the air descends on the plains from the snow-fields of the higher mountains. Of another type is the derecho of the western parts of the U. S., an occasional non-vortical wind which spreads in a fan shape as it advances from the N. W. These squalls are often mistaken for tornadoes, which are vortical local storms. The white squalls of the tropical seas on the west coast of Africa are sudden and furious bursts, whose approach is indicated by an advancing but harmless-looking white cloud. MARK W. HARRINGTON.

**Squarcione**, squär-chō'nā, FRANCESCO: painter; b. at Padua, Italy, 1394. His love of art led him to travel much in Greece and Italy, where he became acquainted with the masterpieces of ancient sculpture. He then formed a collection of busts, torsos, and bas-reliefs, with which he adorned his studio, and opened a school which became very popular, and in which Andrea Mantegna studied. He employed the help of his assistants to such an extent that only one picture exists in Padua which is supposed to be entirely his work, viz., the *St. Jerome and other Saints*, painted for the Lazzare family and placed in the Carmelite church. D. at Venice, 1474. W. J. S.

**Square Root**: See ROOT.

**Squares, Method of Least** [*square* is from O. Fr. *esquarre* > Fr. *équerre*, carpenter's square, deriv. of *équarrer*, as Ital. *squadra* of *squadrare* < Lat. **exquadra're*, make square; *ex* + *quadra*, a square]: a process used for the purpose of obtaining the most probable value of a quantity from a series of observations. In all measures, from the ordinary rude weighings and measurings of agriculture and commerce up to the most refined astronomical work, there is a liability to error which can not be avoided. An ordinary scale, for instance, can be used to measure down to a sixteenth of an inch; that is, if carefully used, its results will be correct to that limit. The level of a transit-instrument can make its measures, when used with care, to a ten-thousandth of an inch or even less; but in this case the hundred-thousandths will be uncertain. An ordinary observer notes his time to minutes only, and is likely to state the time incorrectly to the extent of at least half a minute; the man who is trying a fine watch will note its errors to seconds, or even half seconds; the astronomer uses tenths of seconds in his rough data and hundredths or thousandths in his calculations, but even here there is always uncertainty in the fractions of a second.

Observations or measures of the same thing never agree perfectly—that is, in the minutest fractions; how shall the true result be ascertained from discordant evidence? The ordinary experience of mankind has shown that it is best to "strike an average." When, for instance, two equally good surveyors measure a field a little differently, the half sum of their results is taken. The average prices of commodities are taken for their real prices, or at least for a better estimate of their real value than the extreme prices either way as affected by temporary fluctuations. The whole business of insurance rests upon this law of averages.

The "method of least squares" is the application of this law to the results of physical measurements, especially in astronomy and geodesy. The mathematicians whose names are most prominently connected with it are Legendre, Gauss, Bessel, and Encke; Legendre and Gauss seem to have discovered it independently. A short sketch of the history of the method will help in its explanation. Before the method of least squares, as we now have it, was discovered, the method of averages, or of the arithmetical mean, was applied to all physical measures which give a direct result. But in astronomy the things to be found out can not always be directly measured, but must be indirectly inferred from measurements of other things. The observations upon the transit of Venus afford an instance. Here the main thing to be found out is the solar parallax; the thing directly observed is the planet's ingress upon or egress from the sun. The time of this depends upon several unknown quantities, of which the solar parallax is one, and also the unknown time of conjunction, and the unknown distance of the planet's and sun's center at that time, as well as the apparent angular diameters of planet and sun. Each observation, then, gives an equation of condition between these five unknown quantities, and at any one place four observations of contacts are made. At thirty stations there would be 120 equations for five unknown quantities; if the best five of these were selected, a good value of the solar parallax might be obtained; but many thousand good combinations can be made, each of which gives a different result, owing to the errors of the observations. How, then, can such a combination be made as to answer to the average in more direct measures? or, to express it mathematically, How can the superfluous equations of condition be combined so as to give the best possible result? The mathematical problem here treated is analogous to the combination of ordinarily discordant evidence in a perplexed case in the courts of law: when the result here needed is one capable of numerical expression, as in the assessment of damages, the average is taken; but where not, the evidence is reconciled as well as possible. Gauss has shown that in simple cases the ordinary law of averages is justified, and that in complex work, like the transit-of-Venus reductions, the following rule is to be used, which is the more general form of the same law: "In treating observations of equal precision the unknown quantities are to be so determined that, after allowing for constant error, the sum of squares of the remaining errors shall be the least possible." This is the "method of least squares." Its practical working is easy after the data are put into proper shape, and its advantages are so great that it is very largely used. It affords a thorough criticism upon one's own work and that of others, and for this reason is in great favor where the observers are most delicate, keen, and courageous, especially in Russia, Germany, and the U. S. Revised by S. NEWCOMB.

**Squaring of the Circle**: See QUADRATURE OF THE CIRCLE.

**Squash** [from Massachusetts Ind. *asquash*, plur. of *asq*, green, raw]: a name applied in North America to fruits and plants of *Cucurbita maxima*, to the bush or summer varieties of *C. pepo*, and also sometimes to varieties of *C. moschata*. Usage varies as to the application of the name, but it belongs to *C. maxima* rather than to the others. (See PUMPKIN.) The fruits of *C. maxima* have soft, cylindrical stems which are not inflated at their insertion, the flesh is dry and orange-yellow, and the seeds are large and not thin-margined. Varieties of this species are Hubbard, Boston Marrow, the Turbans, Marblehead, and the like. L. H. B.

**Squash-bug**: the *Anasa tristis*, a hemipterous insect, well known for its ravages upon squash and pumpkin vines. It belongs to the *Coreidæ*. It is six-tenths of an inch long, about three-tenths of an inch in breadth, and of a dirty brown. It emits a powerful and offensive odor. The striped squash-bug is *Diabrotica vittata*, a beetle of the family *Chrysomelidæ*, a much smaller but even more destructive insect, which infests cucurbitaceous vines of almost all kinds in the U. S. As a rule, these insects are most destructive while the plants are young; and the squash-hills should be protected by a frame covered with millinet, or powdered gypsum and shell-lime may be freely sprinkled upon the plants, and will be found to impede the destructive work, particularly that of the striped bug. The use of salt in the manure is no avail with respect to the bug, and is injurious to the plant. Revised by J. S. KINGSLEY.

**Squash Family**: the *Cucurbitaceæ*. See the article on the GOURD FAMILY.

**Squatter Sovereignty**: a term used in the political history of the U. S. to deride the principle of leaving to the settlers within the Territories of the U. S. the decision of the question whether slavery should be permitted by the constitutions to be adopted when the Territories became States. See KANSAS (*History*) and UNITED STATES (*History*).

**Squeteague**: See WEAKFISH.

**Squid**: a popular name for many decapod cephalopods, particularly those of the family *Teuthidæ* (calamaries), but also extended to the *Sepiidæ* or true cuttlefishes, and even to the poulpes or *Octopodidæ*. The squids proper are found in nearly all seas; they form an important part of the food of many fishes and crustaceans, are extensively used as fish-bait, and in many countries are much used as food. (See CEPHALOPODA, CUTTLEFISH, FLYING SQUID, HOOK-SQUID, etc.) There are several true squids which are common on the U. S. coasts. Revised by D. S. JORDAN.

**Squier**, EPHRAIM GEORGE: archæologist; b. at Bethlehem, N. Y., June 17, 1821. He received the ordinary education of a farmer's son, was a school-teacher, and subsequently editor of country papers in New York and Ohio, and studied engineering. He was early interested in Indian antiquities, and in 1843–48 made, with Dr. E. H. Davis, an investigation of the mounds of Ohio and the neighboring States; the results were published in the *Smithsonian Contributions to Knowledge* (1848) as *Ancient Monuments of the Mississippi Valley*. Similar investigations in his native State resulted in the *Antiquities of the State of New York* (1851). In 1849–50 he was special *chargé d'affaires* to Central America, arranging treaties with several of the states; and in 1853 he was engaged to examine the line for a proposed interoceanic railway in the same region. He published *Nicaragua, its People, Monuments, etc.* (1852); *Waikna, or Adventures on the Mosquito Coast* (first published with the pseudonym *Samuel A. Bard*, 1856); *The States of Central America* (1857); and several other books and reports in English and French. His work on *The Serpent Symbol* (1852) attracted wide attention. In 1863–65 he was U. S. commissioner to Peru, and his investigations of the Incarian antiquities were the most important and exact that had been made up to the time. Returning, he took up his residence at New York, where from 1868 he was consul-general of Honduras. He was prominent in organizing the American Anthropological Society, and was its first president in 1871. The French Geographical Society voted him its gold medal, and he was a member of many other foreign and American learned societies. Several years were spent in the preparation of a work on Peru, and it was nearly ready for the press when, in 1874, a severe illness incapacitated him for continuous mental labor. The work was published in 1876, and is one of the most important contributions to our knowledge of Peru. D. in Brooklyn, Apr. 17, 1888. Besides the works mentioned, he was the author of numerous scientific papers and magazine articles. Many of his books were translated into Spanish and French. HERBERT H. SMITH.

**Squill** [viâ O. Fr. from Lat. *squil'la*, *scilla* = Gr. σκίλλα]: a drug made from the bulb of *Urginea maritima* (sea-onion), a perennial plant of the family *Liliaceæ*, growing on the Mediterranean coast. The bulb is pear-shaped, of the size of a man's fist, or even larger. It is made up of concentric scales, like other tunicated bulbs, of which the outer are dry and dark colored, but the inner fleshy and juicy, and either colorless or of a pale roseate tint. For use in medicine the bulbs are dried and sliced, and offer the varieties known as white and red squill, according to the tint of the bulb. Squill has little smell, but an acrid, nauseous, bitter taste. It contains a good deal of mucilage, but there is still much uncertainty concerning the nature of the active principles. A resin and a bitter principle probably have to do with the medicinal effects. Squill has been known as a medicine from a very remote period. It is an acrid irritant, affecting the mucous membranes and glands, and in large dose causes vomiting, purging, strangury, and may even prove fatally poisonous. Its medicinal use is from its producing, in small dose, an increased flow of urine, and also modifying in some unknown way the morbid condition of a mucous membrane affected with catarrh, and especially of the bronchiæ. Revised by H. A. HARE.

**Squilla**: one of the stomapod crustaceans. See the article on the STOMAPODA.

**Squinting**, technically termed **Strabis'mus** [Mod. Lat. from Gr. *στραβισμός*, a squinting, deriv. of *στραβός*, distorted, squinting]: the condition of vision when the visual axis of one eye is deviated from the point of fixation. The eye whose visual axis is directed to the object fixed is termed the *fixing* eye; the other is called the *squinting* or *deviating* eye. The deviation may be inward, *convergent strabismus*, outward, *divergent strabismus*, upward or downward, *vertical strabismus*. In convergent squint the visual line of the squinting eye is deviated inward, and intersects that of the sound eye at some point nearer than the object fixed; in divergent squint it lacks the necessary movement inward to intersect that of its fellow at the point of fixation, and hence it deviates outward. Strabismus may be paralytic or concomitant.

(1) In *paralytic* squint the deviation is caused by a paralysis of one of the muscles of the eyeball. The normal position of the eye and the correct direction of its visual line depend upon the tonicity of the four straight muscles, attached one above, one beneath, and one on each side of the eyeball. If one muscle is paralyzed, the eye is deflected to the opposite side by the stronger or intact muscle. Generally with paralytic squint, in addition to the deviation, there is loss of movement in the direction of the action of the affected muscle. Thus, if the outer straight muscle of the right eye were paralyzed, the affected eye could not move toward the temple on that side, and would be turned inward by the action of the inner straight muscle which is unaffected—that is, there would be a convergent squint. There is also generally double vision, because the images from an object do not fall upon identical points in the two retinas, and hence are no longer fused, as is the case when the eyes are normally moved by the muscles. Paralytic squint is caused by diseases of the brain, meningitis, and spinal cord, especially locomotor ataxia, certain general diseases like syphilis, rheumatism, diphtheria, diabetes, etc.; poisons, e. g. lead, and injuries.

(2) In *concomitant* squint the deviating eye is able to follow the movements of the other in all directions. The squint may be either periodic or permanent, and it may affect one eye or it may alternate. The average age for the appearance of concomitant squint is about four years, being usually first noticed when the child is beginning to learn to spell or read with small letters. There are a number of causes for concomitant squint, but the most important is a disturbance in the relation of the power of accommodation in an eye to the power of convergence, i. e. of bringing the eyes closer together. When the eye is far-sighted (hypermetropic) to a given degree, i. e. when it has a low refractive power, a short antero-posterior diameter, and the rays of light are not focused on the retina, it requires an accommodation, i. e. power to adjust itself for different distances and objects, of an equivalent degree to neutralize it, the visual lines being parallel. Generally, however, some convergence will accompany the effort of accommodation. The point of convergence is then nearer than the point for which the eye is accommodated, or, in other words, there is a convergent squint. Far-sightedness is consequently often accompanied by convergent squint. In near-sightedness, on the other hand, or in that condition in which there is a high refractive power and a long antero-posterior diameter, the visual lines often intersect at a greater distance than the point for which they are accommodated, and there is divergent squint. In a great majority of the cases of permanent squint there is amblyopia or imperfect vision of the squinting eye. Two views have been held in regard to this amblyopia, one being that it is due to lack of use on the part of the squinting eye, i. e. that the squint causes the amblyopia; the other that it is congenital and depends upon an imperfect development of the centers of vision in the brain, i. e. that the amblyopia causes the squint. The double vision, which is so marked a feature in squint when it is caused by paralysis, is usually absent in concomitant squint, because the eye involuntarily suppresses the false image, or else has learned to disregard it. In rare cases squint is due to spasm of the internal straight muscle. In paralytic squint the treatment consists in finding the cause and applying the proper remedies. In the low degrees, especially of the periodic varieties of concomitant squint, the eyes may often be straightened by prescribing the proper spectacles to correct the error or refraction which is at the bottom of the trouble. When the squint is marked and persistent it calls for operation: Incision of the ocular conjunctiva or mucous membrane, hooking up the tendon close to the cornea, and severing it. Very young children should not be operated upon. It is better to wait until the sixth or seventh year. G. E. DE SCHWEINITZ.

**Squirrel** [from O. Fr. *esquirel* > Fr. *écureuil*: Span. *esquirol* < Lat. **scurius* for *sciu'rus* = Gr. *σκίουρος*, squirrel]: any one of certain species of the family *Sciuridæ*. The name is more properly applicable to the slender arboreal forms constituting the genus *Sciurus*. These are of moderate size or small, have a rather slender head, no cheek-pouches, rather long ears, no lateral wing-like extension of the skin, a large bushy tail, and the teeth are, as in all the other genera of the family, 24—viz., M. $\frac{4}{4}$, I. $\frac{1}{1}$ × 2—but the foremost upper molars are often early deciduous, and when present very small. The genus grades into *Tamias*, or the chipmunks, and *Spermophilus*, or the ground-squirrels. There are about 150 species, and representatives are found in almost every region, Australasia and Polynesia, the southern extremity of South America, and the West Indies being the only considerable bodies of land in the temperate or tropical zones destitute of them. Eighteen species, with sixteen geographical races, or sub-species, are found in North America N. of Mexico. In time they existed, according to some authors, as early as the Eocene Tertiary, but the affinities of those early forms are doubtful. In habits the living species are all essentially similar. Most of their life is spent among the trees, and they exhibit great agility in running up the trunks and leaping from branch to branch. Their principal food consists of the nuts of trees, and in nut-bearing forests they are especially to be found; they also eat to some extent the larvæ of insects, and attack the nests of birds for their eggs, and even for their young. Their favorite attitude in eating is to sit on their haunches, with their tail thrown upward on the back, and holding the eatables in their paws. In the colder countries they lay up stores of provisions in holes and nooks in or near the trees in which they live. They are mostly readily tamed, and are generally kept in cages with revolving wheels or treadmills, wherein they exercise. Revised by F. A. LUCAS.

**Squirrel-corn**: See DICENTRA.

**Squirrel, Flying**: See FLYING SQUIRREL.

**Srinagar'**, or **Serinagur**: capital of Kashmir, situated in a broad, marvelously beautiful valley at an elevation of 5,276 feet, and with a mean temperature of 56·8° F. (see map of N. India, ref. 3–D). It is built on both sides of the navigable river Jhilam, from which numerous canals, spanned with light wooden bridges, branch off, the lively traffic by boat reminding one of Venice. The most remarkable building is the palace of the maharajah; it is called the Shergarh (citadel), and a large, beautiful flight of stairs leads from it down to the river. Close by the city is Lake Dal, which boasts of the far-famed isle Chinars (*Platinus orientalis*). Vegetables are raised here on floating rafts called gardens. About 21 miles N. W. of the city is Wular Lake, which covers 103 sq. miles. A small steamboat plies between the two lakes. Pop. (1901) 122,536, mostly Mohammedans.
Revised by M. W. HARRINGTON.

**Staal**, MARGUERITE JEANNE CORDIER DE LAUNAY, Baroness de: memoir writer; b. in Paris in 1684, the daughter of a poor painter; was educated in a convent at Rouen; became maid to the Duchess of Maine; took part in Cellamare's conspiracy for depriving the Duke of Orleans of the regency, and was imprisoned in the Bastile 1718–20; married afterward a Baron de Staal, who held a company in the guard of the Duke of Maine, and spent the rest of her life at the ducal court at Sceaux. D. in Paris, June 15, 1750. Her *Mémoires* were published in 1755, and republished in 1846 and 1878; her letters appeared in 1806, her *Œuvres complètes* (2 vols.) in 1821. Her *Mémoires* and letters have considerable interest to the student of history. See Sainte-Beuve, *Portraits Littéraires*.

**Stabat Mater** [Lat., *stabat*, was standing, third sing., imperf. indic. of *sta're*, stand + *ma'ter*, the mother]: the first words, and hence the name, of a Latin hymn ranked among the seven great hymns of the mediæval Church (*The Celestial Country* [from the *De Contemptu Mundi*], *Dies Iræ*, *Stabat Mater*, *Veni Sancte Spiritus*, *Veni Creator Spiritus*, *Vexilla Regis*, *Cantemus Cuncti Melodum nunc*, *Alleluia*, also known as *The Alleluiatic Sequence*). It begins—

| | |
|---|---|
| Stabat Mater dolorosa, | By the cross, sad vigil keeping, |
| Juxta crucem lacrymosa. | Stood the mournful mother weeping. |

As the DIES IRÆ (*q. v.*) has been pronounced the greatest, so the *Stabat Mater* is deemed the most pathetic of hymns. Its author is unknown, but it is customarily assigned either to Pope Innocent III. (d. 1216) or Jacopone da Todi (d. 1306). The hymn is still in constant use in the Roman Catholic Church, being sung during the Holy Week and on the festival of the Seven Dolors of the Virgin Mary, and it is well known in a musical sense to all through the very beautiful and sympathetic music of Rossini. It has been the theme of several of the world's great composers of different eras. Prior to Rossini, Pergolesi perhaps produced the most famous and masterly, if not the most popular, work upon it.

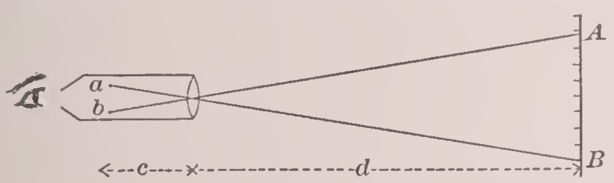
Revised by S. M. JACKSON.

**Stabroek**, staab'rook: See GEORGETOWN, British Guiana.

**Stachys**, stā'kis [Gr. στάχυς, an ear of grain; name of a plant, woundwort]: a genus of labiate plants, with a few species cultivated for ornament, and one, *S. sieboldii* (but generally known as *S. tuberifera* and *S. affinis*), now somewhat grown for its edible tubers. See CHOROGI. L. H. B.

**Stade**, staa'de: an old fortified town of Prussia, province of Hanover; on the Schwinge, near its influx in the Elbe (see map of German Empire, ref. 2–E). The so-called Stade dues, a toll which Hanover levied on all merchandise carried up the Elbe, but which was abolished in 1864, were paid here. Its manufactures are woolen, linen, and cotton stuffs, tobacco, and beer. Pop. (1895) 10,058.

**Stadia Measurement**: in surveying, a method of determining distances by graduated rods and the cross-hairs in the telescope of a transit instrument. The principle of the




Stadia measurement.

method is that of similar triangles, shown in the figure, the two hairs $a$ and $b$ seeming to be projected on the rod at $A$ and $B$. Let $c$ be the distance from the hairs to the object-glass and $d$ the distance from the object-glass to the rod, then

$$d = \frac{AB}{ab}c = \frac{c}{ab}AB,$$

or $d = AB$ if the rod be graduated so that $c \div ab$ represents the unit of distance. This principle is slightly modified by the optical theory of the lens, since $c$ varies for different distances, so that the expression for $d$ becomes

$$d = \frac{f}{ab}AB + f,$$

in which $f$ is the principal focal length of the lens, and in reality the lengths indicated by the intercept $AB$ do not begin at the object-glass, but at a distance $f$ in front of it. As, however, $f$ is small in comparison with $d$, it is generally neglected in topographic work.

When the telescope and line of sight are not horizontal the angle of inclination is read, and the rod held vertical. Then the reading on the rod is to be multiplied by the square of the cosine of the inclination to give the horizontal distance, and by one-half the sine of twice the inclination to give the vertical distance. By the help of tables these computations are readily made in the field, and thus both the horizontal distances and the elevations of points with respect to a given station are quickly obtained.

The precision of stadia-work is fully equal to that of ordinary chaining on rough ground, the uncertainty being about $\frac{1}{500}$th of the length of the line. Stadia measurements were introduced by Porro, an Italian engineer, about 1840; soon after used in topographical work in Switzerland, and introduced into the U. S. by J. R. Mayer about 1850. The word *telemeter* is generally employed instead of stadia on the U. S. Coast and Geodetic Survey, which seems to be alone in this usage. Most text-books on surveying give the principles and practice of the method. A small work with tables is Winslow's *Stadia Surveying* (New York, 1884).

MANSFIELD MERRIMAN.

**Sta'dium** [= Lat. = Gr. στάδιον]: the principal Greek measure of length for journeys, used in later times also for other linear measurements, especially by the Romans. Its length was fixed by that of the foot-race course (*stadium*) at Olympia, and was 600 Greek = 625 Roman = $606\frac{3}{4}$ English feet, or one-eighth of the Roman mile. Stadium was originally the name of the foot-race course in which running and other athletic exercises took place. Stadia existed at many Greek cities, but the most famous was that of Olympia. The stadium was laid out in two parallel oblong areas, connected at one end by a semicircular tract. The whole was surrounded by seats for spectators.

Revised by J. R. S. STERRETT.

**Stadt'holder** [Dutch *Stadhouder*, town-holder]: a governor of a country or province. In the course of the revolt of the Netherlands against Spain the seven United Provinces chose William, Prince of Orange, as their stadtholder. The title was intentionally a modest one, intimating that the revolt was not against the sovereign, but against the tyranny of his viceroy, the Duke of Alva. It involved the chief civil and military command, was given to Maurice, son of William, in 1587, and was held with some intermissions by the head of the state until the annexation of Holland to the French empire in 1802. On the restoration of the house of Orange in 1814 the title of king was assumed.

**Staël-Holstein**, Fr. pron. stāal'ōl-stān', ANNE LOUISE GERMAINE (*Necker*), Baroness de: historian, essayist, and novelist; b. in Paris, Apr. 22, 1766; daughter of Jacques Necker, the famous finance-minister of Louis XVI. She showed a precocious intelligence, and grew up in the brilliant salon of her mother, where she imbibed the intellectual curiosity and scientific spirit of the men who frequented it. In 1786 she married Baron de Staël-Holstein, Swedish ambassador at Paris, to whom she bore two sons and a daughter. Her marriage was not happy, and she was later separated from her husband, and mainly lived apart from him. Possessing remarkable gifts for conversation, she drew about her a circle of literary and public men, whom she charmed and dazzled. She greeted the beginning of the Revolution with sympathy, and her salon was the gathering-place of the admirers of the English Constitution. In 1792 she fled from the growing violence to her estate at Coppet, near Geneva, and then for a time to England; but in 1795 she returned to Paris and sought to re-establish her salon. In the same year she fell under the suspicion of the Directory, and withdrew again to Coppet, but returned once more in 1797, and her salon attained to new brilliancy and power. Among its assiduous visitors were Mme. Récamier, Mme. de Beaumont, C. Jordan, Fauriel, and especially Benjamin Constant, with whom she fell in love and from whose capricious and unhappy character she had much to suffer. Her salon was decidedly hostile to Napoleon, who in Oct., 1803, sent her away from Paris. She traveled then in Germany and Italy, and in 1805 established herself again in Coppet, where her old friends and many new ones flocked about her, and where she held a kind of intellectual court. She traveled again in Germany in 1807, and upon her return announced her religious conversion. The appearance of her book on Germany was the signal for still severer measures by Napoleon. The French edition was destroyed, and she was ordered to retire to Coppet, where she was kept under surveillance, a virtual prisoner, and forbidden to receive her friends. She escaped in 1812 and took refuge successively in St. Petersburg, Sweden, and England. On the fall of Napoleon she returned to Paris in 1815, but she was disappointed at the tendencies of the restored monarchy. D. July 14, 1817. In 1811 she had secretly married Albert de Rocca, an officer but twenty-three years old, to whom she bore a son. Though her conspicuous influence upon her contemporaries was wielded by personal contact, and her written works were considered to fall far behind the power and brilliancy of her improvisation in the excitement of conversation, her books are among the most important of the post-revolutionary period, and furnished a great stimulus to the new currents of French literature that were preparing romanticism. They are marked by fervid and sometimes hysterical sentiment, that often appears to protest against social conventions, especially in the essay *De l'Influence des passions sur le bonheur des individus et des nations* (1796), and the novels *Delphine* (1802) and *Corinne*

(1807); and by a wide range of intellectual view and just and profound ideas, which some have denied her the credit of originating, but which she at least grasped, communicated, and made available. These are exhibited especially in *De la Littérature considérée dans ses rapports avec les institutions sociales* (1800); *De l'Allemagne* (1810); and *Considérations sur la Révolution française*, her last work, published by her son in 1818. *De l'Allemagne* was of great importance in stimulating the influence of German thought and literature in France by giving the French public a more complete and sympathetic revelation of Germany than it had ever had. Other works are *Lettres sur les écrits et le caractère de J. J. Rousseau* (1788) and *Dix années d'exil* (posthumous). Her son published her *Œuvres complètes* (17 vols., 1821). See Lady Blennerhasset, *Frau von Staël* (3 vols., 1888–89); A. Sorel, *Madame de Staël* (Paris, 1890).

A. G. Canfield.

**Staff**: an exterior covering for buildings, resembling plaster or stucco, first used at the Paris Exposition of 1889, and employed for most of the buildings and exterior decorative work of the Columbian Exposition at Chicago in 1893. It is made of hydraulic cement, sand, and a binding material of jute fiber. M. M.

**Staf'fa**: a small, uninhabited island of Argyleshire, Scotland; 6 miles W. of Mull; celebrated for its curious caverns, among which that called Fingal's Cave (*q. v.*) is the most remarkable. Among the other caves are the Cormorant and the Clam-shell. The greater part of the coast is girt with cliffs from 84 to 112 feet high. In the N. E., however, in the lee of the prevailing winds, is a tract of low shore stretching out in beaches and forming a landing-place, and the interior table-land is covered with rich soil and luxuriant grass, which feeds a number of black cattle.

Revised by M. W. Harrington.

**Staff and Staff Schools**: the assistants of the general-in-chief of an army and of his generals, and the institutions in which they are trained for service on the staff. The term staff as commonly used includes (1) the heads of departments (such as artillery and engineers, military law, medical, quartermaster, pay, etc.), (2) the personal staff (including aides, orderly officers, etc.), (3) adjutants, and (4) a special body of officers, intrusted with duties connected directly with military operations, entitled the *general staff*.

The general staff has been universally recognized as an essential part of modern army organization. Its purpose is to convert the ideas of the general commanding into orders, not only by conveying them to the troops, but far more by working out all the necessary matters of detail (Clausewitz); and to watch over and preserve the fighting condition and material welfare of the troops (Schellendorf).

*Germany.*—All European states since the great success of the Prussian armies in their contests with Denmark, with Austria, and with France, in the campaigns of 1864, 1866, 1870–71, have made the Prussian staff system in some degree their exemplar. The origin of a general staff is probably to be found in the Swedish organization of the seventeenth century (then regarded as a model), and traces of it (no doubt taken therefrom) are found in the army of the great Elector of Brandenburg, who had, in 1655, two quartermaster-generals, officers doing special duty other than the direct command of troops—the germ of the German general staff of to-day. In 1657 were added to the general staff a field-marshal, a commissary-general and his assistant, 2 adjutant-generals, a judge-advocate, a provision-master, a quartermaster, a paymaster, a chaplain, a surgeon and an apothecary, a wagon-master, a provost-marshal with 3 assistants, and 11 clerks.

Frederick the Great had few staff officers. This great captain was not only his own chief of general staff, but he often assumed the functions of a staff officer of an inferior grade. The staff of the quartermaster-general then had merely a nominal existence. In 1741 there were 5 colonels, 4 adjutant-generals, 1 brigade-major, 5 majors (wing-adjutants), 1 quartermaster-general with 1 colonel and 2 majors as assistants, and 9 colonels and lieutenant-colonels of the army on general staff-duty. The king's instructions to his quartermaster-general, dated 1757, contain the principles of the construction, attack, and defense of fortresses and fortified camps; reconnoissance duty was performed by his engineers; the captain of the guides conducted columns of route, as no maps then existed, while the brigade majors regulated the guard duties in camp. In 1796 the survey of the kingdom was intrusted to the quartermaster-general's staff.

These were the beginnings of the general staff, but it was not until 1806 that Col. von Massenbach gave it a definite organization, and had assigned to its officers their proper duties, which, in general outlines, are still retained.

After the destruction of the Prussian army by Napoleon in the campaign of 1806, Col. von Scharnhorst in 1808 became lieutenant quartermaster-general of the Prussian army, with rank of major-general. His staff consisted of thirty-four officers in all; one officer was attached to each brigade, and one (sometimes two) to each corps. After 1815 the organization of the staff, which had rendered distinguished and important services during the closing campaigns against Napoleon, was seriously studied. A part of its officers, placed under a special chief as the *great general staff*, was assembled at Berlin, while its other officers, doing staff duty in the general and divisional commands, were in direct contact with the troops. The general staff was under the Minister of War till 1821, when the king named Lieut.-Gen. von Mueffling chief of the general staff, which then acquired an independent position, taking its orders directly from the chief of the state and commander-in-chief of the army—a position it retains. To this independence of all subordinate authority the Prussian staff attributes its ability to render the services in its later campaigns which have placed it as first among military organizations. Lieut.-Gen. von Mueffling was succeeded in 1829 by Lieut.-Gen. von Krauseneck, who was followed in 1848 by Lieut.-Gen. von Reyer, on whose death, in 1857, Gen. von Moltke became chief of the general staff. The part played by this general staff in changing the map of Europe makes its history one of great interest.

The campaign of 1866 showed the necessity of having ready at the moment of mobilization of the army a great general staff, capable of being doubled, and of leaving behind it when the army takes the field a sufficient number of trained staff officers to make sure of the means and measures of military transportation, and to insure the continuance of the supplies necessary for the army of operations. In 1867 a royal order established the staff on the following footing: *Principal list*: chief of general staff of the army; chiefs of division at the offices of the great general staff; chiefs of staff of the army-corps, etc.; total, 88 officers. *Scientific list*: 21 officers at the office of the great general staff. Total, 109 officers, 46 belonging to the great general staff.

At the breaking out of the war of 1870 the German army contained 200 staff officers, which number was considerably increased in the course of the campaign. In 1891 the general staff proper consisted of 186 officers—127 attached to the staff of the corps, divisions, etc., 49 to the great general staff of Berlin, 10 to that of Munich; the auxiliary staff (*scientific list*), officers simply detached from their regiments and doing duty under the great general staff, consists of 68 officers. Besides these, the general staff comprises military *attachés* (about 10), directors of military schools (about 20), commissaries of railroads residing at important railway centers (25), and officers undergoing probation as staff officers (80). Moreover, there are some 400 adjutants, selected and assigned to duty by the chief of the general staff, so that there are about 800 officers employed on general staff duty.

The work of the great general staff is distributed to separate divisions. The chief of the general staff directs the whole. In his office, under direction of his aide-de-camp, questions relating to the personnel of the staff, to its organization and administration, are considered. The work of collecting military information, domestic and foreign, the use of railways, the pursuit of military science, preparation of maps, etc., are distributed to various sections, grouped according to their work or the countries to whose study they are devoted. The staff is divided into three sections, whose duty is to study attentively all military events, domestic and foreign; to keep themselves acquainted with the changes affecting the organization, recruiting, arming, and equipment of armies; to study the military geography of different countries, the establishment or demolition of fortresses, the development of the network of roads, railways, canals, etc. Each is directed by a chief. Several staff officers, and a number of officers ordered on staff duty and charged with the special study of military questions in different countries, are under the orders of each chief.

The fourth section is that of railways. This section is charged with all that relates to military transportation. It should know the connections of the railways at home and abroad, the equipment and rolling stock; and it elaborates the great schemes for army transportation by railway. In consequence of the great number of officers needed to manage the movement of a great army by railway, as many officers as possible are from time to time attached to this section with a view to their instruction in these duties.

In the scientific corps of the staff are the officers who have charge of the section of military history, of the archives, and of the library. In this scientific corps belong also the section of geography and statistics and the preparation of military maps of foreign countries. The general service of charts belongs, under a chief of the trigonometric survey, to another part of the great general staff.

The officers of the general staff are selected from the ablest graduates of the military schools after a certain term of service in the line. They serve on the staff in greater number than can possibly become permanent staff officers. They return to the line and serve a term with their regiments. As vacancies occur in the permanent staff, they are filled by selection, at the discretion of the chief of the general staff, from those officers who have, while under his eye, given proof of greatest capacity and devotion.*

*France.*—In the French army, previous to 1880, the general staff was a separate corps of officers, but since that year it has been merely a service to which officers of the line are detailed for a term of years, these officers still belonging to their respective arms and being regularly promoted therein. By the law of June 24, 1890, the number of officers in the general staff was limited to 640, comprising 30 colonels, 40 lieutenant-colonels, 170 majors, and 400 captains, under whose orders are placed 180 archivists, constituting a special corps of officers, employed in clerical work and in keeping the records.

In time of peace the general staff comprises (1) the military household of the president; (2) the special staff of the Minister of War; (3) the general staff of the army; (4) the staffs of the military governors of Paris and of Lyons; (5) the staffs of army-corps, divisions, and brigades; (6) the staffs of territorial divisions and subdivisions; (7) the staffs attached to fortified places; (8) the staffs of marshals of France and general officers specially employed; (9) military *attachés* abroad; (10) the staff of the commanders of the artillery and the engineers.

The supply of officers for the staff comes mainly from the superior war school (see MILITARY ACADEMIES), but officers who have not gone through this school are allowed to compete for a staff certificate at examinations held concurrently with the final examination at this school. The officers who pass serve a probationary term of two years in the staff, after which the best are selected as required.

The personnel of the staff is brought up to the war footing by calling in all officers possessing the staff certificate who are in the active army, and by recalling all certified officers and archivists belonging to the reserve or the territorial army.

The general staff of an army-corps is composed of (1) 1 chief of staff (general or colonel), 1 colonel or lieutenant-colonel, 2 majors (sometimes 3), 3 captains, 2 orderly officers, 2 archivists and 8 secretaries in time of peace; in time of war, of 14 officers and 66 men; (2) the staff of the artillery, 8 officers and 19 men; (3) the staff of the engineers, 4 officers and 8 men.

A division has, in time of peace, 1 chief (lieutenant-colonel or major) and 1 orderly officer (captain or lieutenant); in time of war, 1 captain or lieutenant, and 30 men in addition.

A brigade has, in time of peace, 1 orderly officer (lieutenant or captain possessing the staff certificate), and 1 corporal or private as secretary; in time of war, 1 lieutenant of the reserve as orderly officer, and 9 men in addition.

The artillery and engineers have also a special staff, that of the former comprising 310 colonels, lieutenant-colonels, majors, and captains, also the second lieutenants of the school of application; that of the latter comprising 486 officers. The duties of the former consist in superintending the various establishments of that arm and supplying the troops with ammunition; those of the latter in constructing and repairing fortifications and military buildings, directing the engineer schools, military telegraphy, and the military pigeon-houses.

*Russia.*—The officers of the general staff in Russia form a special corps, and are exclusively graduates of the general staff school (Nicolas Academy) at St. Petersburg. Entrance to this school is by competitive examination, open to officers of all arms who have served at least three years; the course is two and a half years, the last six months being devoted entirely to practical work in the field; about 80 students enter every year and about 60 graduate. Upon graduation the 30 best enter the general staff. There is also a geodetic subdivision of 20 officers, who, after a two and a quarter years' course here, have a two years' course at the observatory at Pulkowa and then enter the general staff. The general staff comprises about 480 colonels, lieutenant-colonels, and captains, who do duty in the different bureaus of the great general staff at the office of the Minister of War, or in the military schools, or in the general staff of the generals exercising command. Before being promoted they are always required to have served with troops, exercising certain commands, so that a number is always detached on such duty. The corps also comprises about 80 general officers doing general staff duty and about 170 on special duties of various kinds. Topographical work is not done by the general staff, as in other armies, but by a special corps of military topographers, about 450 officers; and there is still another corps, doing duty related to that of the general staff, viz., the *Feldjaeger*, about 45 officers, selected from various arms, for reconnoissance work, carrying important orders to a distance, etc. General officers also have their aides-de-camp, selected from the officers of their commands, and simply detached, but not considered part of the general staff.

*Austria-Hungary.*—The general staff of Austria-Hungary, suppressed as a special corps in 1871, but re-established as such by the law of Dec. 23, 1875, comprises on the peace footing 260 officers, besides a number attached for temporary duty. The corps proper is a closed corps, and an officer once admitted remains a part of it, whether he afterward does duty with troops or continues on general staff duty, but it is open for admission to all officers up to the rank of major.

Before entrance lieutenants are generally required to pass at the staff school (*Kriegsschule*),* located in Vienna. Admission to this school is by competitive examination, open to first or second lieutenants of at least three years' service, who are under thirty years of age and unmarried; each year about 45 enter. The course is two years, terminated by an examination, at which other officers who have not taken the course may also compete. Those who pass are assigned to the staff for a probationary tour of duty as required; they number usually about 135. If acceptable they become captains of the general staff; if not, they return to their regiments. Majors may come directly from the line, either by passing a special examination or by selection of the chief of the general staff. Promotion in the corps is by seniority.

Employed in the bureaus of the general staff of the army are about 30 officers, taken either from the retired list or from a special body of officers, not fit for active service, but who can be utilized for sedentary duties, called the *Armeestand*, who have their own uniform and are promoted among themselves. Besides these about 100 officers, detached from their regiments, are detailed on topographical work. The total on general staff duty is about 700.

*Italy.*—General staff duty in Italy is performed by a special corps of about 150 officers, drawn from the captains, graduates of the general staff school, who have commanded a company, squadron, or battery for at least one year. Upon promotion they generally return to the line, and are not again recalled to the general staff as majors until after serving another year with troops; but captains who served two years before admission may be promoted in the corps.

There are also about 120 officers temporarily attached to the general staff, including those graduates of the staff school (usually about 24) who are making their trial tour. Generals in command, besides their general staffs, have also orderly officers, selected from among the troops of their command and detailed for a term not exceeding three years; brigade commanders have neither general staffs nor orderly officers, but aides-de-camp are detailed to the brigade (not to its commander) by the Minister of War. The number of orderly officers and aides-de-camp is about 100. There are, therefore, about 370 officers on general staff duty.

* Saxony has its own cadet corps, and Bavaria has its own cadet corps, war school, artillery and engineer school, and war academy.

* Austria-Hungary also has a military orphan asylum at Fischau, 4 lower military realschools at St. Pölten, Güns, Eisenstadt, and Koschau, a higher military realschool at Mährisch-Weisskirchen, 12 infantry cadet schools, 1 cavalry, 1 artillery, 1 engineer, and 1 pioneer school, the military academy (for cavalry and infantry) at Wiener-Neustadt, the technical military academy (for artillery, engineers, and pioneers) at Vienna, the higher artillery and engineer course, and the field officers' course, besides regimental and other schools for soldiers and schools of practice and application for officers.

*Great Britain.*—It can scarcely be said that there is any British military staff as a separate and distinct corps of officers. The British War Department is dual, embracing both political and military officers. Command and administration are separate. The War Office and the Horse Guards, long distinct, were united into one department by act of Parliament in 1870. The general commanding-in-chief was thus brought into the War Office, which is under the Secretary of State for War. The latter is alone responsible to Parliament, while the former is subordinate, and can exercise his authority only under approval of the secretary; in practice, however, the secretary concerns himself with the army estimates only, and exercises merely a general control over the general-in-chief, who has immediate direction of all military affairs; two Under-Secretaries of State are placed immediately under the Secretary of State for War—the parliamentary secretary and the permanent under-secretary. The first retires at a change of ministry, and assists his chief in Parliament; the second does not sit in Parliament: he has the real direction of business, and does not go out with the ministry.

The military affairs come under the military department of the secretary, and are arranged under several bureaus: (1) That of the military secretary, dealing with matters relating to officers personally, such as orders, leaves of absence, detail to staff-duty, etc.; (2) that of the adjutant-general of the army, concerned with all questions of recruitment, organization, mobilization, instruction, and discipline; (3) that of the quartermaster-general, comprising clothing, equipment, quartering, food, forage, and transportation: the quartermaster-general has control of the commissariat and transport corps and the pay department; (4) that of the inspector-general of engineers and fortifications; (5) that of the director-general of artillery; (6) that of the director of military intelligence; (7) the director of military education, surgeon-general, chaplain-general, and principal veterinary surgeon.

The yearly army estimates and administrative matters are under the financial department, at the head of which is the financial secretary (a civil officer), under whom are four bureaus: (1) The accountant-general (specially charged with the army estimates); (2) the director of contracts; (3) the director of clothing; (4) the director of ordnance-factories.

There are two branches of general staff service in England; viz., the staff of the commands and the personal staff. The former comprises those officers who form the staff proper of general officers, those on topographical work, and those sent on special missions. The staff of a general officer is divided into two distinct bureaus, the adjutant-general's and the quartermaster-general's. In brigades a single officer, called brigade-major, combines the duties of both.

The personal staffs of generals comprise aides-de-camp and military secretaries.

The officers of the staff are taken exclusively from the regular army, and should have spent two years at the staff college or passed the final examination for graduation at that college. A condition of eligibility to examination for admission to the staff college is five years' service in the army. Every officer who presents himself for the graduating examination at Sandhurst Staff College (see MILITARY ACADEMIES) must have had seven years' service.

Officers on staff duty generally serve but five years, after which they return to their regiments and are not again available for at least two years.

*United States.*—In the U. S. there is no general staff properly so called, but (as in Great Britain) some of the duties of this body are performed by officers of certain departments or by officers of the line temporarily detailed. The so-called staff departments are (1) the adjutant-general's, comprising 1 brigadier-general, 4 colonels, 6 lieutenant-colonels, and 6 majors, their principal duties being the ordinary routine of office-work, the wording and issue of the orders of commanding generals, and in the war department all matters relating to recruitment; (2) the inspector-general's (1 brigadier-general, 2 colonels, 2 lieutenant-colonels, and 2 majors), their duties consisting in inspecting the various posts, garrisons, military schools, and military departments of colleges to which officers are detailed, and the money accounts of disbursing officers; (3) the quartermaster's department (1 brigadier-general, 4 colonels, 8 lieutenant-colonels, 14 majors, and 30 captains), whose duties consist in constructing and repairing quarters and other public buildings, roads, etc., furnishing transportation and supplying fuel, forage, clothing, and material; (4) the subsistence department (1 brigadier-general, 4 colonels, 3 lieutenant-colonels, 8 majors, 12 captains), furnishing supplies of food (principally the ration) and certain other articles; (5) the judge advocate-general's department (1 brigadier-general, 1 colonel, 3 lieutenant-colonels, and 3 majors), who attend to questions of law and assist in revising charges and court-martial proceedings; (6) the medical department; (7) the pay department; (8) the Corps of Engineers, part of the line in European armies, but forming a closed corps in the U. S., recruited exclusively from the highest graduates of the military academy, mainly employed in time of peace on river and harbor work, a few in charge of repairs to forts or serving with the battalion of engineers, and one on the staff of the commander of each military department in the country; (9) the ordnance department (corresponding to the construction branch of European artilleries), employed in the various arsenals, work-shops, and gun-foundries, one on the staff of each department commander; (10) the signal corps; (11) the post chaplains. The chiefs of these departments, together with a certain number of officers of each, constitute a kind of staff to the Secretary of War and the general of the army. An intelligence bureau has been organized at the War Department. Each military department commander usually has one officer of each staff department on his staff; quartermasters, commissaries, and surgeons are also located in the large cities in charge of dépôts, etc. Each department commander has also his personal aides—a major-general 3, a brigadier-general 2.

Each regiment has also a regimental staff, comprising the adjutant and quartermaster of the regiment, detailed from the lieutenants for four years. Each post, moreover, has a post adjutant and a post quartermaster and commissary, detailed by the commanding officer from the lieutenants of the post.

For further information consult von Schellendorf, *Duties of the General Staff*; Rau, *L'état militaire des puissances étrangères* (1891); von Löbell, *Jahresberichte über die Veränderungen und Fortschritte im Militärwesen*; and L. Beaugé, *Manuel de législation, d'administration et de comptabilité militaires* (1892).

Revised by JOHN P. WISSER.

**Staffeldt**, ADOLF WILHELM SHACK, von: poet; b. on the island of Rügen, Germany, 1769; studied in the military academy at Copenhagen, and entered the Danish army. In 1791 resigned, and studied law, archæology, and the history of art at Göttingen, after which he spent several years in travel. In 1800 he returned to Denmark, and held important Government positions there until his death in 1826. His earliest collections of poems (1803 and 1808) attracted little attention at the time of their appearance, and on account of their depth of thought and frequent obscurity of language they have never won general popularity. Unlike Oehlenschläger, Staffeldt continued to be strongly influenced by German romanticism. Among his later works are the romances *Troubadouren*; *Trende Nætter* (Three Nights); *Roserne* (The Roses); and *Indvielsen* (The Consecration). See his *Collected Poems* (2 vols., Copenhagen, 1843). D. K. D.

**Stafford**: county town of Staffordshire, England; on the Sow; 29 miles N. N. W. of Birmingham, and 133 N. W. of London (see map of England, ref. 9-G). Among the churches are St. Mary's, restored by Sir G. Scott in 1845, and St. Chad, originally of Saxon origin, restored 1855-85. Shoemaking is carried on. Stafford returns one member to Parliament. Pop. (1891) 20,270.

**Stafford**, WILLIAM HOWARD, Viscount: statesman; b. in England, Nov. 20, 1612; was brought up a Roman Catholic; married a sister of Baron Stafford, to whose title Howard succeeded. During the civil war Stafford adhered to the royal cause, but after the Restoration often opposed in the House of Peers the measures of the court; was intimate with Shaftesbury, and was, on account of his religion, selected by the infamous Titus Oates as one of his victims. Accused of participation in the "Popish plot" by Oates in his first examination before the House of Commons, Stafford surrendered himself on the following day, and was committed to the Tower with four other accused noblemen Oct. 30, 1678. On Nov. 30, 1680, his trial for high treason was begun before the House of Lords, Sir Heneage Finch (afterward Earl of Nottingham) presiding as lord high steward. Stephen Dugdale and one Turberville, the chief witnesses, swore that Stafford had offered them rewards to participate in a conspiracy against the life of the king, and Bedloe, Dangerfield, and Denis offered confirmatory testimony.

Stafford defended himself with spirit, but he was convicted Dec. 7, by 55 votes against 31, four of the Howard family being of the majority. Stafford was executed on Tower Hill, Dec. 29, 1680, protesting his innocence in terms which carried great weight with the spectators. His widow was created countess, and his eldest son Earl of Stafford, by James II. (1688); but the title became extinct on the death of the fourth earl in 1762. The attainder was reversed by act of Parliament in 1824, and Sir George William Jerningham was recognized as Baron Stafford in 1825.

Revised by F. M. Colby.

**Staf'fordshire**: a west midland county of England; area, 1,169 sq. miles. The central part of the county is low and undulating, but in the north and the south the ground rises and the surface becomes hilly. The soil is generally cold, clayey, and not very productive. The coal-fields are very rich in the northern and southern parts of the county; iron, copper, and lead are found, together with marble, freestone, and an excellent potter's clay. With respect to its manufactures, chiefly china, earthenware, and iron, this county is the third in rank in England. Seven members are returned to Parliament. Pop. (1901) 879,625.

**Stafford Springs**: borough; Tolland co., Conn.; on the Willimantic river, and the Central Vt. Railroad; 20 miles N. by W. of Willimantic, 50 miles N. of New London (for location, see map of Connecticut, ref. 7–J). It contains manufactories of woolen and iron goods, Congregational, Methodist Episcopal, Protestant Episcopal, and Roman Catholic churches, high and graded schools, public library (founded in 1874), a national bank with capital of $50,000, a savings-bank, and a weekly paper. Mineral springs add to the attractions of the place as a summer resort for invalids and pleasure-seekers. Pop. (1890) 2,353; (1900) 2,460. Editor of "Press."

**Staff-tree Family**: See Spindle-tree Family.

**Stag**, or **Red Deer**: the largest deer of Europe, the *Cervus elaphus*, a species much resembling the American wapiti. The male is called the *hart*, the female the *hind*, and the young the *calf*; the male under three years is called a *brocket*; under four, a *spayad*; under five, a *staggard*; and under six, a *stag*; so that strictly, in sporting parlance, a stag is a red deer five years old. At six years he is a *hart of ten*, and when seven years old he is a *hart crowned*, and is considered fair game. The stag is distributed over the greater part of Europe, and is found in Northern Asia as far as the Lena and Lake Baikal. It inhabits Exmoor, in England, and the Highlands of Scotland. Its horns are lofty and branching. In summer it is yellowish-brown; in winter, reddish-brown; the color deepens much with age, and in winter the old stags are nearly black. The flesh is inferior to that of the fallow deer. Revised by F. A. Lucas.

**Stag-beetle**, or **Horn-bug**: any one of several large beetles of the family *Lucanidæ*, remarkable for the great size of the head and for the large horn-like mandibles. *Lucanus dama* of the U. S. is a well-known inhabitant of decaying wood, piles of chips, etc., and is capable of inflicting a severe bite. *L. cervus* is European.

**Stage**: See Theater.

**Stage-coach**: See Carriages.

**Staggers**: a popular name for several diseases of horses and sheep. Blind staggers in horses is a sort of epilepsy; mad staggers, an inflammation of the brain; grass staggers, an acute and dangerous gastritis. The treatment of the first is by setons about the head, but the disease is incurable. The second usually receives treatment by means of blisters, cathartics, and thorough bleeding. The last-mentioned disease calls for active enemata and good-sized doses of calomel and opium. Staggers in sheep is caused by larvæ of *Œstrus ovis* in the nostrils; they may sometimes be removed by throwing into the nostrils snuff mixed with whisky.

**Staghound**: a large, rough-haired dog, much like the greyhound in general build, although somewhat heavier. It is strong, swift, and fearless, and the rival of the bloodhound in powers of scent. It is supposed to be a cross-breed of the bloodhound and the greyhound, and is used in Europe for hunting the stag, and, to some extent, in the western parts of the U. S. for hunting antelope. F. A. L.

**Stagi'ra** [= Lat. = Gr. Στάγειρα]: town of Chalcidice, in Macedonia. It was a colony from Andros, but fell into decay during the Peloponnesian war. It was the birthplace of Aristotle, and in honor of his great tutor Alexander restored the city, but its prosperity was merely temporary.

**Stagirite, Aristotle the**: See Aristotle.

**Stagne'lius**, Erik Johan: poet: b. in Gärdslösa, Sweden, Oct. 14, 1793. Although at first strongly influenced by Phosphorism (see Swedish Literature) and never entirely freeing himself from its obscurity, Stagnelius developed a style and view of life quite his own. All his works are treatments, in one form or another, of the different aspects of gnosticism, and in these speculations he goes to the furthest extreme. In some of his aspects he has not inaptly been compared to Shelley. Among his works are *Wladimir den store* (1817); *Liljor i Saran* (Lilies of Sharon, 1821), his most characteristic collection of poems; *Martyrerne* (The Martyrs, 1821), his best drama; and *Bacchanterna* (The Bacchantes, 1822). D. Apr. 13, 1823. His collected works were published in 1867–68 (11 vols., Stockholm).

D. K. Dodge.

**Stahl**, Friedrich Julius: jurist; b. in Munich, Jan. 16, 1802, of Jewish parents; embraced Christianity in 1819; studied law at Würzburg, Heidelberg, and Erlangen; was appointed Professor of Jurisprudence in 1832 at Erlangen, and in 1840 at Berlin. His specialty was the philosophy of law, and in his system he was a disciple of Schelling. Assuming that human reason is incapable of arriving at a positive conception of truth by itself, he deduces the ideas of state, government, etc., from the doctrines of Christian revelation, and bases the authority of officials and the obedience of citizens on a divine ordinance. As a member of the upper house of the Prussian Diet he became the leader of the feudal and aristocratic party during the period of reaction which followed the abortive revolution of 1848 in Berlin. D. at Brückenau, Bavaria, Aug. 10, 1861. His principal works are *Philosophie des Rechts* (3 vols., 1830); *Ueber den Christlichen Staat* (1847); *Was ist Revolution?* (1853).

**Stahl**, Georg Ernst: chemist and physician; b. at Ansbach, Bavaria, Oct. 21, 1660; studied medicine at Jena; was appointed physician to the Duke of Weimar in 1687, Professor of Medicine at the University of Halle in 1694, and physician to the King of Prussia in 1716. D. in Berlin, May 14, 1734. He invented a theory of phlogiston which was generally adopted, and considered valid up to the time of Lavoisier. (See Chemistry.) His principal works are *Experimenta et Observationes Chemicæ* (1731) and *Theoria Medica Vera* (1707).

**Stahr**, staar, Adolf Wilhelm Theodor: author; b. at Prenzlau, Brandenburg, Prussia, Oct. 22, 1805; studied classical languages and literature at Halle; was appointed professor at the gymnasium of Oldenburg in 1836; settled in 1852 at Berlin, where he married the authoress Fanny Lewald in 1855. He was a very prolific writer; his numerous books and articles for periodicals treat subjects of antiquity and modern times, history and art, critically and in a descriptive manner. Some of his works have been translated into English, as, for instance, *Torso, oder Kunst, Künstler, und Kunstwerke der Alten* (2 vols., 1854–55), in *The Crayon* (New York, 1858–59); and his somewhat superficial but cleverly written biography of Lessing, *G. E. Lessing, sein Leben und seine Werke* (2 vols., 1859), by Prof. E. P. Evans, of Michigan University (Boston, 1866). He wrote the text to Kaulbach's *Goethe Gallerie* (part i., Goethe's *Frauengestalten*). His *Oldenburgische Theaterschau* (2 vols., 1845) drew great attention to the stage of Oldenburg. D. at Wiesbaden, Oct. 3, 1876. Revised by Julius Goebel.

**Staigg**, Richard Morrell: painter; b. in Leeds, England, Sept. 17, 1817; removed to the U. S. in 1831; became a mechanic at Newport, R. I., where he took lessons in painting from Washington Allston and Jane Stuart; became eminent as a miniature-painter, a branch of art which he subsequently relinquished for genre-pictures and coast-scenes. Among his best productions are *The Crossing-sweeper*, *Cat's Cradle*, *Knitting*, *The Love-letter*, *The Sailor's Grave*, and *News from the War*. D. at Newport, R. I., Oct. 11, 1881.

**Stained Glass**: See Glass.

**Stainer**, Sir John: composer and organist; b. in London, June 6, 1840; studied entirely in England; entered the choir of St. Paul's Cathedral when seven years of age, remaining until his voice broke in 1856, playing the organ on occasion. He occupied several positions as organist till 1872, when, on the resignation of Sir John Goss, he was appointed organist of St. Paul's, and remained until 1888, when he was obliged to resign on account of failing eyesight. In that year he was knighted, and on the death of

Sir F. A. Gore Ouseley in 1889 was appointed to succeed him as Professor of Music in Oxford University. His degrees and honors are as follows: Mus. Bac. Oxon. 1859; B. A. 1863; Mus. Doc. Oxon. 1865; M. A. 1866; Hon. Mus. Doc., Durham, 1885; Chevalier of the Legion of Honor 1878. He is also honorary member of the Royal Academy of Music and honorary fellow of the Tonic Sol-Fa College. His compositions are chiefly sacred and include three sacred cantatas, *The Daughter of Jairus*, Worcester festival, 1878; *St. Mary Magdalene*, Gloucester festival, 1883; *The Crucifixion*, 1887; the oratorio *Gideon*, an early work; and many church anthems and services. He has also written several theoretical works, a treatise on the *Music of the Bible*, and a *Dictionary of Musical Terms*. D. E. HERVEY.

**Stair**, JAMES DALRYMPLE, Seventh Baron and First Viscount: jurist; b. at Drummurchie, Ayrshire, Scotland, in May, 1619; graduated M. A. at the University of Glasgow 1637; obtained a commission as captain in the Scottish army, but at the age of twenty-two accepted the professorship of philosophy at Glasgow, which he held till 1647; was admitted an advocate at the Scottish bar Feb., 1648; was secretary to the commissioners sent to treat with Charles II. at Breda 1649–50; became a lord of session July 1, 1657; was knighted by Charles II. 1660, and confirmed as lord of session Feb. 13, 1661; resigned office 1663 from unwillingness to subscribe the declaration against the Covenants of 1638 and 1643 appended to the oath of allegiance, but his resignation was declined, and he was made a baronet June, 1664; became lord president of the court of session Jan., 1671; refused to take the new test oath, and was removed from his offices 1681; published in that year his *Modus Litigandi* and *The Institutions of the Law of Scotland*—a work which has been called the Scottish Blackstone; becoming involved in a dispute with Claverhouse he was forced to flee to Holland Oct., 1684; prepared there his *Decisions of the Lord of Council and Sessions 1661–81* (Edinburgh, 2 vols. folio, 1683–87); published at Leyden his Latin treatises *Physiologia Nova Experimentalis* (1686); received a pardon 1686; accompanied the Prince of Orange to England 1688; was reinstated in the presidency of the court of session, and made Viscount Stair Apr. 21, 1690; published an *Apology* for his political course (1690) and a *Vindication of the Divine Perfections* (1695). D. in Edinburgh, Nov. 29, 1695.

**Stair**, JOHN DALRYMPLE, First Earl of, better known as the Master of Stair, son of Viscount Stair: b. in Scotland about 1648; was admitted as advocate in the court of session Feb., 1672; was one of the council for the Earl of Argyll on his trial for treason 1681; was twice imprisoned between 1681 and 1685; was received into favor on the accession of James II., by whom he was made lord advocate 1685 and lord of session and lord justice clerk 1686; supported the Revolution 1688; was a leading Scottish member of the Convention Parliament Mar., 1689; was one of the three commissioners sent to London to offer the crown of Scotland to William and Mary May, 1689; was reappointed lord advocate 1690; became one of the Secretaries of State for Scotland 1691; plotted the massacre of GLENCOE (*q. v.*), Jan., 1692, for which act he was dismissed from office 1695 and censured by a parliamentary committee of inquiry, but was never subjected to prosecution; succeeded his father as Viscount Stair in 1695; was sworn of the privy council on the accession of Anne 1702; was created Earl of Stair Apr. 8, 1703; was one of the commissioners who negotiated the treaty of union between Scotland and England 1706, and was mainly instrumental in passing that measure through the Scottish Parliament. D. Jan. 8, 1707. See Graham, *Stair Annals* (1875).

**Stair**, JOHN DALRYMPLE, Second Earl of: soldier; b. in Edinburgh, July 20, 1673; had the misfortune in boyhood to kill his elder brother by the accidental discharge of a pistol; educated at the University of Leyden, where he was distinguished for scholarship; entered the army as a volunteer under the Earl of Angus, and commanded the Cameronian Regiment at the battle of Steinkirk 1692; was aide-decamp to the Duke of Marlborough at Venloo and Liège 1702; succeeded to the earldom 1707; obtained command of the Scots Greys; was commissioned general; distinguished himself at Ramillies and Oudenarde 1706, and at Malplaquet 1709; withdrew from the army in 1711; became privy councilor and representative peer for Scotland 1714; was appointed commander-in-chief of the forces in Scotland on the accession of George I. (1715); was ambassador to France 1715–20; resided on his estate at New Liston, Scotland, and devoted himself to scientific agriculture 1720–40; was made field-marshal commander-in-chief of British forces in Flanders and ambassador extraordinary to the States-General of Holland 1741; won the battle of Dettingen June 27, 1743, and subsequently filled several important public posts under the Walpole administration. D. in Edinburgh, May 9, 1747. The *Memoirs of the House of Dalrymple*, published from family papers (1876), contains important historical data.

**Stalac'tites** [from Gr. σταλακτός, dropping, oozing out in drops, deriv. of σταλάζειν, to drop]: icicle-like masses of lime, limonite, chalcedony, pyrites, etc., attached to the roofs of caverns; they are formed by the evaporation of water holding these substances in solution. Stalactites sometimes form columns reaching from floor to roof of high chambers; sometimes they imitate curtains, waterfalls, etc., and constitute notable features in some of the most famous caves. The name *stalagmite* (Gr. στάλαγμα, a drop) is given to accumulations of material of the same nature as stalactites, but deposited on the floors of caverns. This sometimes forms continuous sheets over the surface, sometimes rises into columns, which meet and blend with the stalactites above. Stalactites are often tubular, and, indeed, generally begin to form as tubes, since the solid matter held in solution by a drop of water when precipitated by evaporation forms a ring at the base and outside of the drop.
Revised by ISRAEL C. RUSSELL.

**Staley**, CADY, Ph. D., LL. D.: civil engineer and educator; b. at Scotch Bush, Montgomery co., N. Y., Dec. 12, 1840; educated at Union College. He has been in engineering work on the Central Pacific Railroad, Professor of Civil Engineering in Union College 1867–86, and dean of the faculty, and since 1884 president of the Case School of Applied Science in Cleveland, O. He is the editor of recent editions of Gillespie's *Surveys* and *Roads and Railroads*, and (with G. S. Pierson) author of *The Separate System of Sewerage* (1886).

**Stalker**, JAMES, D. D.: minister; b. at Crieff, Perthshire, Scotland, Feb. 21, 1848; was educated at the University and New College of Edinburgh, Universities of Berlin and Halle; minister of St. Brycedale Free church, Kirkcaldy, 1874–87; since 1887 of St. Matthew's, Glasgow. He was Cunningham fellow at New College 1874, and Lyman Beecher lecturer at Yale Theological Seminary 1891. Dr. Stalker has published *The Life of Jesus Christ* (Edinburgh and New York, 1879; many later editions; translated into several foreign languages); *The New Song: Sermons for Children* (1883); *Life of St. Paul* (1884; several later editions); *Imago Christi* (1889; 7th edition, 1894; translated into Norwegian, German, Japanese, and other languages); *The Preacher and his Models*, Lyman Beecher lectures (New York, 1891; 2d ed. 1892); *Men and Morals* (1892); *The Four Men and Other Chapters* (1892); *The Trial and Death of Jesus Christ* (1894). C. K. HOYT.

**Stall**, SYLVANUS: See the Appendix.

**Stalwarts**: a name applied to the section of the Republican party that in 1881 opposed the administration of President Garfield. The quarrel arose from the appointment of a collector of the port of New York in opposition to the wishes of Conkling and Platt, the Senators from that State. The party was divided into Stalwarts and "Half-breeds," as friends of the administration were called, and this helped the Democrats to win in 1884. See REPUBLICAN PARTY.

**Stamboul**, stăm-bool': the wealthiest, most populous, and important of the territorial divisions forming the city of CONSTANTINOPLE (*q. v.*), called Istamboul by the Ottomans. Stamboul is a triangular-shaped promontory, projecting eastward toward the Bosphorus from the mainland, and included between the Golden Horn and Marmora. It comprises thirteen of the fourteen *regions* or *climata* of the Nova Roma of Constantine. E. A. G.

**Stamen** [= Lat., liter., warp in an upright loom, thread, fiber, deriv. of *sta're*, stand; cf. Gr. στήμων, warp (in an upright loom), deriv. of ἱστάναι, stand]: the pollen-bearing organ in plants. Morphologically it is a leaf, upon which one or more pollen-sacs (spore-sacs or sporangia) are produced. On account of its special function it is rarely an expanded structure, although it is so in water-lilies, cannas, and some other cases (Fig. 1, *a*). In its usual form (Fig. 1, *b*) the slender stalk (*filament*) is surmounted by the pollen-sac (*anther*), which at maturity contains many loose cells, the

POLLEN (*q. v.*). In *Taxus* (*c*) several pollen-sacs are attached to the under side of the peltate stamen, while in *Ginkgo* (*d*)

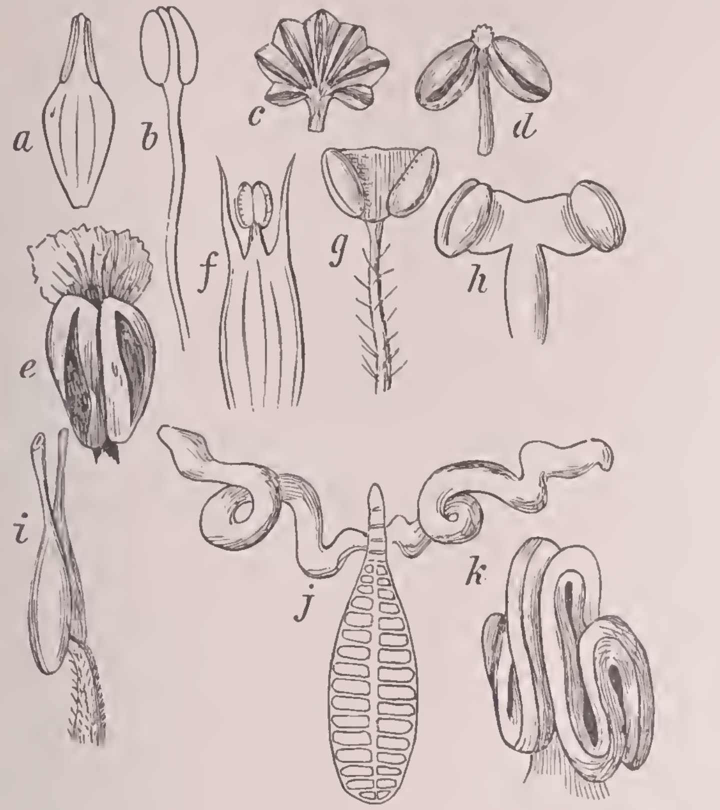



FIG. 1.—Stamens: *a*, water-lily; *b*, anemone; *c*, *Taxus*; *d*, *Ginkgo*; *e*, *Picea*; *f*, *Allium*; *g*, *Tradescantia*; *h*, *Thymus*; *i*, *Oxycoccus*; *j*, *Acalypha*; *k*, *Cucurbita*.

the two sacs are attached by the tips only. In *Picea* (*e*) and the pines the sacs are attached at the back of the leaf-like stamen. Other forms are shown in *f* to *k*, the most curious being found in *Acalypha* (*j*), where the sacs are long and spirally twisted.

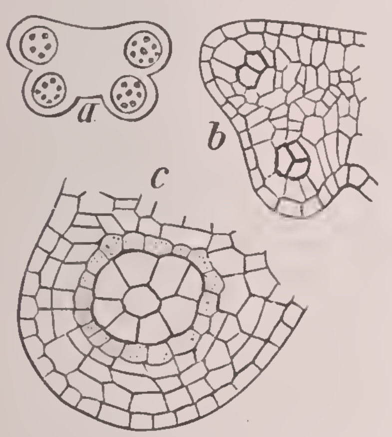



FIG. 2.—*a*, cross-section of a mature anther; *b c*. cross-sections of young anther-lobes showing differentiated cells, highly magnified.

When young, the pollen-sacs are composed of uniform tissue, but soon certain cells in vertical rows become differentiated (Fig. 2, *b c*), and eventually by subdivision produce the pollen-cells. At maturity there may therefore be one, two, or four cavities (Fig. 2, *a*) containing pollen, and this is set free by the longitudinal rupture of the anther (Fig. 1, *b e k*), or by the opening of a terminal or lateral pore (Fig. 1, *i*).

When associated with the pistil in the same flower the stamens are usually below it (hypogynous), but by the adhesion of the floral parts they may be above it (epigynous). Normally they are separate from one another, but in some cases they are more or less united by their filaments, as in peas and beans, or even by their anthers, as in the *Compositæ*. See FLOWER.

CHARLES E. BESSEY.

**Stamford**: town and city; Fairfield co., Conn.; on Long Island Sound, Mill river, and the N. Y., N. H. and Hart. Railroad; 34 miles N. E. of New York, 78 miles S. W. of Hartford (for location, see map of Connecticut, ref. 13–D). The main part of the town lies in a valley, with hills on three sides and the Sound on the S. The harbor has been improved by the U. S. Government and is suitable for vessels of large draught. There is a daily steamboat line to New York. At Shippan Point, on the shore, are fine cottages, hotels, and other public resorts, and the Stamford Yacht Club building. The city comprises four-fifths of the population of the town, and has an excellent water-supply from Trinity Lake, sewerage system, paid police and fire departments, well-organized public-school system with high-school building erected in 1895, several private boarding and day schools and seminaries, a hospital and home maintained by St. John's church (Protestant Episcopal), the Ferguson Library, 2 national, a State, and 3 savings-banks, electric-light and railway plants, and a daily and 3 weekly newspapers. The town and city have a combined bonded debt of $600.000. There are extensive lumber-mills, a woolen-mill, a pottery, and manufactories of locks, builders' hardware, hoisting appliances, post-office equipments, pianos, stoves, shoes, patent medicines, chemicals, straw hats, carriages, and other articles. Stamford was settled in 1641; had its name changed from the Indian, Rippowam, in 1642; and was incorporated as a borough in 1830 and as a city in 1893. The assessed valuation of city property is about $17,000,000. Pop. (1880) 11,298; (1890) 15,700; (1900) 15,997.

ROBERT WHITTAKER.

**Stammering** [from O. Eng. *stamor*, adjec. stammering; cf. O. H. Germ. *stammalōn* > Germ. *stammeln*, whose root appears in Goth. *stamms*, stammering, in Germ. *stemmen*, make to halt (**stamjan*), and in *ungestüm*, violent, unchecked]: an affection of the faculty of speech characterized by irregular, imperfect, or spasmodic actions of the muscles concerned in articulation. It is in reality a choreiform, often hysterical, condition of the muscles concerned, a defective power of co-ordination. It may be manifested under two somewhat different forms. In the one there is a difficulty in beginning the enunciation of words, and this is shown especially in regard to those words which begin with what are called the "explosive consonants" (*b*, *p*), and which require the sudden opening of the lips. In the other form the word is begun, but after the enunciation of a syllable there is a spasmodic, and for a time uncontrollable, reiteration of the same syllable. To this variety the term *stuttering* is sometimes applied. Stammering is one of the mimic diseases, and may be acquired by carelessness in speech or by association with others similarly affected, or even by mocking such persons. In the majority of cases it disappears after the attainment of adult age, probably in consequence of the constant efforts of the subject to improve his habit of speaking. It is generally increased by emotional disturbance, especially fright and apprehension, and is much mitigated, and often cured, by the patient acquiring confidence in himself, never attempting to speak in a hurry or when the chest is empty of air, or by reading measured sentences slowly and with deliberation. Stammerers never have any difficulty in singing, for they know that a certain definite manner is to be observed, and this gives them the confidence they require. The affection is sometimes permanently removed in time by the patient performing some trifling muscular action consentaneously with the enunciation of the words over which he stumbles. Thus he can sometimes prevent the fault by moving a finger at the very instant that he begins to utter the word. Revised by W. PEPPER.

**Stamp Acts**: laws requiring that stamps purchased from the government be placed on certain legal documents. In the history of the British colonies in North America the term Stamp Act refers to a law passed by the British Parliament Mar. 22, 1765, "for granting and applying certain stamp duties and other duties in the British colonies and plantations in America." It took effect from Nov. 1, 1765, but was the occasion of such excitement, protests, and overt resistance in most of the colonies that it was repealed Mar. 18, 1766, and a bill of indemnity for those who had incurred penalties was passed June 6 of the same year.

**Stamp-mill**: See GRINDING AND CRUSHING MACHINERY.

**Stamps**: official marks set upon things chargeable with some duty or tax, showing that the tax has been paid. These stamps may be either embossed, or printed separately and made adhesive by being gummed on the back. The British Government has long required the use of such stamps on checks, receipts, bank drafts, and legal documents of all kinds, and during the civil war in the U. S. (1861–65) a similar use of stamps was made for revenue purposes. Stamp duties were also levied during the same period on proprietary articles, lucifer matches, and a great variety of other commodities. Internal revenue stamps are used in the U. S. only for such articles as tobacco, snuff, cigars, ales, etc., and since 1894 for playing-cards.

*Postage-stamps* are also of two kinds: (1) those that are impressed on envelopes, newspaper wrappers, and post cards, and (2) adhesive labels. Their use is an evidence of prepayment of postage. Before their introduction it was the custom to take letters to the nearest post-office and prepay the postage or tax in cash, the postmaster then stamping such mail matter as prepaid. The introduction of the postage-stamp did away with this cumbersome method by enabling the corresponding public to purchase in advance the evidence of prepayment, and facilitated not only correspondence, but also the work of the postal authorities by obviating the necessity for a separate handling of each piece of mail matter.

The first introduction of postage-stamps for regular issue took place in Great Britain on May 6, 1840, and was the result of the earnest efforts of Sir Rowland Hill, who had fought for three years in the House of Commons for postal reform. Prior to that time, James Chalmers, of Dundee, Scotland, had invented an adhesive label intended to be used as a postage-stamp, but he was unable to introduce his invention, and the real credit must remain with Sir Rowland Hill, who carried through successfully his scheme for the reduction of postage, and at the same time the introduction of evidences of prepayment. It is true that Sir Rowland Hill did not attach so much importance to the adhesive label as to prepaid envelopes, and his fame rests on the Mulready envelopes (engraved by W. A. Mulready), representing Britannia sending letters to all parts of the world; these were first placed on sale on May 6, 1840. The envelopes were received with ridicule throughout the United Kingdom, and were soon dropped out of use, the adhesive label taking their place.

It was in France that the first attempt was made to prepay letters by means of a cover, envelope, or band at a fixed rate. De Velayer, master of petitions, was the inventor; the idea of cheap postage might also be ascribed to him, although it was only for the Paris local post. A postal system already existed in France and other countries, but no city had a delivery system. De Velayer obtained in 1653 a special privilege from King Louis XIV. to establish a little post-office in Paris, and placed numerous boxes all over the city, which were to be emptied each day. He announced that in order to expedite the service his clerks would not receive any money, but that the letters must be accompanied by a ticket showing prepayment, which ticket must be attached to, wrapped around, or placed within the letter in such a manner that the clerk could easily remove it; when an answer was required the sender had to attach or inclose a second ticket. These tickets cost one sou (about a cent) each, and the principal office for their sale was at the palace. The postal system had some success as a curiosity, but it was in advance of its time, and, besides suffering from the indifference of the public, it was soon attacked by evil-wishers; the boxes were soiled, malicious people going so far as to put rats, mice, and even worse things into them, and the enterprise was soon abandoned.

Some collectors of postage-stamps accept certain letter-sheets stamped in the kingdom of Sardinia in 1818 and 1819. These stamps, however, represent the exact contrary of a postage-stamp, as they indicate the amount of tax paid by the writer for the privilege of sending his letter by other means than the regular postal service; this is a revenue tax, and not in any sense a postal tax.

The example of Great Britain was first imitated in the U. S., where the proprietors of local delivery companies began to sell postage-stamps to their patrons as early as the year 1842. The first one was the City Dispatch Post, owned by Alexander M. Greig, operating in the city of New York; in Aug., 1842, he sold the entire outfit to the U. S. Government, which retained his design for the postage-stamp, a three-quarter face portrait of Washington, changing the inscription to read "United States City Despatch Post." The Government of the U. S. was rather tardy in accepting the new system, and until 1847, when the first stamp for general use was issued, the postal service depended either upon the old cumbersome system or the individual enterprise of the postmasters in various towns, who, on their individual responsibility, had postage-stamps printed and sold to the patrons of their respective offices. This occurred in the following cities: Baltimore, Md. (1845); Brattleboro, Vt. (1846); Millbury, Mass. (1847); New Haven, Conn. (1845); New York, N. Y. (1845); Providence, R. I. (1846); St. Louis, Mo. (1845). It is of interest to note that before the introduction of postage-stamps in the U. S. the post-office authorities in large cities kept regular running accounts with all well-known merchants. Business houses sent their mail matter to the post-office daily, and the cost of postage was calculated by the clerks and charged up to the merchants, bills being rendered at the end of each month.

Among established governments, Brazil was the first to follow the example of Great Britain with an issue of stamps for general postal use. These appeared on July 1, 1843, and were of three values, 30, 60, and 90 reis; each bore simply the numeral of value on an engine-turned groundwork. Postage-stamps were first issued by France on Jan. 1, 1849, in a set of two, bearing an allegorical head of Liberty; and by Belgium in Nov., 1849, in a set of two, with the portrait of King Leopold. Bavaria, which issued stamps in Nov., 1849, was the first of the many states and principalities which now constitute the German empire to adopt the new system; Prussia and Hanover followed in 1850, and Baden, Würtemberg, and Saxony in 1851. The Princes of Thurn and Taxis, who for centuries had enjoyed the monopoly of the postal service in certain of the German states, issued their first stamps in 1852. These continued in use till 1868, or until the formation of the North German Confederation, which included all the states that employed the service of the Princes of Thurn and Taxis, with the addition of Prussia and Saxony. On the formation of the German empire in 1871 all the separate postal administrations, except those of Bavaria and Würtemberg, were superseded by the service of the central Government.

The federal administration in Switzerland did not issue postage-stamps until 1850, but of the separate cantons Geneva and Zurich had issued them in 1843 and Basel in 1845. Most of the other prominent governments in Europe followed in rapid succession, but some were very slow in accepting the reform, as appears from the following list: Spain (1850), Italy (1851), Denmark (1851), Portugal (1853), Norway (1854), Russia (1857), Sweden (1858), Greece (1861), Turkey (1863).

In North America, Canada, New Brunswick, and Nova Scotia made their first issues in 1851, Mexico in 1856, and Newfoundland in 1857. In South America Brazil was followed by British Guiana in 1850, Chili in 1852, and Uruguay in 1856, while Ecuador waited until 1865, Bolivia until 1867, and Paraguay until 1870.

Every colony in Australia adopted the reform early in the fifties, while Mauritius, the Cape of Good Hope, and Natal were the first in Africa, Egypt being next in order in 1866, with a set of seven stamps bearing a representation of a pyramid. India in 1854 was the first government to issue postage-stamps in Asia, using the familiar portrait of Queen Victoria.

The processes employed for the manufacture of postage-stamps are extremely varied in character, every style of engraving and printing having been used in various parts of the world. Among them the most used are engraving on steel, on copper, on zinc, and on wood, surface-printing from steel, copper, and wood, and lithography. All early issues of postage-stamps were imperforate or with plain edges, until in 1848 Henry Archer, in London, invented a machine for perforating. The first experiments were in the nature of trials, and the device was not officially used until 1854, when Mr. Archer sold his device to the British Government.

The number of stamps issued by different countries, as well as the extremes, both high and low, of denomination, vary greatly. The U. S. enjoys the distinction of having had in regular use at one time a larger number than any other country. From 1873 to 1884, besides the regular issue for general use, which consisted of 13 adhesive stamps, 13 envelopes, and 2 wrappers, each department of the Government had its own series, with a total of 92 adhesives, 12 envelopes, and 2 wrappers; besides these there were 7 postage-due and 24 newspaper and periodical stamps. This enumeration does not take into account minor varieties of die or the different colors of paper used for the envelopes. The postage-stamps which have the lowest face value are the $\frac{1}{2}$ milesimo stamp of Cuba and Porto Rico and the $\frac{1}{4}$ centimo of Spain, each representing about $\frac{1}{20}$th of a cent. These are used for local newspaper postage. The stamp of largest denomination is the £20 of South Australia, which is available for both postage and revenue purposes.

*Overprinted Stamps, etc.*—One of the most interesting developments of the use of postage-stamps is the means employed by postmasters in various parts of the world for providing a particular value the stock of which may have become exhausted. The usual method is to surcharge or overprint stamps of some other value with the new value intended to be given to the stamp, and the first instance of such practice appears in France in 1850, when, to supply the demand for a 25-centime stamp, to meet a newly established rate of postage, a quantity of 20-centime stamps, which had been printed by error in blue, were overprinted with the figures "25." These were not, however, placed in circulation, as a new supply of the desired value was prepared in time.


Philadelphia local delivery stamp, Blood & Co., 1841.


Baltimore, Md., 1846.


Brattleboro, Vt., 1846.

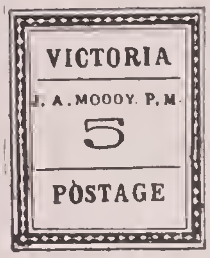

New Haven, Conn., 1845.


New York city carrier stamp, 1843.


Providence, R. I., 1846.


St. Louis, Mo., 1845.


Millbury, Mass., 1847.


Livingston, Ala. Victoria, Tex.
Confederate postmasters' stamps.

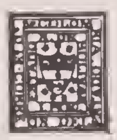

Anjouan (Johanna).
Current type for all French colonial stamps.


Trinidad, 1852.
Type used also in Barbados and Mauritius.

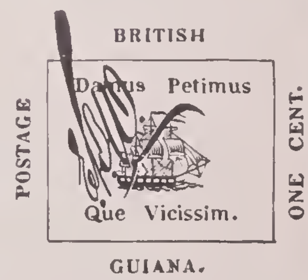

Barbados, 1892.

Afghanistan.
Printed from ivory.


British Guiana, 1850.
The plainest stamp.



Bolivar, Colombia, 1863.
The smallest stamp.




British Guiana, 1856. The rarest stamp; only one known.

Korea, 1884.
Used only one day.


Canada, 1851.


Cape of Good Hope, 1853.
The first triangular stamp.


Congo, 1894.
The handsomest stamp.


North Borneo, 1894.
One of the handsomest stamps.


Spain, 1855. Type used for all Spanish colonies.

Great Britain, 1840. Mulready envelope, greatly reduced. The first stamp issued.


Hankow, 1893. One of the Chinese treaty-port issues.


Hawaii, 1851.
One of the rarest stamps.

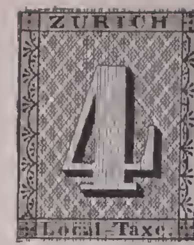
REPRESENTATIVE TYPES OF POSTAGE-STAMPS.


Basel.


Vaud.


Geneva.

Swiss cantonal stamps.




Zurich.

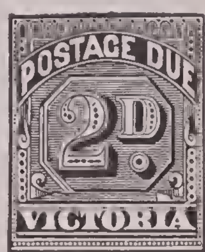

Portuguese India. Type used for all Portuguese colonies.


Bavaria, 1849. The first German stamp.


Guadalajara, 1867. Issued during Mexican revolution.


New Caledonia, 1858. The worst engraved stamp.


Dominica, 1882. Stamp cut in half and surcharged.




Victoria, 1890. Unpaid letter stamp.


Obock, 1894. Camel post.


Portugal. Type introduced in 1871 and afterward used for all colonies.


Labuan, 1880. Stamp surcharged by pen and ink.





Surcharged stamps.


San Marino, 1894. Issued to celebrate the opening of a new palace.


Pacific Steam Navigation Co. Also used by Peru as an experiment.


Portugal. 1893. Jubilee issue in memory of Prince Henry the Navigator.


Salvador, 1892. Issued to commemorate the Columbus celebration.


Mauritius, 1847. One of the greatest rarities.


Brazil, 1843.


New Brunswick, 1851.


New South Wales, 1850. View of Sydney harbor.

REPRESENTATIVE TYPES OF POSTAGE-STAMPS.

As almost all such overprinted or surcharged stamps are made to supply a temporary want, in the nature of things they are rarer than the ordinary issues, and the increase in the number of collectors in recent years has opened this as a profitable field for speculation. Collectors and dealers in various parts of the world have succeeded in inducing postmasters and other officials to surcharge small quantities of stamps, supplying a few to the public for its correspondence and turning over the remainder to the speculator. In many such cases, the postmaster has participated in the profits. Another means of providing a temporary or provisional issue is to cut in half, in quarter, or in other sections stamps of a higher denomination, using the fraction to indicate such portion of the value of the original stamp as the fraction will represent. The most prolific producers of surcharged stamps have been the British and French colonial possessions; but the Colonial Office in London has taken steps to stop further abuse by requiring responsible officials to maintain a sufficient supply of every value, imposing a fine in case this requirement should be neglected.

*Memorial Stamps.*—Another interesting feature of the use of postage-stamps, and a direct result of the wide and varied interest manifested in all parts of the world, is the issue of a special kind of stamps on the occasion of any celebration or jubilee. The first issue of this description was made in Great Britain in 1887, on the fiftieth anniversary of the accession of Queen Victoria to the throne. The example was not followed for some years, but it has become fashionable to make such issues, and among them may be mentioned especially the Columbus issue made by the U. S. in 1893 to celebrate the discovery of America, and similar issues made in the Argentine Republic, Nicaragua, Salvador, Honduras, Venezuela, and Porto Rico in 1892 and 1893. All of these were legitimate issues, made to commemorate an event of real importance, but they have opened the eyes of other governments to the speculative value of such stamps, and 1894 saw a flood of jubilee and commemorative issues. Flagrant examples of such abuse are an issue in the republic of San Marino to commemorate the opening of a new palace, and an issue in Portugal to commemorate the 700th anniversary of the birth of St. Anthony of Padua, both of which are avowedly made solely on account of the profits to be derived from the sale to postage-stamp collectors.

*Stamp-collecting.*—The collecting of postage-stamps for amusement is said to have begun about the year 1850, or as soon as it was noticed that stamps of different colors, designs, and values were being received in mails from various parts of the world. The value and rarity of any particular specimen was not taken into account at all, and one frequently hears of exchanges made among collectors in years gone by of specimens, some of which are now worth hundreds of dollars, for others which still have no appreciable value. As the practice of collecting became more general, the study of postage-stamps became more and more minute, and the collector of early times can hardly realize the extent to which the study of postage-stamps has been carried. Every minute variation of paper, style of printing, perforation, gum, water-mark, etc., is considered as marking a different issue, and in some instances as many as fifty distinct variations of a single stamp are collected where in former years a single specimen would have been considered fully representative of the type.

Full recognition is also accorded to certain classes of adhesive labels which can not, in any sense, be justly termed postage-stamps, but in some instances represent the exact contrary. Prominent among these are the postage-due stamps issued by many countries for the convenience of the postal administration, and which indicate that the postage has not been prepaid, and the newspaper and periodical stamps issued by the U. S., which are never sold to the public but are used only as vouchers in the books of the Post-office Department.

The literature of philately (as the study of postage-stamps is called) embraces every section of the globe, and monthly and weekly journals are published even in India, China, Australia, and Africa. The chief books of reference are *A Catalogue for Advanced Collectors of Postage-stamps*, by the Scott Stamp and Coin Company (New York); *Catalogue de Timbres-Poste*, by J. B. Moens (Brussels); and the publications of the London (England) Philatelic Society. The leading philatelic journals are *The American Journal of Philately*) Scott Stamp and Coin Company, New York); *The London Philatelist* (The London Philatelic Society); *The Monthly Journal* (Stanley Gibbons, London); *Le Timbre-Poste* (J. B. Moens, Brussels); *Der Philatelist* (Dresden); and *Illustriertes Briefmarken-Journal* (Gebrüder Senf, Leipzig). HENRY L. CALMAN.

**Stanberry**: city; Gentry co., Mo.; on the Omaha and St. L. Railway; 50 miles N. by E. of St. Joseph, 110 miles S. E. of Omaha, Neb. (for location, see map of Missouri, ref. 1–D). It is in an agricultural region, and contains a State bank with capital of $20,000, a private bank, and a semi-weekly, a bi-weekly, a monthly, and 3 weekly periodicals. Pop. (1880) 1,207; (1890) 2,035; (1900) 2,654.

**Stanbery**, HENRY: jurist; b. in New York, Feb. 20, 1803; graduated at Washington College, Pennsylvania, in 1819; admitted to the bar in 1824; removed to Ohio and became attorney-general of the State in 1846; appointed Attorney-General of the U. S. in 1866 under the administration of President Johnson, for whom he acted as leading counsel in the impeachment trial of 1868; returned to the practice of his profession at Cincinnati. D. in New York, June 26, 1881.

**Stanbridge**, JOHN: teacher and author; b. at Heyford, Northamptonshire, England, about 1450; became perpetual fellow of New College, Oxford, 1481; first usher of the free school connected with Magdalen College about 1486, and afterward for many years its head master. D. about 1525. He was the first author of school-books that were extensively printed and used in England, though now so rare as to have become bibliographical curiosities. Among them were *The Accydence of Mayster Stanbrydge's owne Makynge* (printed before 1500); *Embryon Relimatum, sive Vocabularium* (of which at least eight editions were printed by Wynken de Worde); and *Vocabula Magistri Stanbrigi* (1510).

**Stanchio**: See Cos.

**Standards**: See BANNER and FLAG.

**Standards of Value**: See MONETARY STANDARDS.

**Standard Time**: See TIME.

**Standish**, MILES: soldier; b. in Lancashire, England, about 1584; claimed to be descended from the knightly family of Standish of Duxbury Hall, Lancashire; served on the Continent, probably with the English forces; became a captain; settled in Leyden, and, though not a member of the English Church or congregation, accompanied the Pilgrims of the Mayflower to New England 1620; lost his wife, Rose, during the first winter; is said by tradition to have employed his friend John Alden to negotiate his marriage with the fair Priscilla Mullins (see Longfellow's *Courtship of Miles Standish*), with the well-known result that Alden married the maiden; rendered important services to the colonists in preserving them from the open and secret hostilities of the Indians, having with his own hand killed at Weymouth (1623) Pecksuot, an Indian chief who had planned a massacre; visited England as agent for the colony 1625, returning with supplies 1626; broke up the settlement at Merry Mount (see MORTON, THOMAS) 1628; was one of the original proprietors and settlers of Duxbury, having given that name to the town in memory of the seat of his English ancestors; was for the remainder of his life either magistrate or a member of the board of assistants to the governor, and took part in the settlement of Bridgewater 1649. D. at Duxbury, Oct. 3 O. S., 13 N. S., 1656. He was of small stature and choleric temper, and possessed great energy and force of will. One of his swords and other relics are preserved in the Pilgrim Hall, Plymouth. A monument to his memory stands on the commanding eminence in South Duxbury, formerly called Captain's Hill, from having been the place of his residence. Many incidents of his career are given, with a partial genealogy of his descendants, in Justin Winsor's *History of Duxbury* (1849). Also see De Costa, *Footprints of Miles Standish* (Charlestown, Mass., 1864).

**Stand-pipe**: a vertical cylindrical tower connected with a water-supply system to provide pressure and sometimes to serve partly as a storage-tank. Stand-pipes are made of wrought-iron or steel plates riveted together, and usually vary in diameter from 3 to 20 feet, although a few have been built 50 feet in diameter. The height depends upon the pressure required, and is usually from 60 to 150 feet, although some are nearly 250 feet high. Sometimes the upper part of the tower constitutes a tank supported by a trestle, the water being carried to it by a pipe of much smaller diameter. A stand-pipe is used only in connection with a pumping system, and is most effective when placed near the pump.

The water is forced up against the head in the stand-pipe, and this in turn maintains the pressure throughout the pipe system. Stand-pipes are sometimes destroyed by wind or by accidents due to other causes. For an account of these, see a series of articles by Pence in *Engineering News* during 1884. MANSFIELD MERRIMAN.

**Stanfield**, WILLIAM CLARKSON: landscape and marine painter; b. at Sunderland, Durham, England, in 1793; d. at Hampstead, May 18, 1867. He was a sailor in the British navy, became a scene-painter while still a young man, and taking up painting of landscape and naval battle scenes attained success and was elected a Royal Academician in 1835. Among his most celebrated works are *Battle of Trafalgar* (1836) and *Battle of Roveredo* (1851). W. A. C.

**Stanford**: town; capital of Lincoln co., Ky.; on the Lexington and East. Railway; 38 miles S. by W. of Lexington, 104 miles S. E. of Louisville (for location, see map of Kentucky, ref. 4–H). It is in an agricultural region, and contains woolen, flour, and grist mills, the Stanford Female College, a national bank with capital of $200,000, a banking and trust company with capital of $200,000, and a semi-weekly newspaper. Pop. (1890) 1,385; (1900) 1,651.

**Stanford**, CHARLES VILLIERS: composer; b. in Dublin, Ireland, Sept. 30, 1852; went to Leipzig to study in 1874, and then to Berlin, returning home in 1876. His compositions include several symphonies, much sacred music in large forms, the two oratorios *The Three Holy Children*, for the Birmingham festival of 1885, and *Eden*, for the Birmingham festival of 1891; three operas—*The Veiled Prophet*, produced at Hanover, Feb. 6, 1881, *Savonarola*, Hamburg, Apr. 18, 1884, and *The Canterbury Pilgrims*, for the Carl Rosa Company, Apr. 28, 1884; the cantata *Elegiac Ode*, 1884, being a setting of Walt Whitman's *Burial Hymn*; music to the Greek plays *Eumenides* and *Œdipus Tyrannus*; and Psalm cl. in cantata form (1887). He received the degree of Mus. Doc. from Cambridge in 1883, succeeded Otto Goldschmidt as conductor of the Bach Choir in 1885, and was appointed Professor of Music in Cambridge University Dec., 1887, on the death of Sir George Macfarren. D. E. HERVEY.

**Stanford**, LELAND: capitalist and philanthropist; b. at Watervliet, N. Y., Mar. 9, 1824; received a common-school education; studied law, and was admitted to the bar in 1849; soon afterward removed to Port Washington, Wis., where he practiced law till 1852, when he went to California and engaged in gold-mining; settled in San Francisco in 1856, and entered into business with three of his brothers. He first appeared in politics as a delegate to the convention at Chicago in 1860 which nominated Abraham Lincoln for the presidency; was elected Governor of California in 1861, and in his inaugural address urged the importance of building the Pacific Railroad, and a company for that purpose, of which he was elected president, was formed on July 1 of that year. He superintended the construction of that part of the road that crossed the mountains, spending personally more than $20,000,000 on a stretch of roadway of 100 miles. He became interested in the construction of other railways and in the development of the agriculture and manufactures of California. He was elected to the U. S. Senate as a Republican for the term 1885–91. With his wife he founded LELAND STANFORD JUNIOR UNIVERSITY (*q. v.*). D. at Palo Alto, Cal., June 20, 1893.

**Stanhope**, CHARLES MAHON, F. R. S., Third Earl Stanhope and Viscount Mahon: inventor; b. in London, England, Aug. 3, 1753; entered Parliament 1780; succeeded to the peerage 1786; was noted for his radical opinions; declared himself a republican, and laid aside the insignia of nobility; distinguished himself by his scientific researches; made many improvements in the art of printing, and in 1816 invented the Stanhope printing-press. D. in London, Dec. 15, 1816.

**Stanhope**, EDWARD: statesman; second son of the fifth Earl of Stanhope; b. in London, Sept. 24, 1840; educated at Harrow and Oxford; called to the bar 1865; entered Parliament 1874; Under-Secretary of State for India 1878–80; vice-president of the committee of council on education 1885; president of the Board of Trade 1885–86; Secretary of State for the Colonies 1886; Secretary of State for War 1887–92. D. at Sevenoaks, Dec. 22, 1893.

**Stanhope**, Lady HESTER LUCY: daughter of Charles, third Earl Stanhope; b. at Chevening, Kent, England, Mar. 12, 1776; was for ten years a member of the family of her uncle, William Pitt, to whom she acted as confidential secretary until his death in 1806; received thereafter a pension of £1,200, upon which she resided some years in Wales; proceeded in 1810 to Syria; visited Jerusalem, Damascus, Baalbec, and Palmyra; acquired by her magnificent and singular ways of living the respect and veneration of the Arabs, who treated her almost as a queen; established herself in 1814 in the deserted convent of Mar Elias, 8 miles from Sidon, upon a crag of Lebanon; adopted the dress and style of an emir, having at her command a guard of Albanians, over whom she exercised an absolute authority; became a benefactress to political refugees and to the poor of every kind; exerted considerable political influence; and practiced astrology. D. at Mar Elias, June 23, 1839. Her *Memoirs* (3 vols., 1845) and *Seven Years' Travels* (3 vols., 1846) were published by her physician, Dr. Meryon.

**Stanhope**, JAMES, First Earl Stanhope: soldier; b. in Paris, France, in 1673; resided in Spain, where his father was minister during 1690–94; entered the army 1694; was wounded at the siege of Namur 1695; served in Flanders until the Peace of Ryswick; was elected to Parliament 1702; took part in the expeditions of 1702 and 1704 in Spain; was a brigadier-general at the siege of Barcelona 1705; major-general 1707; commander-in-chief in Spain, and took Port Mahon, Minorca, 1708; defeated the Spaniards at Almenara and Saragossa (Aug., 1710), but was forced to surrender to the Duke of Vendôme at Brihuega, Dec. 8, 1710; was appointed Secretary of State on the accession of George I., 1714; became First Lord of the Treasury and Chancellor of the Exchequer 1717; was created Viscount Stanhope of Mahon July 2, 1717, and Earl Stanhope Apr., 1718; was again Secretary of State, and took part in negotiating the Quadruple Alliance 1718. D. in London, Feb. 5, 1721.

**Stanhope**, PHILIP DORMER: See CHESTERFIELD.

**Stanhope**, PHILIP HENRY, Fifth Earl Stanhope, better known as Lord Mahon: statesman and author; b. at Walmer, Kent, England, Jan. 31, 1805; was a grandson of Charles, the third earl; graduated from Christ Church, Oxford, 1827; was elected to Parliament in 1830; was Under-Secretary of State for Foreign Affairs (the Duke of Wellington being the secretary) in the first Peel ministry 1834; was secretary to the board of control in the last year of the second Peel ministry 1845–46; supported the repeal of the corn-laws; introduced and carried the copyright act of 1842; was chosen president of the Society of Antiquaries 1846; was defeated at the parliamentary elections of 1852 in consequence of having voted with the protectionists against the modification of the navigation laws; succeeded to the earldom Mar. 2, 1855; founded the Stanhope prize for the study of modern history at Oxford 1855; was chosen lord rector of the University of Aberdeen 1858, and one of the six foreign members of the Academy of Moral and Political Sciences at Paris May 11, 1872. D. at Bournemouth, Hampshire, Dec. 24, 1875. Author of *History of the War of Succession in Spain* (1832); *History of England from the Peace of Utrecht to the Peace of Versailles, 1713–83* (7 vols. 8vo, 1836–53); *Essai sur la Vie du Grand Condé* (privately printed, 1842, and afterward appeared in English as *The Life of Louis, Prince of Condé*, 1845); *The Life of the Right Hon. William Pitt, with Extracts from his Unpublished Correspondence and MS. Papers* (4 vols., 1861–62; 4th ed. 1867); and a *History of England, comprising the Reign of Anne, until the Peace of Utrecht* (1870). Several fragments of his great work have been separately published, as *The Forty-Five, being a Narrative of the Rebellion in Scotland in 1745* (1851) and *The Rise of Our Indian Empire* (1858). Lord Stanhope edited, with notes, *The Letters of Philip Dormer Stanhope, Earl of Chesterfield* (4 vols., 1845); *The Memoirs of Sir Robert Peel* (2 vols., 1856–57).

**Stan'islas Augustus**, King of Poland: See PONIATOWSKI.

**Stanislas Leszczynski**, -lesh-tseēn'skēē: King of Poland; b. at Lemberg, Galicia, Oct. 20, 1677, of one of the oldest and wealthiest families of the Polish nobility; held a high position at the Polish court, and was palatine of Posen when the war broke out between Charles XII. of Sweden and Augustus II. of Poland and Saxony. By the diplomatic negotiations which he carried on between Augustus and Charles he won the favor, and even the friendship, of the latter, and when, after the complete defeat of Augustus, Charles declared the Polish throne vacant, Stanislas was by his influence elected King of Poland in 1705. He was a noble character, and not without talent as a ruler, but after the disaster of Charles at Poltava in 1709 he was compelled to flee from Poland, where even his private fortune was confiscated. He joined his friends at Bender, and was in 1714 made governor of the duchy of Zweibrücken, but after the death of Charles in 1718 he fled to France, and settled at Weissenburg in Alsace. In 1725 his daughter, Marie Leszczynski, was married to Louis XV., and at the death of Augustus II. (in 1733) he was re-elected King of Poland by French influence. Russia, however, was opposed to his restoration, and by the intervention of a powerful Russian army Augustus III. was raised to the Polish throne. After a desperate resistance at Dantzic, where he was besieged by the Russians, he fled for the second time from his native country, but by the Peace of Vienna (1735) his family estates were restored to him, he received the duchy of Lorraine as a pension, and retained the title of King of Poland. He subsequently resided at Lunéville or Nancy, where he held a brilliant court, gathered scientific men around him, founded splendid educational institutions, erected magnificent public buildings, and was generally called *Le Bienfaisant*. D. Feb. 23, 1766. Among his *Œuvres du Philosophe bienfaisant* (4 vols., 1767) is a little essay, *Voix d'un Citoyen*, in which he predicts the division of Poland.

**Stanislow'**: town and railway junction in the province of Galicia, Austria; pleasantly situated between two branches of the Bistricza, in the center of a very fertile and well-cultivated plain; 75 miles S. E. of Lemberg (see map of Austria-Hungary, ref. 4–L). It has several good educational institutions and some manufactures and trade. Pop. (1890) 22,391.

**Stanley**, Arthur Penrhyn, D. D., LL. D.: clergyman and author; son of Bishop Edward and nephew of the first Lord Stanley of Alderley; b. at Alderley, Cheshire, England, Dec. 13, 1815; was a favorite student of Dr. Thomas Arnold at Rugby 1829–34; gained a scholarship at Baliol College, Oxford, 1834; took the Newdigate prize for his English poem, *The Gypsies*, the Ireland scholarship, and a first class in classics (1837); a fellowship at University College 1838; and was tutor for twelve years, and examiner 1841; obtained the chancellor's Latin essay 1839 and the chancellor's English essay and the Ellerton theological essay 1840; took orders in the Church of England 1840, affiliating himself with the Broad Church party; was selected preacher to the University of Oxford 1846–47, secretary to the Oxford University commission 1850–52; canon of Canterbury 1851–58, Regius Professor of Ecclesiastical History at Oxford 1856–64, and canon of Christ Church 1858–64; became chaplain to Prince Albert 1854, to Dr. Tait, Bishop of London, 1857, and to Queen Victoria and the Prince of Wales 1862; declined the archbishopric of Dublin 1863, was installed dean of Westminster Jan. 9, 1864, and was elected lord rector of the University of St. Andrews Nov., 1874. He made a tour in the East, visiting Egypt and Palestine, 1852–53, and again as chaplain and traveling companion to the Prince of Wales 1862; was prominent as a defender of broadmindedness in the Church of England in the controversies connected with the celebrated *Essays and Reviews* (1861), Bishop Colenso's work on the *Pentateuch* (1862), and the later series of ecclesiastical prosecutions; was an active promoter of charitable, missionary, and educational enterprises and of biblical, antiquarian, and scientific researches, cultivated friendly relations with Dissenters to an extraordinary degree, and was much more popular with them than in his own church; and was for some years regarded as the leading representative of the progressive school of British theology. Dec. 23, 1862, he married Lady Augusta Bruce (1822–76), daughter of the Earl of Elgin, and the most intimate friend of the Queen. Her death broke his heart. He was a sensitive, highly gifted, poetic, spiritual, pure, and very picturesque personality. He was the author of many publications, which have passed through numerous editions and been reprinted in America. The chief of these are *The Life and Correspondence of Thomas Arnold* (1844); *Sermons and Essays on the Apostolic Age* (1847); *The Epistles of St. Paul to the Corinthians, with Critical Notes and Dissertations* (2 vols., 1855; 4th ed. 1876); *Historical Memorials of Canterbury Cathedral* (1855); *Sinai and Palestine, in connection with their History* (1856; 20th ed. 1874); *Lectures on the History of the Eastern Church* (1861; New York, 1862; new ed. 1870); *Lectures on the History of the Jewish Church* (vol. i., 1862; vol. ii., 1865, vol. iii., 1876); *Historical Memorials of Westminster Abbey* (1867: 4th ed. 1874); *Lectures on the History of the Church of Scotland* (1872); and *Christian Institutions* (1878). He was a voluminous contributor to reviews and periodicals; furnished a valuable series of biblical biographies to Dr. William Smith's *Dictionary of the Bible*; and published many notable sermons. See the bibliography in Prothero's *Stanley* (vol. ii., 575–582). He was a member of the Bible revision committee. In 1878 he visited the U. S., and in 1879 published a volume of addresses and sermons delivered there. D. in the deanery, Westminster, July 18, 1881, and was buried in Henry VII.'s chapel, Westminster Abbey. See his *Life* by R. E. Prothero (London and New York, 1894, 2 vols.).

Revised by S. M. Jackson.

**Stanley**, David Sloane: soldier; b. at Chester, Wayne co., O., June 1, 1828; graduated at the U. S. Military Academy July 1, 1852, and was appointed brevet second lieutenant in the Second Dragoons. As a cavalry officer he served almost constantly on frontier duty, and in 1859 was complimented by Gen. Scott in general orders for a successful fight with the Comanches. On the outbreak of the civil war in 1861, having attained the rank of captain in the First Cavalry, he was sent to the field of active operations in Missouri, and on Sept. 28 was commissioned a brigadier-general of volunteers. He commanded the second division of the army of the Mississippi at the capture of Island No. 10; in the Corinth campaign, including the battle of Farmington and pursuit of the enemy upon the evacuation of Corinth; at the battles of Iuka (Sept. 19) and Corinth (Oct. 3–4). In Nov., 1862, he was appointed chief of cavalry of the army of the Cumberland, and the same month promoted to be major-general of volunteers, and was engaged in the battle of Murfreesboro, the Tullahoma campaign, including the action of Shelbyville and frequent minor engagements until Sept., 1863, when compelled by sickness to take a short leave. Returning to duty in November, he was assigned to the first division of the Fourth Army-corps, and held command of the corps from July, 1864, until the close of the war. In Sherman's invasion of Georgia he bore a conspicuous part in the severe and almost constant fighting from Dalton to Atlanta, being wounded at the battle of Jonesboro, Sept. 1. During the month of October his command was engaged in pursuit of Hood's army until the 27th, when it was detached from the army of Gen. Sherman to strengthen Gen. Thomas at Nashville, to whom was intrusted the duty of opposing an invasion of Tennessee. With numerous skirmishes the Fourth and Twenty-third Corps had arrived at Franklin, Tenn., Nov. 30, where, being closely followed by the enemy, a stand was made and a notable victory gained. During the fight Gen. Stanley was severely wounded. He was breveted lieutenant-colonel, colonel, brigadier-general, and major-general for gallantry in battle. On Feb. 1, 1866, he was mustered out of the volunteer service, and resumed his commission in the regular army, having become major of the Fifth Calvary in 1863. He was appointed colonel Twenty-second Infantry July, 1866; in command of Yellowstone expedition 1872–73; of various military posts 1873–84; promoted to be brigadier-general U. S. army Mar. 24, 1884; commanded the district of New Mexico and the department of Texas until he was retired June 1, 1892. Revised by James Mercur.

**Stanley**, Edward John, second Baron Stanley of Alderley: statesman; b. at Alderley Park, Crewe, England, Nov. 13, 1802; studied at Eton; took the degree of B. A. at Oxford, 1823; entered Parliament as a Liberal 1831; was Under-Secretary of State for the Colonies 1833–34; patronage Secretary of the Treasury 1835–41; paymaster-general of the forces several months in 1841; Under-Secretary of State for Foreign Affairs in the Russell administration 1846–51; was raised to the House of Peers as Baron Eddisbury 1848; succeeded to his father's title 1850; held the conjoint offices of paymaster of the forces and vice-president of the Board of Trade a few weeks in 1852, and again 1853–55; was president of the Board of Trade 1855–58, and Postmaster-General 1860–66. D. in London, June 16, 1869.

**Stanley**, Frederick Arthur, G. C. B., Baron Stanley of Preston: b. Jan. 15, 1841; educated at Eton. He is the second son of the fourteenth Earl of Derby; was formerly a captain in the Grenadier Guards. He was civil lord of the Admiralty Aug. to Nov., 1868; financial secretary to the War Office 1874–77; Secretary to the Treasury 1877–78; Secretary of State for War 1878–80; Secretary of State for the Colonies 1885–86; and president of the Board of Trade 1886–88. He was Governor-General of Canada May 6, 1888, to July 15, 1893. He married (May 31, 1864) Lady Constance Villiers, eldest daughter of the fourth Earl of Clarendon;

was created Baron Stanley of Preston in the peerage of Great Britain in 1886, and on the death of his brother in 1893 became sixteenth Earl of Derby. NEIL MACDONALD.

**Stanley**, HENRY MORTON, D. C. L.: African explorer; b. near Denbigh, Wales, in 1841, of humble parentage. He was placed in the poorhouse, where he remained until his thirteenth year, after which he taught in a school, and subsequently shipped as cabin-boy for New Orleans, where he was adopted by a merchant, whose name he assumed instead of his own, which was John Rowlands. His adoptive father having died without a will, and the civil war breaking out, he enlisted in the Confederate army; was taken prisoner; volunteered in the U. S. navy, and became acting ensign on an ironclad. After the close of the war he went as a newspaper correspondent to Turkey and Asia Minor, and in 1868 accompanied the British expedition to Abyssinia as correspondent of *The New York Herald*, a portion of his correspondence being subsequently embodied in a volume. In Oct., 1869, being then in Spain, he was employed by the *Herald* to head an expedition to learn the fate of Livingstone, the African explorer, from whom only vague intimations had been heard for two years. He reached Zanzibar in Jan., 1871, and toward the end of March set out for the interior, with a company of 192 men. In November he found Livingstone, who was living near Lake Tanganyika, and furnished him with supplies for further explorations. After having explored the northern portion of the lake, Stanley set out on his return journey in Mar., 1872, reaching England in July, where he was received with distinguished honor, the Queen sending him a gold snuff-box set with diamonds, and the Royal Geographical Society awarding to him in 1873 its patron's medal. Tidings having been received of the death of Livingstone in Central Africa, Stanley was placed at the head of an expedition, the cost of which was jointly undertaken by *The New York Herald* and the London *Daily Telegraph*, to explore the lake region of equatorial Africa. He left the coast in Nov., 1874, at the head of 300 men, and after many hardships and some severe contests with the natives reached Lake Victoria Nyanza Feb. 27, 1875, having in the meantime lost 194 men by death and desertion. He circumnavigated the lake in a boat brought with him in pieces, and found it to be a single large lake, and not, as supposed by Burton and Livingstone, a group of lagoons, thus confirming the opinions of Speke and Grant. He started Apr. 17, 1875, to continue his explorations in the direction of Lake Albert Edward Nyanza. He arrived at the mouth of the Congo river Aug. 12, 1877, having explored its whole course; returned to the Congo in 1879, at the head of a Belgian international expedition; lectured in the U. S., on Africa, in Dec., 1886; returned to Congo Free State in 1887 with an expedition for the relief of Emin Bey, whom he found on the Albert Nyanza Apr. 28, 1888. He returned with Emin toward the east coast in May, 1889, and reached the coast himself on Dec. 6 of the same year. On the return trip he discovered the Ruwenzori Mountains S. of Albert Nyanza. On his return to England in 1890 he received honorary degrees from the universities, and a special medal from the Royal Geographical Society. In the following year he visited the U. S. and Australia on lecturing tours, returning to London in 1892. In 1895 he was elected to Parliament as a Unionist from Lambeth (N.). His principal works are *How I found Livingstone* (London and New York, 1872); *Coomassie and Magdala* (1874); *Through the Dark Continent* (1878); *The Congo, and the Founding of its Free State* (2 vols., 1885); *In Darkest Africa* (1890); *My Dark Companions* (1893); and *Slavery and the Slave-trade in Africa* (1893).
Revised by M. W. HARRINGTON.

**Stanley**, THOMAS: classical scholar; b. at Comberlow, Hertfordshire, England, in 1625; was carefully educated at home; graduated at Cambridge 1641: studied law at the Middle Temple; published in 1647 a volume of *Poems and Translations* (from Anacreon, Bion, Moschus, etc.), frequently reprinted; issued his chief work, *The History of Philosophy, containing the Lives, Opinions, Actions, and Discourses of the Philosophers of every Sect*, in 4 vols., at intervals between 1655 and 1662 (2d ed. folio. 1687; best ed., with *Life* of the author, 4to. 1743), and in 1663–64 his elaborate edition of *The Tragedies of Æschylus*, with Latin translation, Greek scholia, and commentary, which long maintained its ground among English scholars (best ed. by Butler, 1809–16). D. in London, Apr. 12, 1678. See Brydges's edition of Stanley's *Poems* with *Life* (1814–15).

**Stannard**, HENRIETTA ELIZA VAUGHAN (*Palmer*): novelist; b. at York, England, Jan. 13, 1856; daughter of Rev. Henry Vaughan Palmer, rector of St. Margaret's, York; married, 1884, Arthur Stannard, a civil engineer. Her father had been an artillery officer before taking holy orders, and Mrs. Stannard's numerous fictions have dealt mainly with army life. Among these, published under the pseudonyms of John Strange Winter and Violet Whyte, are *Cavalry Life* (1881); *Regimental Legends* (1883); the very popular *Bootle's Baby* (1885); *Houp-la* (1885); *Army Society Life in a Garrison Town* (1886); *Garrison Gossip* (1887); and *A Siege Baby* (1887). H. A. BEERS.

**Stan'naries** [from Lat. *stan'num*, tin]: in general, tin mines; in a special sense, those of Cornwall and Devon, concerning which there are peculiar laws and usages. The court of the stannaries is very ancient, exercising a jurisdiction in the time of Lord Coke which was "guided by special laws, by customs, and by prescription time out of mind." It was established in order that the workers in these mines might sue and be sued in their own court, "and not be drawn from their business to their own private loss and to the public detriment by attending their lawsuits in other courts." The early charters, records, and acts of Parliament relating to this subject are summarized in Coke's *Fourth Institute*, chap. xlv. The principal modern statutes bearing upon the stannaries are 6 and 7 Will. IV., c. 106, as amended by subsequent acts, which regulates the constitution and the procedure in these courts, and 32 and 33 Vict., c. 19, amended by 50 and 51 Vict., c. 23, relating to mining partnerships within their jurisdiction. The judges of the stannaries court are appointed by the Duke of Cornwall (the Prince of Wales), or, when there is none of full age, by the crown. See Bainbridge on *Mines*, ch. vi., §§ 3–5, and Batten's *Stannaries Act*.
FRANCIS M. BURDICK.

**Stannic Acid**: a hydrate, $SnO(OH)_2$, obtained from stannous oxide. See TIN (*Compounds of Tin*).

**Stanovoi' Range** [Russ. *Stanovoi Khrebet*, i. e. backbone]: name given by Pallas to the mountains at the source of the Olekma, but since expanded to embrace the whole Siberian watershed between the Arctic and Pacific drainage systems. It is very imperfectly known, but appears to extend N. E. from near Urga, in North Central Mongolia, to the Chukchu Peninsula, a distance of 2,700 miles. It consists of parallel ranges of mountains with elevated plateaus, which are often very marshy, is more rugged on its eastern than on the western slopes, and is through much of its extent clothed with forests and rich in minerals. A principal range on the western side is the Yablonnoi Khrebet, which borders the plateau of Vitim. The highest point is Mt. Sokhondo (lat. about 50° N., lon. 110° E.), about 9,250 feet.
MARK W. HARRINGTON.

**Stanstead**: the *chef-lieu* of Stanstead County, Quebec, Canada, and the terminus of a branch of the Boston and Maine Railway line, which runs through the Masawippi valley (see map of Quebec, ref. 6–C). It is close to the boundary-line of the U. S., which separates it from North Derby or Derby Line, Vt. It includes Stanstead Plain and Rock Island: in the former there is a Wesleyan College and several churches; in the latter are several factories. It is on the edge of a rich farming and grazing country. Pop. 4,200. J. M. H.

**Stanton**: city; capital of Montcalm co., Mich.; on the Detroit, Lans., and N. Railroad; 15 miles N. E. of Greenville, 62 miles N. N. W. of Lansing (for location, see map of Michigan, ref. 6–I). It is in an agricultural region, and contains a public high school, flour-mills, planing-mills, foundry, machine-shops, a private bank, and two weekly newspapers. Pop. (1890) 1,352; (1900) 1,234.

**Stanton**, EDWIN MCMASTERS: lawyer and Secretary of War; b. at Steubenville, O., Dec. 19, 1814; admitted to the bar in 1836; reporter of the Supreme Court of Ohio 1842–45, reporting vols. xi.–xiii. of *Ohio Reports*. In 1845 he successfully and with distinction defended in the criminal court at Washington Caleb J. McNulty, clerk of the House of Representatives, tried for embezzlement. He first acquired national reputation as a lawyer in the important case of *The State of Pennsylvania* vs. *The Wheeling Bridge Company*, involving the question whether control of bridges over navigable rivers of the West flowing between the several States is vested by the Constitution in Congress or the State Legislatures. It was decided that Pennsylvania's interest in the controversy gave her standing in that court, and that regulation of bridges over navigable rivers of the

West is vested in Congress, exclusive of State control. Successive arguments in the case by Stanton were so marked by legal learning, logic, and eloquence that at once and at a comparatively early age he took place in the front rank of national lawyers. In 1856 he removed to Washington to attend to his practice before the U. S. Supreme Court, and in 1858 went to California and remained nearly a year as counsel for the U. S. in certain land-cases involving many millions of dollars. Besides carrying to a successful issue those cases to which his employment especially related, his services were invaluable in the collection, collation, and translation of Mexican archives. The archives collected through his efforts furnished conclusive evidence of an organized system of fabricating land-titles carried on for a long time in California. The value of lands claimed under forged grants was estimated at not less than $150,000,000. Afterward, however, these archives furnished the means of distinguishing valid from forged grants, and enabled a successful defense to be made to every fraudulent claim.

In Dec., 1860, when active preparations were being made for secession and the indications as to the political future of the republic were appalling, Cass, Secretary of State, suddenly resigned, and Black, Attorney-General, succeeded him. Stanton, then in Cincinnati arguing a case before the U. S. circuit court, was appointed Attorney-General. Acceptance of the office involved relinquishment of profitable professional business and assumption of great responsibility, with little prospect of personal distinction. He accepted the office, and in it his attitude was that of resolute maintenance of national honor and determined opposition to treason. Only a handful of U. S. troops was assembled at Washington, and the residents of the capital were mainly in sympathy with secession. To a greater extent probably than any of his associates in the cabinet, Stanton perceived the danger of an attempt to prevent Lincoln's inauguration, to seize and hold the capital and insignia of government for the seceding States, and thus to exhibit the latter to the world as a government *de facto*, succeeding to the power and authority of the U. S. On Mar. 4, 1861, Stanton retired with the outgoing administration and resumed his profession. After the civil war had existed several months, patriotic citizens and eminent capitalists, without Stanton's knowledge, urged President Lincoln to place him in charge of the War Department. On Jan. 20, 1862, he became Secretary of War. Excepting a brief meeting in 1857 in Cincinnati, in a lawsuit in which they were both of counsel, there had previously been no intercourse between Lincoln and Stanton; but after the latter entered the War Department their mutual friendship and confidence grew with every day. The characteristics of Stanton's administration were integrity, energy, determination, singleness of purpose, and capacity to comprehend the magnitude of the insurrection and the labor and cost in blood and treasure involved in suppressing it.

After Lincoln's assassination and Johnson's accession to the presidency, Stanton was connected with the latter's administration for three years. He supported many measures which were vetoed by the President and re-enacted by Congress, including those for the establishment of the Freedmen's Bureau, for protection of civil rights, for admission of Colorado as a State, for organization of governments in insurrectionary States, and for conferring suffrage without regard to color in the District of Columbia. These differences of opinion and the continued adherence of Stanton to the Republican party and the President's separation from and aggressive hostility toward it, led the President on Aug. 5, 1867, to notify Stanton that public considerations of a high character constrained him to request the latter's resignation; to which Stanton answered that public considerations of a high character, which alone had induced him to remain at the head of the department, constrained him not to resign before the next meeting of Congress. On Aug. 12 the President notified him of his suspension from office. After Congress convened, the Senate refused by a vote of 35 to 6 its concurrence in the suspension. Having received official information of this from the Senate, Stanton on the next day (Jan. 13, 1868) resumed his office. On Feb. 21, 1868, the President undertook to remove him and to appoint Lorenzo Thomas Secretary of War *ad interim*. The Senate, being on the same day officially informed by the President of this action, resolved that under the Constitution and laws the President had no power to remove the Secretary of War and designate another officer to perform the duties of that office, and officially communicated this resolution to Stanton. The House of Representatives immediately decided to impeach the President. In consequence of this action of both houses of Congress and the general apprehension of revolutionary purposes on the part of the President, Stanton refused to relinquish control of his department. After the trial and acquittal of the President under articles of impeachment, Stanton relinquished his office. The Senate on May 28 again resolved that he had not been legally removed, and based its confirmation of his successor, Gen. Schofield, upon Stanton's voluntary retirement. Soon afterward both houses of Congress passed a vote of thanks to him for his great ability, purity, and fidelity.

With his health shattered by his labors in the War Department, he resumed his profession and argued several important cases. The last was *Whitney* vs. *Mowry*, an important patent cause, which, in consequence of Stanton's feeble health, was heard by Judge Swayne in Stanton's own library two weeks before the latter's death. He never again left his chamber. On Dec. 20, 1869, he was nominated by President Grant as an associate justice of the U. S. Supreme Court, and was immediately confirmed by the Senate; but on Dec. 24 he died without having entered upon the duties of his new office. Revised by C. K. ADAMS.

**Stanton**, ELIZABETH (*Cady*): reformer; b. at Johnstown, N. Y., Nov. 12, 1815; daughter of Judge Daniel Cady; educated at the Johnstown Academy, where she studied with a class of boys; was fitted for college at the age of fifteen, and pursued her studies at Mrs. Willard's Seminary at Troy; had her attention turned to the disabilities of sex by her own educational experience and a study of Blackstone, Story, and Kent; married, in 1840, Henry B. Stanton (reformer, author, and State Senator; d. 1887); accompanied him to the World's Anti-Slavery convention at London; there made the acquaintance of Lucretia Mott; resided in Boston until 1847, when they settled at Seneca Falls, N. Y.; with Lucretia Mott signed the call for the first woman's rights convention, which met at her place of residence July 19–20, 1848, on which occasion the first formal claim of suffrage for women was made; circulated petitions for the married woman's property bill, and had a hearing before a legislative committee 1844; addressed the New York Legislature in 1854 on the right of suffrage, in 1860 in advocacy of divorce for drunkenness, and in 1867 both the Legislature and the constitutional convention, maintaining that during the revision of the constitution the State was resolved into its original elements, and that all the citizens had therefore a right to vote for members of that convention. Since 1869 she has frequently addressed congressional committees and State constitutional conventions. She canvassed Kansas in 1867, and Michigan in 1874, when the question of woman suffrage was submitted in those States; was one of the editors of *The Revolution*. Most of the calls and resolutions for conventions, addresses to women, legislatures, and Congress, have been from her pen. She was president of the national woman's rights committee 1855–65, of the Woman's Loyal League 1863, and of the National Association until she withdrew in 1892; spoke many times in great conventions in England and Scotland, and at parlor meetings in London; contributed articles to *The Westminster Review* and to journals and magazines in the U. S. She was president of the first International Council of Women held in Washington in 1888. With Miss Susan B. Anthony and Mrs. Matilda J. Gage she is the author of *The History of Woman Suffrage* (New York, 1881–86). SUSAN B. ANTHONY.

**Stanton**, OSCAR F.: See the Appendix.

**Stanton**, THEODORE, M. A.: journalist; son of Mrs. Elizabeth Cady Stanton; b. at Seneca Falls, N. Y., Feb. 10, 1851; educated at the College of the City of New York and at Cornell University; was Berlin correspondent of *The New York Tribune* 1880; settled in Paris to engage in journalism; member International Jury, Paris Exposition, 1889; resident commissioner in France, Columbian Exposition, 1893; Chevalier of the Legion of Honor; translator and editor of Le Goff's *Life of Thiers* (New York, 1879); author of *The Woman Question in Europe* (1884) and of contributions to periodicals.

**Stanwix**, JOHN: soldier; b. in England about 1690; entered the British army 1706; served as an officer of grenadiers and marines; became lieutenant-colonel 1745; equerry to Frederick, Prince of Wales, 1749; was governor of Carlisle and its representative in Parliament 1750; became deputy quartermaster-general of the forces 1754; was made colonel commanding the first battalion of the Sixtieth Regiment (Royal Americans) Jan. 1, 1756; was in command of the southern district of the American colonies, with headquarters at Carlisle, Pa., 1757; was appointed brigadier-general Dec. 27, 1757; was relieved by Gen. Forbes early in 1758, and intrusted (1758) with the erection of the important fortress known as Fort Stanwix at the "Oneida carrying-place" (now Rome) on Mohawk river, at an expense of £60,000, as a defense against incursions from the French in Canada; returned to Pennsylvania; was appointed major-general June 19, 1759; repaired and fortified the old fort Du Quesne at Pittsburg, securing the good will of the Ohio Indians; resigned his commission in America to Gen. Monckton May 4, 1760, and returned to England; was appointed lieutenant-general Jan. 19, 1761; was made lieutenant-governor of the Isle of Wight and colonel of the Eighth Foot, and was elected member of Parliament for Appleby. He was lost at sea in Dec., 1765, while crossing the Irish Channel from Dublin to Holyhead in a packet.

**Stan'yhurst**, Richard: historian and theologian; b. in Dublin about 1545; educated at University College, Oxford; studied law; returned to Ireland; married, became a Roman Catholic, and went to the Continent. On the death of his wife he became a priest, and was appointed chaplain to Archduke Albert, governor of the Spanish Netherlands. D. at Brussels in 1618. He translated into English heroic verse *The First Foure Bookes of Virgils Æneis* (1583); furnished a *Description of Ireland* to Holinshed's *Chronicles*; wrote historical treatises (in Latin) on Ireland, and English and Latin theological works.

**Staphylin'idæ**: the Rove-beetles (*q. v.*).

**Stapleton**, Thomas, D. D.: theologian, b. at Henfield, Sussex, England, in 1535; educated at Canterbury and Winchester schools and at New College, Oxford, where he was admitted perpetual fellow 1554; took orders in the Church; became a Roman Catholic; was appointed by Queen Mary prebendary of Chichester; retired on the accession of Elizabeth to Louvain, where he acquired publicity by his polemical writings against Calvin and Beza, Jewel, Horne, Whitaker, and other Protestant divines; became Regius Professor of Divinity at the University of Douay, where he had already become doctor of theology; returned to Louvain, where he was appointed divinity professor as successor to Baius. D. at Louvain, Oct. 12, 1599. His best-known works are *Principiorum fidei doctrinalium Demonstratio, Relectio principiorum fidei doctrinalium, Defensio auctoritatis ecclesiasticæ, De Justificatione, De magnitudine Ecclesiæ Romanæ, Propugnaculum fidei primitivæ Anglorum, Antidota Evangelica, Antidota Apostolica, Promptuarium Morale, Promptuarium Dogmaticum, Tres Thomæ.* Cardinal Duperron looked on him as the greatest of the polemical theologians, and Döllinger says that he was the greatest champion of the Church against the new doctrines. His works were published at Paris, 1620 (4 vols. fol.).

J. J. Keane.

**Star**: See Stars.

**Star-anise**: See Anise-seed.

**Star-apple Family**: the *Sapotaceæ*, a small family (400 species) of gamopetalous, dicotyledonous shrubs and trees, mostly latex-bearing. The flowers are regular and hermaphrodite in the axils of the leaves, and have one or two series of stamens, and a superior two to five celled, few-ovuled ovary. They are mainly tropical and sub-tropical. In the Southern U. S. there are nine or ten species, five of which are small trees of the genus *Bumelia*. "Several species of this family are useful to man. The fruits of *Lucuma mammosa*, the marmalade of the West Indies, are a very agreeable food, as are those of *Achras sapota* (the sapodilla-plum) and various species of *Chrysophyllum* (star-apples), which are much sought after in the Antilles." Some species of *Bassia*, the butter-trees, yield a fatty substance by pressure of the seeds. Gutta-percha is obtained from *Isonandra gutta*, a large tree of the East Indies, by the evaporation of its milky juice. Charles E. Bessey.

**Starch** [deriv. of *starch*, stiff < O. Eng. *stearc*, strong] ($C_6H_{10}O_5$ or $C_{12}H_{20}O_{10}$): a substance (also called *fecula*, *amidon*, and *amylum*) widely diffused in the vegetable kingdom, being found in almost every plant, at least at some period of its development. It is especially abundant in some families of plants, and often occurs in large quantities in the seeds, pith, stalks, bark, bulbs, tubers, roots, etc. There are two other substances found in plants which resemble starch in many respects—the inulin, which occurs in the dahlia, elecampane, dandelion, chicory, mustard-seed, etc., and the lichen-starch which is found in Iceland moss, carrageen-moss, and several of the lichen and fucus tribes of plants. See Inulin and Lichenine.

*Preparation.*—Starch is extracted from a great variety of plants, chiefly from wheat, Indian corn, rice, pototoes, the root of manioc or cassava, *Jatropha manihot* (tapioca), the root of several species of the *Maranta* (arrowroot), and the pith of a great variety of palms (sago). Wheat-flour contains from 50 to 80 per cent. of starch. The starch is extracted from the whole wheat by "softening" in cold water and pressing under millstones or rollers, or in bags under water, as long as milky water runs off from it. This liquid, when left to itself, deposits starch containing gluten; the latter, however, dissolves for the most part in the supernatant liquid, which gradually turns sour; and on decanting this acid liquid, repeatedly stirring up the starch with fresh water, and leaving it to settle, it is at length obtained pure, and may be dried in suitable desiccating chambers. Corn-starch is extensively manufactured in the U. S. by soaking corn in water containing caustic soda or hydrochloric acid to dissolve the gluten, grinding, washing on sieves, etc. The cheapness and excellence of this starch has put an end to the importation of starch from foreign countries, and large quantities are now exported. Rice-starch is largely manufactured in Great Britain, France, and Belgium. The rice is first soaked in a weak lye, then ground, and washed on a sieve. Potato-starch is largely manufactured in Europe and in the U. S. Horse-chestnut starch is made in France. A solution of sodic carbonate is used to remove the bitter principle. The yield is about 20 per cent. For Arrowroot, Sago, and Tapioca, see those articles.

*Properties.*—"Starch is a white shining powder, soft to the touch, grating between the fingers or the teeth, sometimes consisting of amorphous masses, but more frequently of granules recognizable by the microscope. . . . Starch, so long as it retains its natural state of aggregation, is insoluble in *water, alcohol*, and *ether*; but when placed in contact with *hot water*, the water penetrates between the different layers of which the granules are composed, swelling them up and forming a gelatinous mass known as *starch-paste*, and used for stiffening linen, etc."—*Watts's Dictionary.*

*Applications of Starch.*—Starch is used for stiffening cotton and linen cloth, paper, etc. Wiesner says corn-starch possesses the highest, and potato-starch the lowest stiffening qualities. It is used for food in the form of arrowroot, tapioca, sago, etc., for making paste, for powdering the hair, for the manufacture of dextrin, glucose (corn-sirup), etc. See Food. Revised by Ira Remsen.

**Star Chamber**: an English high court of justice prominent in the fifteenth, sixteenth, and seventeenth centuries, supposed to have derived its name from the fact that the room in which it was held at Westminster was decorated with gilt stars. The first historical instance of the use of the title is in the reign of Edward III., when the chancellor, treasurer, justices, and others are mentioned as exercising jurisdiction in the "star chamber." Its powers are thought to have been derived from the council which in 1453 was recognized as having jurisdiction over all cases not determinable by common law, but which declined in power during the Wars of the Roses. By the act of 1488 Henry VII. empowered a committee of the council, consisting of the chancellor, treasurer, keeper of the privy seal, chief justices (or, in their absence, two other justices), a bishop, and a temporal lord to act as a court of justice with jurisdiction over cases in which the operation of the law was wrongfully impeded. It had the right to punish without a jury the misdemeanors of sheriffs and juries, and in spite of its arbitrary nature was of use in quelling the turbulent spirit of the great nobles and bringing in a period of good order. In Henry VIII.'s reign its powers were reabsorbed by the council, but thenceforth the composition of the court was uncertain. Its jurisdiction, which was equally vague, comprised in practice almost every class of offenses, and it could inflict any penalty short of death. The peculiar uncertainty of its legal rules made it the defense of absolute power, and under the Stuarts its arbitrary decisions and cruel punishments brought down upon it the popular hatred. It was abolished by the Long Parliament in 1641. F. M. Colby.

**Stare Decisis**, stā'rē-dē-sī'sis [Lat.]: a shortened form of the maxim, "*stare decisis, et non quieta movere*"—"to stand by decisions and not to disturb matters once settled."

Ordinarily, it applies only to decisions of the court in which the question is again mooted, or to those of its superior. At times, however, the rule is followed with regard to decisions of inferior courts and even to decisions of executive departments, which have been acquiesced in by the public and under which rights have been acquired. (*Schell* vs. *Fauché*, 138 U. S. 562.) The reasons for the rule and its limitations are considered in the article on PRECEDENTS (*q. v.*).

FRANCIS M. BURDICK.

**Starfish**: any animal belonging to the class of *Echinodermata*, order *Asteroidea*; characterized by having the body more or less plainly star-shaped, and without sharp distinction between the five or more rays or arms and the central disk. The body-wall is hardened with calcareous plates and spines; the mouth is in the center of the lower surface of the disk, and the vent, when present, is above. Each arm bears on its lower surface two zigzag rows of tubular suckers (ambulacra), by means of which the animal moves about or anchors itself; while at the tip of each ray is an eye-spot. The round spot noticeable on the upper surface is a strainer (madreporite) through which water is admitted to tubes connected with the ambulacra. The sexes of the starfish are separate, and the eggs, which are usually committed to the waves, undergo in most forms strange metamorphoses in their development. Starfish lack all hard armature to the mouth, and they eat by protruding the stomach, inserting it into the mollusc upon which they feed. They are extremely destructive to oysters. See Alexander Agassiz, *North American Starfishes* (1877); *Development*, Field, *Quarterly Jour. Micros. Sci.* (1892); Fewkes, *Bulletin Mus. Comp. Zoöl.* (xiii., 1887). J. S. KINGSLEY.

**Stargazers**: marine fishes of the family *Uranoscopidæ*. The best-known species is *Uranoscopus scaber* of the Mediterranean; *Astroscopus anoplos* and *Upsilonphorus y-græcum* are found on the Atlantic coast of the U. S., but most of the species are East Indian. They are spiny fishes, having the eyes on top of the head, whence the name. The cyprinodont fishes of the genus *Anableps*, found in Guiana, are also called stargazers. See ANABLEPS.

**Starke**, JOHN: soldier; b. at Londonderry, N. H., Aug. 28, 1728; became a farmer, and in 1752 was taken prisoner by the St. Francis Indians, but after six weeks was ransomed, having in the meantime gained so much favor with his captors that he was subsequently adopted into their tribe. In 1755 he was appointed a lieutenant in Rogers's Rangers; took part in Abercrombie's campaign in 1758, and in Amherst's reduction of Crown Point and Ticonderoga in 1759; early in 1775 was chosen a member of the New Hampshire committee of safety; as colonel of the New Hampshire troops took part in the battle of Bunker Hill; accompanied Montgomery's expedition to Canada 1775–76; joined Washington at Newton, N. J., Dec., 1776, and took part in the battle of Trenton. Being aggrieved at the action of Congress in regard to promotions, he resigned his commission in Apr., 1777. Upon the advance of Burgoyne from Canada, the authorities of New Hampshire commissioned him to raise a force for the defense of the State, which was then held to include Vermont. He attacked the Hessian colonel Baum near Bennington Aug. 16, 1777, routed him, and later in the day defeated a force under Col. Breymann. For this he received from Congress a commission as brigadier-general; served under Gates in the Saratoga campaign; was with Gates in Rhode Island in 1778–79, and in 1780 joined Washington at Morristown; was a member of the court martial for the trial of Maj. André, and in 1781 was placed in command of the northern department. After the close of the war he retired to his farm. D. at Manchester, N. H., May 8, 1822. His *Biography* was written by Edward Everett for Sparks's *American Biography*, and his *Life and Official Correspondence*, edited by his grandson, was published in 1860 (Concord, N. H.).

**Starkie**, THOMAS: jurist; b. at Blakeburn, England, Apr. 12, 1782; graduated at Cambridge, where he was senior wrangler and Smith's prizeman 1803; was called to the bar at Lincoln's Inn May, 1810; became Downing Professor of Law 1823, and a judge of the county court at Clerkenwell 1847. His most important service in a public capacity was his labor in a commission appointed for the amendment of the law, and for digesting it into a code, for which his fullness of information especially fitted him. D. in London, Apr. 15, 1849. Besides *A Practical Treatise on the Law of Slander, Libel, and, incidentally, of Malicious Prosecutions* (1812), *A Treatise on Criminal Pleading* (2 vols., 1814), and *A Practical Treatise on the Law of Evidence and Digest of Proofs in Civil and Criminal Proceedings* (3 vols., 1824), which (especially the last) are his most important works and have been repeatedly reprinted, he published *Reports of Cases Determined at Nisi Prius, King's Bench, and Common Pleas* (1817–23), and numerous magazine articles.

Revised by F. STURGES ALLEN.

**Starkville**: town; capital of Oktibbeha co., Miss.; on the Ill. Cent. and the Mobile and Ohio railways; 20 miles S. W. of Aberdeen, 25 miles W. of Columbus (for location, see map of Mississippi, ref. 5–H). It is in a stock-raising and hay-making region, is the seat of the Mississippi Agricultural and Mechanical College, and contains the Starkville Female Institute, a savings-bank with capital of $25,000, and two weekly newspapers. Pop. (1880) 1,500; (1890) 1,725; (1900) 1,986.

**Starling** [M. Eng. *sterlyng*, dimin. of *stare* < O. Eng. *stær* (> Eng. *stare*, starling): O. H. Germ. *stara* > Mod. Germ. *star*, starling; cf. Lat. *stur'nus*, starling]: the *Sturnus vulgaris*, a common European bird of the family *Sturnidæ*. It is a great favorite, especially with the Germans, who often have it caged, and teach it to whistle tunes and even speak words very plainly. It makes a nest of twigs, straw, grass, and roots in holes of rocks and buildings and in hollow trees. The bird is 8½ inches long, black, with violet and green reflections and buff spots.

Revised by F. A. LUCAS.

**Starni'na**, GHERARDO: painter; b. in Florence in 1354; a pupil of Antonio Veneziano. After painting the history of St. Nicholas and St. Anthony on the ceiling of the Castellani chapel in Santa Croce, he was taken to Spain by some Spaniards who were enthusiastic admirers of his art. In that country he worked for the king and other patrons, and returned to Italy rich and covered with honor. Of his frescoes for the chapel of St. Jerome in the Carmelite church, executed soon after his return, nothing remains but the *Death of St. Jerome*. When Pisa was conquered by the Florentine republic Starnina was commissioned to paint on the façade of the Guelph palace an effigy of St. Denis, it being on his day that the city surrendered. He was one of the most consummate draughtsman of his time. Masolino da Panicale, Masaccio, and Antonio da Pistoia were his pupils. D. about 1407. W. J. STILLMAN.

**Star-of-Bethlehem**: the *Ornithogalum umbellatum*, a common spring garden-flower of the family *Liliaceæ*. The genus includes many bulbous-rooted plants of the Old World and of Southern Africa, several of which are cultivated. The above-mentioned species (white star-of-Bethlehem) is a native of Europe, and is sparingly naturalized in the U. S.

**Star of India, Order of the**: a British order of knighthood, provided to reward distinction in the Government service in India. It was instituted in 1861, and reorganized in 1866 and 1878. It consists of the sovereign, the viceroy of India, and three classes of members, viz.: 1, knights grand commanders (G. C. S. I.); 2, knights commanders (K. C. S. I.); and 3, companions (C. S. I.). The badge of the order is a light-blue ribbon with white stripes and the motto "Heaven's Light our Guide."

**Staroverski**: See PHILIPPINS.

**Starr**, FREDERICK: See the Appendix.

**Starr**, MOSES ALLEN, M. D., LL. D.: neurologist; b. in Brooklyn, N. Y., May 16, 1854; educated at Princeton College (A. B. 1876, A. M. 1879, Ph. D. 1884, LL. D. 1899), and at the College of Physicians and Surgeons, New York (M. D. 1880); studied at the Universities of Berlin, Heidelberg, Vienna, and Paris; was Professor of Nervous Diseases, New York Polyclinic, 1886–88, and has been Professor of Diseases of the Mind and Nervous System, College of Physicians and Surgeons, New York, since 1888; is attending and consulting physician to a number of hospitals; corresponding secretary of New York Academy of Medicine 1888 to 1895; president New York Neurological Society 1892–94. He delivered the Middleton Goldsmith lectures of the New York Pathological Society in 1887, his subject being *Multiple Neuritis*. Among his works are *Familiar Forms of Nervous Diseases* (New York, 1890); *Lectures on Insanity* (1891); and *Brain Surgery* (New York, 1893). S. T. ARMSTRONG.

**Stars** [M. Eng. *sterre* < O. Eng. *steorra*: O. H. Germ. *sterro*, *sterno* (> Mod. Germ. *stern*: Goth. *stairnō* < Teuton. *ster(n)*-: Lat. *stel'la* (for **ste'rula*): Gr. ἀστήρ]: in general, immense masses of matter, at a temperature so high as to be self-luminous, scattered through the celestial spaces, and of the same general nature as the sun. From the standpoint of the nebular hypothesis, each mass is hot because it has never had time to cool since it was first formed from the condensation of the nebulæ. Like the sun, the stars are surrounded by atmospheres of vapor, cooler than themselves, and spectrum analysis shows that they are composed of chemical elements similar to those found upon the earth.

*Number of Stars.*—The number of stars which can be seen at one time by the average eye, on a clear evening, may be estimated as between 2,000 and 2,500. As only half the celestial sphere is above the horizon, and few stars can be seen near the horizon, owing to the vapors in the lower part of the atmosphere, the number in the whole celestial sphere is more than double that visible at any one time. The total number in the heavens which the ordinary eye can see may be roughly estimated at 5,000; but these are only a small proportion of the whole number, the great majority being invisible without telescopic aid. It was estimated by Struve that 20,000,000 were visible with Herschel's 20-foot telescope. The more powerful the telescope, the greater the number. No exact estimate has ever been made of the total number visible with the great refractor of the Lick Observatory, but it would probably exceed 50,000,000.

*Magnitudes of the Stars.*—A glance at the nocturnal sky shows that the stars are of widely different degrees of brightness. A system of estimating the apparent magnitudes or brightness of the stars, which has come down to us from ancient times, is still in use by astronomers. On this system, in its original form, the stars were divided into six different orders of brilliancy. About twenty of the brightest stars in the heavens were called of the first magnitude. Next in order came the brightest stars of the Great Bear and of Cassiopeia. These were called of the second magnitude. The successive magnitudes corresponded with the continually diminishing degree of light, until the sixth was reached, which included the faintest visible with the naked eye. The original division into magnitudes was not founded on any exact photometric scale, but merely on general impressions derived from estimates by means of the eye. In modern times greater exactness has been aimed at. The general system which astronomers have attempted to follow is that the amounts of light represented by increasing magnitudes shall decrease in geometrical progression. Supposing this system to be exactly followed, a star of the second magnitude would be one which emitted two-fifths as much light as one of the first; one of the third magnitude would be two-fifths as bright as one of the second, and so on. Computing this ratio down to the sixth magnitude, we see that it would represent but little more than one-hundredth part of the light of a star of the first magnitude. The same ratio is continued in the star invisible to the naked eye; a star of the eleventh magnitude means one emitting about 1 per cent. as much light as one of the sixth magnitude. This scale of increase, however, is not perfectly exact, owing to the difficulties of making precise photometric comparisons between stars of greatly different magnitudes. The general rule has been that the magnitudes have been determined merely by estimates, and thus the results given by some observers have been systematically different from those given by others. This is especially true in the case of telescopic stars. Even in the case of the stars visible to the naked eye the difference of light is probably greater than that given by the above rule, some magnitudes being, in a general average, three times as bright as those next below them. The most recent investigators have gone far, however, toward removing all these discrepancies by using a uniform light ratio of two and a half for a unit difference of magnitude.

On the ancient system every star was supposed to belong to one of the six orders of magnitude, and no distinction was made between those belonging to the same order; but, as a matter of fact, the stars range over every degree of brilliancy from the first to the sixth, and the classification into magnitudes is arbitrary. How exact soever we might make it, the brightest star of the fifth magnitude would be equal with the faintest star of the fourth, the brightest star of the fourth equal to the faintest star of the third, etc.; hence astronomers have striven to express the magnitudes more exactly by introducing subdivisions. At first each magnitude was divided into three subdivisions: a bright one, a medium, and a faint one. The two extreme subdivisions were designated by writing the number both of that magnitude and the one next to it. For example, the magnitude of an average third-magnitude star was represented by the number 3 simply. A star between the third and fourth, but nearer to the third, was represented by the number 3·4. The next class in order would be the brightest stars of the fourth magnitude, which were represented by 4·3. Then the average fourth-magnitude stars were represented by 4 simply. Next, the fainter stars of this order, or those which approached the fifth magnitude, were called 4·5. Next came the brighter fifth-magnitude stars, which approached the fourth magnitude, and were called 5·4, etc. This system, though very recently in use, is too clumsy to meet the requirements of exactness in science, and it is now common to consider the magnitudes as regularly variable quantities, and represent them in the usual way by numbers and decimals. Accordingly, in modern photometry units and tenths are used. An average third-magnitude star is represented by 3·0; one fainter by a certain amount is called 3·1; next, 3·2, etc. The progression of 0·1 in each magnitude corresponds to an increase in light of nearly one-tenth; that is to say, a star of magnitude 2·9 is about one-tenth brighter than one of 3·0; one of 2·8 a tenth brighter than one of 2·9, etc. This rate of increase is such that a change of a whole magnitude will correspond to an increase of about two and a half times. Indeed, in the most recent photometrics the decimals are carried to hundredths.

This system does not express the amount of light emitted by a star, but rather the negative of its logarithm. It is more convenient, however, than one which would attempt to express the exact amount of light. Photometric estimates are necessarily made by the eye, and do not admit of direct measures. Now a geometrical progression of this sort can be estimated better by the eye than one in which an attempt is made to measure the quantity of light.

The number of stars of each magnitude increases with their minuteness. Roughly speaking, there are three times as many of the second magnitude as of the first; three times as many of the third as of the second, and so on. In the case of the fainter stars, however, the progression is not so rapid. There are between two and three times as many stars of the sixth magnitude as of the fifth; probably about twice as many of the seventh as of the sixth, and so on. An idea of this order may be gained by saying that the absolute amount of light emitted by the entire number of all the stars of any given order of magnitudes is not extravagantly different from the third down to the fainter telescopic stars. For example, each star of the sixth magnitude emits about two-fifths as much light as one of the fifth; but as there are two and a half times as many stars, the greater number nearly compensates for their smaller brilliancy, so that the total amount of light emitted by all of the sixth magnitude is about the same as the total amount emitted by all of the fifth.

*Constellations and Names.*—In former ages the figures of men, animals, or natural objects were supposed to be delineated on the face of the nocturnal sky, so as to include all the principal stars, and the stars were designated by the particular limb or part of the animal in which they were found. The bright red star, Aldebaran, for example, in the constellation Taurus, formed the eye of the bull, and two other smaller stars were at the ends of his horns. So we have three stars forming the belt of Orion, and three others his sword. In ancient times special names were given to several of the brighter stars; thus Arcturus is alluded to in the book of Job. The Arabs introduced special names for 100 or 200 of the stars. Some of these names are still used, but the tendency in astronomical practice is to drop them and designate the stars according to the system of Bayer. This system, now in vogue for all the more conspicuous stars, was introduced by Bayer about the year 1600. It is analogous to that which is used in distinguishing persons by two names, the surname and the Christian name. All the stars of a constellation have the name of that constellation as a surname. The Christian names are the letters of the Greek alphabet, $\alpha$ $\beta$, etc. These letters are used in each constellation in the same manner that persons of different families may have the same Christian name. The first letters of the alphabet are applied to the brighter stars, but their order as laid down by Bayer on his maps is not exactly that of brilliancy. Thus $\alpha$ Ursa Minoris is one of the two brightest stars in Ursa Minor; $\beta$ Ursa Minoris is the other; $\gamma$ Minoris is the third in the order of brilliancy, etc. So $\alpha$ Aquilæ is the brightest star in the constellation Aquila; $\beta$ Aquilæ the next brightest, etc. When the Greek alphabet was exhausted, in the case of any one constellation, the Italic alphabet was used. In modern times several stars are represented by one of Bayer's letters and a number attached to it. Thus two stars in Aquarius are represented by $h_1$ and $h_2$ respectively. Flamsteed, in making his great catalogue of stars, found that he had to include so many stars not lettered by Bayer that he adopted the plan of using numbers, instead of the Greek and Italic letters. These numbers were arranged in the orders of right ascension; thus 1 Scorpii was the first star in Scorpius which passed the meridian, 2 Scorpii the second, etc. The system commonly used now is to designate the star by Bayer's letter, when it has one, otherwise by Flamsteed's number. Stars which have neither letter nor number are distinguished simply by their magnitude, right ascension, and declination, or by their number in some well-known catalogue; but for uniformity the constellation to which they belong is frequently indicated.

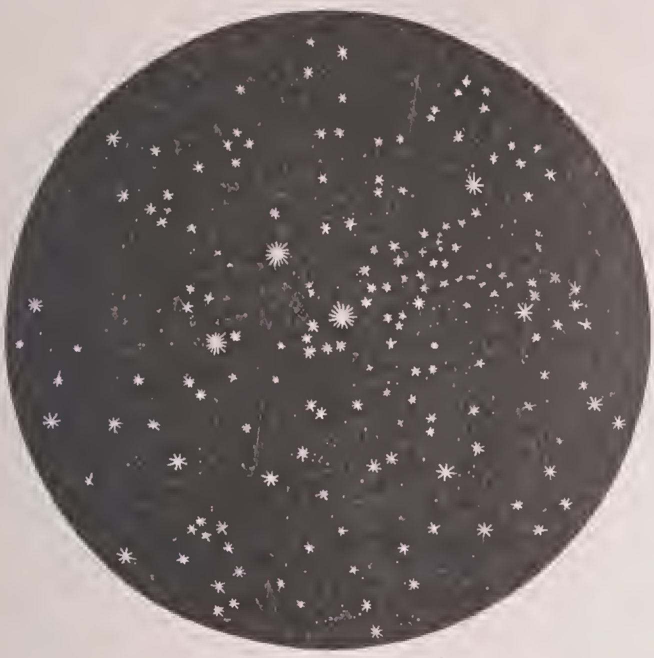


FIG. 1.—Portion of the group in Perseus.

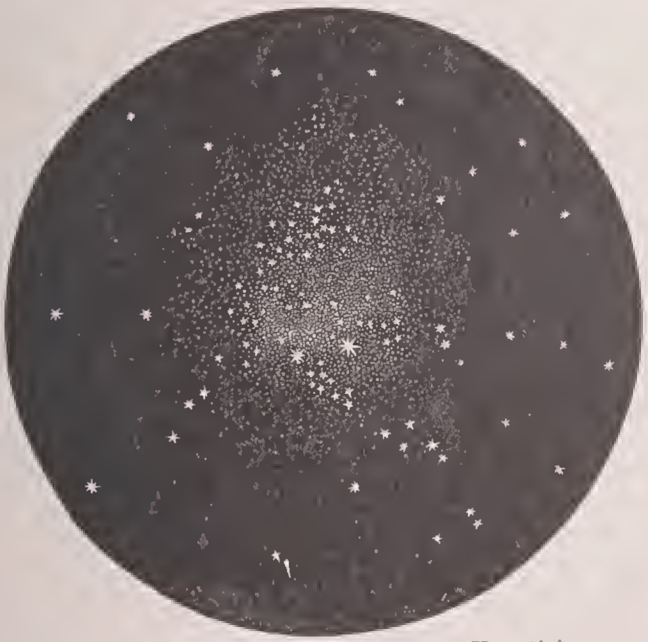


FIG. 2.—Globular cluster in Canes Venatici.

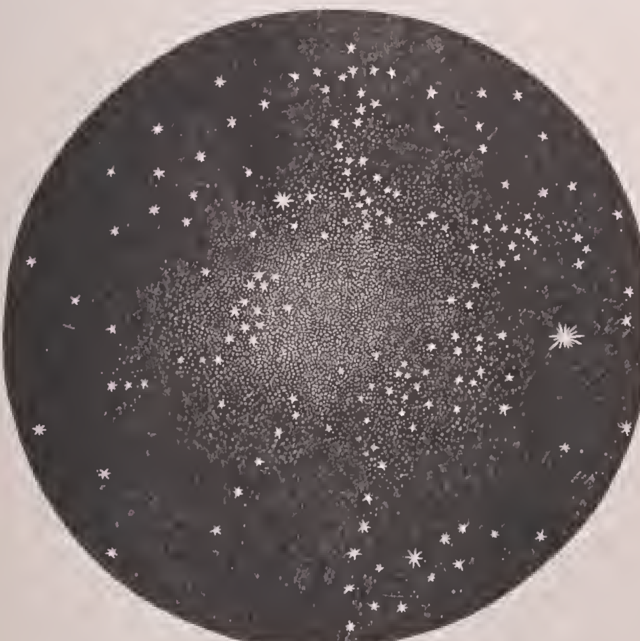


FIG. 3.—Globular cluster in Aquarius.

*Distribution of the Stars.*—The distribution of the stars in space has been considered by Herschel and other astronomers, but, though some traces of arrangement have been discerned, no distinct law has yet been formulated. (See GALAXY.) In certain parts of the heavens the stars are heaped together in clusters. The telescope reveals wonderful groups, such as that in Hercules, which contains thousands of stars in a small space, spreading at the edge into curved sprays. A group near $\kappa$ of the Southern Cross shows an aggregation of variously colored stars. In Fig. 1 the central portion of the group in Perseus is exhibited. Figs. 2 and 3, representing clusters in Canes Venatici and Aquarius, give an idea of groups composed of immense numbers of small stars arranged in a globular form.

TABLE A.—DISTRIBUTION OF STARS ACCORDING TO THEIR CONSTELLATIONS AND MAGNITUDES. (STARS VISIBLE TO THE NAKED EYE IN THE LATITUDES OF THE NORTHERN UNITED STATES.) SEE ALSO CONSTELLATION.

| | CONSTELLATIONS. | | Mag. 1. | Mag. 2. | Mag. 3. | Mag. 4. | Mag. 5. | Mag. 6. | Var. | Clus. | Neb. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A. *Northern Constellations, between the zenith of latitude 45° and the pole.* | | | | | | | | | | | |
| 1 | Ursa Minor | | .. | 2 | 1 | 3 | 8 | 40 | .. | .. | .. | 54 |
| 2 | Draco | | .. | 1 | 9 | 8 | 39 | 163 | .. | .. | .. | 220 |
| 3 | Cepheus | | .. | .. | 5 | 4 | 21 | 127 | 2 | .. | .. | 159 |
| 4 | Cassiopeia | | .. | 2 | 2 | 6 | 21 | 93 | 2 | .. | .. | 126 |
| 5 | Perseus | | .. | 1 | 4 | 13 | 23 | 90 | 2 | 3 | .. | 136 |
| 6 | Camelopardus | | .. | .. | .. | 2 | 25 | 110 | .. | 1 | .. | 138 |
| 7 | Lacerta | | .. | .. | .. | 1 | 12 | 35 | .. | .. | .. | 48 |
| 8 | Lynx | | .. | .. | 1 | 1 | 12 | 73 | .. | .. | .. | 87 |
| 9 | Ursa Major | | .. | 6 | 9 | 5 | 39 | 166 | 2 | .. | .. | 227 |
| 10 | Canes Venatici | | .. | .. | 1 | 1 | 18 | 65 | .. | 2 | 1 | 88 |
| | B. *Mean Constellations, between the zenith of latitude 45° and the equator.* | | | | | | | | | | | |
| 11 | Andromeda | | .. | 3 | 1 | 13 | 14 | 106 | 1 | .. | 1 | 139 |
| 12 | Equuleus | | .. | .. | .. | 1 | 4 | 11 | .. | .. | .. | 16 |
| 13 | Pegasus | | .. | 2 | 4 | 8 | 22 | 140 | 1 | .. | 1 | 178 |
| 14 | Pisces | | .. | .. | 1 | 10 | 21 | 96 | .. | .. | .. | 128 |
| 15 | Triangulum | | .. | .. | 1 | 2 | 4 | 22 | .. | .. | 1 | 30 |
| 16 | Aries | | .. | 1 | 1 | 4 | 11 | 63 | .. | .. | .. | 80 |
| 17 | Auriga | | 1 | 1 | 2 | 4 | 18 | 115 | 2 | 1 | .. | 144 |
| 18 | Taurus | | 1 | 1 | 2 | 15 | 28 | 140 | 1 | .. | .. | 188 |
| 19 | Gemini | | 1 | 2 | 5 | 5 | 13 | 78 | 1 | 1 | .. | 106 |
| 20 | Canis Minor | | 1 | .. | 1 | .. | 5 | 30 | .. | .. | .. | 37 |
| 21 | Cancer | | .. | .. | .. | 5 | 5 | 79 | 1 | 1 | 1 | 92 |
| 22 | Leo | | 1 | 2 | 5 | 8 | 20 | 124 | 1 | .. | .. | 161 |
| 23 | Leo Minor | | .. | .. | .. | 3 | 6 | 30 | 1 | .. | .. | 40 |
| 24 | Coma Berenices | | .. | .. | .. | 2 | 17 | 51 | .. | .. | .. | 70 |
| 25 | Boötes | | 1 | 1 | 5 | 10 | 23 | 100 | .. | .. | .. | 140 |
| 26 | Corona Borealis | | .. | 1 | .. | 6 | 7 | 15 | 2 | .. | .. | 31 |
| 27 | Hercules | | .. | 1 | 9 | 12 | 28 | 172 | 3 | .. | 2 | 227 |
| 28 | Lyra | | 1 | .. | 1 | 5 | 8 | 52 | 2 | .. | .. | 69 |
| 29 | Cygnus | | .. | 2 | 4 | 15 | 34 | 138 | 3 | 1 | .. | 197 |
| 30 | Vulpecula | | .. | .. | .. | 1 | 14 | 47 | .. | .. | .. | 62 |
| 31 | Sagitta | | .. | .. | .. | 4 | 2 | 12 | .. | .. | .. | 18 |
| 32 | Delphinus | | .. | .. | 1 | 4 | 2 | 24 | .. | .. | .. | 31 |
| | C. *Southern Constellations, from the equator to the southern horizon.* | | | | | | | | | | | |
| 33 | Cetus | | .. | 2 | 6 | 7 | 24 | 122 | 1 | .. | .. | 162 |
| 34 | Eridanus | | .. | .. | 7 | 17 | 24 | 99 | .. | .. | .. | 147 |
| 35 | Orion | | 1 | 3 | 4 | 6 | 25 | 95 | 2 | .. | .. | 136 |
| 36 | Monoceros | | .. | .. | .. | 4 | 15 | 90 | 1 | 2 | .. | 112 |
| 37 | Lepus | | .. | .. | 2 | 6 | 10 | 26 | 1 | .. | .. | 45 |
| 38 | Columba Noachi | | .. | 1 | 1 | 3 | 1 | 2 | .. | .. | .. | 8 |
| 39 | Canis Major | | 1 | 2 | 4 | 5 | 13 | 44 | .. | 1 | .. | 70 |
| 40 | Argo Navis | | .. | .. | 1 | 4 | 13 | 52 | .. | 1 | .. | 71 |
| 41 | Hydra | | .. | 1 | 4 | 10 | 20 | 117 | 1 | .. | .. | 153 |
| 42 | Sextans Uraniæ | | .. | .. | .. | 1 | 5 | 42 | .. | .. | .. | 48 |
| 43 | Virgo | | 1 | .. | 6 | 9 | 19 | 144 | 2 | .. | .. | 181 |
| 44 | Crater | | .. | .. | 1 | 4 | 2 | 28 | .. | .. | .. | 35 |
| 45 | Corvus | | .. | 3 | 1 | 1 | 4 | 17 | .. | .. | .. | 26 |
| 46 | Centaurus | | .. | .. | 2 | 3 | 2 | 5 | .. | .. | .. | 12 |
| 47 | Serpens | | .. | 1 | 5 | 5 | 10 | 59 | 1 | 1 | .. | 82 |
| 48 | Ophiuchus | | .. | 2 | 7 | 7 | 24 | 71 | .. | 2 | .. | 113 |
| 49 | Scutum Sobieskii | | .. | .. | .. | 1 | 5 | 4 | 1 | .. | .. | 11 |
| 50 | Aquila et Antinous | | 1 | .. | 5 | 4 | 17 | 95 | 1 | .. | .. | 123 |
| 51 | Libra | | .. | 2 | .. | 1 | 8 | 41 | 1 | .. | .. | 53 |
| 52 | Lupus | | .. | .. | .. | .. | 4 | ... | .. | .. | .. | 4 |
| 53 | Scorpio | | 1 | 1 | 7 | 5 | 10 | 17 | .. | .. | .. | 41 |
| 54 | Sagittarius | | .. | 1 | 6 | 8 | 19 | 53 | 2 | 1 | .. | 90 |
| 55 | Capricornus | | .. | .. | 3 | 7 | 12 | 41 | .. | .. | .. | 63 |
| 56 | Aquarius | | .. | .. | 5 | 11 | 31 | 98 | .. | 1 | .. | 146 |
| 57 | Piscis Australis | | 1 | .. | .. | 3 | 13 | 5 | .. | .. | .. | 22 |
| | Northern | 10 | .. | 12 | 32 | 44 | 218 | 962 | 8 | 6 | 1 | 1,283 |
| | Mean | 22 | 7 | 17 | 43 | 137 | 306 | 1,645 | 19 | 4 | 6 | 2,184 |
| | Southern | 25 | 6 | 19 | 77 | 132 | 330 | 1,367 | 14 | 9 | .. | 1,954 |
| | Totals | 57 | 13 | 48 | 152 | 313 | 854 | 3,974 | 41 | 19 | 7 | 5,421 |

*Variable Stars.*—It has long been known that certain stars vary in brilliancy from time to time. The two most remarkable ones, which have long been known, are *o* Ceti and *β* Persei, or Algol. During the greater part of the time the former of these stars is invisible to the naked eye; But at intervals of about eleven months it increases so as to become plainly visible, and after retaining a maximum brilliancy for some two weeks fades away again. Its maximum brilliancy, however, is very different at different appearances, ranging from the second all the way to the fifth. The law of variation is so irregular as not to admit of any exact statement; even the period of 331 days varies from time to time. Owing to the manner in which it blazes up, it was formerly called Mira Ceti. For an account of the variations in the light of Algol, and the discoveries to which they have given rise, see ALGOL.

In the southern hemisphere there is a star, *η* Argus, which for several centuries past has varied in the most singular manner. The first record of it was by Halley in 1677, when it was classed as of the fourth magnitude. In 1837 Sir John Herschel, while making observations at the Cape of Good Hope, was astonished by the appearance of a new star of the first magnitude, which on referring to a map he found to be *η* Argus. Its light was, however, nearly trebled, being then greater than that of Rigel. He states that the light continued to increase until the beginning of 1838, when it was brighter than most of the stars of the first magnitude. It then gradually faded away for two or three years, but in 1842 and 1843 blazed up brighter than ever, so as to be the brightest star in the heavens, except Sirius. Since that time it has been steadily diminishing; in 1868 it was no longer visible to the naked eye, and since that time has sunk to about the eighth magnitude.

Why some stars vary while others do not science has not been able to explain, except in a few cases. One of these is Algol, whose variations are due to a partial eclipse by a dark body revolving around it. There are a few other stars whose light slightly fades away at certain intervals, and whose variations are therefore presumed to be due to a similar cause. With most of the variable stars, however, the changes of light go on so continuously as to show that it is due to the constitution of the star itself. It has been suggested that such stars are brighter on one side than on the other, and show different faces as they revolve. This hypothesis is a purely speculative one, not only without proof, but without any great degree of probability. The theory which at present seems to rest upon the best foundation is that the variations are due to a process analogous to that of the formation of spots on the sun. The actual area of the sun covered by spots is so small that the variation of the light thus caused would evade photometric measurement: but it may easily be supposed that this spotted area upon a few of the stars so much exceeds that of the sun, both in variation and amount, as to be sensible to such measurement. The spots on the sun go through a regular period in eleven years. It may therefore be called a variable star, with a period of eleven years. It may therefore be said, with a considerable degree of probability, that variations in brilliancy among the stars are due to the regular formation of spots like those on the sun, at intervals which are sometimes fairly regular, and at other times very irregular, according to the constitution of the star itself.

*Colored Stars.*—A very slight examination will show to any observer of the heavens that the stars are of different colors. The great majority are what would be called white. A few, however, such as Sirius and Alpha Lyræ, have a slightly bluish tint. Many others, as Aldebaran, Arcturus, Antares, and Alpha Orionis, have a reddish tinge. These differences of color are probably due in part to differences in the temperature of the stars, and in the absorbing power of the atmospheres which surround them. It is familiarly known that the color of the light emitted by a piece of heated iron is at first red, and then it changes toward white as the iron gets hotter. This law is so well established in the case of terrestrial bodies that little doubt is felt that the red stars are not at so high temperature as those of other colors. Another curious fact in connection with this is that variability predominates among the red stars. It is thus rendered likely that the red stars are those in the most advanced stage of cooling, and most subject to the formation of spots. Probably if such a star were brought as near to us as the sun is we should find the spots frequently covering half the disk, or more, and changing from time to time in amount, as the spots on the sun change.

*Stellar spectra* can be distinguished into four categories or types. The first is that of the white or azure-tinted stars, like Sirius, Lyra, etc., *β*, *γ*, *δ*, *ε*, *ζ*, *η* of the Great Bear, etc. The spectra of these are almost continuous, except that they are furrowed by four strong black lines, which are absorption-lines of hydrogen. All four lines can be seen in the most brilliant, as Sirius, Lyra, etc.; in the feeblest only the $H\beta$, or the F of the sun, is ordinarily visible; but in general this is broad and dilated, and frequently diffused at the edges, especially in Sirius. This is an indication of a very high temperature, and of great density in the hydrogen atmosphere of the stars of this order. There are also seen traces of other lines, as of magnesium, sodium, and some of iron; but these are extremely feeble, and require for their observation an atmosphere of great purity. Many stars appear of uniform light, without lines, which studied with care are found to belong to this type.

The second type is that of the yellow stars. They have very fine lines, and their spectra are perfectly similar in character to that of the sun. Capella, Pollux, and many others feebly yellow have such a character. The fineness of the lines requires that in these researches the atmosphere should be very clear and quiet. Sodium, hydrogen, and iron are very conspicuous in them. Arcturus and Aldebaran, in their periods of lively yellow light, approach this type, and in the periods of red light the following. It is curious that *α* Ursæ Majoris is of this type, while all the others of that constellation belong to the first.

The third type is that which is exhibited by the orange and red stars. It is formed of lines and zones or nebulous bands. A specially striking example is *α* Orionis, the prototype of this class, to which belong also *α* Scorpionis, *o* Ceti, *β* Pegasi, *α* Herculis, and many other beautiful examples. This spectrum ought to be considered as really composed of two spectra superposed—one formed of broad zones of gradually deepening cloudiness, producing the effect of lights and shadows in a fluted column; the other formed of black absorption-lines of the metals. This, for the structure of the broad zones, has for type *α* Herculis, where the principal channelings are seven in number, but upon these channelings, in the periods of lively red color, the black lines can be perceived. In some variable red stars, in the period of feebleness, is seen a spectrum of a few lively bright lines, as, for example, in *o* Ceti. The black reversion-lines of hydrogen are feeble, and sometimes not present at all in these spectra, while the sodium, iron, and magnesium lines are very strong; hydrogen is truly there, but is difficult of detection, because the lines are not perfectly reversed.

The fourth type embraces some curious stars, for the most part red. They have only three bands, coinciding in limits with those of the third type, but having twice the breadth; and they are bright notwithstanding the minuteness of the stars. There are lucid lines in some of them, but in general these are feeble and few. They have the bright and well-defined side of their channelings turned toward the violet, while those of the third type turn it toward the red. They appear to give a spectrum similar to that of carbon as it is seen in the central part of the voltaic arch projected between two carbon points: except that, in the stars, the shading off is in the opposite direction—that is, the maximum light is turned toward the violet, while in the carbon arch it is turned toward the red. Many of these stars exhibit only a few luminous lines, and are without the channeled and cloudy spaces; all such are of a deep red, and among them are found the most beautiful spectra.

TABLE B.—THE MORE REMARKABLE STARS OF THE FOURTH TYPE.

| Right ascension. | Declination. | Magnitude. |
|---|---|---|
| 4*h*. 36·2*m*. | +67° 54′ | 6. Fine. |
| 4 42·8 | +28 16 | 8 |
| 4 58·1 | + 0 59 | 6 |
| 6 26·9 | +38 33 | 6·5. Fine. |
| 7 11·5 | −11 43 | 7·5 |
| 9 44·6 | −22 22 | 6·5 |
| 10 5·8 | −34 38 | 7 |
| 10 30·7 | −12 39 | 6. Fine. |
| 10 44·8 | −20 30 | 6·5 |
| 12 38·5 | +46 13 | 6. Very fine. |
| 13 19·3 | −11 59 | 7·5 |
| 13 47·3 | +41 2 | 7 |
| 19 26·5 | +76 17 | 6·5 |
| 20 8·6 | −21 45 | 6 |
| 21 25·8 | +50 58 | 9 |
| 21 38·6 | +37 13 | 8·5 |
| 23 39·2 | + 2 42 | 6. Fine. |

*New Stars.*—The view has sometimes been entertained that new stars show themselves in the heavens from time to time and that old ones disappear; but neither of these impressions is correct. There is no well-established case of a known star disappearing from the heavens. The supposed cases were those when an observer had made some mistake in recording the position of a star, so that future observers on looking at the place found it vacant. The direct proof that no really new star ever appears is not so easy. As a matter of fact, stars apparently new do appear in the heavens from time to time. The most extraordinary on record was that of 1752, which was described by Tycho Brahe. For nearly a month it was so bright as to be discernible in full daylight. It then faded away, and at the end of another year gradually became invisible. The position of the star was determined by Tycho as well as his instruments would permit, and there is now found to be a telescopic star near the place. Kepler records a similar star, which appeared in 1604, in the constellation Ophiuchus. In October of that year it was of the first magnitude, and remained visible during 1605. It faded away early in 1606.

The question whether such stars were new might have been considered an open one until the appearance of T Coronæ in May, 1866. It was first seen on the 11th of that month, when it had attained the second magnitude. On the question whether the star was visible before that day the testimony is conflicting. The most important circumstance connected with this star is that it was found to have been already recorded in Argenlander's catalogue, being a telescopic star of the ninth magnitude. A few days after it blazed forth in the way just described it began to fade again, and has since diminished to its former state. In 1892 a new star appeared in the constellation Aurigæ, but it did not rise above the fifth magnitude, and would therefore have passed unnoticed but for the watchful eyes constantly directed at the heavens. No certain explanation can be given of these phenomena. In the case of T Coronæ spectroscopic observation seemed to show that the increase of light was due to glowing hydrogen. The suggestion has been made that the outburst was caused by a collision, perhaps by a planet falling into the star. The explanation is purely hypothetical.

*Proper Motions of the Stars.*—To the unaided vision the stars seem to preserve the same relative position in the heavens from year to year and from century to century. The earliest maps of the constellations show the same arrangement of the stars as the latest ones, but the refined measurements of modern astronomy show a slow motion to be taking place in at least all the brighter stars. This motion, however, does not follow any exact law that has yet been discovered, except to the extent that there is a preponderance of motions in a certain direction in the heavens which may be described as from the constellation Hercules in the northern hemisphere toward that of Pictor in the southern. The common and natural explanation of this is that the sun has a proper motion toward the constellation Hercules. The preponderance of motions on which this view rests is, however, only the result of a general average; the actual motions of the individual stars take place in all directions. Clusters of stars frequently have a common motion among themselves. This is especially true of the Pleiades, which are moving southward at the rate of about six seconds in a century. The proper motions of the stars all take place in straight lines, so far as observations have yet shown. If any deviations occur, many centuries will be required to show them. For shooting stars, see METEORS.

BIBLIOGRAPHY.—For a very complete general outline of stellar astronomy, reference may be made to the book of Miss Agnes M. Clerke, *The System of the Stars.* The best accounts of the methods of measuring the magnitudes of the stars, and the results of such work, are found in the *Annals of the Harvard Observatory*, especially vols. xiv. and xxiv., and in the *Publicationen* of the Potsdam observatory, vol. ix., 1894. For details concerning the spectra of the stars, see Scheiner, *Spectrum Analysis*, translated by E. B. Frost (Boston, 1894). A catalogue of the variable stars, by Chandler, is found in *Gould's Astronomical Journal*, vol. xiii. Among star maps are Proctor's and Cottam's, published in England, and Heis's, in Germany. S. NEWCOMB.

**Starstone**: a variety of sapphire, the *asteria* of Pliny and the ancients, found in Ceylon. It presents, when cut *en cabochon*, or in a hemispherical form, and viewed in a direction perpendicular to the axis, a peculiar reflection of light in the form of a star.

**Starvation**, or **Inanition** [*starvation* is deriv. of *starve* < M. Eng. *sterven*, die < O. Eng. *steorfan* : O. H. Germ. *sterban* > Mod. Germ. *sterben*, die; cf. Icel. *starf*, toil, labor. *Inanition* is from Lat. *inani'tio*, emptiness, deriv. of *inani're*, to empty, deriv. of *ina'nis*, empty]: the condition of tissue-waste, exhausted vitality, and death resulting from prolonged privation of food. A slower starvation ensues when food is scanty and impure, or is persistently deficient in one or more of the several constituents essential to the mixed diet of man. Animals have been fed experimentally on single classes of food—one upon albuminoid matter, another partaking of only farinaceous substances, a third only of the hydrocarbons or fats. Such exclusive diet, of whichever kind, proved disastrous; emaciation, enfeeblement, and death by starvation ensued. The phenomena of starvation, complete and partial, have often been studied and recorded by the shipwrecked, by persons immured in mines, soldiers deprived of supplies, Arctic explorers, as also in the case of the insane and others practicing voluntary starvation. Prolonged abstinence necessitates bodily waste; hence the reported cases of prolonged subsistence without food, usually women apparently in a state of trance or catalepsy, are not to be accredited; carefully investigated, they invariably prove to be artful deceptions by hysterical or demented persons. Rigid exclusion of food and drink causes death, on an average, in from five to eight days. Water, freely supplied, with exclusion of solid food, may prolong life two or three weeks, exceptionally longer. Water constitutes over half the weight and bulk of the body; it is the solvent for all nutritive matter entering the body, and all azotized products which are to be excreted. Even solid food, so called, is in part water. If desiccated food alone be supplied, with no drink, death will result in a few days. Starvation at the outset produces urgent hunger; this may gradually lessen, be replaced by faintness, loss of appetite, and even loathing of food. The strength fails, the body wastes, the mind becomes enfeebled; in some cases there is listlessness and stupor, in others marked nervous excitement and delirium—phenomena excited by non-excreted effete matter accumulated in the blood. The starving person is liable to intercurrent disease, and the community suffering privation is often visited by epidemics of contagious and infectious diseases, which assume an unusually malignant and fatal type, consequent upon the nervous depression and vitiated blood of the persons attacked. Starving persons, when rescued, should not be supplied too suddenly or freely with food; the enervated digestive apparatus can retain and assimilate but small quantities at a time, an excess exciting irritation and dangerous and fatal diarrhœa. Certain diseased conditions may cause starvation; such are stricture and cancer of the œsophagus and upper orifice of the stomach, gastric ulcer, atrophy of the peptic and intestinal glands, and tubercle of the intestine. Revised by W. PEPPER.

**Stass'furt**: town and railway junction; in province of Saxony, Prussia; on the Bode; 20 miles S. S. W. of Magdeburg (see map of German Empire, ref. 4–F). It is noted for the immense layer of rock-salt in its vicinity, which was discovered in 1837 at a depth of 826 feet and with a thickness of about 1,000 feet. A shaft was finally opened in 1852 and steam-engines used to operate the mine. The total production in 1887 was 201,962 tons of rock-salt and 1,294,081 tons of other salts. An extensive chemical industry has been built up. Pop. (1895) 18,981.

**State** [M. Eng. *stat*, from O. Fr. *estat* < Fr. *état* : Ital. *stato* < Lat. *sta'tus*, a standing, position, condition, status, rank, public condition, the commonwealth]: in its present sense, a body politic; a self-governing community organized under permanent law which has for its aim justice and the security of all. It is the best term for denoting communities on their political side whatever their form of government be. The term *nation* implies common origin and language, and so Cicero spoke of the *Greek nation*, although the Greeks never formed a state, nor even a confederation, embracing all who spoke the Greek tongue; and, on the other hand, the kingdom of the Netherlands, such as it was before the disruption in 1830, consisted of inhabitants speaking three languages—Dutch, Flemish, and French—with various earlier institutions and political connections. This was in no sense a nation, but was a state. So Austria at present is not a nation, but is a state where three nationalities at least—a German, a Hungarian, and a Slavonic, to say nothing of Polish and Roumanian and other subjects—are bound together under the same political institutions.

The political senses which the word state and others from the same source took on were more than one. Thus the estates of the later feudal kingdoms were the three or four groups holding the property and represented in the assemblies called the assemblies of the estates. These were the clergy, nobles, burghers, and, in a few countries, the peasants. In the Dutch republic much later each province held a meeting of its estates, and the general meeting of the provinces was called the States-General, where all were represented. The abstract sense of an organized body politic also came into the word. When the North American colonies called themselves free and independent states this sense was adopted, and this sense remained in the term *United States*, which was attached to the new federal republic for want of a better. The reasoning from this term and from sovereignty as to what the rights of the States and of the Union are under the Constitution, instead of discovering from their attributions and powers what they are, has been a source of much confusion and error. Political science, however, is not responsible for this confusion. It knows of independent and of dependent states, of states formed out of states and of simple states, of states under the most varied and dissimilar forms. From the word state, then, we can argue nothing positively of the attributes of that which is so called. The most that can be said is that a state entirely independent and self-governing in order to carry out the ends of its existence ought to have such and such powers. See also SOVEREIGNTY and INTERNATIONAL LAW.

Revised by T. S. WOOLSEY.

**State, Department of**: the name of an executive department in the U. S. Government, having charge of the relations of that Government with foreign powers. Its head is the Secretary of State, who ranks as the first of the cabinet officers, and is aided in the administration of his office by an assistant secretary, and second and third assistant secretaries. The Secretary not only is charged, under the direction of the President, with all negotiations relating to foreign affairs, but is the medium of correspondence between the President and the executive of the several States, is custodian of the great seal of the U. S., and publishes the laws and resolutions of Congress, proclamations admitting new States into the Union, and amendments to the constitutions. He is further required to issue annual reports to Congress containing information received from members of the consular and diplomatic service.

**Staten Island** [named by the Dutch in honor of the States-(Dutch *Staten*) General]: largest island in New York harbor; formerly Richmond co., N. Y., now the Borough of Richmond, New York city (see map of New York, 8–A). It has an extreme length of 13 miles, extreme width of 8 miles, and area of 58½ sq. miles, and is bounded on the N. by the Kill von Kull, E. by New York harbor, New York Bay, and the Narrows, S. S. E. by Raritan Bay and the lower bay of New York, and W. by Staten Island Sound. On Jan. 1, 1898, it was annexed to the city of New York as the Borough of Richmond, and the five towns into which it was formerly divided became wards instead. Staten Island is connected with Manhattan by steam-ferry from St. George, with Perth Amboy, N. J., by ferry from Tottenville, and with Elizabeth, N. J., by a railway bridge across the Arthur Kill. The island is very hilly, but has lines of railway extending from St. George to Tottenville and from South Beach to Erastina. A mile S. E. of Clifton is Fort Wadsworth with a long line of water-batteries, on the north shore is the Sailors' Snug Harbor, and between St. George and Tompkinsville is a U. S. lighthouse station. The island contains many churches, public and private schools, libraries, newspapers, and manufacturing establishments, has excellent drives, and is a place of residence of many New York business men. Pop. (1880) 38,991; (1890) 51,693 (Castleton, 16,423; Middletown, 10,557; Northfield, 9,811; Southfield, 6,644; Westfield, 8,258); (1900) 67,021.

**State Rights**: See SOVEREIGNTY.

**State's Evidence**, or (in Great Britain) **King's** or **Queen's Evidence**: a phrase popularly used to describe the evidence of an accomplice, generally given under an arrangement made with the officer representing the state (in Great Britain the crown) that the witness so testifying shall not himself be prosecuted for the crime of which he confesses himself to be guilty while he is disclosing the guilt of the party on trial. It is often necessary, in order that the ends of justice may not be defeated, that one of several criminals, whether indicted jointly with the others or indicted separately, or perhaps not indicted at all, should be procured or suffered by the prosecution to become a witness for the state and to testify on the trial of his fellows, although his evidence may show himself to be guilty of the same offense or of some other offense. When this is done there is generally a tacit understanding or an express agreement with the prosecuting officer that the person whose disclosures are thus used on behalf of the public shall not be brought to trial and conviction. When and with whom such an arrangement shall be made rests on the sound discretion of the officer who represents the people, or, if suit has already been instituted, of the court, and largely depends upon the exigencies of each particular case. The evidence given under such circumstances is of course very suspicious, and it has even been said that as a matter of law no conviction can be had upon the uncorroborated testimony of an accomplice. The better doctrine, however, is, that this is a rule not of the law, but of practice and of expediency. A jury has the power to convict upon such evidence, and their verdict could not be set aside as illegal. The judge should always instruct the jury that the testimony of an accomplice is to be most carefully scrutinized, and that, unless confirmed in material points by other and reliable evidence, a conviction upon it is inexpedient—that the corroboration should extend not merely to the circumstances of the crime itself, but also to the participation therein by the accused who is on trial. Still, such instructions are rather in the nature of advice than of direction or command, and they may therefore be disregarded.

Revised by F. STURGES ALLEN.

**States-General**: an assembly composed of representatives of the nation. In France it consisted of representatives of the three orders of the kingdom—the nobility, the clergy, and the third estate, or the *bourgeoisie*. Its origin seems to date back to the time of Charlemagne. The first convocation of which history gives an elaborate and authentic report is that of Blois, 1302, by which Philippe le Bel tried to give a greater weight to the course he had adopted in his quarrel with Pope Boniface VIII. The most memorable convocation was that of 1789, which ushered in the Revolution. (See FRANCE, HISTORY OF.) In Holland the name States-General is applied to the legislative body of the kingdom, there distinguishing that assembly from the merely provincial states. The Dutch States-General is composed of two chambers—the upper, elected by the provincial states, and the lower, chosen by the citizens.

**States of the Church**: See PAPAL STATES.

**Statesville**: city; capital of Iredell co., N. C.; on the Southern Railway; 25 miles W. by N. of Salisbury, 45 miles N. of Charlotte (for location, see map of North Carolina, ref. 3–E). It is in a stock-raising, a corundum-mining, and a cotton, tobacco, and grain growing region, and contains a U. S. Government building, 7 churches, academy for boys, several public and private schools, manufactories of cotton and tobacco, a national bank with capital of $50,000, and 2 weekly newspapers. Pop. (1880) 1,062; (1890) 2,318; (1900) 3,141.

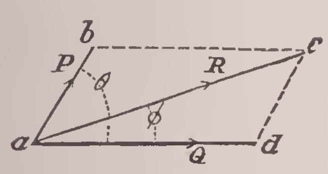
EDITOR OF "LANDMARK."

**Statice**: a genus of plants to which the MARSH ROSEMARY (*q. v.*) belongs.

**Statics** [plur. of *static*, from Gr. στατική (sc. τέχνη, art), the art of weighing, liter., fem. of στατικός, causing to stand, skilled in weighing, deriv. of ἱστάναι, cause to stand]: that branch of mechanics which treats of the properties and relations of forces in equilibrium. By equilibrium is meant that the forces are in perfect balance, so that the body upon which they act is in a state of rest. According to the classification presented in some text-books on the subject, and, in fact, usually employed by engineers, the word statics is used in opposition to dynamics, the former being the science of equilibrium or rest, the latter of motion, and both together constituting mechanics. Other books regard statics as a subdivision of dynamics. See DYNAMICS.

In statics, forces are measured by the pressures that they will produce, and for convenience the unit of pressure is a certain effect of the force of gravitation as indicated by a spring-balance (not by a steelyard or scales) acted upon at some assigned place by a definite quantity of matter. Thus the unit may be the pressure called an ounce, a pound, or a kilogramme, as may be agreed upon beforehand. In the discussions of statics it is convenient to represent forces by lines, the lengths of the lines being proportional to the intensities of the forces, their directions parallel to the directions of the forces, and their ends denoting the points of application of the forces; reasoning upon the properties of the lines then leads to the properties and relations of the forces themselves.

The resultant of two or more forces is a single force which produces the same effect as the several forces acting together. The components of a single force are forces whose united action produces the same effect as the single one. The process of combining forces into a resultant is called composition, and that of separating a single force into components is called resolution. These processes are effected by means of the principle of the parallelogram of forces, which is thus stated: If two forces $P$ and $Q$ acting upon the material point $a$ are represented in intensity and direction by the lines $a\ b$ and $a\ d$, their resultant $R$ will be represented in intensity and direction by the diagonal $a\ c$ of the parallelogram $a\ b\ c\ d$ constructed upon the two given sides. Since the relations between the forces $P$, $Q$, and $R$ are the same as between the corresponding lines in the parallelogram, the two following equations result:




$$R^2 = P^2 + Q^2 + 2PQ \cos \theta, \text{and } \cos \phi = \frac{R^2 + Q^2 - P^2}{2RQ}.$$

The first determines the intensity of $R$ when $P$, $Q$, and the angle $\theta$ are given, and the second determines the direction of $R$, or the angle $\phi$ which it makes with the given force $Q$. These two equations contain five quantities, and hence, if three of them are given, the other two may be found. The two forces $P$ and $Q$, acting at a given angle $\theta$, may thus be compounded into their resultant, and the single force $R$ may be resolved into any two components whose directions are given. If the resultant $R$ act as represented in the figure from $a$ toward $c$, it will replace the two forces $P$ and $Q$; if it be taken as acting from $c$ toward $a$ it will hold them in equilibrium.

Another fundamental law of the greatest importance is the principle of moments. (See MOMENT.) This teaches that if several forces acting upon a body be in equilibrium there will be no tendency to rotation in any direction, while that of the parallelogram of forces teaches that there will be no tendency to a motion of translation in any direction. Text-books on statics, after having established and illustrated these fundamental principles, proceed to the consideration of parallel forces and to the determination of centers of gravity and moments of inertia of bodies, after which the equilibrium of forces acting through the cord, lever, pulley, inclined plane, and screw, of which all machines are compounded, is discussed, both in its simplest theoretic conception and as modified by the forces of friction and cohesion. The laws of the equilibrium of gases and of liquids (hydrostatics), with their applications to the barometer, pump, and hydrostatic press, are then developed and illustrated. The treatment of these questions in the elementary text-books exhibits, however, only the first principles, and forms merely the introduction to the science, whose complete development in its several departments must be sought for in special and technical treatises. Among these, where experiment lends its aid to theory by determining the necessary constants for the full discussion and application of the laws of friction, elasticity, and tension, may be mentioned the theory of the equilibrium of arches and bridges, the theory of the flexure of elastic bodies, the theory of the strength of materials subject to forces of tension, compression, shearing, or torsion, the theory of the tension of fluids, and the statics of molecules.

The forces which come under consideration in statical investigations are all the forces of nature which can be measured by pressures. As to their origin, they may be forces of gravitation, of molecular attraction and repulsion, of friction, or of muscular strength. If the equilibrium of a system of forces is disturbed, motion ensues, and statics passes into kinetics. The very disturbance of equilibrium, however, calls into action the resistance of inertia, and by the consideration of this resistance as a force the laws of statics become applicable, even though the body be not at rest. For by the principle of d'Alembert (which is nothing more than a particular case of Newton's third law of motion) the resistance of the inertia of a body at any instant of its motion is equal and opposite to the resultant of all the exterior forces acting upon it. Hence, regarding inertia as a force, all the forces acting upon a moving body at any instant are in equilibrium, and the principles of statics suffice for their discussion. It thus appears that statics is but a special case of kinetics, and that the law of d'Alembert furnishes the means of passing from one to the other.

HISTORY AND LITERATURE.—The first recorded principle of statics is that of the equilibrium of weights on a lever, which is a special case of the principle of moments. This was discovered by Archimedes (B. C. 287–212), as also its application to the determination of the centers of gravity of plane figures; in his writings also appear the first investigations concerning the equilibrium of bodies floating or immersed in liquids. For 1800 years after his time there was no further advance. The next step was made by Stevinus (1548–1603), who represented the intensity and direction of forces by straight lines, deduced the principle of the resolution of forces in rectangular directions, and investigated the equilibrium of a body resting upon an inclined plane. Next followed the principle of the parallelogram of forces, which, partially implied by the methods of Stevinus, was only completely established by the labors of Galileo (1564–1642), Varignon (1654–1722), and Newton (1642–1727). To Varignon is also due the development of the simpler properties of the force and equilibrium polygons. About the same time the statics of fluids began to receive attention, the first true explanation of their equilibrium being due to Torricelli (1608–47), the inventor of the barometer. The application of these principles has since those days occupied the attention of a host of writers, and the science has grown to a vast extent. The new branch of graphic statics may be said to have been entirely developed since 1866, when Culmann's work appeared. For detailed information concerning the early history of the subject, see the section on mechanics in Whewell's *History of the Inductive Sciences* (London, 1847; New York, 1859). See COMPOSITION OF FORCES, DYNAMICS, FORCE, GRAPHIC STATICS, HYDROSTATICS, MECHANICS, MOMENT, and STRESSES. MANSFIELD MERRIMAN.

**Stations of the Cross**: a series of figures or pictures, usually fourteen in number, representing the various stages of the *Via Dolorosa*, or our Lord's Passion on the way to Calvary. They are generally found in every Roman Catholic church. In Roman Catholic countries they are often erected by the wayside, in cemeteries, on prominent sites, etc. J. J. K.

**Statis'tics** [plur. of *statistic*, liter., pertaining to a statist or to matters of state]: in its simplest meaning, a description of any class of facts expressed by means of figures. The credit of having founded a science of statistics is usually given to Prof. Achenwall (1712–72), of the University of Göttingen. According to him the total of *Staatsmerkwürdigkeiten* (the remarkable things pertaining to the state) makes up the constitution of a state in its broadest sense, and "an account of such constitutions of one or more states is statistics." In the development of statistics since Achenwall there seems to have been two stages, or, as Maurice Block prefers to express it, a twofold tendency. The one confines itself to descriptive statistics, that is to say, to a picture of society or of the state, or of any phase of human activity, drawn in figures, and in this manner reduced to measurements. The chief merit of this phase of statistics lies in the fact that it permits a study of conditions by means of comparison. The other tendency in the development of statistics goes a step further than description, and by submitting any class of facts at different times to systematic observation reduces change itself to numerical measurement, and in this way seeks to prove relationships and to discover laws of growth.

*Historical Sketch.*—(a) *Statistics as a Branch of Government Service.*—The collection of facts pertaining to a state was undertaken long before scientific statistics were thought of. The book of Numbers is in fact a statistical report. There is record of statistical work in China in 2300 B. C. In Greece and Rome also there was considerable activity in systematic collections of data pertaining to national life. In 594 B. C. a census was taken in Greece for the purpose of levying taxes which divided the people into four classes according to wealth. Athens took a census of population in 309 B. C. The constitution of Servius Tullius, 550 B. C., distinguished six property classes. These are all instances of work which in modern times would be called statistical. Also there is evidence that in the Middle Ages there was national enumeration of population or of property. The work, however, was suggested by some practical necessity,

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as, for example, the *Domesday Book* of William I., 1088 A. D., or the *Land Register* of Waldemar II., 1231 A. D. In the fifteenth century evidently there was an unusual interest in systematic investigations into the conditions of the various countries of Europe. A second revival of interest in statistical work took place in the latter part of the eighteenth century, due to the new measures, the new hopes, and the new ideas which came in with the French Revolution. In France the need of definite information was formally recognized, and a commission established to collect data for reforms in administration and finance. This finally led to the establishment of statistical bureaus in France, as also in all other countries which felt the influence of modern political life. The need of statistical investigation is one which increases as the spirit of popular government becomes more intense, or the means of realizing popular government more perfect.

(*b*) *Statistics as a Branch of Knowledge.*—When statistics was first recognized as an independent study, the claims made for it were very broad and comprehensive. The course of lectures in which Achenwall founded this branch of investigation placed before itself this purpose, "To gain political wisdom by means of a knowledge of the various states." His plan contemplated a comparative study of all modern states under seven distinct heads: Literature, geography, physiography and fertility, the number and character of inhabitants, the rights of the several classes, the organization of the state, and a consideration of the needs of the state. The work of Achenwall exerted a great influence throughout Europe. The name of Süssmilch (1707–67) must also be mentioned, since his work was the first which conclusively proved the existence of a rigid law in the matter of births and deaths. Annuities and life-insurance, which presupposed such a law, existed indeed in the Middle Ages, but they were not regarded as a business which could be conducted on a scientific basis. The view taken by Süssmilch was carried further by the well-known Belgian writer, Quetelet (1796–1874), whose work entitled *Sur l'homme et le développement de ses facultés ou essai de physique sociale* declares that the constant averages in moral statistics are a proof that the actions of mankind are regulated by laws. The field of statistics as it was first defined was curtailed by the rise of independent sciences in the latter part of the eighteenth century. The development of political economy at the hands of Adam Smith took from statistics one phase of its investigation. The development of public and administrative law and of practical life-insurance deprived it of other lines of investigation. Thus the scope of statistics as originally held has been very materially narrowed.

*Is there a Science of Statistics?*—The phrase "science of statistics" has been loosely used to convey a number of indefinite ideas. Its claim to be a science usually rests on the observation of uniformity in those domains of human activity which are commonly regarded as subject to the control of the individual. For example, one would suppose that suicides, being wholly under the direction of the individual will, would show no rule of recurrence, but a study of the statistics of suicides shows that nothing is more constant in its recurrence than the cause for which, the time in which, and the manner by which suicides are committed. The same is true in any domain of human activity, so much so indeed that by the use of statistics one is able to predict with a very great degree of assurance what is likely to happen. This fact, however, does not seem to make good the claim that statistics may be regarded as an independent science, but indicates rather the possibility of scientific treatment of all social and moral questions. From this point of view statistics comes to be a method of investigation. It is not an independent science, but a branch of the science of logic. Were the existence of a science of statistics admitted, it would necessarily be a science that would include investigations into every department of political, social, and industrial life, since all of these may be studied by the statistical method. Accepting then statistics as a science of method, it may be regarded as consisting in a systematic observation and classification of facts.

*Methods of Comparison in Statistics.*—The chief use of statistical investigation, in addition to the discovery of laws of constant recurrence, is the discovery of laws of change. It is the peculiar office of statistics to discern the direction of progress and to measure both the actual and the relative strength of the forces which impel it, and this it does by providing the means of accurate comparison between conditions of society and phases of human activity at various times. This, however, is no light task. The difficulty in carrying it through arises from the fact that the mass of data necessary for accurate description is likely to be so great that the mind can not grasp it. The student who avails himself of statistics as a means of reasoning is, on this account, obliged to reduce the mass of information presented to him in the form of tables of figures to some simple equivalent for the purpose of comparison, or, if the data comprises incongruous factors, they must be reduced to some common denominator. There are several methods by which this may be accomplished, and the trustworthiness of the conclusions arrived at depends in very large measure upon the intelligence with which these methods are followed. Three of these methods may be noted: First, statistics may make use of percentages as a basis of comparison either for the purpose of measuring the relative importance of similar factors, which, taken in the aggregate, comprise a total, or for the purpose of measuring the progress or regress of specific lines of facts during a definite period of time. The chief error to which the use of percentages as a basis of comparison is liable arises from the failure to observe the basal numbers upon which percentages are computed. For example, an increase of 10 miles in railway mileage in a district which had but 10 miles to start with would show a higher percentage of increase than an increase of 1,000 miles in a district which had 10,000 miles of line at the outset. One who reasons by means of percentages must hold constantly in mind that he is dealing with ratios and not with absolute facts. A second method of bringing large masses of facts into usable shape is by means of "index figures." All investigations must of course begin at some definite period of time, and all the facts subjected to observation are arbitrarily reduced to some common basis. The subsequent changes for each line of facts are then set down in their relation to this assumed basis, and the divergence which in this manner is brought to light shows clearly the relative movements. For the purpose of illustration let it be assumed that one desires to investigate the changes in the prices of various commodities. The price of all articles considered will be set down, let us say, as 100; subsequent variations from what may be termed the original price are noted with relation to this figure, and the divergence of quotations from the assumed index figure shows the changes in price of any particular commodity as compared with other commodities. The general movement also in the price of commodities as compared with the index figure indicates the trend of general prices. Thus the index figure serves for the statistician a purpose similar to that which the "bench mark" serves for the civil engineer. Third, the most common basis of comparison is by means of averages. The idea of an average is to obtain a typical unit. A typical unit may be accepted as the representative of the mass of facts from which it is deduced, and as such can be used as a basis of comparison. There is great danger, however, in reasoning upon a basis of averages. This is not because the theory of averages is incorrect, but is due to the difficulty of obtaining an average which is really typical in character. Two rules must be observed in arriving at a true average. In the first place, a sufficiently large number of individual facts must be collected to nullify the influence of any unusual or abnormal cases. In the second place, individual facts should be allowed to influence the average in proportion to their relative importance. For example, wheat is relatively of more vital importance to the people than silks, and any investigation which holds in view the effect of changes in prices upon the wellbeing of a community must lay greater stress on variations in the price of wheat than in that of silks. Again, it will not do in determining the average of wages to rely upon the daily rate of wages reported as paid, but the number of days in the year for which the workmen receive the stated wages must also be taken into account. As in the case of percentages, it is necessary that averages should be used in an intelligent manner, and with a clear appreciation of what they mean and how they are obtained.

*Use of Statistics.*—The most familiar use made of statistics is to portray existing social conditions and to measure the strength of existing social forces. A statistical inquiry has been aptly termed an instantaneous photograph expressed in figures. They are of immense importance to the statesman in gaining a knowledge of the exact condition of the country, and if several statistical investigations, taken at different times, be subjected to comparative scrutiny and studied in the light of current history, the knowledge thus gained should guarantee society against pernicious legislation. This is the original idea of statistics, and it is perhaps at present the most significant. The economist and the student of philosophy also derive great assistance from statistical investigations in that they throw light upon the character of nations and the character of individuals, without which no trustworthy conclusions may be arrived at. At present, however, there is another and a more practical use which statistics are in some degree coming to serve. The tendency toward combination of industries and concentration of capital is very marked. The trust and various forms of combinations among corporations seem to have become a permanent form of industrial organization. This tendency has brought society face to face with the monopoly problem, and the question frequently presents itself, How will society be able to control this great aggregation of capital and at the same time maintain the conditions of individual liberty? Without attempting a discussion of this question, it is suggested that the more clearly the organic character of society is recognized the more complete will be the reliance placed upon the principle of publicity as a principle of control. Wherever the principle of publicity is realized, however, there statistics must become of relatively more and more importance. The final use of statistics, then, as here suggested, is that they may serve as the medium for realizing the conservative influence which lies in the principle of publicity. The revival of interest in statistics since 1870 can only be explained by a recognition of their great importance from the point of view of administrative control.

*Branches of Statistical Inquiry.*—There is no limit, so far as theory is concerned, to the possible development of statistical investigation, nor is there any universally accepted classification. The classification here submitted is the one adopted by Haushofer, professor in the School of Technology at Munich, and gives four heads: Population statistics, industrial statistics, statistics of social and political life, and moral statistics. Under population statistics are included an extensive class of facts. Thus in addition to the actual count there is included a classification of population by territorial groups for the purpose of discovering the density of population. Changes in population are also included, thus bringing into notice all questions of birth-rate and death-rate (see VITAL STATISTICS) and immigration. The facts pertaining to the physical life of the people are also included under population statistics, as, for example, expectation of life at various ages (see LIFE-INSURANCE), classification on a basis of age, and other like facts. Under industrial statistics are included all facts pertaining to the production, the exchange, the distribution, and the consumption of wealth, as also to the means or instruments by which the industrial process is carried on. Statistics of wages, capital, railways, money, prices, and the like are all included under the head of industrial statistics. The statistics of social and political life include that large range of facts descriptive of the manner in which people live and of the governments under which they live. Under the head of moral statistics are included all facts which indicate the character and habits of the people. Here are to be found the statistics of education, of religion, of crime, of marriage, of the dependent classes, and others of like character.

*Official Statistics in the U. S.*—It is not possible to give a complete list of the bureaus of investigation for which the State and Federal governments have made provision in the U. S., but a few of the more important may be mentioned. In the Federal Constitution it is provided that a census shall be taken once in ten years, and many of the States also require that a State census shall be taken at certain intervals. In 1870 the scope of the Federal census was greatly extended until at present it may be regarded as a statistical bureau in the widest sense of that term. (See CENSUS.) The Agricultural Department has a bureau of statistics which aims to collect all facts of interest to the growers and consumers of farm products. The Treasury Department, in addition to financial statistics, maintains a bureau of statistics which makes regular reports on the imports and exports of the U. S. The comptroller of the currency makes annual reports upon the condition of banking, and the director of the mint upon coinage and the production of the precious metals. The commissioner of education publishes a yearly report on education in the U. S., showing the number of schools, colleges, and universities in the republic, the number of pupils attending each grade of school, the number of teachers, their compensation, and other similar facts. There is also a department of labor established by Congress for the purpose of collecting statistics of especial interest to the working classes. The interstate commerce commission also provides for an annual publication of the statistics of railways. In addition to these provisions for the collection and compilation of statistics, Congress frequently authorizes special investigations into special topics. The public documents of the Federal Government are rich in statistical material, while many of the States maintain efficient bureaus for the collection of facts of local interest.

LITERATURE.—The following are some of the important statistical works: *Lehr- und Handbuch der Statistik*, by Dr. Max Haushofer; *Traité Théorique et Pratique de Statistique*, by Maurice Block; *The History, Theory, and Technique of Statistics*, by August Meitzen, translation into English by Roland Falkner; *Die Moralstatistik*, by Alexander von Oettingen; *Journal of the London Statistical Society*; publications of the American Statistical Association; *Bulletin de l'Institut International de Statistique.*

HENRY C. ADAMS.

**Sta'tius**, CÆCILIUS: See CÆCILIUS STATIUS.

**Statius**, PUBLIUS PAPINIUS: author; b. about 45 A. D. in Naples; seems to have acquired early and rapidly a great fame by his victories in the Alban poetical contests, and then to have lost it again as rapidly after his defeat in the quinquennial contest instituted by Domitian, but very little is known of his personal life. He lived at one time in Rome and enjoyed the favor of Domitian, but died about 96 A. D., in retirement at Naples. Juvenal is the only contemporary author who mentions him. For the story that Domitian stabbed him in a fit of anger there is no foundation. Of his works are still extant *Silvarum Libri V.*, a collection of miscellaneous poems; *Thebaidos Libri XII.*, translated into English, the first book by Pope, the first five books by Thomas Stephens (1648), the whole poem by W. L. Lewis (1767); *Achilleidos Libri II.*, unfinished, translated into English by Howard (1660); best editions by Amar and Lemaire (4 vols., Paris, 1825–30); *Thebaidos Libri I.–VI.*, by O. Müller (Leipzig, 1870); *Silvæ*, by Bährens (Leipzig, 1876); and *Achilleis und Thebais*, by Kohlmann (Leipzig, 1879–84).

Revised by M. WARREN.

**Statoblast**: one of the peculiar thick-walled buds occurring in fresh-water sponges and polyzoans, which serve to carry the species over periods of drought or of freezing weather.

**Statuary**: See SCULPTURE.

**Sta'tus**: a term of the Roman law, borrowed thence by the jurisprudence of continental Europe, denoting the legal condition of a person, or the sum of his capacities and incapacities to hold legal rights or to be subjected to legal duties. The word does not belong to the technical nomenclature of the American and English law, although it is used by some modern text-writers in the same general sense in which it was employed by the Roman jurists. In the Roman law there were three grades of status or legal condition, the lower and more general of which might exist without the others, while the higher and more special always presupposed the lesser. The first and most general was that of liberty (*status libertatis*), by virtue of which a person was either a freeman (*liber*) or a slave (*servus*). The second was that of citizenship (*status civitatis*), by virtue of which a person was either a citizen (*civis*) or a stranger (*peregrinus*). The highest was that of the family (*status familiæ*), by virtue of which a person might be the head of a household (*paterfamilias*) and his own master (*sui juris*), or under the control of another (*alieni juris*), as a son, daughter, wife, ward, and the like. An individual might be a freeman without being a citizen or the head of a household, but he could not be the head of a household without being at the same time a freeman and a citizen. It was possible that a person might lose a higher status, and yet remain in a lower condition; he might cease to be *sui juris*, and still be a citizen; he might forfeit his citizenship, and yet remain free; finally, in the earlier periods of Roman history at least, he might sink from freedom into slavery. Although there is not in U. S. law the technical term *status*, it is plain that to a certain extent the facts denoted by it are present. It is true that at birth a person becomes clothed with the great mass of rights conferred by the law of the U. S., but he may be subjected to certain special capacities or incapacities depending upon the existence of particular circumstances. Among these incapacities are those resulting from infancy, lunacy, marriage in case of the wife, conviction or imprisonment for crime, public pauperism, and the like. Among the special capacities the most important are those pertaining to citizenship and to the electoral franchise. In the U. S. the differences of legal condition or status belonging to class, rank, profession, or trade have no existence, for every person—at least every sane person—is clothed with the same capacity in respect to these subjects. See LIBERTY, CITIZEN, and MARRIAGE. Revised by F. M. BURDICK.

**Statute of Frauds**: See FRAUDS, STATUTE OF.

**Statutes** [viâ O. Fr. from Late Lat. *statu'tum*, liter., something established, neut. perf. partic. of *statu'ere*, *statutum*, set up, establish, deriv. of *sta'tus*, condition, status]: laws in a written form enacted by the supreme legislative authority of a nation or commonwealth, as contradistinguished from laws established by judicial decision. In its generic sense the term includes all legislative as opposed to judicial creations of the law, whatever be the nature and organization of the body—persons or person—which exercises the creative function.

*Their Sources.*—The sources from which statutes have emanated or may emanate, according to the varying political constitutions of different states, are the general or partial assemblies of the citizens, the emperors, kings, or other single heads of despotic governments, and the representative assemblies, either hereditary or elective. The *leges* and *plebiscita* of the Roman citizens during the republic were produced by the first class of legislators; the "constitutions" of the Roman emperors by the second; while the parliaments of Great Britain and of many other European nations, the U. S. Congress, and the State Legislatures are the modern forms of the third. The extent of the powers held by these bodies is determined by the organic law of each country. The British Parliament is said to be omnipotent; which simply means that the restrictions under which it ordinarily acts are self-imposed. In the U. S. the most remarkable feature of the political organization is the express, positive, and extensive limitation of the legislative function contained in all the written constitutions, which are themselves fundamental statutes adopted by the people in their sovereign capacity. With every new revision of the State constitutions this limitation in reference to the forms and modes of legislation, as well as its subject-matter, is made more far-reaching, minute, and prohibitory.

*Their Kinds.*—Statutes are variously classified, according to their external form and according to their subject-matter and effects. See LAW and JURISPRUDENCE.

*Their Parts.*—Statutes in Great Britain and the U. S. may, and sometimes do, comprise the following distinct parts: the title, the beginning or enacting clause, the preamble, and the purview. The *title* is a brief preliminary description, e. g. "An act for the amendment of the law." It has become of great importance in the law of the U. S., since most of the State constitutions prescribe in substance that every statute shall contain but one subject, and that this shall be properly expressed in the title. By the *commencement* is meant the formal enacting clause—namely, "Be it enacted by the Senate and House of Representatives of the U. S. of America, in Congress assembled," and "Be it enacted by the queen's most excellent majesty, by and with the advice and consent of the Lords spiritual and temporal and Commons in this present Parliament assembled, and by the authority of the same." The *preamble* is a preface setting forth the reasons and motives for the act. Once very common, it is now generally omitted. The *purview* is the main body, the effective portion of the statute, which contains a statement of the legislative will, and declares its object and purpose. Among the special clauses or subdivisions which may be found in it are the interpretation clause, the saving clause, the repealing clause, the provisoes, the exceptions, and the schedules, the objects of which are sufficiently indicated by their names. In codes, whether complete or partial, a more orderly and scientific arrangement of parts is always made, and a division, according to some general plan, into books, titles, chapters, sections, and the like is universal.

*When Operative.*—The time when statutes take effect is fixed in most of the States of the U. S. either by a constitutional provision or by a general law. In some they become operative at the expiration of a specified number of days after the close of the session, in others at a specified period after the day of their passage; but the Legislature may in the body of a statute prescribe a different time, as, for example, that it shall take effect immediately. The common law made an act operative from the first day of the session at which it was passed, but this absurd doctrine was abolished in the thirty-third year of George III., and all laws were declared to be binding from the time when they received the royal assent. The repeal of a statute may be either express or by implication. It is express when effected by a clause inserted for that specific purpose in a subsequent act; it is by implication when the provisions of a later enactment are wholly and irreconcilably inconsistent with those contained in an earlier one. Repeal by implication is not favored. If the two statutes concerning the same subject-matter can possibly be harmonized, both will stand; if the contradiction is absolute, the prior one gives way. For a treatment of other topics connected with the general theory of statutes, see INTERPRETATION, CONSTITUTION, CODE, LAW, and LAW-MAKING, METHODS OF.

Revised by F. STURGES ALLEN.

**Statutes of Limitation**: See LIMITATION OF ACTIONS.

**Stäudlin**, stoid-leen', KARL FRIEDRICH: author; b. at Stuttgart, July 25, 1761; studied theology at Tübingen 1779–84; traveled in Switzerland, France, and England, and was appointed in 1790 Professor of Theology at Göttingen, where he died July 5, 1826. His numerous writings relate mostly to Church history, such as *Universalgeschichte der christlichen Kirche* (Göttingen, 1806; 5th ed. 1833); *Kirchliche Geographie und Statistik* (2 vols., 1804); *Allgemeine Kirchengeschichte von Grossbritannien* (2 vols., 1819); or to the history of special theological disciplines, such as *Geschichte der Sittenlehre Jesu* (4 vols., 1799–1822); *Geschichte der christlichen Moral seit dem Wiederaufleben der Wissenschaften* (1808); *Geschichte der Moralphilosophie* (1822), etc. His first work, strongly impregnated by the reigning rationalism, was *Geschichte und Geist des Skepticismus* (2 vols., 1794). His autobiography was published by J. T. Hemsen (1826). Revised by S. M. JACKSON.

**Staunton**: village; Macoupin co., Ill.; on the Chi., Peoria, and St. L. and the Wabash railways; 14 miles S. S. W. of Litchfield, 36 miles N. E. of St. Louis (for location, see map of Illinois, ref. 8–D). It is in an agricultural and coal-mining region, and contains a private bank and a weekly newspaper. Pop. (1880) 1,358; (1890) 2,209; (1900) 2,786.

**Staunton**: city (incorporated in 1749); capital of Augusta co., Va.; on the Balt. and Ohio and the Ches. and Ohio railways; 39 miles W. by N. of Charlottesville, 60 miles N. of Lynchburg (for location, see map of Virginia, ref. 5–F). It is in an agricultural region; has important manufactories; is the seat of the State Deaf, Dumb, and Blind Institution and of the Western Lunatic Asylum; and is noted for its educational institutions, which include a military academy, 4 seminaries for young ladies, and 2 business colleges. There are 2 national banks with combined capital of $300,000, a savings-bank, and a daily, a monthly, and 8 weekly newspapers. Pop. (1880) 6,664; (1890) 6,975; (1900) 7,289. EDITOR OF "NEWS."

**Staunton**, Sir GEORGE LEONARD: traveler and diplomatist; b. at Cargin, Galway, Ireland, Apr. 19, 1737; educated at Dublin and at Montpellier, France, where he graduated in medicine; returned to England 1760; wrote for London periodicals, acquiring the friendship of Dr. Johnson and other eminent men of letters; settled in 1762 as a physician in the island of Grenada in the West Indies, where he held several official positions, including that of attorney-general, for which he had qualified himself by legal study, and acquired a considerable fortune, which he invested in landed estates; formed in 1774 an intimate friendship with Lord Macartney, the new governor of the island, with whom he was sent prisoner to France on the capture of Grenada in 1779, and whom he accompanied as secretary during his governorship of Madras (1781–84) and his celebrated embassy to China (1792), of which he published in 1797 an interesting narrative. D. in London, Jan. 14, 1801. He was made a baronet 1784 in reward for his success in negotiating a treaty with Tippoo Sahib.—His son, Sir GEORGE THOMAS, b. at Milford, England, May 26, 1781, accompanied his father to China in 1792; learned the Chinese language; held important posts in China in the service of the East India Company; returned to England 1817, and was a member of Parliament, with short intervals, from 1818 to 1852. D. Aug. 10, 1859. He wrote a *Memoir* of his father (1823), an autobiography (1856), and published various works on China.

**Staunton**, HOWARD: Shakspearean scholar and chess-player; b. in England in 1810; educated at Oxford; settled in London; was the champion chess-player of his day; edited for many years *The Chess-players' Chronicle* and the chess column of *The Illustrated London News*; published several manuals of the game, including the *Handbook* (1847), the *Companion* (1849), the *Chess Tournament* (1851), and *Chess Praxis* (1860). He published an edition of Shakspeare's *Plays and Poems* (3 vols., 1857–60, and library ed., 4 vols., 1863), preceded by a *Life*, a photo-lithographic facsimile of the celebrated "first folio" of 1623 (1866); *Memorials of Shakspeare, his Will, Indentures of Conveyance, etc.*, photographed (Apr., 1864); also published *The Great Schools of England* (1865; 2d ed. 1869). He was extremely familiar with Elizabethan dramatic literature, and sometimes acted, chiefly in Shakspearean dramas. D. in London, June 22, 1874. Revised by H. A. BEERS.

**Staunton**, WILLIAM, D. D.: clergyman; b. at Chester, England, Apr. 20, 1803; removed to the U. S. in 1818; was ordained deacon in the Protestant Episcopal Church June 9, 1833, and priest Sept. 7, 1834; rector of churches at Roxbury, Mass., Morristown, N. J., Brooklyn, N. Y., and Potsdam, N. Y. He was the author of *A Dictionary of the Church* (New York, 12mo, 1844), republished, much enlarged, as *An Ecclesiastical Dictionary* (New York, 8vo, 1861); *The Book of Chants, Songs, and Prayers for the Family Altar* (1860); *The Book of Common Praise* (1866); *Voluntaries for the Organ*; and a prize *Te Deum*. D. in New York, Sept. 29, 1889.

**Staunton River**: a stream of Southern Virginia; rising in the Alleghany Mountains in Montgomery County, flowing E. and S. E. through a pass in the Blue Mountains, and uniting with the Dan at Clarksville, Mecklenburg County, to form the Roanoke. In the first 20 miles of its course it descends 1,000 feet; its entire length is about 200 miles.

**Staupitz**, stow'pits, JOHANN, von: ecclesiastic; descended from a noble family in Meissen, but his parentage and birthdate are unknown; entered the Augustinian order; became prior of its convent in Tübingen 1497, where he took D. D. 1500. Turning entirely from the barren method of the schoolmen, he found in the writings of Augustine and the mediæval mystics his spiritual models; took a very active part in the foundation of the University of Wittenberg 1502, and was appointed its first Professor of Theology; became, as vicar-general of the Augustine order in Germany (1503), acquainted with the young Luther, for whom he conceived a warm friendship, and on whom he exercised considerable influence; procured his appointment as professor in Wittenberg 1508, approved fully of his theses against the sale of indulgences, and gave him, during the first stage of his contest with the Roman Catholic Church, his valuable and effective support. Subsequently, when the controversy became too violent, and an open breach with the Church took place, he retired from Wittenberg 1512, but continued to be vicar-general until 1520. He then went to Salzburg as court-preacher to the archbishop and became abbot of a Benedictine monastery 1522. D. there of apoplexy, Dec. 28, 1524. His friendship for Luther remained unabated to his death; all the Reformer's writings were found in his library, and his own works, *De Amore Dei* and *De Fide Christiana*, show the spiritual sympathy he felt for the Reformation. Roman Catholic writers have explained the support he gave Luther as an act of jealousy because the sale of indulgences was given to the Dominican and not to the Augustine order. A new edition of his works was begun by J. K. F. Knaake (vol. i., *Deutsche Schriften*, Gotha, 1867). For his *Biography*, see works by T. Kolde (Gotha, 1879) and L. Keller (Leipzig, 1888).

**Stavang'er**: an old town of Norway; at the head of Buknefjord; about 100 miles S. of Bergen (see map of Norway and Sweden, ref. 11–A). It has a cathedral dating from the eleventh century and two harbors. It exports timber and salt herrings. Pop. (1891) 23,930.

**Stave**, or **Staff**: in music, the lines and spaces on which the notes are placed. See NOTATION.

**Stavenhagen**, BERNHARD: See the Appendix.

**Stavro'pol**: government of Russia, bordering on the Caspian Sea; area, 23,397 sq. miles. It is mostly low and flat, dotted all over with shallow lakes and covered with extensive swamps. In the southwestern part agriculture is the principal occupation; wheat, millet, wine, and mulberries are cultivated. In the northeastern part the inhabitants are nomads, and immense herds of cattle, horses, and sheep are reared. Pop. (1897) 873,863.

**Stavropol**: capital of the government of Stavropol, Russia; a fortified town with a trade in cattle, horses, sheep, skins, wool, and honey (see map of Russia, ref. 11–F). Its sulphur springs are much frequented. Pop. (1897) 41,621.

**Stchedrin**, stched-reen': pseudonym of MIKHAIL EVGRAFOVICH SALTYKOV', a satirical writer born in the government of Tver, Russia, Jan. 15, 1826. He entered the Government service in St. Petersburg in 1844, but was removed two years later to Viatka for his two first published stories. Pardoned in 1855, he continued his official career till 1863, after which he devoted himself exclusively to literature. He ranks with the greatest Russian authors of his day, and with the chief satirical ones of all time. In his numerous tales and sketches he touched on every class of society, bringing out with masterly skill their characteristics, at times with brilliant wit, at others with deep pathos, alternately scathing, sad, and amusing, full of originality as well as of the most acute observation. Unfortunately, his works demand an intimate acquaintance with Russian affairs, and, owing to the necessity of escaping the jealousy of the censors, often have to convey their meaning by allusions almost impossible for a foreigner to grasp. Of the many volumes of his works, among the best known are the *Satiry v Proze* (Satires in Prose) and *Nevinnye Raskazy* (Innocent Tales, both in 1863); *Dvevnik Provintsiala* (Diary of a Provincial), *Tashkentsy* (The People of Tashkend), *Blagonamerennyia Rechi* (Well-meant Speeches, 1876), etc. Two or three of his stories have been translated into English; more into French and German. D. in St. Petersburg, May 10, 1889. A. C. C.

**Stead**, WILLIAM THOMAS: journalist; b. at Embleton, Northumberland, England, July 5, 1849; son of a Congregational minister; became editor of *The Northern Echo*, a halfpenny daily, 1871; assistant editor to John Morley on *The Pall Mall Gazette* Sept., 1880; editor of that paper 1883–90; founded *The Review of Reviews* Jan., 1890. As the editor of *The Pall Mall Gazette* he introduced the system of interviewing and illustrations into the daily newspapers of Great Britain. In July, 1885, he published *The Maiden Tribute of Modern Babylon*. For some of his acts in procuring the evidence on which his statements were based he was imprisoned for three months. The Criminal Law Amendment Act of 1885 was passed in consequence of his exposures. In 1893 he established *Borderland*, a periodical devoted to Spiritualism. He has also published *No Reduction, No Rent, a Plea for the Plan of Campaign*; *Truth about Russia*; *The Pope and the New Era*; and *If Christ came to Chicago*. C. H. THURBER.

**Steam** [M. Eng. *stem* < O. Eng. *stēam*, vapor, smoke: Dutch, *stoom*: Fris. *stoame*, steam]: aqueous vapor. This substance is of great interest to students of physics and likewise, on account of its application in nearly all thermal engines, to the engineer.

The physical properties of steam, which, like those of other vapors, are less simple than those of a perfect gas, have been exhaustively studied. Some of these properties will be briefly described.

*Fluctuations of Boiling-point, Maximum Tension.*—Water is converted into steam, at all temperatures, by evaporation. Even below the freezing-point the solid aqueous materials known as ice and snow evaporate slowly unless surrounded by an atmosphere saturated with aqueous vapor.

The process by which steam is obtained for practical purposes, however, is ebullition, which begins whenever, at any temperature, the tension of the forming vapor within the mass of the liquid becomes equal to the pressure exerted upon it by the liquid itself and by the superincumbent atmosphere above the surface of the latter. Boiling depends then upon a property of steam which enables it to exert pressure, an expansive power which is a function of the temperature. This property, for which the term tension, or sometimes vapor-tension, is used, has been determined with the utmost exactitude by Regnault. His results are given in Table I., in which the vapor-tension is expressed by means of the height (in centimeters) of the column of pure mercury which the steam is capable of sustaining. This is the quantity given in the second column. It is also expressed in terms of the pressure in grammes which the steam exerts upon a square centimeter of surface (third column of the table).

If the data given in the first two columns of Table I. are plotted with temperatures as abscissas and tensions as ordinates, the result will be a graphical representation of the results obtained by Regnault. This method of presentation

TABLE I.—TENSION OF STEAM AT VARIOUS TEMPERATURES.

| Temperature. | Tension in cm. | Pressure upon 1 sq. cm. | Temperature. | Tension in cm. | Pressure upon 1 sq. cm. |
|---|---|---|---|---|---|
| | | Grammes. | | | Grammes. |
| −30° C. | 0·0386 | 0·52 | 105° C. | 90·641 | 1,232·36 |
| −25 | 0·0605 | 0·82 | 110 | 107·537 | 1,462·10 |
| −20 | 0·0927 | 1·26 | 115 | 126·941 | 1,725·90 |
| −15 | 0·1400 | 1·90 | 120 | 149·128 | 2.027·55 |
| −10 | 0·2093 | 2·85 | 125 | 174·388 | 2,370·98 |
| −5 | 0·3113 | 4·23 | 130 | 203·028 | 2,760·37 |
| 0 | 0·4600 | 6·25 | 135 | 235·373 | 3,200·13 |
| +5 | 0·6534 | 8·88 | 140 | 271·763 | 3,694 90 |
| 10 | 0·9165 | 12·46 | 145 | 312·555 | 4,249·50 |
| 15 | 1·2699 | 17·27 | 150 | 358·123 | 4,869·04 |
| 20 | 1·7391 | 23·65 | 155 | 408·856 | 5,558·81 |
| 25 | 2·3550 | 32·02 | 160 | 465·162 | 6,324·34 |
| 30 | 3·1548 | 42·89 | 165 | 527·454 | 7,171·27 |
| 35 | 4·1827 | 56·87 | 170 | 596·166 | 8,105·47 |
| 40 | 5·4906 | 74·65 | 175 | 671·743 | 9,133·02 |
| 45 | 7·1391 | 97·06 | 180 | 754·639 | 10,260·1 |
| 50 | 9·1981 | 125·05 | 185 | 845·323 | 11,493·0 |
| 55 | 11·7478 | 159·72 | 190 | 944·270 | 12,838·3 |
| 60 | 14·8791 | 203·23 | 195 | 1,051·963 | 14.302·5 |
| 65 | 18·6945 | 254·17 | 200 | 1.168·896 | 15,892·3 |
| 70 | 23·3093 | 316·92 | 205 | 1,295·566 | 17,614·5 |
| 75 | 28·8517 | 392·27 | 210 | 1.432·480 | 19,476·0 |
| 80 | 35·4643 | 482·17 | 215 | 1,580·133 | 21,483·5 |
| 85 | 43·3041 | 588·77 | 220 | 1,739·00 | 23,643·9 |
| 90 | 52·5450 | 714·40 | 225 | 19.097·04 | 25,964·3 |
| 95 | 63·3778 | 861·68 | 230 | 20,926·40 | 28,451·5 |
| 100 | 76·0000 | 1,033·30 | | | |

offers many advantages over a table, but in order to make it of service in a case like the above it must be plotted to a very large scale. Fig. 1 shows the general form of the curve between + 40° and + 230° upon a scale too small to be of service for actual readings.

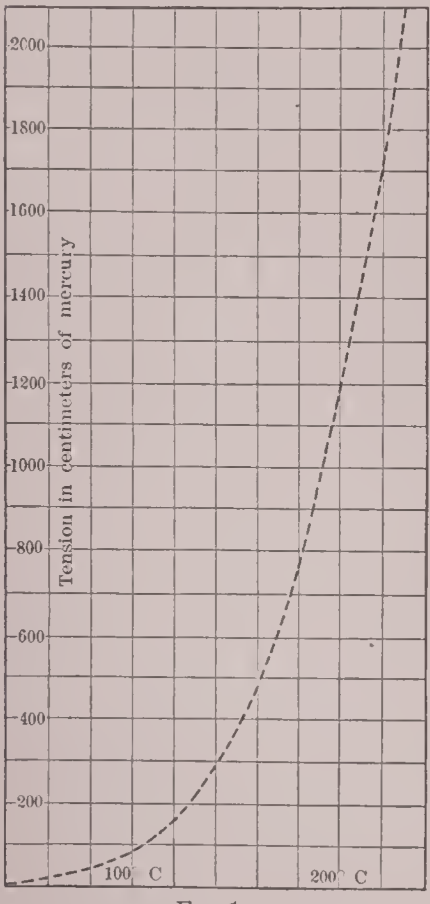



FIG. 1.

For many practical purposes one needs to use only a small portion of the entire range of temperatures. If, for example, the change in boiling-point under ordinary barometric fluctuations is desired, the extreme range of ordinates to be considered is from 70 cm. to 80 cm. Fig. 2 is such a boiling-point curve. It follows from the definition of ebullition given in an earlier paragraph that the boiling-point corresponding to a given pressure is simply the temperature at which steam acquires a tension equivalent to the pressure in question. Since tensions, like atmospheric pressures, are measured in centimeters of mercury, the tension-curve for a vapor is also the boiling-point curve of the liquid for the same range. Thus in Fig. 2 abscissas give temperatures at which aqueous vapor attains various tensions, and also the temperatures at which water boils when subjected to atmospheric pressures represented by the ordinates of the curve.

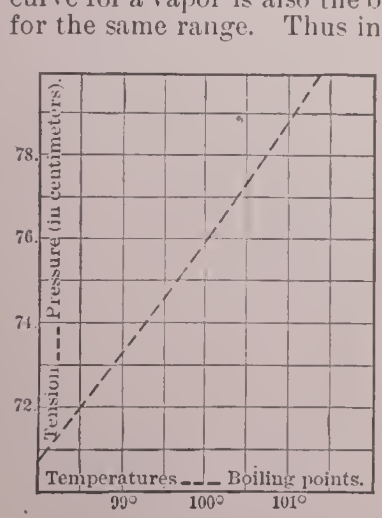



FIG. 2.

Closely related to the property of steam just described, and equally important, are its variations of volume when subjected to changes of temperature and pressure. A perfect gas possesses a coefficient of expansion (by constant pressure) of 0·00367, a coefficient constant for the range of pressures and temperatures within which the gas obeys Charles's law. Steam, according to Hirn (*Théorie mécanique de la Chaleur*), possesses a coefficient considerably larger than the above at ordinary temperatures and gradually approaches it as the temperature rises. See Table II.

TABLE II.—COEFFICIENT OF EXPANSION OF STEAM AT CONSTANT PRESSURES.

| Range of temperature. | Mean coefficient. |
|---|---|
| 0° to 119° | 0·004187 |
| 0° to 141° | 0·004089 |
| 0° to 162° | 0 004071 |
| 0° to 200° | 0·003938 |
| 0° to 247° | 0·003799 |

The behavior of a gas or vapor when subjected to simultaneous changes of *pressure* and *temperature* can be expressed by means of a surface, the three Cartesian co-ordinates of which are *volume* ($v$), *pressure* ($p$), and *temperature* ($t$). For a perfect gas this surface is hyperbolic, its intersection with any plane parallel to the axes $v$ and $p$ being a rectangular hyperbola (Fig. 3). This hyperbola is an isothermal curve for the gas. The intersection of the surface with planes parallel to the axes $v$ and $t$ forms a series of straight lines, showing the relation between $t$ and $v$ for constant $p$. The characteristics of vapors, as distinguished from true gases, as has been pointed out in the article PNEUMATICS (*q. v.*), are too great compressibility to satisfy Mariotte's law and too great a change of volume when heated or cooled to satisfy the law of Charles. The result of these peculiarities is to alter the form of surface which exhibits the relation between $p$, $v$, and $t$ in such a manner as to cause the isothermal curves to deviate from the hyperbolic form, while at the same time the intersections with planes parallel to the plane $t\ v$ are no longer straight lines. The existence of such a divergence in the case of steam appears at once from inspection of Table II. The curve marked *Vapor* in Fig. 3 shows the character of the divergence of the isothermal curve from the hyperbolic form.

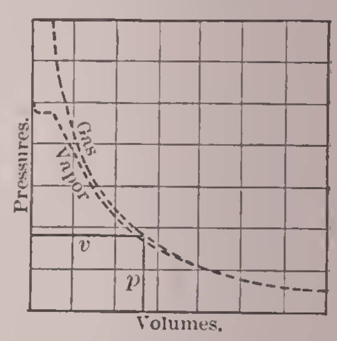



FIG. 3.

The conditions under which steam is made and used compel the consideration of its behavior under conditions different from those of an isolated mass of vapor, which loses nothing by condensation and gains nothing from the evaporation of contiguous liquid. Ordinarily we have steam in the presence of unvaporized water, from which it receives or to which it gives up portions of its substance at every change of condition. Steam thus situated is said to be saturated. It is much easier to study the properties of saturated than of unsaturated steam, and its behavior when in that condition is of prime importance.

*Energy required for the Production of Steam.*—In the conversion of a gramme of water at 0° C. into steam at any given temperature there is a double process: (1) the heating of the liquid up to the boiling-point, and (2) ebullition of the liquid. If the given temperature lies above the boiling-point for the pressure at which the experiment is to be performed—if, that is to say, we are to produce superheated instead of saturated steam—a third process must be added: (3) the heating of the vapor resulting from ebullition from the boiling-point to the required temperature.

To compute the expenditure of energy in these three processes the specific heat of water throughout the range of temperature, from 0° to the boiling-point, the heat of vaporization at the latter temperature, and the specific heat of steam must be known.

*The specific heat of water*, although taken as a reference unit in calorimetry, was found by Regnault to vary slightly from its value at low temperatures when the investigation was extended over a considerable range. This variation, the existence of which has been abundantly verified by subsequent observers, is of the nature of a very slight increase in the specific heat. Regnault expressed the change by means of the empirical formula,

$$c = 1 + 0{\cdot}00004t + 0{\cdot}0000009t^2,$$

in which $c$ is the specific heat and $t$ the temperature. Table III. gives the results of Regnault's determination.

*The heat of vaporization* of water is likewise a function of the temperature, diminishing as the temperature rises,

TABLE III.—SPECIFIC HEAT OF WATER (AFTER REGNAULT).

| Temperature. | Sp. heat. | Temperature. | Sp. heat. |
|---|---|---|---|
| 0° C. | 1·0000 | 120° C. | 1·0177 |
| 10 | 1·0005 | 130 | 1·0204 |
| 20 | 1·0012 | 140 | 1·0232 |
| 30 | 1·0020 | 150 | 1·0262 |
| 40 | 1·0030 | 160 | 1·0294 |
| 50 | 1·0042 | 170 | 1·0328 |
| 60 | 1·0056 | 180 | 1·0364 |
| 70 | 1·0072 | 190 | 1·0401 |
| 80 | 1·0098 | 200 | 1·0440 |
| 90 | 1·0109 | 210 | 1·0481 |
| 100 | 1·0130 | 220 | 1·0524 |
| 110 | 1·0153 | 230 | 1·0568 |

and finally disappearing altogether at the "critical temperature" of the liquid.

The heat of vaporization of water between 0° C. and 200° C., and the *total heat* in lesser calories necessary to convert a gramme of water at 0° into steam at the required temperature, are given in Table IV. The quantity designated as *total heat* is calculated by means of the equation

$$\gamma = \int_0^t c dt + r,$$

where $\gamma$ is the total heat, $c$ the specific heat of water, $o - - - t$ is the range of temperatures through which it is necessary to raise the water to bring it to the boiling-point, and $r$ is the heat of vaporization at the boiling-temperature.

TABLE IV.—HEAT OF VAPORIZATION AND "TOTAL HEAT" OF STEAM.*

| Temperature of vaporization. | Heat applied to liquid ($q$). $q = \int_0^t cdt$. | Heat of vaporization ($r$). | "Total heat." $\gamma = q + r$. | Temperature of vaporization. | Heat applied to liquid ($q$). $q = \int_0^t cdt$. | Heat of vaporization ($r$). | "Total heat." $\gamma = q + r$. |
|---|---|---|---|---|---|---|---|
| 0° C. | 0·000 | 606·500 | 606·500 | 105° C. | 105·568 | 532·957 | 638·525 |
| 5 | 5·000 | 603·025 | 608·025 | 110 | 110·641 | 529·409 | 640·050 |
| 10 | 10·002 | 599·548 | 609·550 | 115 | 115·721 | 525·859 | 641·575 |
| 15 | 15·005 | 596·070 | 611·075 | 120 | 120·806 | 522·293 | 643·100 |
| 20 | 20·010 | 592·590 | 612·600 | 125 | 125·898 | 518·727 | 644·625 |
| 25 | 25·017 | 589·108 | 614·129 | 130 | 130·997 | 515·153 | 646·150 |
| 30 | 30·026 | 586·624 | 615·650 | 135 | 136·103 | 511·572 | 647·675 |
| 35 | 35·037 | 582·138 | 617·175 | 140 | 141·215 | 507·985 | 649·200 |
| 40 | 40·051 | 578·649 | 618·700 | 145 | 146·334 | 504·391 | 650·725 |
| 45 | 45·068 | 575·157 | 620·225 | 150 | 151·462 | 500·788 | 652·250 |
| 50 | 50·087 | 571·663 | 621·750 | 155 | 156·598 | 497·177 | 653·775 |
| 55 | 55·110 | 568·165 | 623·275 | 160 | 161·741 | 493·550 | 655·300 |
| 60 | 60·137 | 564·665 | 624·800 | 165 | 166·892 | 489·933 | 656·825 |
| 65 | 65·167 | 561·158 | 626·325 | 170 | 172·052 | 486·298 | 658·250 |
| 70 | 70·201 | 557·649 | 627·850 | 175 | 177·220 | 482·655 | 659·875 |
| 75 | 75·239 | 554·136 | 629·378 | 180 | 182·398 | 479·002 | 661·400 |
| 80 | 80·282 | 550·618 | 630·900 | 185 | 187·584 | 475·341 | 662·325 |
| 85 | 85·329 | 547·096 | 632·425 | 190 | 192·780 | 471·670 | 664·450 |
| 90 | 90·381 | 543·569 | 633·950 | 195 | 197·985 | 467·990 | 665·975 |
| 95 | 95·438 | 540·037 | 635·475 | 200 | 203·200 | 464·300 | 667·500 |
| 100 | 100·500 | 536·500 | 637·000 | | | | |

* From Zeuner's *Grundzüge der mechanischen Wärmetheorie.*

The relations of *heat of vaporization* and *total heat* to one another and to the temperature are shown graphically in Fig. 4, in which abscissas are temperatures. The curve marked $r$ represents the heat of vaporization, and that marked $\gamma$ the total heat.

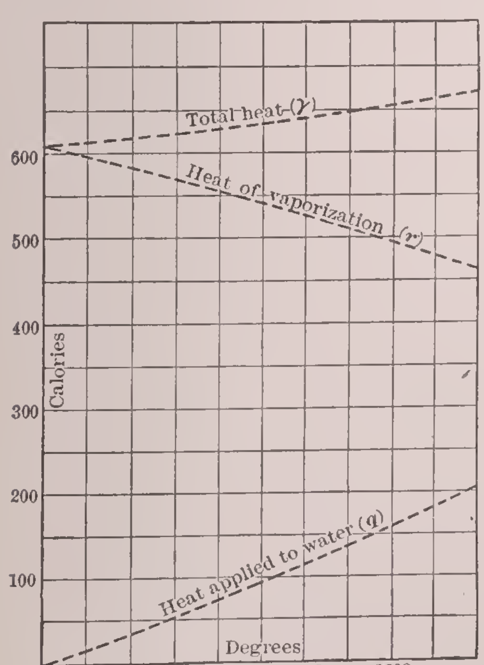



FIG. 4.

*The specific heat of steam* is a subject the experimental investigation of which presents great difficulty. The data thus far obtained show, as might be expected, wide divergence. Thus Regnault found the mean specific heat between 128° and 217° C. to be 0·48051, while Gray (*Philosophical Magazine*, 5, xiii., 1882) obtained for the lower range of temperatures, 100° - - - 125°, the value 0·3787.

Fortunately a precise knowledge of the specific heat is not of prime importance in most practical cases, since the total amount of heat-energy expended in superheating steam is insignificant when compared with that necessary to its production. The study of the properties of a vapor like steam are rendered difficult on account of the presence of finely divided water in the unvaporized form of spray, by the admixture of air, and likewise by the fact that any complete investigation involves the use of temperatures difficult to measure with precision, and of pressures hard to deal with experimentally. The engineer, for his part, is embarrassed by the fact that he must use steam sometimes wet and sometimes superheated, and under circumstances such that it is often impossible to know its precise condition. See Regnault, *Quelques Expériences*; Hirn, *Théorie mécanique de la Chaleur*; Clausius, *Theory of Heat*; Preston on *Heat*; also the chapters on heat, and especially thermodynamics, in the various larger text-books of physics. For the applications of steam in theory and practice, see Rankine's classical work on the steam-engine; Ewing, *Steam and other Heat Engines*; the treatises by Thurston on the same subject, and Carpenter's *Manual of Steam Engineering*. See also LIQUIDS (*Properties of Liquids*), GAS, HEAT, PNEUMATICS, and STEAM-ENGINE. E. L. NICHOLS.

**Steam-boiler**: an apparatus for generating steam by the application of heat. It may be described in general terms as a closed metallic vessel, kept partly filled with water, with arrangements for imparting heat to the water by means of the combustion of fuel. The steam generated is confined in the vessel above the water until it is required for use, when it is drawn off through pipes. This metallic vessel, with its compartments and openings, takes the name of "boiler" in the shops where it is manufactured; but in many classes or forms of boilers the steam-generating apparatus is not complete until the boiler is set up in brickwork, with an external furnace constructed for the combustion of the fuel, and external flues made for conducting the heated gases to the chimney along the sides of the boiler. In others the boiler is ready for use as it comes from the manufacturer, having within its external shell all these necessary arrangements for combustion and draught. In all cases certain adjuncts and appurtenances are necessary, such as the feed-pump or other means of supplying water, with the necessary pipes and attachments, the safety-valve, the steam and water gauges, and grate-bars for the furnace.

Connected with its uses as an instrument of industrial economy the boiler has become an object deserving and requiring the most thorough and critical study. The primary conditions which steam-generators should fulfill are (1) strength to sustain the internal pressures to which they will be subjected; (2) durability; (3) economy or efficiency in evaporating qualities; (4) economy of construction in materials and workmanship; (5) adaptation to the particular circumstances of their use. (6) To these conditions must be added safety, which depends on form, construction, strength, and qualities of materials, as well as upon management.

*Types of Boilers.*—In regard to forms and adaptation to various uses, boilers may be classified under a few types, which serve to illustrate not only general principles of construction, but the adaptability of the various forms to particular circumstances of use.

While the sphere is a form of inclosing envelope which is best adapted for the resistance of internal fluid pressure, it is not the best adapted for the application of heat, nor is it the form of cheapest construction. By having every section a circle, no cross strain is brought upon the metal, but is in uniform tension in every direction. The nearest approach to it which is practicable is the cylinder with hemispherical ends, and it will therefore be found that the cylinder is the initial form of most of the steam-generators.

Boilers may be divided into two great groups known as the externally fired boilers and the internally fired boilers, respectively. In the first class are included all the boilers whose furnace is external to the proper structure of the boiler, and in the second class all those in which the water to be evaporated surrounds the furnace. The first class require a brick setting, while the second class do not, but are self-contained. The latter, while usually more costly, have these advantages: There is less loss of heat from radiation; they make steam rapidly; and a great evaporative capacity is secured in a very compact form.

Of the *externally fired* class, a form much used where gaseous fuels are employed and where the water contains chemical salts liable to precipitation upon boiling is the plain cylinder type shown in Fig. 1. A modification of it to secure additional heating-surface without increased diameter is known as the French or Elephant boiler, shown in Figs. 2

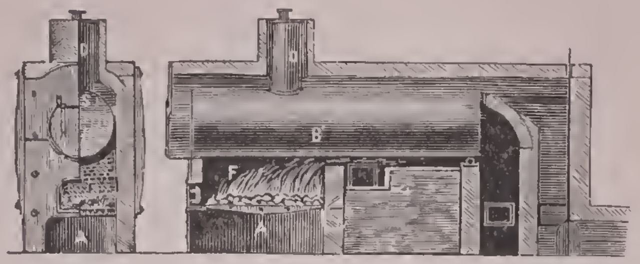
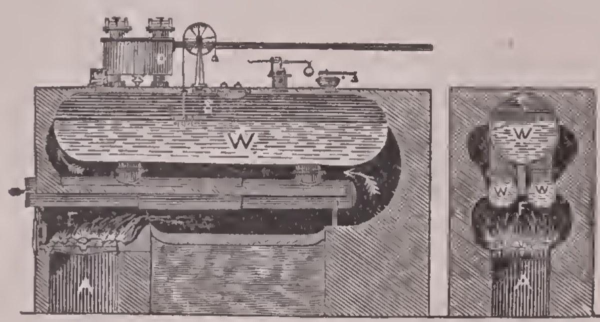


Fig. 1.—Plain cylinder boiler set in brickwork.

and 3. This type has been much used in iron-works practice, where it is desired that a large volume of water serve to



Figs. 2 and 3.—French boiler. A, ash-pit; F, furnace; W, water-space; S, steam-space; D, steam-dome.

store the heat given off from metallurgical furnaces when there may be considerable variation in the intensity of combustion from time to time.

The next types of externally fired boilers are those containing, in the space devoted to water, flues or tubes through which the hot gases pass on their way to the chimney. The difference between a flue and a tube is that of size merely, a tube larger than 8 inches in diameter being designated as a flue. The flue boiler is shown in Figs. 4 and 5, and the

Figs. 4 and 5.—Cylinder-flue boiler.

tubular boiler in Fig. 6. The flue boiler is preferred where the fuel has a long flame from the presence of combustible gas, since the fine subdivision of the products of partial combustion in the tubes tends to extinguish the flame before the union with oxygen is complete. On the other hand, where the fuel is anthracite, or where the combustion can be completed before the gases enter the tubes, the extended

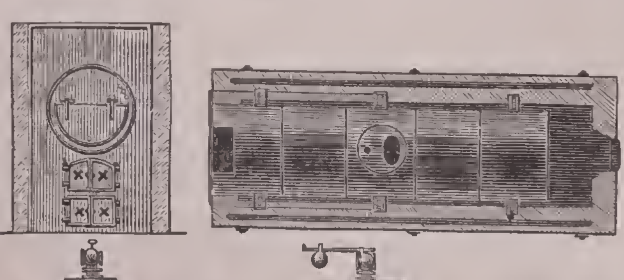


Fig. 6.—Cylinder tubular boiler set in brickwork.

heating-surface of the multitubular boiler gives it the preference, provided the quality of the water is consistent with a design of boiler which has parts to which access is so difficult as in the small spaces about the tubes.

The fourth type of externally fired boiler is what is known as the sectional boiler. It consists essentially of a system of tubes or small units so arranged that a continuous circulation of the water is maintained through the tubes from the mechanical action arising from some portions of the

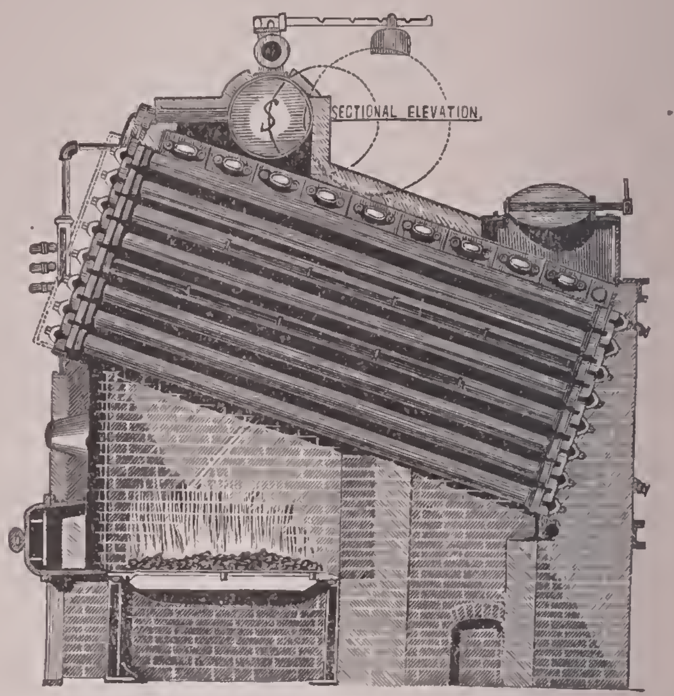



Fig. 7.—The sectional boiler.

tubes being maintained at a higher temperature than others, the heated and lighter water ascending and the cooler and heavier water descending. The large shell is dispensed with, and the heat applied directly by both radiation and contact to the exterior surfaces of the tubes. The steam-space is usually a large drum or a system of drums with which the various sections of tubes are connected, and there are various devices in practical use for connecting and arranging the tubes, so that they shall form a compact arrangement with all the necessary conditions for applying heat, for accessibility, and for securing circulation and disengagement of steam from the water. Fig. 7 shows a side elevation of one of the early pioneers among boilers of this type in the U. S., but many other forms, and the modern type of the form illustrated, are improvements in many respects upon the original type. The origination of this system is generally ascribed to Jacob Perkins, who in 1831 obtained a patent in England for improvements in generating steam, in which he insisted on the advantages to be gained by causing the water to circulate rapidly over the heating-surfaces exposed to the direct action of the fire. In 1839 Perkins obtained a patent for a more complete apparatus involving this idea, under the title "apparatus for transmitting heat by circulating water." Steam-generators constructed with special reference to this idea had already been tried, however, by John Fitch, John Stevens, and others, 1787–1804; later they were abandoned, owing to practical difficulties in their construction and keeping them in repair.

From the sectional type have been derived the water-tube or coil boilers, in which the heating-surface is made up of a great surface of tubes of small diameter in curved or spiral sections within which the water to be evaporated circulates at high velocity either naturally or by means of a forced circulation. The compactness of such boilers and their availability for high pressures have made them popular for small high-speed marine vessels.

Of the *internally fired* boilers, one representative is the locomotive boiler, in which a rectangular fire-box is surrounded by the water to be evaporated on all sides except the bottom. From the front side of this fire-box the tubes carry the hot gases through the water in the barrel of the boiler to discharge them into the smoke-box at the extreme front.

The flatness of the upper side of the fire-box or crown sheet necessitates an elaborate system of bracing or staying for that exposed surface. The sides or water-legs are prevented from bulging by being tied together by stay-bolts. Fig. 8 shows a typical construction of a locomotive-engine boiler without the extension smoke-box, which is designed to catch and hold the cinders and sparks which the intensely rapid draught of the locomotive-engine boiler carries out of the fire-box in great quantities. Many so-called portable boilers are of the locomotive type.

A modification of the locomotive boiler, much used for portable and stationary engines, is known as the *upright*

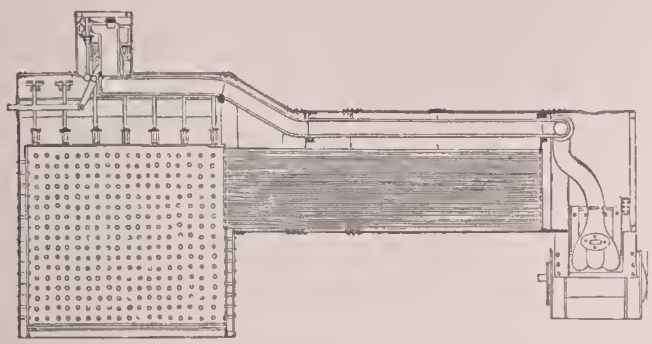


FIG. 8.—Locomotive-engine boiler.

*boiler*, an illustration of which is given in Fig. 9. The simplicity of construction, convenience of access, and small space occupied by these boilers, together with their evaporative qualities and strength, render them peculiarly adaptable for some conditions of use.

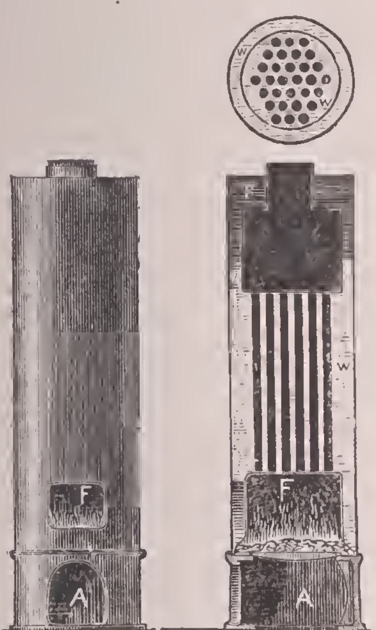


FIG. 9.—Upright boiler.

A form of this boiler which demands special interest and attention is found in the *fire-engine boiler* represented in Fig. 10. This is essentially an upright boiler of the locomotive type, but its peculiarity consists in the great number of tubes and the great extent of heating-surface, compared with the cubic dimensions and the water-space. The tubes are comparatively thin (usually made of brass or copper), thus not only permitting the introduction of a larger number in a given space, but also lessening the time for the first development of steam. The dimensions of the boiler represented in Fig. 10 are as follows: Total height, 5 ft. 4 in.; outside diameter, 31$\frac{3}{4}$ inches; number of brass tubes, 301; diameter of tubes, 1$\frac{1}{4}$ inches; length of tubes, 16 inches; distance from center to center of tubes, 1$\frac{17}{32}$ inches; heating-surface, 157 sq. feet.

For marine practice, where a boiler thoroughly self-contained is a necessity, the internally fired type has received great development. In the days of early and lighter pressures it was usual to give the boiler a shape which would adapt it to fill the cramped quarters assigned to it in the hull.

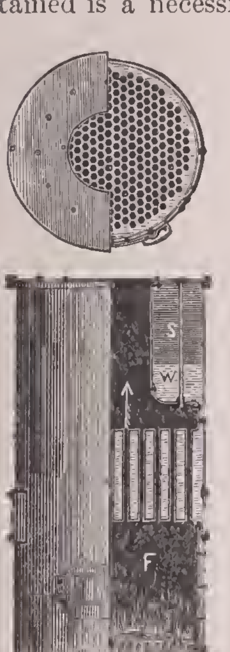


FIG. 10.—Fire-engine boiler.

Fig. 11 represents varieties of a class of boilers which are known as *return-flue boilers*. They were at one time in very general use in steamboats and steamships in the U. S., and are still employed to some extent for lower pressures. They are characterized by having internal furnaces and internal flues, with no external furnaces or brickwork. The shell in these boilers is made sufficiently large to receive within it the direct flues from the furnace, from front to rear, and also the return flues, the arrangements being as exhibited in the plate. As these boilers have large diameters, it is necessary to strengthen the various parts by stays, as shown in Fig. 13. Around the furnaces the plates are stayed and kept in position by sockets and bolts, the sockets acting as struts and the bolts as stays.

Fig. 12 represents a modification of the return-tubular boiler suited to marine purposes. Such a boiler contains several furnaces, and two or more boilers are usually set together on opposite sides of the hold of the vessel, in such a manner as to have a common chimney. Figs. 13–16 show the more prevalent type of boilers for the recent high pressure requirements of both naval and merchant service. They have received the general name of Scotch boilers, while the

FIG. 11.—Return-flue boiler.

type shown in Fig. 12 is usually known as the Martin boiler. The cylindrical furnaces shown in Figs. 13–14 are flues

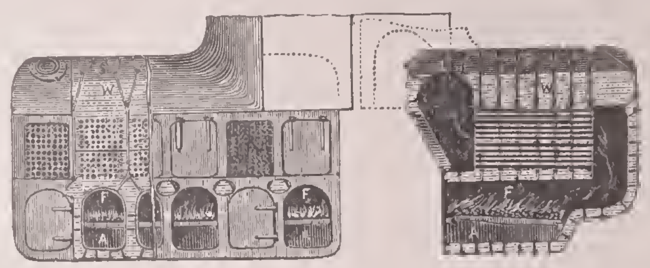


FIG. 12.

corrugated crosswise, so as to secure by this means a greater resistance to the tendency to collapse, which is always pres-

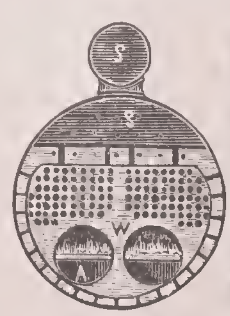


FIG. 13.

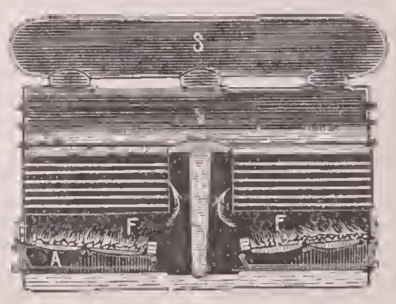
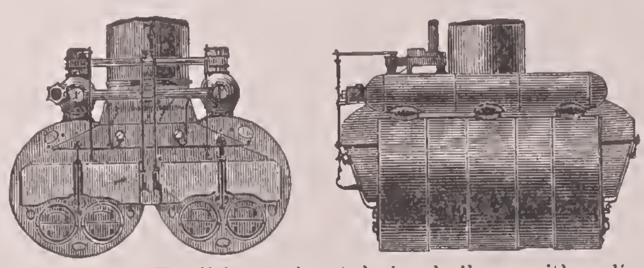


FIG. 14.

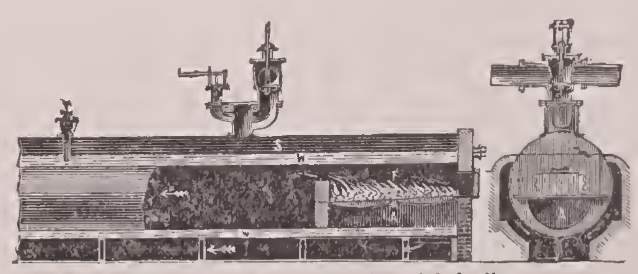
ent in flues of such large diameter. Where the flue is not corrugated it can be stiffened by means of rings of proper



FIGS. 15 and 16.—English marine tubular boilers, with cylindrical shells.

dimensions, to which the more flexible furnace can be attached.

A type of internally fired boiler which has received considerable development in Great Britain is called the Cornish boiler (Fig. 17–18); it has the ordinary form of large in-



FIGS. 17 and 18.—The Cornish boiler.

ternal flue inclosing the fire. The double Cornish boiler has two such flues. The gases pass back through the flue, return to the front at the sides of the boiler, and turn again to the back underneath. This secures abundant contact between the heating-surface and the gases.

What is commonly known as a Galloway boiler is usually a Cornish boiler across whose flue or flues conical water-tubes are inserted, so that the gases shall impinge against surfaces within which the water is circulating. The Field tubes, often applied to the upright or fire-engine boiler and to other internally fired types, consist of tubes closed at the outer end, and each containing concentrically within it a smaller tube. The heavier water descends in the inner tube, while the lighter hot water and steam ascend in the annular space between the inner and outer tube, thus causing a rapid circulation and a rapid transfer of heat.

*Constituent Parts of a Boiler.*—There are many appurtenances or parts of a boiler which are common to all the types. Such details, which are represented wholly or in part in nearly all boilers under the same names, are: (1) The *shell*, or external envelope. (2) The *furnace*, the chamber in which combustion takes place. (3) The *flue* or flues, the passages for the heated gases to the chimney. (4) The *bridge*, or rear wall of the furnace, which forms, with the shell of the boiler above it, the boundary of the *draught-area*. (5) The *ash-pit*, the bottom part of the furnace-chamber, which serves as a receptacle for the ashes and cinders, and also as an entrance for air underneath the grate. (6) The *grate*, which is composed of *grate-bars* or *fire-bars*, forming the bottom of the furnace on which the fuel is laid. (7) The *furnace door*. (8) The *ash-pit door*. (9) The *combustion-chamber*. This is an enlargement of the main flue in the rear of the bridge, formed by dropping the bottom of this flue. This part of the main flue is often called the combustion-chamber, under the assumption that the combustion of the volatile portions of the fuel is not completed in the furnace, and that an enlargement of this flue into a sort of chamber favors a more thorough mixing of the air and the volatile or combustible gases, and thus produces complete combustion. This is especially true where air is admitted by a special arrangement behind the bridge or through holes in the furnace door. When bituminous coal, or fuel containing a large quantity of volatile matter, is used, some such arrangement for burning the volatile matters should be made. (10) The *smoke-box* or smoke-connection is more important in the internally fired than in the other classes of boilers. (11) The *steam-dome* is a vertical chamber set upon the upper surface of the shell, and communicating with it freely through holes in the shell or through a single large aperture. Its object is to furnish a chamber in which the steam may be removed as far as possible from the liquid water, and brought to a quiescent state, so that any particles of water which are carried up with it may be separated by precipitation. In some boilers, especially those for marine purposes, this dome takes the form of an annular space, which is traversed by the smoke-stack or chimney, and is then called the *steam-chimney*. (12) *Water-room* and *steam-room*. The interior of the shell of the boiler is divided by the surface of the water into two spaces, called the water-room and steam-room, or water-space and steam-space; all the space occupied by water below the water-level being water-space, and the space or spaces above the water-level, including the steam-dome, being steam-room. The water-room of a plain cylinder boiler occupies about three-fourths of the whole space, and generally in other boilers about three-fourths of the internal capacity of the shell when the water is at its mean level. (13) *Man-holes, hand-holes*. It is important in the management of boilers to examine all accessible parts frequently, and accessibility to every part is a fundamental principle of construction, not only for cleaning, but for facilitating repairs. *Man-holes* are apertures left in the shell, and closed by strong plates which can be removed at will, the opening being large enough to admit a man. *Hand-holes* are smaller openings, generally near the bottom, which enable cleaning to be done by means of tools. (14) *Heating-surface*. In all boilers portions of the metal plates which form the shell, flues, or tubes, are exposed on one side to the heat of the furnace, or the heat of the gases in their course to the chimney, and on the other side to the contact of the water or steam, the transfer of heat being from the furnace and flues to the water through these portions of the structure. A heating-surface in a steam-generator may therefore be defined to be any surface which acts as a medium for the transfer of heat from the furnace or gases to the water or steam within the boiler. The efficiency of such a surface depends on the conducting power and on the difference between the temperatures of the furnace or gases and the water, and the thorough and rapid circulation of the fluids and gases in contact with the surfaces.

Several appurtenances give efficiency and safety to the boiler, viz.: (15) The *feed-apparatus*, composed of a pump, an injector, or other device, with the necessary pipes for supplying water to the boiler. The injector, often called Giffard's injector, from Giffard, who first reduced it to a practical form, is a jet pump in which a jet of steam is changed by rapid condensation to a water jet. The latter, being much smaller and retaining the same velocity, concentrates its pressure on a much smaller area, and by the conversion of its energy into work is enabled to force other water into the boiler. (16) The *safety-valve*, a valve opening outward, and so adjusted and arranged that it will be opened by the internal pressure of the steam when that pressure exceeds a given amount per square inch. (17) The *steam-gauge*, an instrument which exhibits at all times to the eye of the engineman or stoker the pressure of the steam in the boiler. (18) *Water-gauges* and *gauge-cocks*, which are intended to show at any instant the level of the water within the boiler. (19) The *low-water detector*, an instrument attached to many boilers for the purpose of giving an alarm if the water falls below a given point.

*Chimneys.*—The chimney, in all cases in which the draught is produced by a simple chimney-draught, performs the functions of a machine, and its dimensions (its height and cross-section), taken in connection with the area of the grate and the surface of contact of the fuel exposed to the action of the air, are the principal elements on which not only complete or perfect combustion depends, but also the quantity of fuel burned in a given time. In boilers provided with any other means of draught, such as the steam-jet or the blower, the dimensions of the chimney are not so important. In almost all stationary and in many marine boilers the draught is produced solely by a chimney, which forms an indispensable and important part of the apparatus. The determination of the proper proportions between the heating-surface and the grate-surface depends on the initial temperature of the gases; and as the initial temperature varies with the rate of combustion or the height of the chimney, the height of the chimney indirectly enters into the consideration of this proportion. As is well known, the draught of a chimney is caused by a difference of pressure at the base of the chimney acting in an upward direction, due to the difference between the weight of the heated gases in the chimney and that of a column of the external air of equal height and cross-section.

*Heating-surfaces.*—The quantity of heat transmitted by any surface depends on the extent of the surface and the difference of temperature between the source of heat and the absorbent; or, in the case of steam-generators, the difference in temperature of the incandescent fuel or heated gases and the water in the boiler. The extent or amount of heating-surface is fixed with reference to the initial temperatures of the furnace and gases; or, since these temperatures are proportional to the rate of combustion, the extent of heating-surface will depend on the rate of combustion to be employed. The extent of heating-surface must evidently also be in proportion to the absolute quantity of fuel burned in a given time; or, what is the same thing, it must have a direct relation to the grate-surface.

Inasmuch as it is impossible to vary the heating-surface at will, after a steam-generator is constructed, it is customary to fix the extent of this surface according to average conditions of use, taking into account average rates of combustion. The following proportions represent as near as can be ascertained the usual rules of practice. The grate-surface being 1, the heating-surfaces are for—

| | | |
|---|---|---|
| Plain cylinder boilers | 10 to 15, | average 12 |
| Cornish boilers | 30 to 40, | " 35 |
| French cylinder boilers | 25 to 40, | " 33 |
| Cylinder-flue boilers | 17 to 25, | " 21 |
| Cylinder-tubular boilers (chimney-draught) | 25 to 30, | " 28 |
| Traction-engine boilers | | " 32 |
| Marine tubular and flue boilers—French, English, and American practice | | " 25 |
| Locomotive boilers | 40 to 100, | " 75 |

The rates of combustion per hour and per square foot of grate, in ordinary practice, are, according to Rankine—

| | |
|---|---|
| Slowest rate in Cornish boilers | 4 lb. per hour. |
| Ordinary rate | 10 " " |
| Ordinary rate in factory boilers | 12 to 16 lb. per hour. |
| Ordinary rate in marine boilers | 16 to 24 " " |
| Locomotive boilers | 40 to 120 " " |

The amount of heating-surface required to evaporate 1 cubic foot of water per hour at 212° is for—

| | |
|---|---|
| Plain cylinder boilers | 8·8 sq. feet. |
| Galloway multitubular boiler (water-tube boiler) | 8·5 " |
| Marine tubular boiler | 14·0 " |
| Double-flue Cornish | 11·7 " |

For these the rate of combustion is such that the total heating-surfaces are sufficient to evaporate 9 lb. of water for 1 lb. of coal.

The following conclusions are deduced from Isherwood's experiments. The boilers of various steamships on which experiments were made, with the results, are indicated by the names of the vessels:

| | | | | |
|---|---|---|---|---|
| Jacob Bell | marine tubular | 19·0 | 12·0 | 11·0 |
| Mt. Vernon | " " | 19·0 | 10·5 | 10·5 |
| Valley City | " " | 16·0 | 11·2 | 9·16 |
| Crusader | " " | 16·8 | 11·8 | 9·3 |
| Wyandotte | vert. water-tubes | 20·0 | 12·4 | 10·0 |
| Underwriter | hor. flue boilers | 15·6 | 11·2 | 9·9 |
| Young America | " " " | 15·0 | 10·4 | 9·3 |
| Boston | marine tubular | 18·0 | 11·1 | 11·5 |
| Average | | | | 10·6 |

First column, heating-surface required per one indicated H. P.; second column, number of pounds of water evaporated per hour per pound of combustible; third column, combustible in pounds burned per hour per square foot of grate.

The practice of the Navy Department has been to allow 8 lb. of anthracite coal per hour to evaporate 1 cubic foot of water at 212°, under a pressure of 30 lb. per square inch, which requires two-thirds square foot of grate and 16⅔ sq. feet of heating-surface.

The quantity of water evaporated per pound of coal for the plain cylinder boiler, the cylinder-flue boiler, and the cylinder-tubular boiler, in the order given, is, under the most favorable circumstances, 7, 8, and 9 lb. of water for each pound of coal burned. The boiler of the railway locomotive is the only one in which the rates of combustion are frequently and greatly varied while in use; and in these boilers it is necessary to provide for very high rates of combustion by giving an extreme amount of heating-surface. The locomotive boiler, with ordinary rates of combustion, corresponds, in evaporative efficiency, to the ordinary marine tubular boiler.

*Causes which affect the Efficiency of Evaporation.*—These are, 1, those which influence the *rate of combustion*; and, 2, those which influence the *rate of transfer of heat*. Among the causes which influence the rate of combustion may be mentioned the temperature of the external air, the temperature of the chimney-gases, the presence of moisture in the air, the management of the fires, the quality of the fuel, and defective combustion. The principal causes which affect the transfer of heat are the rate of combustion, which determines the initial temperatures in the boiler; the temperature of the water in the boiler; the accumulations of incrustations and dust in the tubes; and generally all those circumstances which impair the qualities of the heating-surfaces. The management of the fires and the quality of coal are most important influences on the rate of combustion and economy of fuel.

*Supply of Feed-water.*—The supply of water to a boiler is of course indispensable to its performance. It is usually accomplished by an independent apparatus, a pump or an injector being employed. The capacity of the feeding apparatus should be such as to supply sufficient water not only for the highest rate of evaporation likely to be attained, but to supply all losses from priming, leakage, blowing off, etc. Care should be taken that the feed-water does not impinge on the plates or flues, as the sudden cooling at one point is liable to fracture the plates. Such fractures can not always be discovered when the boilers are inspected, and are always a source of danger. For land-engines a capacity of two and a half times the net feed-water required by the engine is the rule given by Rankine. Proper arrangements for regulating the supply to the boiler are required. Where steam is used for heating, the condensed steam is returned to the boiler by the action of gravity, the waste being supplied from time to time by the attendant.

Feed-water heaters or economizers are devices by which the heat which would otherwise be wasted as rejected from the boiler setting or the engine is utilized to raise the temperature of the feed-water before it enters the boiler. They are therefore known as flue-heaters, when so placed as to avail of waste heat in the chimney flues, and exhaust-steam-heaters when the waste steam from the engine performs this same office. Where the feed-water contains mineral matter which can be precipitated in the heater, an obvious advantage is secured by keeping this objectionable material out of the generator. Open heaters are those in which the exhaust steam comes into direct contact with the feed-water. In closed heaters either the steam passes through a coil of pipes on the other side of which is the water, or the water is in pipes surrounded by steam.

*Boiler-explosions.*—The disaster which is known as a boiler-explosion consists of two distinct steps, although one usually succeeds the other instantaneously. (1) There occurs a rupture of the shell or envelope caused by a pressure within the shell greater than it was able to withstand. (2) Through the orifice thus made there is a release of pressure, and the hot water remaining in the boiler forms steam-gas at this reduced pressure with a velocity which is comparable to the rapid formation of gas when a flame is touched to an explosive compound. It can be shown that when the water is under pressure there is stored a force in foot-pounds sufficient if released all at once to produce the phenomena of a most disastrous explosion, so that the study of an explosion is usually mainly concerned with determining the conditions which caused the relative over-strain and the initial rupture. This state of affairs may result because the boiler was too weak for its working pressure by reason of deterioration, old age, defective design, or bad adjustment of the working pressure to its strength. It may also occur because some sudden strain of unequal contraction produced a local superposition of strain which the metal at such weakened place was unable to resist.

Such excessive strains can also follow when, by the sudden opening of a large steam-valve permitting the escape of steam into a cold pipe, there is such a drop of pressure as to cause an ebullition almost concussive in its character, so that the reaction of the weight of water results in such superposition of strains as to cause the first rupture. This explains the frequency of rupture at the moment when steam is turned on and the work-day is about to begin. In the second place, it is surprising in how short a time the pressure within a boiler will increase if there is a constant rate of ordinary evaporation and no outlet for the steam.

The rate of increase of pressure may be found theoretically by means of a formula given by Prof. Zeuner in his work on the *Mechanical Theory of Heat*. Let $T$ be the time, in minutes, which must elapse from the instant that all efflux of steam is prevented in a boiler to the instant when a dangerous or bursting pressure must follow; let $W$ represent the weight of water in the boiler; $t_1$ the temperature of the water at a dangerous pressure; $t$ the temperature at the working pressure; $Q$ the quantity of heat, in British units, transferred to the water per minute—then the equation

$$T = \frac{W(t_1 - t)}{Q}$$

is approximately correct. This formula shows that the time will be proportional directly to the amount of water in the boiler, to the difference of temperatures $t_1$ and $t$, and inversely proportional to the quantity $Q$. The fluctuations of pressure will be less rapid in boilers which contain large quantities of water and have at the same time a low rate of evaporation. Such conditions are found especially in marine boilers, while the reverse is true for boilers containing small quantities of water and having rapid rates of evaporation, such as locomotive and fire-engine boilers. The fluctuations will also evidently be more rapid at high pressures than at low pressures, since at high pressures a greater change of pressure occurs with an equal difference of temperatures.

*Safety-valves.*—It is supposed that the gradual increase of pressure above discussed can never take place if the safety-valve is in good working order and if it have proper proportions. Engineers do not, in practice, place their trust in the safety-valve alone, and it is principally to their watchfulness and attention that the public is indebted for safety.

The theoretical area of orifice $O$ for the efflux of a given quantity of steam from a boiler into the atmosphere, supposing this orifice to be a circular area, may be determined by first ascertaining the theoretical velocity of efflux, and multiplying this by a coefficient ascertained by experiments. The experiments made by R. D. Napier on the efflux of steam at different pressures and with different orifices have not only furnished the means of determining the coefficients of efflux, but for determining formulas for the area required for the discharge of a given weight of steam per second. An approximate formula given by Rankine is as follows: When the pressure in the boiler is equal to or greater than five-thirds the external pressure, then $W = \frac{p_2}{70}$ where $W$ is the number of pounds of steam discharged per square inch of area per second, and $p_2$ is the boiler-pressure in pounds per square inch. Letting $W_o$ represent the pounds of steam per second discharged through the orifice of area $O$, then $W_o = \frac{p_2}{70} \times O$, and therefore $O = \frac{70\ W_o}{p_2}$.

An English empirical rule is that the safety-valve area shall have half a square inch for each square foot of fire-grate, or ·025 of a square inch for each square foot of heating-surface. Another, quoted by Rankine, is as follows: Let $A$ be the area of the piston, $V$ its velocity in feet per minute, $P$ the excess of pressure in the boiler above that of the atmosphere in pounds per square inch; then the area will be $A\ \frac{V}{300P}$, nearly. Still another quoted by the same author is: "$a$ = area in square inches = from $\frac{1}{25}$th to $\frac{1}{30}$th of the number of pounds of coal burned per hour, or $a$ the area in square inches = $\frac{1}{150}$th to $\frac{1}{180}$th of the water evaporated per hour."

In all cases it is not only a matter of observation, but a theoretical law, that as soon as efflux begins there is a considerable diminution of pressure underneath the valve; and numerous devices have been proposed by which the opening of the valve shall not be influenced by the pressure in the orifice, but by the action of the pressure at a point remote from the orifice. Such valves are called pop-valves.

Thére are supposed to be, in some circumstances, sudden evolutions of steam in such quantities that no relief is possible through safety-valves. In regard to such cases, it can easily be shown that by reason of the high specific heat of water, as compared with iron, it is very difficult for any large quantity of steam to be made even from overheated plates, so that the disasters perhaps rightly attributed to low water are the result, not of excessive internal pressure, but of the strain from contraction when such overheated plates are suddenly cooled by contact with water.

The term "horse-power" of boilers is often used as a measure of the work which a steam-generator can do. Such use is liable to misunderstanding, inasmuch as it implies a rate of work, and a boiler ordinarily does no work, but merely supplies to a machine the means for doing it. The term has, however, acquired a conventional significance among engineers. It has been agreed that the commercial horse-power of a boiler shall be an evaporation of 30 lb. of water per hour from a feed-water temperature of 100° F. into steam at 70 lb. gauge-pressure. This is equivalent to 34½ lb. of water evaporated from a feed-water temperature of 212° F. into steam at the same temperature, which corresponds to 33,305 thermal units per hour. A boiler rated upon the above standard of evaporative capacity should be capable of developing that power with easy firing, moderate draught, and ordinary fuel, while exhibiting good economy; and should be capable of being driven to develop at least one-third more than its rated power to meet emergencies when maximum economy is not the most important object to be attained.

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F. R. Hutton.

**Steam-engine**: a device or apparatus for converting into work-units the energy of heat, using the expansive force of the vapor of water as a medium. The steam-engine consists therefore necessarily of two parts—the engine proper, in which the expansive force is expended, and the generator, or boiler, in which the energy of a burning fuel is transferred to the water. (See Steam-boiler.) Essentially the same mechanism as is required by the steam-engine can be used with ammonia, ether, bisulphide of carbon, etc., as a vehicle for the heat. Water has the great advantage of being cheap, everywhere accessible, without odor, and with a vapor which is not combustible. It has further the great advantage that by reason of its low specific heat a given volume of the vapor of water will carry more heat than the same volume of any other medium at the same pressure.

The earliest notice of the use of steam as a motive power is in the *Pneumatica* of Hero (*q. v.*). After many trivial machines by various inventors, the first really useful steam-engine was made by Edward Somerset, second Marquis of Worcester, and described in his *Century of Inventions* (1663). It was designed to raise water. Thomas Savery improved this, and received a patent in 1698; his engine was the first to come into extensive use. Both these engines applied the expansive force of steam directly to the column of water: Savery's then condensed the steam, and by means of valves made use also of the atmospheric pressure. The invention of the piston is due to Denis Papin (1647–1712), but the first practical cylinder-and-piston steam-engine was made by Newcomen (see Newcomen, Thomas). James Watt (*q. v.*) improved this engine by providing a separate vessel to serve as condenser and by making the engine double-acting. The first automatic valve-gear (1713) was the device of a boy named Humphrey Potter; this was improved in 1718 by Henry Beighton. For the invention and description of locomotive engines, see Railways and Locomotive.

The unit for measuring the performance of steam-engines is the "horse-power," which was determined first by James Watt. The horse-power consists of 33,000 foot-pounds moved in one minute, and is a standard unit wherever the English foot and pound prevail. The horse-power in countries which employ the metric system is slightly less (32,549 foot-pounds). The performance of steam-engines is measured either on the revolving shaft of the engine by a measuring apparatus or dynamometer, or it is determined by the effort of the expansive force of the steam, measured in pounds of pressure exerted upon a known area in the cylinder of the engine, which product when multiplied by feet of distance, through which that pressure is exerted, will give a final product in foot-pounds, and measure the performance. That is: If $P$ = the mean effective pressure per square inch of area in the organ receiving the expansive force of the steam, and $A$ = the area, in square inches, of a disk, or piston, fitting steam-tight in a cylinder, then $P \times A$ = a total number of pounds. Furthermore, if $L$ = the length of the traverse of the above movable piston expressed in feet, then $P \times A \times L$ will denote the foot-pounds in one traverse of the piston in the cylinder. If the piston makes a number, $N$, of traverses in a minute, the product $PALN$ will give the foot-pounds of performance per minute; $N$ will usually be equal to twice the number of revolutions per minute. Finally, the horse-power of a steam-engine will be $PALN \div 33{,}000$.

It will appear from the above that two great types of engine can be designed of equal capacity in horse-power. The product $LN$ is called piston-speed of an engine, and with a constant value for this product the length of the stroke may be long, and the number of strokes per minute small, or a greater number of strokes per minute may be made with a short length for each stroke. It is further clear that by making the product $LN$ large we can correspondingly diminish the factor $A$, and by making $N$ large both the diameter and length of the engine will be diminished. When both high rotative speed and high piston-speed are combined the engine becomes compact, is easily regulated, and is light. Such an engine, however, is not ordinarily so economical in the use of steam as a more moderate application of these principles permits, by reason of the large clearance volumes in the cylinder, and by the necessity of a copious lubrication.

The usual engine-cylinder has a circular piston traversing a cylinder whose length varies from the diameter of the piston up to twice its diameter. Steam is admitted alternately on each side of this circular disk or piston, and causes it to move first in one direction and then in the other. This most common form of a cylinder is shown in Fig. 11, which represents a longitudinal section of a cylinder, with its piston and piston-rod. Fig. 1 represents a section of the cylinder of the Corliss engine. It shows a different arrangement of openings for the entrance and exhaust of steam. Fig. 2 represents the piston with its packing-

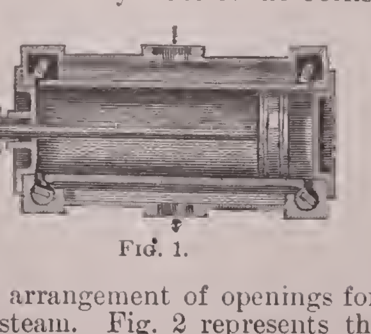

Fig. 1.

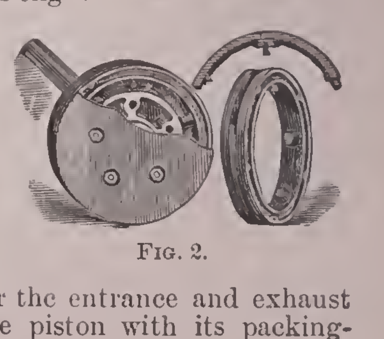

Fig. 2.

rings. These rings serve to prevent the escape of steam past the piston. The steam which has done its work of driving the piston in one direction is permitted to escape from the cylinder, and is called exhaust steam. The motion of the piston is carried outside by a piston-rod through

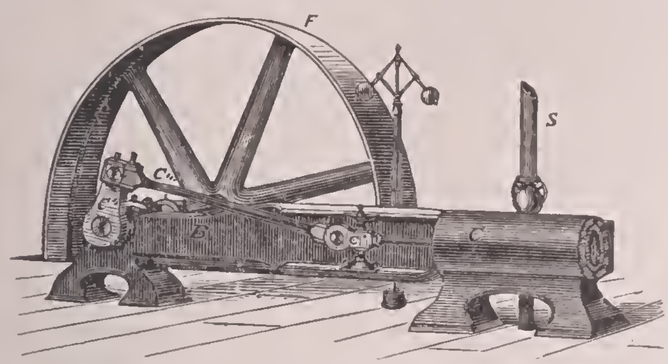

FIG. 3.—Horizontal stationary engine.

a device in the head of the cylinder so constructed as to permit the rod to slide in and out steam-tight. This apparatus is called a stuffing-box, and is arranged so that a fibrous and elastic material is forced against the rod by being compressed by a gland in an annular cavity. The end of the piston-rod which protrudes from the stuffing-box is guided by a cross-head which compels it to move in the axis of the cylinder by sliding between guides. In certain engines this rectilinear movement of the cross-head is secured by a linkage without the use of guides. Such linkage is called a parallel motion. The cross-head carries a pin called the cross-head pin on which vibrates the connecting-rod, by which the motion of the cross-head in a straight line is converted into the continuous rotation of the crank, by whose means the main shaft of the engine is caused to rotate continuously in one direction by the alternating traverse or reciprocation of the piston in the cylinder. The type above described is much the most widely extended, and is considered the most efficient and economical.

Fig. 3 exhibits the mechanism of such a stationary steam-engine, by which the reciprocating rectilinear motion of the piston and piston-rod is converted into continuous rotary motion. In this illustration C represents the cylinder, C′ the cross-head moving in guides, C″ the crank, C‴ the connecting-rod, F the fly or band-wheel, S the steam-pipe. Fig. 4 represents generally the corresponding features of the Corliss engine.

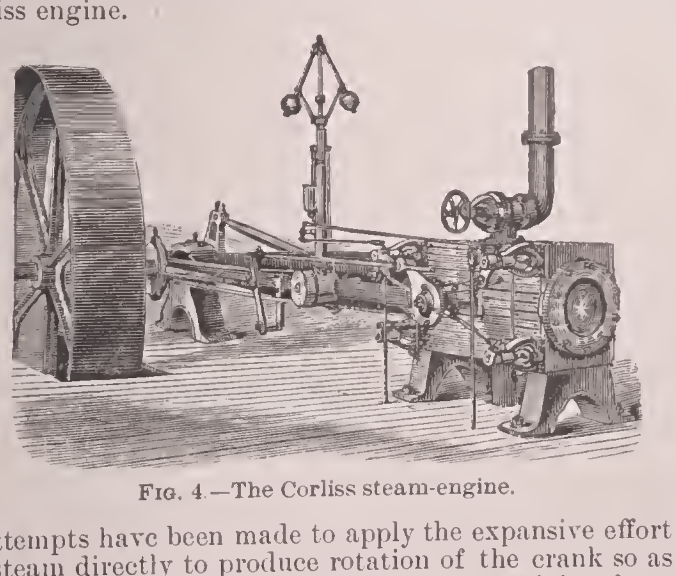

FIG. 4.—The Corliss steam-engine.

Attempts have been made to apply the expansive effort of the steam directly to produce rotation of the crank so as to get rid of the reciprocating motion and the weight of mechanism required for conversion of reciprocating into rotary motion. While the rotary engines offer considerable advantages from their compactness, the direct application of power, the ease with which they are reversed, etc., they are not usually an economical type in consumption of steam by reason of leakage and the difficulty of using steam expansively.

FIG. 5.

Figs. 5 and 6 are sketches illustrating the rotary forms of engine as invented by Watt and Bramah respectively. In these engines the cylinders are truly cylindrical, but the pistons revolve about the axes of the cylinders. Of many hundreds of devices of rotary engines these are the principal types.

If the connecting-rod of a reciprocating engine be thrown out from its mechanism and the free end of the piston-rod attached to the crank, then the piston-rod must have an angular motion to provide for the play of the crank, and this compels the cylinder to have a motion of oscillation. The engine is then called an *oscillating engine*, the cylinder being mounted upon trunnions on which it oscillates, the trunnions being hollow so that steam may enter through one of them and be discharged to the other. While some large engines have been built of this design, the difficulties from leakage when wear has begun are objections to this type. The *trunk-engine* is a mechanism in which the connecting-rod is attached directly to the piston which slides in the cylinder in a straight line. To enable the angular motion of the connecting-rod to pass out of the cylinder steam-tight, it is arranged to swing within a hollow cylinder or trunk whose diameter permits this angular motion without striking the sides and which passes out of the cylinder through a stuffing-box. As this arrangement makes the piston offer only an annular area to the steam on the trunk side, the trunk is often duplicated on the side opposite the crank to equalize the effort on the two strokes. Many illustrations of these trunk-engines are presented by the compact designs of monitors and other small naval vessels. A third type of engine results when the connecting-rod from the cross-head is brought backward at the side of the cylinder or part way to it to a crank at its back head or between the cylinder and cross-head. This type of engine is called a *back-acting engine*.

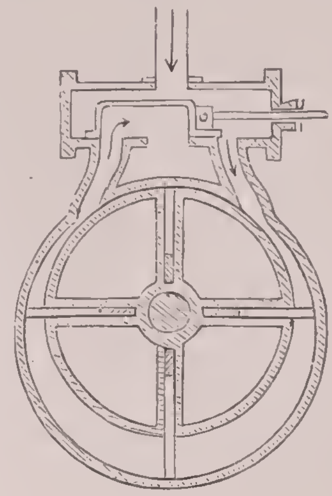

FIG. 6.

Engines may be grouped, according to the direction of the axis of the cylinder, as horizontal, upright, and inclined. The horizontal engine is much the most common because of the easy accessibility of all its parts, the ease with which its foundation can be made, and because all its parts lie close to the foundation. The vertical or upright engine has the advantage of having the piston bear equally over the entire bore of the cylinder without a tendency for the weight of the piston to wear the cylinder out of round. On the other hand, the weight of the reciprocating parts would make the effort on the up and down stroke unequal unless care be taken by special arrangements to neutralize this inequality. The upright engine appears in two forms: with the cylinder above the shaft, known as the inverted vertical, and with the cylinder below the shaft, which may be called the direct vertical. The inverted vertical is much the most usual because the revolving parts are close to the foundation, and the parts which are remote from it are those which have no motion. This is the prevalent type for the marine engine of screw-vessels where the revolving shaft must necessarily be close to the keel (Fig. 10). The direct vertical engine is not much used in the U. S.

In *beam-engines* a vibrating beam is introduced between the reciprocating piston and the revolving shaft. As distinguished from these, other engines are called *direct-acting*. In its most usual form the beam-engine is arranged to have a vertical cylinder from the top of which the piston-rod protrudes. The cross-head is connected by the short connecting-rods to one end of the oscillating beam, which is supported usually at its middle point upon a massive bearing. At the other end of the beam a long connecting-rod passes to the crank-pin, so that the alternating motion of the piston is converted by this means into the rotary motion of the shaft. By reason of the fact that in early engines of the beam type the long connecting-rod from the outer end of the beam was attached to the pump-rods of a mine or pit, this long rod in beam-engines is often called the pitman. Fig. 7 shows the mechanism of the American beam-engine as designed for large steamships and river-boats. In this sketch C represents the cylinder, C″ the condenser, B the working- (or "walking") beam, C″ the connecting-rod, C‴ the crank, A the air-pump, V valve-gearing. The beam-engine as used for pumping gives great convenience of attachment for the rods of the pumping-barrels, and its flexibility in a vertical plane has made it a very favored design for side-wheel vessels, particularly where the condition of shallow water prevented the attainment of vertical stiffness in the hull. Triangular beams have been used to enable a horizontal steam-cylinder to operate vertical pumps at a considerable distance below the level of the engine-room. The beam-engine also is convenient where more than one

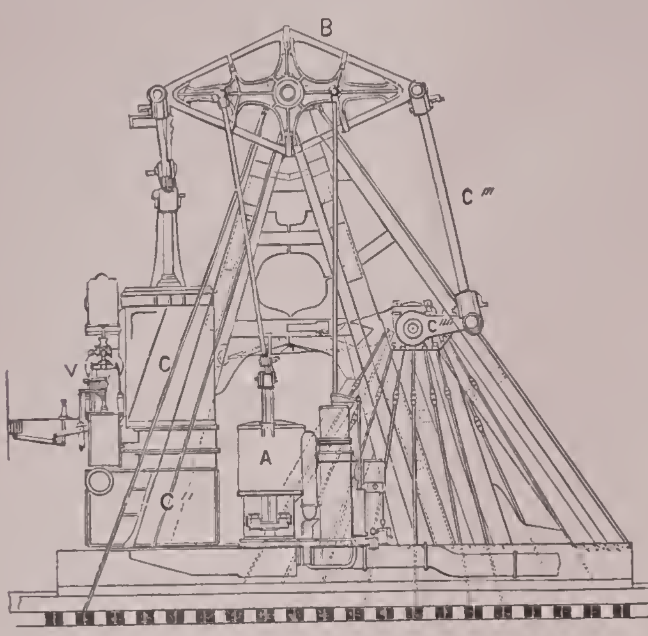


FIG. 7.

cylinder is to be used to produce motion upon one crank-pin. The *side-lever* engine is one in which the beam is placed below or at the side of the cylinder so as to bring the center of gravity low down in the hull of a side-wheel steamer and below a protective deck.

All reciprocating steam-engines may be classified according to the way in which the steam is employed in their cylinders. The steam may be permitted to flow from the boiler into the cylinder throughout the full length of the stroke of the piston. It must then escape as exhaust from the cylinder at the full pressure at which it entered and carrying with it all the heat which corresponds to that pressure. Such an engine is said to take steam at full stroke and to work without expansion in the cylinder or without cut-off. A second class of engine allows the steam to flow from the boiler into the cylinder at full boiler pressure for but a part of the stroke only. The admission of steam is then cut off by the proper valve mechanism, and the steam inclosed in the cylinder expands in the increase in volume as the piston moves under its action toward the end of its stroke. This increase in volume is accompanied by a fall in pressure and a reduction in temperature, so that upon exhaust a less weight of steam and a less number of units of heat are rejected from the cylinder than in the first case. Such an engine is called an expansive-working engine or a cut-off engine. The degree of expansion is the reciprocal of the point of cut-off expressed in terms of the length of the piston-stroke.

Again, the steam may be rejected from the cylinder at the pressure of the atmosphere, escaping as the vapor of water at 212° F., or slightly over. Such an engine is called a non-condensing-engine, because although the steam rejected passes back to water in the atmosphere at large, it is not condensed to water in connection with the engine itself. In the other type the steam is exhausted from the cylinder into a vessel, where it comes immediately into contact with a cool medium, and is thereby reduced back to warm water with the very great reduction of volume which follows such condensation, so that if the condensed water is continuously removed from the condenser a more or less complete vacuum can be maintained therein. Such an engine is called a condensing-engine, and has the advantage over the non-condensing-engine of a greater mean pressure in the cylinder for a given boiler-pressure and point of cut-off, from which results a smaller engine for a given power, or more power from an engine of given proportions. The heat in the steam is also utilized more completely, as the hot water which is caught in the condenser is pumped back again to the boiler at a higher temperature than the feed-water would otherwise have. An air-pump is used for draining the condensed water from the condenser. This, in many types of condensing-engine, is operated from the beam or cross-head of the main cylinder (Fig. 7). In recent practice it has been preferred to operate the air-pump independently with its own steam-cylinder. It can then be run at higher speed than the main engine, the vacuum in the condenser can be created before the main engine is started, and the air-pump can be located where it may be found most convenient. The advantage of the attached air-pump is that the large engine-cylinder is usually more economical than the small detached one. By putting the condenser at a height over 32 feet in the air, with a pipe running down into a reservoir or well, in which it is at all times sealed, it will be apparent that gravity acting upon the water in the condenser and its descending pipe will compel the water to stand in the pipe at a height at which the barometric pressure of the atmosphere will just balance the column. In other words, a Torricellian vacuum prevails in the condenser. By causing the water to meet the exhaust steam at this height condensation is continuous, and all that is necessary is to provide by the principle of induced currents or otherwise for the removal of air which will enter the condenser by leakage and from the steam and water. Such condensers are called gravity-condensers. Two great types of condensers are used. In the first the steam meets the condensing water directly and cools it by contact; the cold water or injection enters the condenser in a jet by atmospheric pressure, which gives to this type of condenser

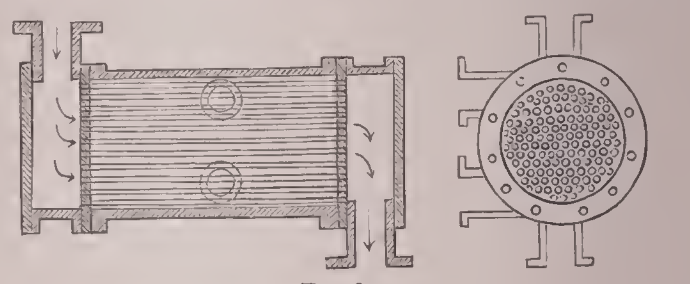

FIG. 8.

the name of jet-condenser. In the other type the steam is condensed by contact with a surface of brass tubes which are kept cold by the circulation through them of the condensing water (Fig. 8). The condensing water enters the tubes at one end, as shown by the arrows, and is discharged at the other, while the steam is admitted around the tubes. A mode of packing the ends of the tubes by ferrules of compressed pine wood is shown in Fig. 9. This device, the invention of Horatio Allen, and others like it have contributed to render the surface-condenser more perfect in its operations. In the jet-condenser a less quantity of water is required and the air-pump handles it all. The steam and condensing water are intimately mixed. In the surface-condenser arrangement the condensed steam is pure distilled water and does not become mixed with the condensing water, which can be impure and unsuitable for use in the boilers. The air-pump handles only the water condensed from the steam, and special pumps, called circulating-pumps, are required to circulate the cooling water around the tubes. In sea-going vessels surface-condensation is almost universal, the salt water from out-

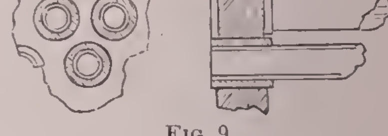

FIG. 9.

side of the hull being circulated through the condenser and overboard, while the pure distilled water from the air-pumps is used over and over again in the boiler.

Another difference which can serve as a basis for classification of steam-engines is brought about by the way in which the alternating traverse of the piston is affected by the pressure of steam. If both strokes forward and back, or upward and downward, of the piston are produced by the pressure of steam upon its area, the engine is said to be double-acting. Where steam drives in one direction only the engine is called single-acting. By far the greatest number of engines are double-acting. What is called the Cornish engine is one of the best known of the single-acting engines. In this design, which is mainly used, and is at its best, for pumping, the steam enters the cylinder from the boiler, and by its direct pressure and after cut-off by its expansion the piston is driven in one direction. When this stroke is completed a valve is opened by which an equilibrium of pressure is established through a side pipe between the top and bottom of the cylinder around the piston. The piston then yields to the action of gravity and returns to its initial position without the use of fresh steam, so that one stroke forward and back is accomplished by a single admission of steam. The Cornish engine appears in two forms: In the first, the piston is connected to the massive pump-rods of a mine-shaft, or to the heavy plungers of a water-works pumping-engine, by means of a beam, so that the working stroke which lifts the weight of the rods or plungers is the down-stroke of the piston, and the piston-rod passes out of the top of the cylinder. In the second type, which is known as the Bull Cornish engine, the piston-rod is attached directly to the rods or plungers, over which the cylinder is placed, so that the piston-rod goes down to the lower head, and the working stroke is the upward traverse of the piston. The Cornish engine has no fly-wheel, and the rapidity of its stroke is controlled by the flow of steam or of water through the valves. It is this peculiarity, which permits the mass of a long column of moving water to be the controlling feature of the velocity of the piston, that made this type of pump a popular form in early days. The objections to the system are the great bulk of the cylinder with comparatively small power, the massive foundations required, and the danger from accident to the engine if the pump-barrels should fail to fill, whereby the engine would make an over-stroke, since there is no crank to regulate the length of the stroke. The Cornish engine is usually designed to have its steam-valve operated by a cataract. The cataract consists of a small cylinder fitted with a plunger. The pump-rods on their working stroke lift the plunger in the cataract-cylinder, and the latter is filled with water. A weight upon the cataract-plunger tends to make it descend, but the speed of its descent is controlled by a valve upon an outlet-pipe whose position, by impeding the outflow of water, controls the time in which the cylinder will empty. The descent of the plunger, when near the bottom, opens the admission-valve of the main engine, and thus causes a stroke to be made. The plunger of the cataract-cylinder thus moving independent of the main engine will cause the latter to make strokes intermitting with periods of rest. For rotative types of engines two single-acting cylinders can be attached to the shaft with cranks at opposite phases, the two producing the same effect as a double-acting engine, with the gain that the pressure is always in one direction, and there should be no lost motion.

Another great principle of classification of engines is determined by the fact that the expansion of the steam in the cylinder may take place in a single cylinder, or be made continuous in two or more cylinders. This difference divides engines into simple, compound, and multiple expansion. In the simple engine the steam does its work upon one stroke of the engine, and then escapes as exhaust either into the atmosphere (non-condensing) or into a condenser, where it is reduced to water and causes a vacuum (condensing). A simple engine may have more than one cylinder, but if each cylinder takes steam direct from the boiler, and that steam is rejected at exhaust without doing additional work in another cylinder, such engine is not a compound engine. In the compound engine the steam enters a cylinder of a certain volume from the boiler and works in it as in a simple engine. The exhaust steam from this cylinder passes into a second cylinder of larger volume (usually three or four times that of the first), where it acts as a driving pressure, and from which it is exhausted when the stroke is completed. It will appear, therefore, that the driving steam for the second cylinder is a back-pressure on the exhaust side of the first cylinder, but as the areas are different the net effort is positive to produce motion of the larger cylinder. If the first cylinder has no cut-off, but takes steam full stroke from the boiler and without expansion, it is obvious that the final volume of the steam is as many times greater than its initial volume as the capacity of the larger cylinder is greater than the smaller, so that an expansive working of the steam is secured, although the first cylinder has a constant propelling effort from the beginning to the end. In a simple engine this expansive effect could be produced only by cutting off admission early in the stroke, whereby the propelling effect would have to be in excess at the beginning of the stroke in order that at the end, when the pressure had fallen, there might still be sufficient propelling effort to overcome a constant resistance. The compound engine, moreover, by distributing the range of temperature between the initial and final pressures of the steam, when the number of expansions is considerable, in more than one cylinder, causes a diminished loss of heat, both by radiation and contact of the walls of the cylinder with the steam. The transfer of heat by both these processes is greatest and most rapid when the difference of temperature is greatest. By keeping this difference of temperature less by having it distributed in two cylinders, the total loss is less than it would have been in the larger cylinder if the latter had been used alone in a single engine. The principle of the compound engine was first proposed by Jonathan Hornblower for the single-acting engine in 1781. It was reintroduced by Arthur Woolf for the double-acting engine in 1804. It was applied, to some considerable extent, to beam-engines by McNaught about 1845, but really secured its modern development by the application of the principle to marine practice by John Elder, of Glasgow, in 1854.

When the expansion is made continuous, as in the compound engine, through three cylinders, the engine is called triple expansion (or tri-compound); when the expansion is continuous in four cylinders the engine is called a quadruple expansion, or the general name of multiple expansion is given to an engine having the expansion continuous in more than two cylinders. It is the continuity of expansion and not merely the number of cylinders which gives the engine its name. It is often inconvenient in engines of great power to construct a single large cylinder of volume sufficient to secure a sufficient increase of volume to attain the desired range of pressures and the ultimate low temperature. It is usual to call the cylinder which receives the steam directly from the boiler the high-pressure cylinder; the last one in the series, from which the exhaust steam escapes, is called the low-pressure cylinder: if the expansion is continuous in three cylinders the middle one between the high and low pressure cylinders is called the intermediate cylinder. If the steam passes through four cylinders continuously there will be two intermediate cylinders, called respectively the high-pressure intermediate and the low-pressure intermediate. In a multiple-cylinder engine, in which the steam exhausts from one cylinder into two others, and acts in each at the same pressure, such two cylinders of equal pressure are designated as the first and second intermediate, or the first and second low-pressure, as the case may be. When two pistons of unequal diameter, working with steam of continuous expansion, are arranged upon the same piston-rod, the engine is called a tandem-engine; when the small cylinder is vertically over the larger in an inverted vertical engine, the name steeple-engine has been given to it. The cranks of a two-cylinder compound engine (sometimes called a bi-compound) can be arranged so as to be parallel to each other, so as to be 180 degrees apart, or so as to be 90 degrees apart. In the first two arrangements the steam can pass directly from one end of the smaller cylinder to the same or opposite end of the larger; in the third case, when the cranks are quartering, a receiver must be provided into which the steam from the high-pressure cylinder shall pass while the low-pressure piston at its dead point at the end of its cylinder offers no volume to receive the steam discharged from the preceding one. Such engines are therefore called receiver-compound engines, and when arranged, as they usually are in stationary practice, so that their two cranks are on opposite ends of the driving-shaft, compelling the steam to cross over a short passage between the cylinders, the engine is called a cross-compound engine. This receiver type and the cross-compound form offer the advantages possible from introducing into the receiver a device called a reheater, reheating or regenerating the steam in its passage from one cylinder to the other. The advantages of economy and from securing ability to use high pressure for the entering steam have been the great reasons for the wide increase in the development of the multiple-expansion engine, both condensing and non-condensing.

A classification of the steam-engine finally, with respect to the uses to which its developed power is to be applied, would be almost an enumeration of all the foregoing types in their different forms. A rough classification might be first into engines for propulsion and engines for stationary uses. The engines for propulsion on land are the locomotive and the traction engine, and on the water the type of marine engine of transatlantic and naval practice, and the type of beam-engine used more for coastwise traffic and in shallow waters where the paddle-wheel is the means of propulsion.

The locomotive and the traction engine consist of an internally fired boiler (see STEAM-BOILER) supported upon wheels, and carried by a frame to which the effort of the cylinders through the wheels gives the desired motion. The wheels receiving the effort of the steam are called driving-wheels, and are four, six, eight, or ten in number, dependent upon the desired traction or hauling power of the machine; this latter is, under ordinary circumstances, one-fourth of the weight borne on such driving-wheels, and the diameter of the cylinder and its stroke is usually proportioned so that the power of the cylinders shall be able to cause the driving-wheels to slip. Ability to start heavy trains is secured by giving a relatively small diameter to the driving-wheel, while very high speed requires a relatively larger diameter of the wheel, inasmuch as the circumference of the driver measures the space through which the engine will move forward in one revolution, which corresponds to two traverses of the piston. If the driver is too small for a high speed the number of revolutions per minute will become excessive.

In the traction-engine for hauling upon common roads, where the speed is relatively low, it is usual to reduce the speed of the driving-wheels from that of the engine-shaft by intermediate gearing. The driving-wheel also needs to have a tire of great breadth to distribute the weight of the boiler and engine over a large area of yielding roadway. The tires are also usually corrugated or roughened to give adhesion. The traction-engine must have a very efficient means for steering it to enable it to make the sharp turns required in ordinary roads, and it is furthermore usually so designed that by throwing out the intermediate gearing from connection with the traction-wheels, the steam-engine proper can be used as an agricultural engine for threshing, milling, and other similar purposes.

The marine engine of transatlantic practice is usually an inverted vertical compound or triple-expansion, double-acting reciprocating engine. The cylinders are supported on massive cast-iron or cast-steel frames shaped something like a letter A, while the revolving shaft is below the cylinder and between the frames so as to secure immersion for the

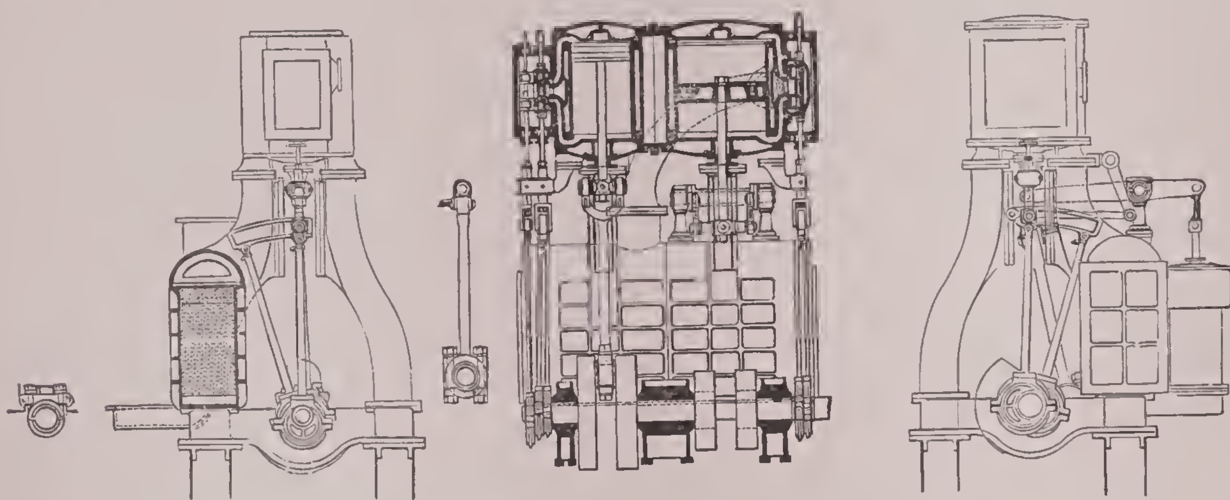

Fig. 10.

screw or propeller at the stern (Fig. 10). In the triple engine the cranks stand at angles of 120 degrees from each other, securing a good distribution of the turning effort upon the shaft. The cross-heads of the first and last cylinders usually operate the air-pump, by which the surface-condenser is freed from the condensed steam, while detached circulating pumps force the water of the ocean through the tubes to cool them. Injury to the valves by which the ocean water for condensation enters the engine has been the occasion of some noteworthy disasters to transatlantic vessels. The turning effort of the engine-shaft is transmitted from the engine to the propeller through a long shaft provided with the necessary bearings, and, in particular, a massive thrust-bearing, upon which is imposed the resistance to endwise motion which the reaction of the screw exerts as the vessel is forced forward. The thrust-bearing accommodates a series of collars, or enlargements of the shaft, whose area and number are proportioned so as to keep the pressure per inch of surface below that at which lubrication becomes difficult or impossible.

For the side-wheel vessel the necessity for having the center of the water-wheel shaft elevated above the water a distance nearly equal to the radius of the wheel has made the beam-engine and the inclined direct-acting engine the type most frequently met. Oscillating cylinders have been used in the past, but are not likely to be selected for large designs in the future. The inclined engine in the earlier practice was a simple condensing-engine; it has been made more recently compound and triple expansion. The advantage of the inclined type is that the center of gravity of the engine is low; the advantage of the beam type has been the flexibility which that construction permits, and that it secures a high piston-speed with a relatively small number of revolutions imposed by the large paddle-wheel, and allows a long stroke and a long connecting-rod without taking up valuable deck-room desired for cargo space in vessels of little depth of hull. On the other hand, when conditions necessitated such exceeding shallowness of hull, due to very light draught of water, that the concentrated weight of the vertical cylinder and the overhead beam became impracticable, there was developed a type of horizontal engine with long stroke and small diameter of cylinder, so that the weight of the engine might be distributed over a long length of the hull. The rapid current and tortuous channel of Western rivers suggested also the advisability of making the paddle-wheels on the two sides operate by separate cylinders, with a further advantage in distributing the weight of the engine. Furthermore, for towing on such rivers a type of steamer with the water-wheel at the stern has been developed, the wheel driven by cranks at each end of the shaft which are operated by long connecting-rods, one at each side. Great advantage has followed, where absence of ice makes the practice possible, from arranging the floats of paddle-wheels so that they will enter the water and leave it perpendicularly. The radial float tends to lift the vessel as it strikes, and to lift the water as it leaves; the perpendicular or feathering paddle produces all its effect in propulsion, without wasting a lifting effort. Feathering is secured by connecting the floats by a system of linkage which appears in several different forms.

For land engines and stationary practice probably the five most widely extended uses which involve the largest units are for pumping, for electric lighting and power, for mill and manufacturing purposes, for hoisting and air-compressing in mining, and for driving the roll-trains of iron and steel works.

For pumping, in addition to the Cornish engine, mentioned above, the two great types most usual are the beam-engine and the direct-acting pumping-engine. The older form of beam-engine was a single cylinder condensing-engine with overhead beam. The beam gives most convenient attachment for connecting-rods and plungers. More recently the compound and triple-expansion types have come forward, with either the beam below the cylinders or employing a beam of angular type, to various points of which are attached the rods to the fly-wheel shaft and to the pumps. An objection to the use of the fly-wheel in massive pumping-engines is its tendency alternately to accelerate and retard the flow of water in the main as the varying crank angle permits the piston to change its velocity. The direct-acting pumping-engine has no fly-wheel, but is so constructed that it can not stop when its stroke is completed by the expedient of having the valve which distributes the steam in the cylinder operated by another or an auxiliary engine, which latter receives its steam by the action of the piston of the main engine. This arrangement makes it impossible for the engine to stop with both steam passages covered by the valve. If this second or auxiliary steam-engine is made also to be a pumping cylinder, the type of direct-acting pump known as the duplex pumping-engine results. This type prevails very largely, and besides the advantage of having no fly-wheel and no dead centers, it offers the advantage of keeping the column of water always in motion, while a moment's pause at the end of the stroke of each cylinder permits the valves in that cylinder to seat themselves quietly before the return stroke begins. In some recent designs the horizontal type has been selected with fly-wheel and vertical beams.

For electric-light and power stations, and for electric railways, the type of horizontal engine, simple or compound, has been much used, the power being distributed among a large number of small units. In more recent practice, with larger units, the inverted vertical type, compound and triple expansion, has been extensively introduced, in many cases the revolving armature for the dynamos being continuous with the revolving shaft of the engine.

For both mill and manufacturing purposes the horizontal engine in tandem, cross-compound, or triple-expansion form has been by far the most widely distributed. The fly-wheel of such engines is usually made with a broad face, so as to be used as a belt or band wheel from which the power could be taken off to different driven shafts as required. The engines for cable-railway practice are usually of this type, but instead of flat belts, round ropes bearing in grooved pulleys are much more generally applied.

For hoisting-engines in mines and for elevator service it is usual to reduce the speed of the engine-shaft to that of the shaft which carries the hoisting-drum by means of toothed wheels or gearing; this permits the use of cylinders of smaller diameter operating at a high speed with the corresponding advantages. In air-compressing and blowing engines the horizontal and vertical type are very usual, the steam and air pistons being upon the same rod, and two connecting-rods from a cross-head between the two cylinders being coupled to crank-pins on the fly-wheel shaft. These air-compressing and blowing engines require a heavy fly-wheel by reason of the fact that the resistance is least at the beginning of each stroke, so that energy must be stored in them if the engine is working expansively, to be given out at the end of the stroke when the effort of the expanding steam is the least. For rolling-mill engines both horizontal and inverted vertical engines are used, in most cases connected directly to the train of rolls. The great variation in the resistance met by the rolls requires a very massive fly-wheel construction.

The requirement that the piston in the engine cylinder shall admit steam alternately upon its one side and the other, and shall at the same time discharge exhaust steam from one end while receiving live steam from the boiler at the other end, has given rise to a great many different types of mechanism for this purpose. The simplest type is a single valve, sliding upon a flat surface made at a convenient place on the side of the cylinder. The valve is caused to slide by means of a crank or eccentric, usually upon the revolving shaft, and so important is this function in the operation of an engine that space must be taken for a full description of the fundamental forms.

Fig. 11 represents a section of an engine-cylinder by which the action of the common D slide-valve (so called from

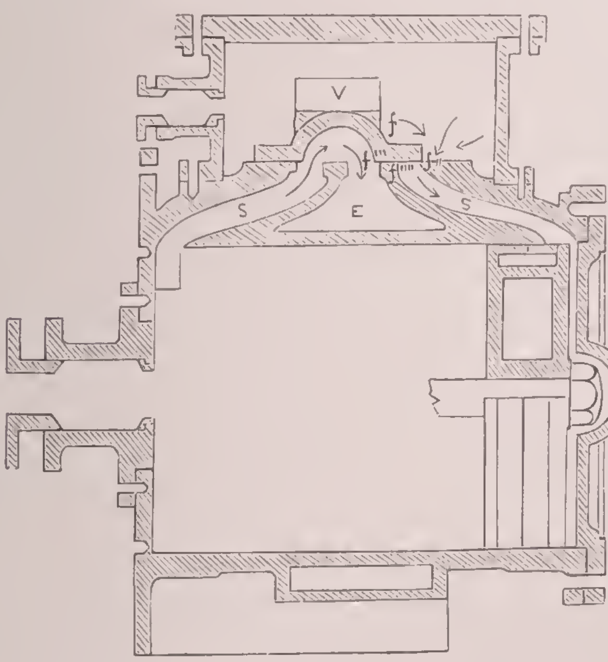


Fig. 11.

the shape of its section) may be explained. In this section V represents the valve, situated in a rectangular box or casing, which is in full communication with the boiler when the engine is running. This box, called the *steam-chest*, situated on the side of the cylinder and forming part of it, is constantly full of steam at nearly the boiler-pressure when the engine is in motion. S S are passages called steam-passages leading from this chest to the ends of the cylinder; E, a passage called the exhaust-port leading to the open air or to the condenser. The ports are long rectangular openings in a plane surface on the side of the cylinder. The valve V has such form and dimensions that it covers all these ports when in its neutral or middle position, and is caused to slide back and forth just enough to uncover alternately the steam-ports S S, the amount of this sliding, even in the largest engines, in which the valve may have a superficial area of several square feet, being only 3 or 4 inches. In small engines the extent of sliding in one direction may be only a fraction of an inch. This movement of the valve to the right and left is produced by means of an eccentric or small crank and a special connected rod attached to the valve, by which its motions are made to correspond in point of time with the motions of the piston; but the eccentric and main crank being keyed to the shaft in different positions, these motions, although taking place in the same times, will not at each moment correspond in direction or velocity.

It will be seen from the figure that the piston is at the end of its stroke, and its return to the opposite end depends on its receiving the impulse of steam admitted from the steam-chest just at this moment to drive it back. It will be observed, also, that the valve has been moved from its central position, covering all the ports, already sufficiently far to open the steam-port on the right a small amount, and steam is already admitted and fills the narrow space to the right of the piston. Thus the full boiler-pressure, or nearly so, is already acting on the right of the piston to drive it back. The condition of things on the left of the piston at this moment is quite different. The steam which has been confined in that part of the cylinder to the left, and which by its expansive action has driven the piston toward the right, is free to pass from this space into the atmosphere back through the steam-port S through which it came, but not into the steam-chest—the port S leading through the hollow of the valve to the exhaust-port; and this opening is by the movement of the valve already larger than the opening for admission on the right. The phenomena which take place while the piston moves from the right to the left are as follows: The valve completes its excursion to the left, and returns, so as to shut off the supply of steam on the right of the cylinder, while the piston is still in motion to the left. After the supply is cut off, the confined steam continues to act by its expansion alone, no more being admitted. The fraction of the stroke at which this occurs depends on the dimensions of the valve and the arrangement of the mechanism by which it is moved. It may happen, also, that by the same movement of the valve on its return to the right, and while the piston is still moving to the left, the exhaust-passage is closed so as to confine a portion of the steam in the left-hand part of the chamber, to act as a sort of cushion. This will occur at the moment the inner edge of the hollow part of the valve on the left reaches the inner edge of the steam-port. As the valve continues to move to the right, the outer edge of the valve on the left approaches the edge of the steam-port, and at a certain instant opens that port, letting new or "live" steam from the boiler into this end of the cylinder, which mingles with the exhaust steam already confined there as a cushion. This phenomenon usually takes place but an instant before the piston reaches the end of its stroke, in order that it may meet not only a cushion of exhausted steam, but of steam at full pressure from the boiler.

Fig. 12 represents on a larger scale a section of a simple

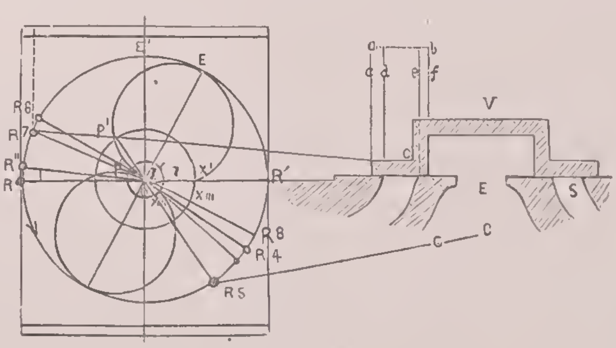


Fig. 12.

slide-valve and the cylinder ports, the valve being in its middle or neutral position, covering all the ports. The projection of the outer edges of the valve beyond the edges of the steam-ports, so that the ports are more than covered by the valve, is called the outside lap. It exercises an important influence on the distribution of the steam. The projection of the inside edges of the hollow part of the valve over the inner edges of the steam-ports is called the inside lap; it is always relatively small, and often does not exist to an appreciable amount.

The adjustment of the single slide-valve with a single eccentric, when once made, can not be easily changed while the engine is running. Where this is desirable in order to change the degree of expansion, and by that means the power of the engine, the link-motion is generally used. This is a device shown in Fig. 13, by means of which the

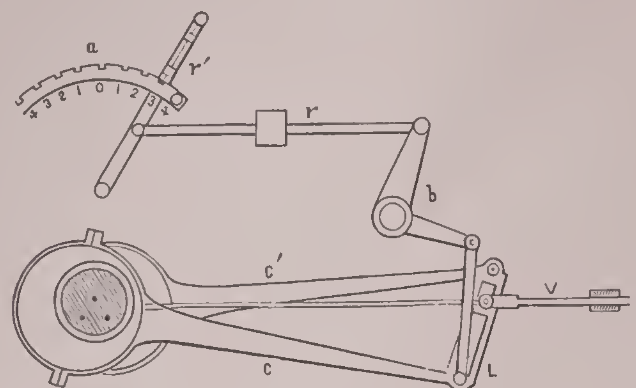


Fig. 13.

angle of advance and the eccentricity are simultaneously altered; and it is accomplished by means of two eccentrics, $C\ C'$, and a link, L, the effect of the two, with the link, being to make one virtual eccentric. The arrangement shown in Fig. 13 is that commonly used in locomotives, and is known as Stephenson's link-motion. It is arranged with a reversing lever, $r'$, by which either the eccentrics C and $C'$ can be caused to move the valve independently of each other, but one giving a forward motion and the other a backward motion to the engine. At positions of the link intermediate between these the virtual eccentric, which is the resultant of the two, controls the movements of the valve, and varies the degree of expansion. The notches in the arc ($a$) determine certain positions of the link with reference to the valve-stem, V. Applying Zeuner's valve-circle diagram to the Stephenson link with open rods, as in Fig. 14, O E is the

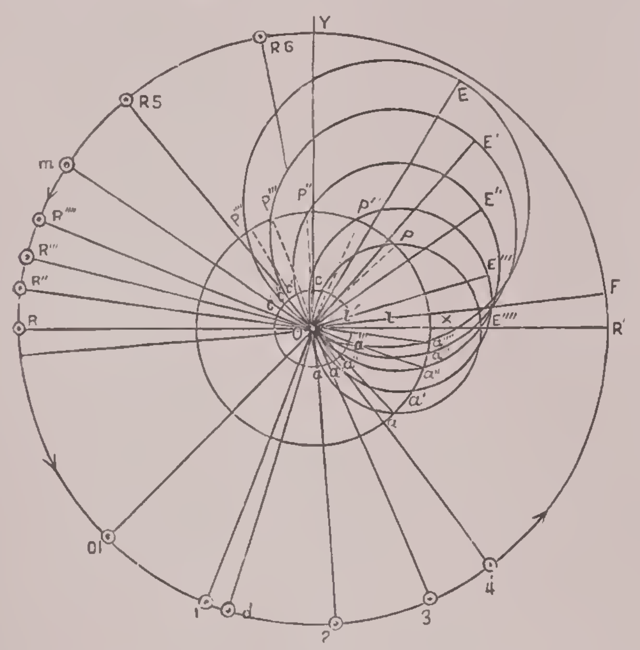


Fig 14.

eccentric and Y O E angle of advance for full forward gear (notch 4). For the third notch, O $E'$ gives the corresponding eccentric and angle of advance, and so on to mid-gear (notch 0), in which the eccentricity is O $E''''$ and the angle of advance 90°. The points of admission $a\ a'\ a''\ a'''$ on the left, from mid-gear to full-gear, the corresponding angles of lead, the points of cut-off $p\ p'\ p''\ p'''\ p''''$, the points of release $d\ d'\ d''\ d'''$ on the right of the piston, and the points of compression $c\ c'\ c''\ c'''$ on the right, are all shown for different grades of expansion; and the study of the diagram will also show the variations of lead, $l\ x$, for these different grades.

The extent of sliding movement of the valve is a consideration of importance, since the hurtful work of its friction depends directly on the extent of its motion. When slide-valves are very large, this useless work becomes an important item of expense. There are two means of reducing it: first, by reducing the travel or space passed over at each stroke; and, second, by relieving the back of the valve from a portion of the pressure of the steam in the valve-chest. Fig. 15 represents a valve in which both these methods are used. P is a plan of half of the valve, and S a section. There are two steam-ports, $s\ s$, on each side of the exhaust-port. When the valve moves from left to right, for instance, both ports $s\ s$ on the left are uncovered simultaneously; steam enters the *outer* port directly from the steam-chest, and the *inner* port indirectly through the arched opening in the valve O, the exhaust taking place on the opposite side, into the hollow of the valve and into the exhaust-port E. A partial vacuum is maintained on the back of the valve by means of a packing-ring, $r\ r$, which slides against the lower surface of the steam-chest cover, the space inclosed between this and the valve being connected with the condenser. This kind of valve is called an equilibrium double-ported slide-valve. The valve of which this is a representation had a total length of over 5 feet and a width of over 4 feet, the diameter of the packing-ring being about 4 feet; the extreme travel of the valve in one direction was only 5 inches, the outside laps less than 3 inches, and the inside laps only $\frac{1}{32}$d of an inch. It formed a part of the mechanism of a large marine engine.

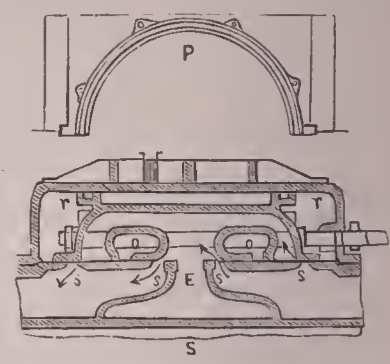


Fig. 15.—Double-ported equilibrium slide-valve.

To avoid long steam-passages, which are disadvantageous, two slide-valves are often connected by a bar and attached to the same valve-stem within the chest, these separate valves being then placed near the ends of the cylinder and having a common exhaust.

*Expansion-valves* and *cut-offs* designate special combinations of valve-mechanism by means of which the steam may be suddenly cut off at any point of the stroke independently of any other phenomena of the distribution of steam. The simple slide-valve, moved by a single eccentric, can not be arranged to cut off the steam at less than one-half the stroke advantageously, because, as will be evident from the inspection of the valve-diagrams for the link-motion, where the higher grades of expansion are used, the compression and release begin so much earlier that the power of the engine exerted in each stroke is diminished, and the efficiency—i. e. the economy—of the power is also diminished. To preserve the efficiency of the steam undiminished, and to place in the hands of the engine-driver the means of adapting the power of the engine to the work to be performed, two systems of construction are employed—one in which the variation in the expansion may be adjusted or controlled by the engine-driver by hand; for instance, when for a considerable period of time the engine is not required to perform its full amount of work, and a single adjustment for the given time is all that is required; and second, when a momentary variation of power may be advisable, so that the speed of the engine may remain invariable. The first system is an arrangement of expansion-valves, operated as required by the engine-driver; and the second system the "cut-off" system, in which the degree of expansion or the supply of steam at each stroke is regulated by the governor.

A great variety of expansion-valves, as well as variable cut-offs, are employed in practice. The most common, and perhaps the most simple and perfect, expansion-valve is exhibited in Fig. 16. In this figure the upper surface of the D-valve is made plane, and it is extended some distance beyond the outside laps, a mortise or rectangular aperture, nearly equal in area to the steam-port, being made in the ends. The valve is in other respects precisely like all other D slide-valves, and is moved by an eccentric, sometimes by two eccentrics, with a link for reversing the engine. The expansion-valve consists of two plates E sliding on the top of the D-valve (which is called in this combination the *distribution-valve*). These two plates are on the same valve-stem, S, which passes through both, and is supplied with screw-threads, right and left hand, so that when the stem is turned on its axis the two plates will approach or recede from each other. On their distance apart depends the period of cut-off, and a device may be attached to the valve-stem outside of the steam-chest by means of which this distance can be made greater or less by turning a hand-wheel even while the engine is running. The degree of expansion is thus controllable by hand. The expansion-valve is moved by a separate eccentric.

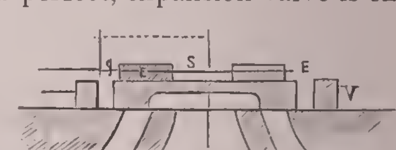


Fig. 16.

*Governor Cut-offs.*—Devices for cut-offs adjustable by the governor are very numerous. The old combination of the governor and throttle-valve is not a cut-off. Its action is to diminish or increase the pressure in the cylinder as the speed of the engine is increased or lessened, and thus diminish or increase the work per stroke; but a diminution of the initial pressure in the cylinder and the pressure throughout the stroke entails waste of heat and power, and is therefore only admissible where these considerations are not regarded as important. In stationary engines employed for many purposes it is not only important in point of economy that this waste should be avoided, but the character of the work may be such that variations of speed, to any considerable degree, are to be avoided. The action of the governor in causing a complete cut-off of the steam at any point of the stroke depends primarily upon the speed of the engine by which it is moved (see GOVERNORS), and secondarily upon its connection with the valves which close the steam-ports. The power of the governor is not sufficient, generally, to move these valves directly, and hence its action consists in nearly all cases in throwing into or out of gear mechanism driven by the engine itself; by which the requisite movement of the valve is produced. One mode consists in a sudden disconnection of the mechanism which moves the valve, which is then driven back so as to cover the steam-port by means of a weight or spring. The closing of the valve is thus almost instantaneous—a matter of importance both in the opening and closing of the valves. The Corliss engine furnishes an instance of this kind of cut-off. Fig. 17 repre-

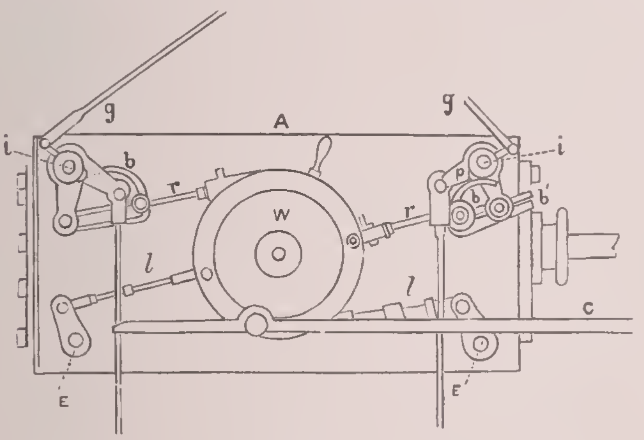

FIG. 17.

sents a section of the cylinder of a Corliss engine, with its four valves—the exhaust-valves and the steam induction-valves. The cut-off mechanism is exhibited in this figure, in which A represents a side elevation of the cylinder. The steam-valves move about axes projecting at *i i*, the exhaust-valves about axes at E E. W is a plate mounted on an axis projecting from the side of the cylinder. It performs the part of a "rocker" simply, being moved backward and forward by the eccentric-rod, *c*. The lever-arms of the lower or exhaust valves are connected with this "wrist-plate" by two links, *l l*, which are permanently adjusted, so as to cause the exhaust to take place at the proper moment. The upper corresponding lever-arms for the induction-valves have the form of bell-cranks, to one arm of which a weight is attached by a long vertical rod, shown in the drawing. The links, *r r*, attached to the wrist-plate are not permanently jointed to the bell-cranks, but the ends of these links or bars slide along the ends of the bell-crank; a notch in the sliding end catches the arm on the return motion and draws it back, opening the valve. The disengagement of this notch is effected by a bent piece, shown at *b*, which, as the link, *r*, is drawn back, strikes a small protuberance, *p*. The position of this small protuberance depends only on the governor. The governor-rods, *g g*, are attached to the ends of levers which move plates or rings embracing the axes, *i i*, and on these plates the protuberances are made. When the hook or bent piece strikes the protuberance, the notch is disengaged, and the weight, acting on the valve, closes it. The cutting off of the steam is thus instantaneously effected.

Another example may be given to illustrate the use of a cam-motion controlled by the governor. Fig. 18 represents a section of the cylinder of such an engine; V V the valves, which are balanced *poppet-valves*. These valves are double—that is, they have two conical seats—and when they are closed, the steam-pressure acting on both sides of the valve, it is nearly balanced. The stems of these valves extend to a position near the middle of the cylinder, and are there actuated by a cam, C, being alternately opened by the cam. When the cam in its revolution releases either valve, it is carried back promptly by a spring. The cam slides vertically on a rod, the vertical motion bringing a new arc of

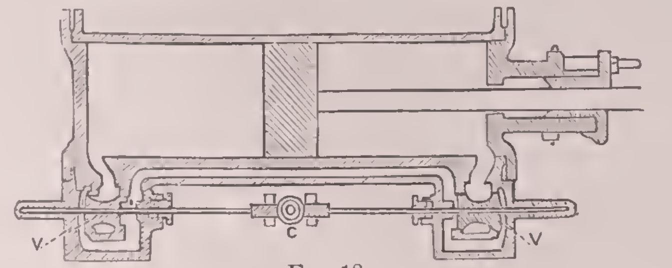

FIG. 18.

the cam into action. This vertical motion is controlled by the governor. Other efficient devices might be mentioned which are deservedly popular, but these are sufficient to illustrate the principle. The Stevens cut-off, so common on U. S. river-steamers, has poppet-valves, the vertical valve-stems having strong toes or projections attached to them which are lifted by corresponding toes or arms attached to the rock-shaft. This cut-off is not controlled by the governor, but is adjustable by the engine-driver. The Ryder cut-off is one in which by an ingenious device the governor performs the work of moving the expansion-valve unassisted by the engine.

*Fly-wheel.*—The fly-wheel is an important and essential appendage to the steam-engine under many conditions.

A stationary engine with a single cylinder requires a moving mass between the piston and the working-point, which by its alternate accelerations and retardations will store up and give out energy in such a manner as to keep the power, reduced to or at the working-point, nearly constant. As an example, the rolling-mill is perhaps the most striking. The useful work to be performed is in this case the driving of a heavy plastic bar or plate of iron or other metal between rolls—an operation not continuous, but occurring only at intervals. With a single-cylinder engine of the ordinary type the pressure of the steam on the piston at any instant is not usually sufficient to overcome the great resistance offered; by the interposition of a heavy fly-wheel, however, the action of the engine produces gradually a high velocity of revolution in the fly-wheel, causing an accumulation of energy. When the metal enters the rolls, this accumulated energy is given out; and even if the steam were suddenly shut off, the fly-wheel would carry the metal through the rolls. This is accomplished, however, only at the cost of a loss of velocity in the fly-wheel, which loss must again be restored by the engine. Again, when the resistance is sensibly constant, as when an engine is driving a shop or factory, the power of the engine is nothing at the dead-points, and is a maximum at nearly mid-stroke. If there were no moving mass to store up and give out energy, the engine must cease working at the first dead-point; for at that point the piston, which is the working-point, comes to a stop and begins to return on its course. When, in addition to the above considerations, the action of the steam on the piston is not constant, but diminishes gradually from the time it is cut off, the necessity for the fly-wheel to keep up a uniform or nearly uniform motion in the shaft is still greater; or, rather, the conditions on which its dimensions depend become more complicated. In cases where the energy of the fly-wheel is required for a short period of time to perform nearly the whole useful work, as in the case of a rolling-mill, its dimensions can not be theoretically estimated with certainty. Precedents and experience must then be the chief guides to the engineer. The dimensions suitable for a given engine, in which the resistances are supposed constant, may, however, be determined from theoretical considerations, at least with the aid of experiments made to determine certain constants which enter the formulas. It is impossible to establish a perfect uniformity of motion in the crank-shaft of an engine, because the mass, which by alternately gaining and losing energy preserves a uniform velocity during certain periods of motion, can only act by itself gaining or losing velocity momentarily at intervals of those periods; but under given conditions the variations of velocity may be made as small as is desirable.

The space available permits only a brief discussion of the theory of the action of steam in the steam-engine.

A certain quantity of steam enters the cylinder at each stroke of the piston, depending on the cut-off or degree of expansion. During this period the piston is actuated by the full pressure of the steam in the cylinder, generally a little less than that in the boiler, and performs a quantity of work represented in foot-pounds by the product of the pressure multiplied by the volume traversed during the period of full pressure, or $p_1 V_1$. After the steam is cut off it continues to act on the piston by its expansive force, but with a constantly diminishing pressure, to the end of the stroke. It is usually assumed in practice that the diminution of pressure takes place during this part of the stroke, according to the law that the pressure is inversely proportional to the volume; and on this supposition the mean pressure throughout the whole stroke is determined by the formula—

$$p_m = p_1 \frac{(1 + \log. r)}{r},$$

$p_m$ being the mean pressure, $r$ the ratio of expansion; the logarithms being taken in the Napierian system. As the piston returns, a certain back or negative pressure is unavoidable, due to the resistance offered by the steam that is being expelled from the cylinder. That pressure can not be determined from theoretical considerations, but it is approximately known from experience.

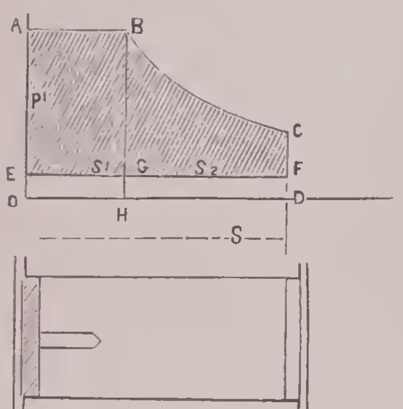

Fig. 19.

In engines in which the grade of expansion may be varied at will, the power of the engine will correspondingly vary. The engine making $n$ revolutions per minute, the distance passed over by the piston per minute will be $2nS$, which varies in practice from 200 to 800 feet. The formula is evidently a purely mechanical one—i. e. the force of the steam is treated as though it were any other force subjected to like variations, and acting upon the area of the piston. Questions of the quantities of heat do not enter. The action of this force is usually illustrated by a diagram as follows (Fig. 19): Let $OD = S$ represent the length of stroke of the piston; $AB = S_1$ the distance passed over by the piston before the steam is cut off. The ratio of expansion will be $\frac{S}{S_1} = r$, and that will be equal to the ratio of the volumes $\frac{V}{V_1}$ of the steam at point of cut-off and at the end of the stroke. Let $OA = p_1$ represent the initial pressure of the steam in pounds per square inch; then $p_1 A \times 144$ will represent the total force on the piston $= P$. The work performed during the travel from $O$ to $H$ or $A$ to $B$ will be represented by $PS_1$ or $A \times p_1 S_1 \times 144$. The area of the rectangle $OABH$ will then represent this work. The work performed during the travel from $H$ to $D$ will in the same manner be represented by the area $HBCD$, on the assumption that the curve $BC$ is an equilateral hyperbola. This area will be equivalent to $PS_1 \log. r$, and the sum of these two areas representing the whole work of the steam during one stroke,

$$PS_1(1 + \log. r).$$

It is assumed, further, that on the return of the piston the steam that filled the cylinder is discharged at a constant pressure, and that the fall of pressure at the end of the stroke, as well as the rise of pressure on the entrance of the steam, takes place suddenly while the piston is at rest. The area of the rectangle $OEDF$, subtracted from the sum of the areas given above, will then give an area, $EABCF$, which represents the work performed. The area $EOFD$ is represented by $p_2 V_2$, the value of $p_2$ being assumed.

The "efficiency" of a machine is a term used to designate the ratio of the disposable or theoretical work to the useful work. This is the usual mode of estimating the loss of effect in employing any machine. If the disposable work is estimated in the cylinder of the steam-engine in the theoretical manner above indicated, calling $W$ the disposable work and $W'$ the real work, the efficiency will be $\frac{W}{W'}$, a fraction always less than unity, because, on account of friction, there is always in any machine a certain amount of useless or ineffective work. There are generally also other causes of loss, so that the efficiency of a machine becomes still less. The efficiency of machines can be determined, therefore, only when the disposable work $W$ and also the useful work $W'$ can be determined.

In estimating theoretically the power of an engine furnished with a steam-jacket, it is impossible to assume with certainty the actual conditions of the problem. It is not known, for instance, precisely what quantity of heat will be furnished by the steam-jacket, nor what relative quantities of vapor and water will be found in the cylinder at the beginning of the expansion. It is usually assumed that enough heat enters the cylinder from the jacket during the expansion to prevent the condensation which would occur if no heat were added—i. e. if there were no steam-jacket; that the curve of expansion is the curve of quantity of vapor constant, and that the steam is saturated and dry at the beginning of the expansion. The curve of expansion is then represented by Rankine by the formula

$$PV^{1\cdot06} = P_1 V_1^{1\cdot06} \text{ or } P = C_1 \frac{1}{V^{1\cdot06}} = C\frac{1}{V^{1\frac{1}{16}}},$$

and the mean forward pressure is given by the formula

$$p_m = p_1\left(17\frac{1}{r} - 16\frac{1}{r^{1\frac{1}{16}}}\right),$$

$r$ being the ratio of expansion. The mean effective pressure $(p_m - p_2)$ is then known when $p_2$ is assumed.

The application of purely theoretical rules to the expansion is complicated by an important secondary phenomenon which can not well be submitted to analytical investigation. The cylinders of ordinary engines are made of cast iron, which takes up and gives out heat as a sponge takes up and gives out water. On this account, the expansion line of actual engines differs so much from any theoretical line that can be drawn that it is only from experiments with the indicator that the effect of this interchange of temperature between the iron cylinder and the mixed steam and water can be determined.

The use of the steam-jacket, or annular casing enveloping the cylinder with hot steam from the boiler, is an economizer of heat, not because condensation during expansion by the adiabatic curve is in itself a loss of heat, but because the presence of liquid water in the form of cloud, or in any other form, in the cylinder facilitates and renders more rapid the interchanges of heat with the metal of the cylinder and the hot steam entering from the boiler. Thus the initial pressure is diminished and the final pressure is increased in a way that can not be estimated theoretically. As nearly all engines work expansively, it is therefore generally impracticable to ascertain theoretically, except as a mere approximation, the quantity of work which an engine under given conditions is actually exerting. The only true resource is the indicator.

The following table gives the quantity of vapor required per horse-power per hour for an ideal engine:

| Pressures in atmospheres. | Pounds of water or vapor per horse-power per hour. | |
|---|---|---|
| | Non-condensing-engines. | Condensing-engines. |
| $1\frac{1}{2}$ | 73·9 | 15·6 |
| 3 | 33·3 | 12·9 |
| 4 | 26·7 | 12·0 |
| 5 | 23·2 | 11·5 |
| 6 | 21·0 | 11·0 |
| 8 | 18·3 | 10·4 |
| 10 | 16·7 | 10·0 |

The efficiency of a steam-engine in actual use may be ascertained by comparing the quantity of steam actually used to give one horse-power per hour with the quantity given by the above table for the same initial and terminal pressures of the steam. For instance, a non-condensing-engine may give a horse-power per hour with a consumption of 35 lb. of water or steam at a pressure of 6 atmospheres—a common performance. The theoretical quantity required in a perfect engine, according to the preceding table, for the same initial pressure is 21 lb. The efficiency of the engine under these circumstances, measured by the standard of steam required, is $\frac{21}{35} = 0·6$. Ordinary boilers of the best type may evaporate 9 lb. of water for 1 lb. of coal burned, the maximum of evaporation of the boiler being about 13·5 lb. of water per pound of coal. The efficiency of the boiler is then $\frac{9}{13·5} = \frac{2}{3}$. Multiplying these efficiencies together, we have the efficiency of the boiler and engine equal to $0·6 \times \frac{2}{3} = 0·4$.

The efficiency of the apparatus, measured by the ratio of the work in foot-pounds accomplished to the number of foot-pounds of work, which are equivalent to the heat evolved in the combustion of fuel, gives a different result. A non-condensing-engine that requires 35 lb. of water per horse-power per hour will require a consumption of about 4 lb. of coal per horse-power per hour, of which only about six-tenths are available, the other four-tenths being waste heat of the boiler, heat required to produce the draught, etc. One horse-power per hour is equivalent to 1,980,000 foot-pounds per hour of actual work. The available heat of combustion of 4 lb. of coal is about 24,000,000 foot-pounds. The efficiency of the whole apparatus on the basis of the heat which is imparted to the water by the combustion of the fuel will be $\frac{1,980,000}{24,000,000} = \cdot 08$, approximately. In condensing-engines a corresponding calculation will give an efficiency of ·17, a horse-power per hour being produced by 1·3 lb. of coal in some instances. The efficiencies of the non-condensing and condensing engines approach each other as the initial pressure increases.

It may be stated, as general conclusions, that the use of a steam-jacket with a single cylinder under ordinary circumstances results in an important saving of fuel, especially for high degrees of expansion; that in the compound engine, with the larger cylinder jacketed, there is a saving in economy over a single cylinder jacketed, even with the same steam-pressures and degree of expansion in both. This last conclusion, although derived from what appear to be conclusive and satisfactory experiments, is perhaps not universally accepted by engineers, the subject being one about which there is still considerable discussion. Large cylinders are more economical in expenditure of fuel for a unit of power than small ones, and slow-speed engines generally less economical than high-speed engines. An engine using steam at high pressures, other things being equal, is more economical than one using steam at low pressure. In regard to the degree of expansion to be allowed in designing an engine, it is to be observed that the point of cut-off with a given pressure determines the mean pressure in the cylinder; and if the speed of the piston be fixed the size of the cylinder is determined.

There is still a want of precise and definite rules for ascertaining the most economical degree of expansion in every given case; and hence a theoretical calculation of the dimensions of the cylinder of an engine to be constructed is a problem which involves some degree of uncertainty as to maximum economy. In a paper presented to the American Society of Civil Engineers by Dr. C. E. Emery, M. E., in 1874, giving an account of experiments made by him for the U. S. Navy Department, the following formula is given, based on the experimental data for the most economical ratio of expansion in a single cylinder:

$$r = \frac{p+37}{22},$$

in which $r$ is the ratio of expansion, $p$ the initial pressure above the atmosphere. For example, taking $p$ equal to 5, 10, 25, 40, 60, 80, 100, the values of $r$ will be 1·9, 2·1, 2·8, 3·5, 4·4, 5·3, 6·2, respectively. Dr. Emery states that these ratios are "nearly correct for single engines of large size, with details of good design, too small for single engines of ordinary construction, and too small for the better class of compound engines." The final performance of an engine can only be satisfactorily tested by the use of the indicator and dynamometer, with condensation of the steam and measurement of the consumption.

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**Steamer-duck**: See Duck.

**Steam-hammers**: hammers which are raised by the direct action of steam on a piston in a steam-cylinder, as distinguished from hammers which are raised by other mechanical means, receiving their power from a steam-engine through the intervention of belts and pulleys or gearing. A heavy mass of iron constitutes the hammer, or "tup," as it is called. This tup slides freely in guides or ways in the frame or upright of the hammer. On top of this framer is placed a cylinder fitted with piston, piston-rod, and valve, after the manner of a steam-engine. The piston-rod, extending downward through a stuffing-box in the bottom cylinder-head, terminates in its attachment to the tup or hammer. Steam admitted under the piston raises it, and thus lifts the hammer; upon the opening of the exhaust and escape of the steam the hammer falls with a force due to its weight, less the friction of the piston, piston-rod, and escaping steam. This form of hammer was at first made single-acting only, that is, the steam is used only beneath the piston, but hammers are now commonly made double-acting, the pressure of the steam above the piston in the down stroke assisting the action of gravity, thus causing the hammer to strike a more rapid and more powerful blow.

The first practical steam-hammer, it is generally stated in English treatises, was invented and constructed by James Nasmyth, of the Bridgewater foundry, Patricroft, near Manchester, England. He had proposed the construction of such a hammer for forging the paddle-wheel shafts of ocean-going steamers in 1837. It is also claimed that the steam-hammer was invented by François Bourdon, in France, in 1839; and one was built from his designs by the Creusot iron-works in 1841. Earlier patents upon steam-hammers were taken out in England, by James Watt, in 1784, and by William Deverell in 1806, but there is no reason to believe that these patents were ever worked.

Nasmyth's first hammers—single-acting only—were worked by hand, but his engineering manager, Robert Wilson, hit upon a plan of operating the valve automatically; and he also, it is believed, first applied the balance principle of valve to the steam-hammer.

Steam-hammers have more cause to deteriorate in use than almost any other machine tool, inasmuch as the severe shocks to which they are submitted while in use tend to destroy their parts. In the earlier hammers the piston-rod seems to have been the part which gave the greatest trouble, and many inventions were made to remedy the defect.

Robert Morrison, of Newcastle-on-Tyne, in 1853 patented a steam-hammer in which the piston-rod was the hammer, and the blow was imparted by the end of the piston-rod properly protected by a shoe or hammer-face. He made the piston-rod very large and of wrought iron, welding the piston to the middle of this long rod, and guiding it by stuffing-boxes in the upper and lower cylinder-heads. To prevent the bar from turning, he cut a flat on the rod above the piston-head, and guided it by a corresponding shape in the top cylinder-head. Hammers for heavy forgings are constructed with double uprights, large-sized hammers, with a long stroke, having a wide spread of base between the legs of the upright to give room for the workmen to handle the iron being forged. The anvil-face is usually set at 18 inches above the floor-level. Fig. 2 shows a double upright hammer of the Morrison type. These large hammers are not made self-acting, as it is found to be more

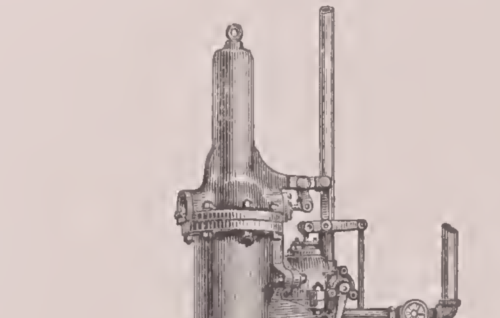


Fig. 1.

advantageous to work them by hand. In light work, such as drawing out bars of steel, an automatic valve-motion is of the utmost importance. Fig. 1 shows the form of a single upright hammer as used for light forging. A hammer weighing 300 lb.—i. e. the hammer-bar, or part which strikes the blow, weighing 300 lb.—should make at least 300 blows per minute to work economically in light forging. An important feature in these rapid-running steam-hammers is the separation of the exhaust-passages in the slide-valve, so that the exhaust from the space below the piston escapes through a passage which does not communicate with the exhaust-

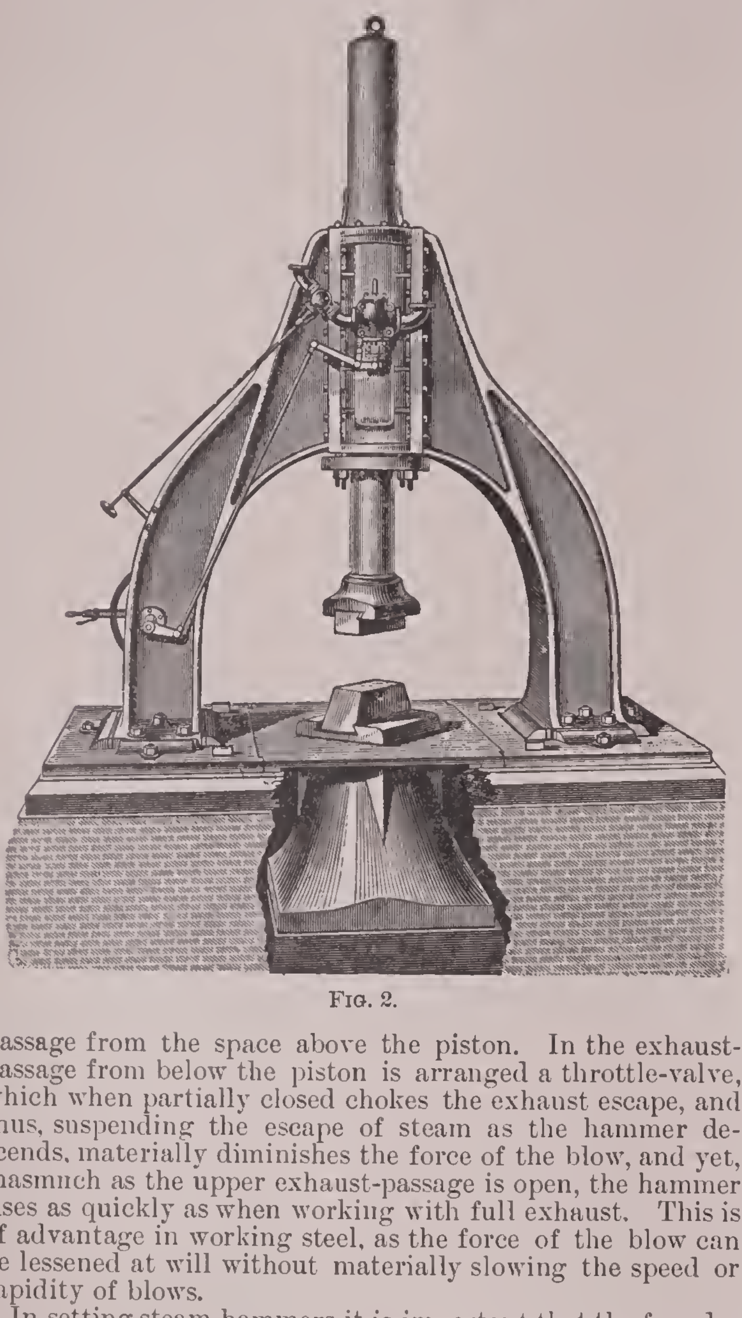


Fig. 2.

passage from the space above the piston. In the exhaust-passage from below the piston is arranged a throttle-valve, which when partially closed chokes the exhaust escape, and thus, suspending the escape of steam as the hammer descends, materially diminishes the force of the blow, and yet, inasmuch as the upper exhaust-passage is open, the hammer rises as quickly as when working with full exhaust. This is of advantage in working steel, as the force of the blow can be lessened at will without materially slowing the speed or rapidity of blows.

In setting steam-hammers it is important that the foundations should be of the most substantial character. It is usual to make the anvil-block separate from the hammer, and to place it on a separate foundation which is underlaid with some thicknesses of wood, say with two layers of closely fitted timbers at least 24 inches in thickness. This gives a degree of elasticity to the anvil and preserves the foundation. The anvil for iron-forging hammers should not be less than five times, and for steel-forging ten times, the weight of the hammer. The direct-acting steam-hammer has numerous rivals in iron making and shaping, such as helve and other power-driven hammers, which are found useful in many lines of manufacture; drop-presses, used for drop-forging; driven rolls; and, finally, hydraulic forging-presses. The steam-hammer forges the metal into the required shape with repeated blows and well-directed skill on the part of the workman. In hydraulic forging the red-hot metal may be made to flow in a solid state into metal moulds, and driven into them by plungers operated by hydraulic presses; but the hydraulic press may also be used to compress metal between a flat movable block and an anvil, thus becoming a direct competitor with the steam-hammer. The first cost of hydraulic apparatus, however, limits the extent of its introduction, and the steam-hammer will probably long continue to be one of the most extensively used forms of apparatus for forging iron and steel.

The largest steam-hammer in the world was built in 1891 at the Bethlehem, Pa., steel-works. The weight of tup, piston-rod, and piston aggregates 125 tons. The cylinder is 76 inches in diameter, and the stroke is 16½ feet. The anvil-foundation contains twenty-two blocks of cast iron, averaging 70 tons each, resting upon steel slabs supported by white-oak timbers. The mass of iron and steel in the foundation weighs 1,800 tons. Revised by William Kent.

**Steam-heating**: See Warming and Ventilation.

**Steam-vessels**: ships propelled by steam. The possibility of using steam for the propulsion of ships seems to have occurred to Roger Bacon in the thirteenth century. It has been stated that Blasco de Garay, of Spain, in 1543, propelled a vessel by steam, but La Fuente, the Spanish historian, having investigated the matter, found that de Garay made (1540–43) trials at Barcelona with paddles on ships furnished by Charles V., but in every case the paddles were moved by men. Suggestions as to the use of steam, none of which were carried out, were made by Salomon de Caus (1615) and the Marquis of Worcester (*Century of Inventions*, London, 1663). The earliest practical effort appears to be that of Papin, who in 1707 applied his steam-engine to the propulsion of a model on the Fulda river at Cassel. Newcomen had in the meantime brought the steam-engine itself to a working condition; and in 1736 Jonathan Hulls patented a marine steam-engine which he proposed to employ in a vessel to be used as a tugboat. About 1763 William Henry, of Pennsylvania, built a small model steamboat, which he tried with success on the Conestoga river; the experiment is notable as having furnished the hint to the efforts made later by Robert Fulton. During the last quarter of the eighteenth century the problem of steam-navigation had begun to engage many minds in Europe and the U. S. In France the Count d'Auxiron and M. Perier made experiments in 1774–75, and the Marquis de Jouffroy, upon a larger scale and with better success, in 1776–83. In the U. S. James Rumsey, of Maryland, was similarly engaged, and in 1786 built a boat which was propelled upon the Potomac by steam at the rate of 4 miles an hour by means of a jet of water forced out at the stern. He built a boat in London with which a successful experiment was made on the Thames in 1792. Meanwhile John Fitch experimented on the Delaware river. His first boat, built in 1786, was propelled by paddles moved by a steam-engine; at first a speed of only 3 miles an hour was attained, but improvements increased that speed to 8 miles. It is noticeable that in his boat he employed side-wheels, with a screw-propeller at the stern. In 1788 Miller, Taylor, and Symington built a boat which consisted of two connected hulls driven by a single paddle-wheel between them, which obtained a speed of 5 miles an hour on Dalswinton Loch. They built a larger vessel in 1789 with a steam-engine of 12 horse-power, which attained a speed of 7 miles. In 1801 Symington built a boat for towing, which drew vessels of 140 tons at the rate of 3½ miles an hour. About 1790 Robert Fulton left the U. S. for England, where he turned his attention to mechanics, and especially to steam-navigation. He made experiments in France, which were only partially successful, but he secured the confidence and aid of Robert R. Livingston, the U. S. ambassador, and in 1806 returned to New York, bringing with him a Boulton & Watt steam-engine, for which a hull was built. This vessel, named the Clermont, made a trial trip to Albany, Aug. 7–9, 1807, returning on the two following days, her average running speed being 5 miles an hour. The Clermont was 130 feet long, 18 feet beam, 7 feet deep, with a burden of 160 tons. She soon began making regular trips between New York and Albany, and for all practical purposes must be considered the first steamboat adapted for the conveyance of passengers and freight. Fulton and Livingston obtained from New York the monopoly for using steam-vessels in the waters of the State. John Stevens, of New York, was even earlier than Fulton an experimenter in steam-navigation. In 1789 he had perfected his plans for a steam-vessel, and in 1804 and 1805 built small vessels which showed that his plans were sound. The Phœnix, his first steamboat, completed in 1807, followed hard upon Fulton's Clermont. Prevented by the monopoly of Fulton and Livingston from navigating the Hudson, he sent his boat by sea to the Delaware, upon which she was afterward employed, and in this voyage demonstrated the problem of the possibility of the use of steam-vessels upon the ocean. Steam-vessels in the U. S. were thus an assured success. Fulton and his coadjutors soon placed a fleet of them upon the

Hudson river and Long Island Sound, while Stevens and his sons placed their steamers upon the Delaware and the Connecticut, and upon the Hudson after Fulton's monopoly had expired. The first steamboat in Great Britain was the Comet, 40 feet long, built in 1812 for the navigation of the Clyde; but before this time Fulton and Livingston had begun to build steamers at Pittsburg, Pa. Upon all navigable rivers and smooth waters of the civilized world steamboats were rapidly introduced, and their use upon the ocean followed. As early as 1819 the steamer Savannah made the voyage from Savannah, Ga., to Liverpool, England, in twenty-two days, and thence to Russia. From that time the development in ocean steamships has been steadily toward larger steamers, including the famous Great Eastern. The Lucania, of the Cunard Line, a screw steamship of steel, 620 feet long and having a gross tonnage of 13,000 tons, crossed the Atlantic from Queenstown to New York in 5 days 7 hours and 23 minutes (Oct. 21–26, 1894).

Revised by Marcus Benjamin.

**Stear'ic Acid** [*stearic* is from Gr. στέαρ, tallow]: the most abundant of the solid fat-acids; obtained in the saponification of all the fats containing stearin, and especially of beef's tallow, mutton suet, hog's lard, etc. The so-called stearic acid (or stearin) of commerce is a mixture of stearic and palmitic acids. This commercial stearic acid is produced by the treatment of neutral fats by superheated steam or by alkalies. See Soap.

*Saponification of fats by water alone*, at a high temperature, was patented by R. A. Tilghman, of Philadelphia, Jan. 9, 1854, and about the same time (Apr., 1854) by Berthelot, who announced that he had resolved the neutral fats with water in closed vessels at a temperature of 428° F. Tilghman specified the preferred temperature of melting lead, 625° F., but names also the melting of bismuth, 518° F., and to promote the reaction caused the mixture of water and fat to traverse small tubes of wrought iron heated in a fire to a pressure of 90 or 100 atmospheres. Tilghman's process, as originally set forth in his patent, was never introduced in practice. The very high temperature employed destroyed the glycerin and contaminated the stearic acid. As subsequently modified, it has been used with success, but, as the courts have decided, not within the limits of the patent. Melsens, of Brussels, almost at the same time with Tilghman took out in Belgium a patent for the use of water slightly acidified by sulphuric acid to act on fats under pressure at a temperature of 356° to 392° F. The presence of a small quantity of sulphuric acid—1 to 10 per cent. of the fat used—favors in a remarkable degree the evolution of the fatty acids. Melsens's method was put into successful operation at Antwerp almost immediately, using a peculiar form of digester, lined with lead, holding a ton of tallow, to which was added 50 per cent. of water, and in six hours the decomposition was complete at a temperature of 356° F. (ten atmospheres), and the fatty acids obtained were very satisfactory.

The possibility of decomposing the fats by water under high pressure was distinctly recognized by Chevreul, who pointed out the perfect analogy between the fats and the compound ethers, which are decomposed when heated in close vessels in contact with water.

George Wilson in 1852 revived the method of decomposing fats at a high temperature, and subsequently distilling off the acids and glycerin separately by a current of superheated steam, originally conceived by Chevreul and attempted by Bussy and Le Canu in 1825, and more successfully by Dubrunfaut in 1841. In 1855 Wilson exhibited to the jury of the Paris Exposition of that year the results of his method on palm oil by means of water and heat alone, distilling off both glycerin and fatty acids in a way to obtain all the products in a state of chemical purity. To this end the oil is heated in a still to the temperature of 550° to 600° F., and then a stream of subdivided, superheated steam passes through it of a temperature of 600° F. Below 550° F. the saponification and distillation of the products is slight; at about 600° F. the distillation is more rapid, but is then accompanied with the production of acroleins. It is by this process that Price's glycerin is produced. This process works well only on palm oil, and is in fact only a slight modification of the previous process of Dubrunfaut. The complete success of the hot-water process was achieved only in 1857 by Wright and Fouché—French patent of 1857, American in 1859. This requires particular mention.

*Wright and Fouché's apparatus by hot water alone* produces complete decomposition of fats into fat-acids and glycerin by a continuous and automatic commingling of water and steam with the fat at a pressure and temperature of ten to twenty atmospheres for a period of twelve to twenty hours. No lime is used; water at the temperature named is the sole chemical agent; and the glycerin produced is of excellent quality; the stearic and palmitic acids (after expressing the oleic acid) are white, fine-grained, hard, and free of odor.

Revised by Ira Remsen.

**Ste'arin** [from Gr. στέαρ, tallow] ($C_3H_5(C_{18}H_{35}O_2)_3 = C_{57}H_{110}O_6$): a glyceride or ether of glycerin, as shown by the formula *tristearin*. In commercial parlance, *stearin* is a term applied to the impure stearic acid obtained by the saponification of fats in the preparation of star candles. Tristearin is the natural form of stearin in hard fats.

**Stearns**, John William: See the Appendix.

**Stearns**, Lewis French, D. D.: theologian; b. at Newburyport, Mass., Mar. 10, 1847; nephew of President William A. Stearns; graduated at Princeton College 1867; studied theology at Princeton, in Berlin, and Leipzig, also in the Union Theological Seminary, New York, where he graduated in 1872. He was pastor of a Presbyterian church at Norwood, N. J., 1873–76, and Professor of History and Belles-Lettres at Albion College, Michigan, 1876–79; Professor of Systematic Theology in the Congregational Seminary at Bangor, Me., 1880, until his death. His inaugural discourse at Bangor (June 1, 1881) attracted much attention for its marked ability. In July, 1891, he read before the Congregational International Council in London a paper of very high merit on the *Present Doctrinal Tendencies of American Congregationalism*. His principal works were the *Lectures on the Evidence of Christian Experience*, delivered at the Union Theological Seminary, New York, in 1890, and subsequently published, and a posthumous volume, *Present Day Theology*. D. Feb. 1, 1892.

George P. Fisher.

**Stearns**, William Augustus, D. D., LL. D.: fourth president of Amherst College; b. at Bedford, Mass., Mar. 17, 1805, the son and grandson of Congregational clergymen; graduated at Harvard College 1827; studied theology at Andover, and after teaching a short time at Duxbury was ordained to the ministry, and installed pastor of the Congregational church at Cambridgeport Dec. 14, 1831. In 1854 he accepted the presidency of Amherst College, which he held till his death June 8, 1876. Besides valuable addresses given during his connection with the college he published several sermons, with papers in the *Bibliotheca Sacra*, *Biblical Repository*, and *New Englander*, a work on *Infant Church Membership* (Boston, 1844), and *Life and Select Discourses of Samuel H. Stearns* (1846).

**Ste'atite**, or **Soapstone** [*steatite* is from Gr. στέαρ, στέατος, tallow, fat]: a kind of stone which receives both its names from its unctuous quality. It is a compact form of talc, and is an impure hydrated silicate of magnesia. It has some use in the porcelain manufacture. A soft white sort is the French chalk of the toilet and of the tailors' shops. Powdered steatite is employed as a lubricant, and is an ingredient in several kinds of steam-packing. Steatite is easily cut into figures, which are then hardened by fire and colored to imitate more costly stones. Steatite is employed in making stoves and foot-stoves for use in cold weather, since it retains heat for a long time. It is abundant in many parts of the U. S. and other countries.

**Stebbins**, Horatio, D. D.: pulpit orator; b. at Hampden, Mass., Aug. 8, 1821; educated at Exeter Academy and Harvard College; graduated at the latter in 1848, and from Harvard Divinity School in 1851; received degree of D. D. from Bowdoin College in 1856; pastor of Unitarian churches at Fitchburg, Mass., and at Portland, Me., where during the civil war he made a civic reputation which led to his call in 1864 to the Unitarian church in San Francisco (where he has since remained) as the successor of Thomas Starr King, who had done the Union cause great service with his voice and pen. He has been actively engaged in educational work and in social reforms; has published sermons and addresses and several orations.

John W. Chadwick.

**Steckel**, Louis Joseph René: engineer; b. at Wintzenheim, Alsace, in 1844; studied engineering and architecture at Quebec; engaged 1861–62 on Gaspé and St. Lawrence road surveys; appointed in 1863 draughtsman of public buildings Ottawa; in 1870 on permanent engineering staff, Public Works Department, Canada; in 1873 assistant engineer on canal, harbor, and river works, Dominion of Canada, and in 1880 was appointed chief clerk engineering branch, Public Works Department. He is author of *Geometrical Solutions of Difficult Problems in Land Surveying* (1866); *An Essay on the Liquid Contracted Vein*; and various technical reports. NEIL MACDONALD.

**Stedman**, EDMUND CLARENCE, LL. D., L. H. D.: poet and critic; b. at Hartford, Conn., Oct. 8, 1833; studied at Yale College; became in 1852 editor of *The Norwich Tribune*, in 1853 of *The Winsted Herald*; settled in New York in 1855; in 1860 was employed upon *The New York Tribune*; was an editor and war correspondent of *The New York World* 1861–63; contributed to *The Atlantic Monthly* and other magazines; was in 1863 in the attorney-general's office at Washington, and has been since 1865 a stockbroker in New York. He is the author of *Poems Lyric and Idyllic* (1860); *Alice of Monmouth, and other Poems* (1864); *The Blameless Prince, and other Poems* (1869); and *Hawthorne, and other Poems* (1877). His *Poems* were collected in a single volume in 1873. He delivered his narrative poem, *Gettysburg*, in 1872 at a meeting of the Army of the Potomac, and his *Ode* at Dartmouth College 1873. Since 1873 he has devoted himself largely to critical work; *Victorian Poets* (1875; 13th ed. with supplementary chapter in 1887) was followed by *Poets of America* (1885), and by *The Nature and Elements of Poetry* (1892), originally delivered in 1891 at Johns Hopkins University as a lecture series on the Percy Turnbull memorial foundation. In 1891 he succeeded James Russell Lowell as president of the American Copyright League. In 1888–90 he edited, with Ellen Mackay Hutchinson, a *Library of American Literature*, in 1897 published another volume of *Poems*, in 1895 brought out *A Victorian Anthology*, and in 1900 *An American Anthology*.

**Steel** [O. Eng. *stēle*: O. H. Germ. *stahal* (> Mod. Germ. *stahl*): Icel. *stāl*; cf. O. Pruss. *stakla*. Russ. *stalĭ* is loanword from Germ.]: a term comprising several modifications of iron. It is necessary to define the term "steel" at some length, since the old classification very inadequately describes the modern cast, malleable compounds of iron, carbon, and metalloids used for structural purposes, and constituting at least three-fourths of the metal now made by steel processes. The old term "steel" referred to the cast malleable product of iron and so much carbon (from $\frac{3}{4}$ to $1\frac{1}{2}$ per cent.) that the metal would harden when heated to redness and quenched in water; it is used almost exclusively for cutting tools. The homogeneity of this metal is, however, an equally distinguishing quality, and is due to its having been poured into a mould while in a fluid state, so that the slag might separate by gravity, and the metal might become solid and crystalline. Wrought iron, on the contrary, while having similar chemical properties, and sometimes as much carbon, consists of pasty masses from which the slag is rarely quite expelled by the pressure that sticks them together; it is therefore laminated in structure. As the soft compounds and those largely varying in chemical constituents came gradually to be produced by casting processes, it was natural and convenient to enlarge the term "steel" to cover them; and the use of the term was at the same time rendered legitimate and scientific by basing the classification on one of the grand characteristics—structure due to casting—rather than on ingredients, as heretofore, especially since structural qualities were constantly increasing in importance. It is found practically convenient to distinguish between all the cast malleable compounds, whether hard or soft, by affixing the name of the metalloid chiefly incorporated, such as chrome steel, manganese steel, and the like, or the percentage of carbon, or both. It is important to know the amount of carbon in structural steels, and this may be readily determined. The general usage of commerce, as well as of works, is rapidly fixing this enlarged definition. As this article is intended to refer to those compounds of iron which are generally known and sold as steel, such as Bessemer rails and open-hearth boiler-plate, as well as tool-steel and spring steel, the definition must for these purposes be as follows: Steel is a compound of iron which has been cast from a fluid state into a malleable mass. The terms "pot" or "crucible" steel, "open-hearth steel," and "Bessemer steel" are convenient for distinguishing processes of manufacture, but they do not necessarily distinguish between steels which differ either chemically or mechanically.

*Nature and Composition of Steel.*—From the preceding definition it will be observed that the grand structural characteristic of steel, to which it largely owes its value for all uses, is homogeneity due to fusion; also, that its chemical constituents and the characters due to them are very various. The important chemical qualities of tool-steel are: (1) The tempering quality, which is due, first, to the presence of say $\frac{3}{4}$ to $1\frac{1}{4}$ per cent. of carbon; second, to the mechanical mixture of this carbon with the metal by means of slow cooling from a red heat, which makes the metal comparatively soft, so that it can be cut with the ordinary tools; third, the extreme hardening of the metal, when, by means of sudden cooling, the carbon is chemically dissolved in the iron. (2) An important condition of tool-steel is its freedom from ingredients, such as phosphorus, which induce brittleness. Excepting some modern steels, in the manufacture of which nickel, manganese, tungsten, chromium, titanium, and some other metalloids are employed, the best tool-steels have but a few hundredths of 1 per cent. of any ingredient except carbon, silicon, and iron.

The more important qualities of structural steels vary with their precise uses. In general, great resistance to statical strains, or to those gradually applied, is accompanied by comparative brittleness and unfitness to resist strains suddenly applied. High resistance, resilience, hardness, and brittleness increase, up to certain limits, with the amount of impurities, chiefly carbon, contained in the metal. Low resistance, softness, ductility, and toughness become more marked, within certain limits, as the impurities become less; but too little as well as too much impurity makes steel weak and unsuitable for structural purposes. It requires what is called body to give it resistance to either statical or sudden strains. This body is imparted by carbon, manganese, silicon, phosphorus, and by other ingredients; but too much of either of them, or of certain compounds of them, weakens the metal. While it is known, generally, that the substances mentioned may to a certain extent replace one another as body-giving elements, and that some of them appear to neutralize others (for instance, that manganese restores the ductility of steel made brittle by phosphorus), comparatively little progress has yet been made in definite and formulated knowledge regarding the mechanical effects of chemical mixture in iron and steel.

*The Manufacture of Steel.*—(1) *The Crucible Steel Process.*—This is the oldest and simplest. It at first consisted in melting wrought iron with carbon in clay crucibles. Thus Indian "wootz" is made, containing as much as $1\frac{1}{2}$ per cent. of carbon, so that it requires decarburization before it can be forged. In the present manufacture other ingredients besides carbon, chiefly manganese, are added. Sometimes substances intended to combine with and remove the impurities in the wrought iron are introduced, but generally these impurities remain in the steel. The finest steel must therefore be made from wrought iron which has been purified by reworking with pure fuel, and which was originally made from pure ores. The melting-point of wrought iron is so high that it has been usual to carburize it by cementation (see FURNACE) in order to fuse it at a convenient temperature in crucibles. This cemented or blistered bar was the steel of commerce until Huntsman melted it in a crucible in 1770, producing a true cast steel. The use of the Siemens furnace and the modern improvement of crucibles render the melting of wrought iron practicable and cheap. The cheaper grades of crucible steel are largely made from Bessemer steel rail-ends, crop-ends, and other scrap. This material, being made directly from cast iron, without that purification from silicon and phosphorus to which wrought iron could have been subjected in puddling, produces an inferior steel to that made from the purest wrought iron for purposes, like tool-steel, requiring both hardness and toughness. By melting wrought iron and a little cast iron together, especially cast iron containing manganese, the cheaper grades of steel are produced. The impurities of the cast iron remain in the steel. Although crucible steel has been cheapened by using the materials mentioned, and by means of the gas-furnace, the less refined grades of steel are made at so much less cost and with so much greater uniformity by the open-hearth process, and within certain limits by the Bessemer process, that the crucible process is becoming gradually confined to the finer grades of tool-steel; and here it must probably long retain its superiority, chiefly because it can begin with a highly refined iron, from which especially phosphorus, silicon, and sulphur have been more or less completely eliminated.

The quantity of steel made by the crucible process is relatively small. The two processes which produce the bulk of the metal for rails, structural material, wire, nails, plates, hoops, tin plates, etc., are the open-hearth or Siemens-Martin process and the Bessemer process. Until the invention of Thomas and Gilchrist the only raw material available for these processes was such as contained only a small quantity of phosphorus, 0·10 per cent. being the limit for pig iron. Since all of the phosphorus in ore enters the pig iron produced in the blast furnace, this restricted the steel-maker in his selection of ores and pig iron. Thomas and Gilchrist ascertained that if there is substituted for the usual silica or "acid" lining of the Bessemer converter or open-hearth furnace a refractory lining consisting of a mixture of calcined dolomite and tar, or of magnesia, a high phosphorus charge can be used. These latter linings are called "basic," in contrast with the older "acid" linings. Since their introduction it is the usual practice to distinguish between the "acid" and the "basic" open-hearth process and the "acid" and "basic" Bessemer process. The principal distinction in the two lies in the use of raw material, which must be low in phosphorus in the case of the acid process, and may or must be high in phosphorus in the case of the basic process. In the open-hearth furnace appliances are practically the same in either, the only difference being that the lime additions lead to the handling of a larger quantity of slag. In the basic Bessemer process the pig iron used must conform to certain specifications as to chemical contents. Silicon must be low, so that the life of the lining is not abridged by fluxing away in contact with the silica formed. From 1½ to 2 per cent. of phosphorus is necessary in the basic Bessemer pig, so that its combustion during the blowing may furnish the necessary heat. Lime additions must be made, and the charging capacity of the vessel is reduced through the room occupied by the greater amount of slag made. This slag is ground to an impalpable powder, and as such is used in agriculture as a substitute for phosphates, an important industry having been thus established.

(2) *The Open-hearth* (*or Siemens-Martin*) *Process.*—The melting of the ingredients of cast steel in large quantities and cheaply on the open hearth of a reverberatory furnace, rather than in small quantities and expensively in crucibles, having been often unsuccessfully attempted, was patented in a more scientific form by the eminent metallurgist Heath in 1845, and was then experimentally carried out with limited success. The Siemens regenerative gas-furnace, by means of the intensity and uniformity of its heat, first furnished practical conditions to the open-hearth process about 1862. It was also demonstrated by Messrs. Martin that the addition of manganese at a certain stage was necessary to the production of sound and practically malleable steel. The Siemens open-hearth steel furnace and its operation are fully exhibited and described under FURNACE. The hearth or bed of the furnace consists of a shallow iron tank, ventilated below to prevent the concentrated heat of the hearth and the regenerators from endangering the structure, and lined with a very refractory material, usually silica, nearly pure, and just fusible enough to set into a solid mass. The red-hot air and gas, entering and burning at, say, the right-hand end of the furnace, play upon the materials placed on the hearth, and pass down into the regenerators at the left end, where they give off their heat to a checkerwork of fire-bricks. The current being reversed after some thirty minutes, the air and gas enter at the left end through the newly heated regenerators and pass out at the right end.

The design of furnaces undergoes some modifications when natural gas is used as a fuel, the Lash furnace being the type most widely adopted in the U. S. An important modification of the ordinary open-hearth furnace has been introduced by H. H. Campbell, of Steelton, Pa., who has placed the entire hearth on rockers, which permit of tilting the furnace. This presents important advantages in charging and in tapping the charge. A plant of six of these furnaces, working 50-ton charges, is in operation at the works of the Pennsylvania Steel Company, three being basic and three acid furnaces.

The materials employed are various, and consequently the process varies, although the decarburization of pig iron is always a part of it. In order to obtain a sufficiently intense combustion there must be a slight excess of air; the flame is therefore oxidizing, and would seriously waste wrought iron or the ingredients usually melted in crucibles. A bath of cast iron, which on account of its carbon can be melted without serious loss, is first necessary; in this are immersed and protected the more readily oxidizable materials for the production of steel. The amount of cast iron varies from 10 to 33 per cent. of the total charge. For fine steels it should be as small as possible, so as to introduce the least amount of phosphorus, silicon, etc.

The more common process is known as the scrap process, and this again is divided into (1) the fusion of pig and scrap wrought iron or steel charged together, the former melting while the latter is heated preparatory to melting; (2) the dissolving of either hot or cold scrap in a bath of pig previously melted; (3) the dissolving of wrought-iron sponge in a cast-iron bath. The operation in all these cases is chiefly the melting of the decarburized iron forming the bulk of the charge, and the oxidation of the greater part of the carbon and silicon in the crude cast iron, and also in the basic process of the phosphorus. A portion of the iron is also oxidized, and this oxide of iron makes the product unmalleable or red-short. To remove the oxygen something must be added which has a greater affinity for it than iron has; for instance, manganese. The latter is easily and cheaply introduced in the form of pig iron called spiegeleisen, which contains 10 to 20 per cent. of manganese, or of an artificial ferro-manganese containing as high as 80 per cent. By using an excess of manganese any desired proportion of it remains in the steel. If the decarburization of the cast iron and the dilution of the carburized and uncarburized portions of the charge are carried only to such an extent that a highly carburized product remains, less manganese is needed to make it malleable, and this may be supplied by melting a manganiferous pig iron with the charge. Dissolving scrap in the bath is the more common process; the scrap is fed in a little at a time, so as not to chill the charge and cause it to set on the bottom of the furnace, and also to maintain uniformity in the temperature and working of the furnace. To save part of the stress on the steel furnace, an auxiliary furnace is employed in some works to heat the scrap and spiegeleisen before charging them into the bath.

In the production of boiler-plate and of steels to be subjected to blows and vibration while in tension, for which the open-hearth process is largely used and well adapted, about 20 per cent. of the best Bessemer pig, containing less than 0·10 per cent. of phosphorus, and preferably not over 1 per cent. of silicon, is employed, the remainder of the charge being charcoal blooms made from Bessemer ores, or puddle-bar made by the boiling process, so as to free it as much as possible from phosphorus. For cheap steels, especially those in which hardness without great resistance to impact are required, a less pure pig and any wrought-iron scrap, such as old rails, may be employed. The phosphorus imparted by the latter may be rendered harmless by employing a rich ferro-manganese at the close of the process, thus adding a large amount (¾ to 1 per cent.) of manganese and only 0·10 to 0·15 per cent. of carbon.

To ascertain when the charge is so far completed as to be ready for the manganese, samples are dipped out of the bath and tested from time to time. The decarburization is accurately denoted by the toughness of the sample and by the appearance of its fracture. As soon as the manganese is thoroughly diffused through the bath the charge is tapped out and cast. In many cases the manganese is added to the charge after it has been tapped into the ladle. The open-hearth furnace is made to hold from 10 to 50 tons, the more usual capacity being from 20 to 25 tons. The time of the operation is from eight to eleven hours.

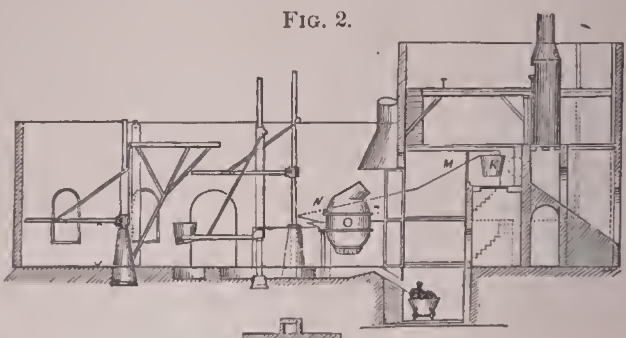
The pig-and-ore process, as developed by Siemens, consists in decarburizing a bath of pig iron by iron ore, and then adding ferro-manganese in the usual manner. The iron in the ore is added to the bath and a little limestone is thrown in to facilitate its separation. The theory is to use ore enough to make good the waste of the iron by oxidation. Although pig and ore may be employed alone with success, there is usually 10 or 15 per cent. of scrap made in rolling and forging, and this scrap is returned to the steel furnace. Sometimes 25 per cent. of scrap is added. The process thus partially takes the character of the pig-and-scrap process, although the use of ore as a rapid decarburizer of the large amount of pig employed gives it a distinctive character. The pig and scrap are first melted, the time being four or five hours. During this period an inch or more of slag forms over the bath. Then the ore, in lumps up to 3 or 4 inches in diameter, is charged a little at a time until the bath is nearly ready for the manganese, when it is allowed to stand so that the iron may work out of the ore and slag. After the charging of the ore begins there are two distinct periods: First, the rising of the slag. This increases in weight, but much more in volume, and is covered with large and heavily moving blotches or bubbles. Second, the boiling of the metal, when the slag settles and becomes thinner and the whole surface of the bath is covered with a lively spouting of the metal and slag, sometimes of the metal through the slag. These periods represent the following operations: (1) The silicon in the pig, having at this temperature a higher affinity for oxygen than the carbon has, is burned out first, partly by the flame, which is somewhat oxidizing, and partly by the oxygen in the ore. Thus slag is rapidly formed and also thickened by the release of the silica and other impurities in the ore. (2) When the silicon of the pig is nearly consumed its carbon begins to burn freely and to throw off carbonic oxide, which makes the now hotter and thinner slag boil violently.

(3) *Bessemer Process.*—The chemical part of the Bessemer process may be generally stated as the oxidation by means of air-blasts of the carbon and silicon (in the acid) or of the carbon and phosphorus (in the basic) in melted crude cast iron so as to make it malleable. During this reaction a certain quantity of iron is also oxidized. This is reduced by adding manganiferous pig iron, which reintroduces the necessary amount of carbon and also adds manganese, whose presence is useful in the subsequent rolling of the steel.

The Bessemer process as first performed, and as still practiced to a very limited extent abroad with irons rich in manganese, consists in applying the blast until all but one-fourth to one-half of 1 per cent. of the carbon is burned out, and then casting the product. Stopping the blast at this point, however, is very uncertain; hardly any irons contain the right amount of manganese for this treatment and the process has certain mechanical objections. Hence the nearly universal practice is to blow the iron until all the carbon is exhausted—a point readily determined; but the product now, as in the open-hearth process before described, contains so much oxide of iron that it is red-short and crumbles in working. To reduce this oxide of iron, manganese, which has a stronger affinity for the oxygen than the iron has, is added by running into the converter melted spiegeleisen, which is a pig iron containing 10 to 20 per cent. of manganese, or by otherwise adding ferro-manganese to the charge. Any desired amounts of carbon and manganese are also thus added to the product. No phosphorus is removed from the iron in the acid Bessemer process. Only the carbon and the silicon are oxidized. It is therefore important to start with pig irons having a little less phosphorus, sulphur, and copper than the steel may safely contain; but it is not usually practicable to use irons low in silicon, for the oxidation of this element produces the high temperature necessary to keep the mass fluid. Manganese is to a certain extent a substitute for silicon in this respect, and always a valuable ingredient, but the greater part of the irons of the world do not contain it in important quantities. Usually a pig containing from 1½ to 2½ per cent. of silicon is required. This will heat the charge to such a degree that 10 to 15 per cent. of scrap may be worked with the pig-iron charge. If there is more silicon than this the charge becomes too hot. One reason why silicon has greater heating power than carbon (it is stated by Akerman to have nine times as much) is because the product of its combustion, slag, remains in the converter, while the product of the combustion of carbon goes out in gaseous form, and carries much heat with it.

A standard American Bessemer plant of a type to which many existing works belong consists (1) of a melting department. The furnace and working-floor are shown in plan by Fig. 1; sections of these floors and the furnaces are shown by Fig. 2. There are hoists at *a* for coal, etc., and at *b* for iron; four cupola furnaces and their platforms and blowing machinery; two ladles, K, standing on scales, for weighing the melted iron; and spouts, M, N, Fig. 2, for conducting it to the vessels or converters; two reverberatory furnaces for spiegeleisen, and their spouts. (2) The converting department, shown in ground plan by Fig. 1 and in cross-section by Fig. 2. It contains two 5-ton to 7-ton vessels, N, in which the melted iron is treated by air-blasts. Such a vessel is illustrated by Fig. 3. Also a ladle and a hydraulic ladle-crane at E, Fig. 1, by means of which the steel is received from the vessels and poured into the ingot-moulds, which stand upon a depressed part of the floor called the pit. Three other hydraulic cranes swing over the pit to set the ingot-moulds and remove and load the ingots. Two of them swing over the vessels to assist in their daily repairs. The water and air pressure reservoirs are surmounted by a platform *d*, Fig. 1, standing upon which boys, by turning valves, admit water to the cranes and air to the vessels by means of underground pipes. All the constant operations of hoisting, lowering, and blowing are conducted from this platform, which overlooks the entire converting department. (3) The engine department, which is not illustrated. It

Fig. 2.



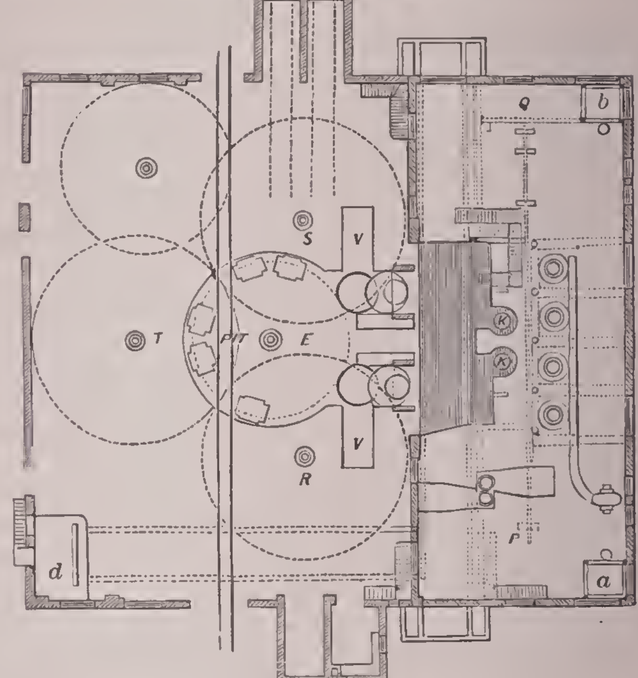



Fig. 1.

contains a blowing-engine, usually a double engine, capable of delivering air at 25 lb. pressure per square inch. The water-pressure machinery for actuating the hydraulic machinery consists of a pair of duplex pumps.

The recent tendency in the U. S. has been to do away with the troublesome casting-pit. In one conspicuous case this is accomplished by pouring the steel into a ladle suspended from an overhead traveling crane. The steel is poured into moulds standing on cars, constituting a train, so that the whole charge can be hauled out of the converting-house by a locomotive soon after it is cast.

A growing practice in Europe and in the U. S. is to dispense entirely with the remelting of the pig iron in cupolas. The molten pig iron as it is tapped from the blast furnace is run into ladles mounted on cars. It is cast into a large vessel holding 100 to 150 tons of molten metal, called the mixer. From this mixer the iron is tapped whenever required, and in the quantities needed, into ladle-cars, from which it is poured into the converters direct. This is called the direct process.

In the older process, the pig iron, having been hoisted to the charging platform, is put, with, say, 10 per cent. of coal, into one of the cupolas and melted. When some 18,000 to 30,000 lb. (whatever charge is determined on) have run into one of the ladles, K, the latter is turned over by means of a worm-wheel, thus pouring the iron into the spout, which leads it to one of the vessels, the simplest form of which is shown in Fig. 3. A vessel that will convert a 6-ton charge is 8½ feet in external diameter and 15 feet high. It is made chiefly of ½-inch to ¾-inch iron plates, and lined nearly a foot thick with refractory material. At one end it has an 18-inch opening, called the nose; at the other a tuyere-box, communicating with the blowing-engine. From the tuyere-box 12 fire-brick tuyeres, each perforated with 12 ⅜-inch holes, project through and are imbedded in the lining. A tuyere is shown in section by A. These tuyeres last but 10 or 15 heats, and are arranged in such a manner as to be readily renewed. The vessel is mounted on trunnions, and turned by a hydraulic cylinder by means of a rack and pinion. When the charge enters for the process the tuyeres are turned up as at C, so that the iron will not run into them. The blast is then admitted, and the tuyeres turned down so that the metal will flow over them, and be pierced by the entering columns of air. The cubical contents of the vessel is eight to twelve times that of the charge of iron,

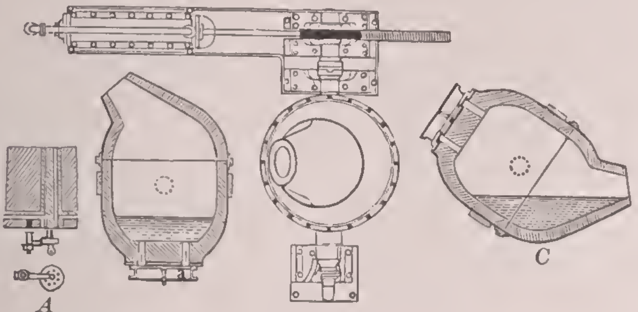



FIG. 3.

in order to give room for ebullition. The vessel lining is heated red hot and the fuel discharged before the iron is turned in. The iron is now subjected to 144 streams of air, three-eighths of an inch in diameter, at 15 to 25 lb. pressure, for about twenty minutes. Most of the silicon is first burned out, the result being slag, and a comparatively dull flame at the converter-mouth. When the carbon begins to burn freely the volume and brilliancy of the flame increase; and as the surging mass grows hotter, and boils over in splashes of fluid slag, the discharge is a thick, white, roaring blaze, and the massive vessel and its iron foundations tremble under the violent ebullition. Toward the close of the operation the flame becomes thinner, and it suddenly contracts and loses illuminating power when decarburization is complete. The determination of this period is the critical point of the process. Ten seconds too much or too little blowing injures or spoils the product. At the proper instant, as determined best by the spectroscope or by colored glasses, but usually by the naked eye, the foreman turns down the vessel and shuts off the blast. The charge of spiegeleisen is then run in, when another flaming reaction occurs. The vessel being still further depressed, the steel runs into the ladle, pure, white, and shining, from under its coating of red-hot slag. A blanket of slag, most useful in preserving its temperature, follows it into the ladle. The metal is then let into the ingot-moulds and, after the exterior surface of the steel has crystallized, the mould is removed, and the ingot is ready for reheating and rolling.

For the basic process the converter is lined with a mixture of highly calcined dolomite (magnesian limestone) and tar, either by ramming it into place or building it up of brick made from the mixture. A certain amount of calcined lime is charged with the iron, further additions being made as required. When the carbon has been blown out, the slag is poured off and a brief period of blowing, called the after-blow, follows, during which the last portions of the phosphorus in the metal are eliminated, passing into the slag.

The ladle-crane (Fig. 4) is a radical departure from the nearest kindred practice. The ladle, instead of swinging from a crane-chain, as in a foundry, is rigidly held in a fixed orbit. This feature was original with Bessemer, and to it he added the old ladle with a pouring-nozzle in its bottom, regulated by a movable stopper (1 and 2). This consists of a loam-coated rod, *a*, armed at its lower end with a round-ended fire-brick or plumbago stopper fitted to the concave top of a fire-brick nozzle. The stopper is raised and lowered by a lever, *o*, in the hand of the workman. Thus the heavy steel is discharged pure, while the lighter slag and impurities are left at the top. Pouring steel into moulds over the rim of a ladle, as in foundries, would make excessive scrap from spilling and chilling, and is wholly impracticable. The vertical motion of the crane is necessary in pouring from the vessel, to keep the ladle close under the nose, thus preventing too great a fall of the stream, and consequent slopping. The ladle is also tipped by a worm and worm-wheel, *h*, to regulate the position of the nozzle over the moulds and to turn over the ladle for heating and repairs. The hydraulic crane generally used in works in the U. S. is also illustrated by Fig. 4, and consists of a cylinder open at the top only, and requiring chiefly vertical support from the solid pier on which it rests. The ram passes through an upper stuffing-box and through a top support in the roof of the building. The jib is placed between these supports, so that the lateral strain on the ram is comparatively small. The ram is stepped upon a column of water which is substantially frictionless.

When the steel is intended for rails—and sometimes 33 per cent. of that made in the U. S. is so used—the charges are so regulated as to cast either five or six ingots, and a little over as a margin for chilling and spilling. Each ingot

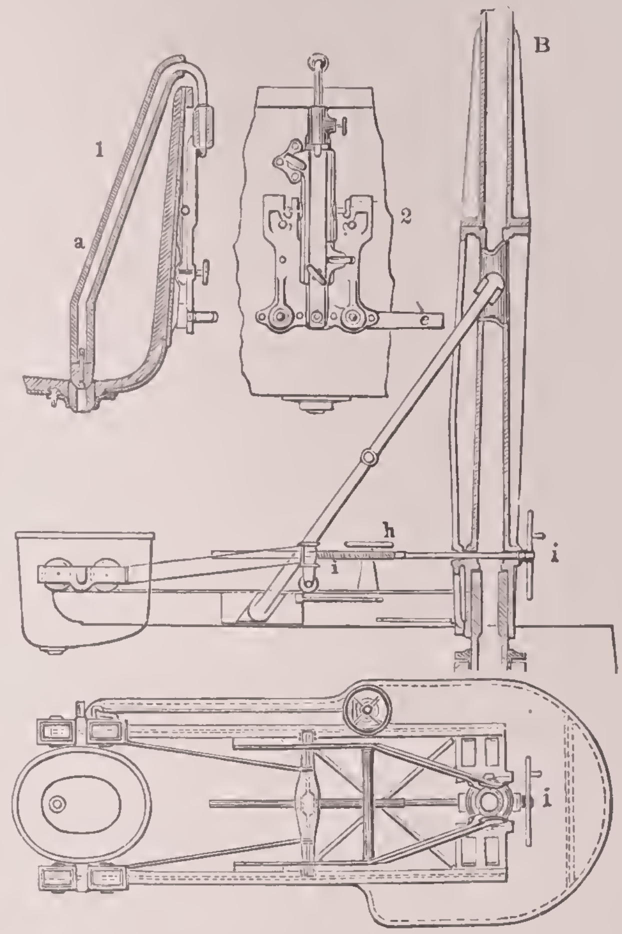



FIG. 4.

makes three or six rails. The ingots are removed hot to the blooming-mill, and if any heating-furnace is ready, they are charged into it directly, thus saving much heat. They must be allowed to crystallize, however, before rolling. If the interior of an ingot is still pasty from the heat of conversion, it will go to pieces in the rolls. Ingots for three to six rails each are used, instead of ingots for single rails—first, to save a repetition of manipulations in working. This must be done by machinery to be done cheaply, and a machine can handle a big ingot as quickly as a little one. Second, the extreme top of an ingot is unsound, and must be cut off and reconverted; the number of scrap ends is reduced to two for three to six rails. The practice is growing in the direction of large ingots and large reductions for all purposes; and the counterpart of this—to cheapen cost—is handling by steam and reducing rapidly by heavier rolls and hammers. See also ROLLING-MILLS.

Since about 1870 open-hearth and Bessemer steel have practically displaced puddled iron in the manufacture of rails, wire, plates, structural shapes, tin plate, and cut nails, and has made heavy inroads into its field, in bars and other shapes.

The production of crucible steel in the U. S. was 84,709 long tons in 1892, 63,613 long tons in 1893, and 101,213 long tons in 1899. The production of open-hearth steel was 669,889 tons in 1892, 737,890 tons in 1893, and 2,947,316 tons in 1899. The production of Bessemer steel was 4,168,435 tons in 1892, 3,215,686 tons in 1893, 3,579,101 tons in 1894, and 7,586,354 tons in 1899.

The total production of basic steel in the world was 3,638,556 tons in 1893, Germany contributing thereto 2,344,754 tons. Of the total productions of basic steel in the world in 1893, 2,808,241 tons was Bessemer and 830,315 tons was open-hearth steel.

Great Britain produced in 1893 1,493,354 gross tons of Bessemer steel ingots and 1,456,309 tons of open-hearth steel ingots. Germany made 2,171,138 metric tons of manufactured steel in 1893. Belgium produced 273,058 metric tons of steel ingots in 1893: France produced 814,977 metric tons of ingots in the same year: Sweden has a record of 82,422 tons of Bessemer and 76,556 tons of open-hearth steel ingots in 1892; and Austria reports 509,734 metric tons of Bessemer and open-hearth ingots in the same year. The production of Russia in 1892 was 365,484 metric tons. Spain made

78,413 metric tons in 1891, and Italy 56,543 metric tons in 1892. A small quantity of steel is also produced in Canada.

See *The Metallurgy of Steel*, by Henry M. Howe (New York, 1890); Bauerman's *Treatise on the Metallurgy of Iron* (London); Percy's *Metallurgy of Iron and Steel* (London); and Wedding's *Eisenhüttenkunde* (Brunswick).

Revised by C. KIRCHHOFF.

**Steele**, DANIEL, A. M., D. D.: minister and educator; b. at Windham, N. Y., Oct. 5, 1824; educated at Wesleyan Academy and Wesleyan University, where he graduated 1848; joined the New England Conference of the Methodist Episcopal Church 1849; was pastor until 1862; Professor of Ancient Languages 1862–69 and acting president of Genesee College 1869–71; and vice-president of Syracuse University 1871–72; since then has taught in school of theology of Boston University, and served in several pastorates. He has published *Commentary on Joshua* (1872); *Binney's Theological Compend Improved* (1874); *Love Enthroned* (1875); *Milestone Papers* (1878); *Antinomianism Revived, or a Refutation of the Doctrines of the Plymouth Brethren* (1885); *Commentary on Leviticus and Numbers* (1891); *Bible Readings* (1892); *Sermons and Essays* (1892). ALBERT OSBORN.

**Steele**, DAVID, D. D.: clergyman and professor; b. near Londonderry, Ireland, Oct. 20, 1827; educated at Miami University and the Theological Seminary of the Reformed Presbyterian Church, Philadelphia; principal of Cynthia Academy, Kentucky, 1857–58; Professor of Hebrew and Greek in Miami University 1858–59; pastor of the Fourth Reformed church, Philadelphia, since 1861; Professor of Hebrew, Greek, and Pastoral Theology 1863–75, and since 1875 of Doctrinal Theology in the Reformed Presbyterian Seminary, Philadelphia; was moderator of the General Synod 1868; delegate to the Pan-Presbyterian Council at Philadelphia 1880; president of the board of foreign missions in the Reformed Presbyterian church since 1883. Dr. Steele edited *The Reformed Presbyterian Advocate* 1867–77; and has published *The Times in which we live and the Ministry which they require* (1872); *Biographical Sketch of Rev. J. N. McLeod, D. D.* (1875); *The Apologetics of History* (1886); and discourses. C. K. HOYT.

**Steele**, FREDERICK: soldier; b. at Delhi, N. Y., Jan. 14, 1819; graduated at the U. S. Military Academy July 1, 1843, and was assigned to the Second Infantry; fought in the war with Mexico, gaining the brevets of first lieutenant and captain for Contreras and Chapultepec; served in California 1849–55, and on the Western frontier from 1855 until the outbreak of the civil war, when, as major of the Eleventh Infantry, he was engaged in Missouri, commanding a brigade in the actions at Dug Spring, Wilson's Creek, and retreat to Rolla. Appointed colonel Eighth Iowa Volunteers in Sept., 1861, and commissioned brigadier-general of volunteers Jan. 29, 1862, he commanded a division in the army of the Southwest until November, when promoted to be major-general of volunteers and assigned to the Thirteenth Army-corps, which he led in the Yazoo expedition and capture of Arkansas Post (Dec., 1862–Jan., 1863); transferred to the Fifteenth Corps, he was engaged in the Vicksburg campaign, when his division was sent to Helena, Ark., and captured Little Rock Sept. 10; in 1864 commanded the department of Arkansas, and on Nov. 29, 1864, went to the aid of Gen. Canby in the reduction of Mobile; was mustered out of volunteer service in Mar., 1867. For the capture of Little Rock he was breveted brigadier-general, and for meritorious services major-general U. S. army. In July, 1866, he was assigned to the coloneley of the Twentieth Infantry, which he held at the time of his death, at San Mateo, Cal., Jan. 12, 1868.

Revised by JAMES MERCUR.

**Steele**, Sir RICHARD: author; b. in Dublin, Mar., 1672; educated at the Charterhouse, London, and at Oxford. In 1695 he enlisted as a private in the Life Guards, and in the same year published *The Procession*, a poem on Queen Mary's funeral. This was dedicated to Lord Cutts, who gave Steele a captaincy in his regiment, the Coldstream Guards. In 1701 he published *The Christian Hero*, a short manual of religious ethics, and in November or December of the same year brought out at Drury Lane his first comedy, *The Funeral*. This was followed by *The Lying Lover* (1703) and *The Tender Husband* (1705). About this time he became a member of the famous Kit-Cat Club, and married a widow, a Mrs. Margaret Stretch, who seems to have died in 1706. In May, 1707, through the influence of Arthur Maynwaring, he was appointed to the Government office of gazetteer. In Sept., 1707, he married Miss Mary Scurlock, of Llangunnor, Carmarthenshire, Wales. His letters to this lady were first printed in 1787. He was always in pecuniary difficulties; but such was his amiability that he always found friends to assist him, and was successively appointed to lucrative offices, among which were commissioner of the stamp office, surveyor of the royal stables, governor of the royal comedians, justice of the peace for Middlesex, and commissioner of forfeited estates in Scotland. In politics he was an ardent Whig. In 1713 he was returned to Parliament for Stockbridge, and was expelled in the following year on account of political articles written by him, but was knighted by the king, and returned to Parliament for Boroughbridge in 1715. In 1720 his patent as governor of the royal comedians was revoked, by which, according to his own statement, he suffered a loss of £10,000, and in the following year he brought out his successful comedy of *The Conscious Lovers*, which was dedicated to the king, who sent him a present of £500. His first wife, who died soon after their marriage, brought him a plantation in the West Indies, and his second wife was a Welsh heiress, but he squandered his large income in dissipation and unprofitable speculations, and being attacked with a paralytic stroke, which disabled him from literary work, he retired to his estate at Llangunnor, where he died Sept. 1, 1729. He was buried in St. Peter's church, Carmarthen. Several of Steele's political essays and pamphlets had a high reputation in their day, and his comedies were well received upon the stage. His chief fame rests upon his connection with *The Tatler* and *The Spectator*, almost the earliest of that long series of periodical works which occupy so prominent a place in English literature, although in these his part was much inferior to that of Addison, who had been his schoolfellow at the Charterhouse. *The Tatler* (1709–11) contained 271 numbers; 188 were by Steele, 42 by Addison, and 36 by both conjointly. This was succeeded by *The Spectator* (1711–12), containing 555 numbers, of which 236 were by Steele and 274 by Addison. After the discontinuance of *The Spectator*, Steele, with the co-operation of Addison, started *The Guardian*, but Addison soon withdrew, and the work was brought to a close with the 176th number, of which 82 were by Steele. Steele started other papers, *The Englishman*, *The Lover*, *The Reader*, *The Theater*, and *The Spinster*, which were comparative failures; and he left two unfinished comedies, *The School of Action* and *The Gentleman*. His *Poetical Miscellanies*, original and translated (1714), possesses little merit. See *Memoirs of the Life and Writings of Sir Richard Steele*, by H. R. Montgomery (London, 1865), and the *Life of Steele*, by Geo. A. Aitken, (2 vols., Boston, 1889). Also *Richard Steele*, by Austin Dobson (1886), who published his *Selected Works* in 1885.

Revised by H. A. BEERS.

**Steel-engraving**: See ENGRAVING.

**Steell**, Sir JOHN, R. S. A.: sculptor; b. at Aberdeen, Scotland, in 1804; studied art at Edinburgh and sculpture at Rome; made the seated statue of Sir Walter Scott which forms part of the monument in Edinburgh; produced the colossal statue of Queen Victoria placed above the Royal Institution, Edinburgh, and the bronze equestrian statue of the Duke of Wellington erected in 1850 in front of the Register House, Edinburgh. Others of his statues are of the Marquis of Dalhousie, and Hon. James Wilson at Calcutta; of Prof. John Wilson, erected at Edinburgh 1865; the Scottish National Memorial to Prince Albert; colossal bronze statues of Sir Walter Scott and of Burns for Central Park, New York; colossal statues of Allan Ramsay and Dr. Chalmers for Edinburgh; and monuments to the Forty-second and Ninety-third Highlanders in the cathedrals at Dunkeld and Glasgow. D. Sept. 15, 1891.

Revised by RUSSELL STURGIS.

**Steelton**: borough; Dauphin co., Pa.; on the Susquehanna river, the Pennsylvania Canal, and the Penn. and the Phila. and Reading railways; 3 miles E. of Harrisburg, the State capital (for location, see map of Pennsylvania, ref. 5–G). It was laid out under the name of Baldwin in 1866, subsequently was known as Steel-Works P. O., and was incorporated under its present name in 1880. It contains the great plant of the Pennsylvania Steel Company, comprising several blast furnaces, rail and blooming mills, and bridge and construction works; several flour, saw, and planing mills; electric railways connecting the borough with Harrisburg; a model public-school building, erected by the steel company; a national bank with capital of $75,000; and a daily and three weekly newspapers. Pop. (1880) 2,447;

(1890) 9,250; (1900) 12,086, not including the suburbs of Highland, Oberlin, New Cumberland, and New Market.

EDITOR OF "ADVOCATE."

**Steelyard**, or **Roman Balance**: See WEIGHING-MACHINES.

**Steen**, stān, JAN: painter; b. at Leyden about 1626; a pupil of Nicolas Knupfer at Utrecht, and afterward, at The Hague, of Jan van Goyen, whose daughter became his wife. In 1648 Jan Steen entered the corporation of painters at Leyden. He was absent from his native city for ten years, following, it is said, the trade of a brewer at Delft; returned to Leyden in 1658 and combined the work of painter with that of tavern-keeper. He died at Leyden in 1679, and was buried Feb. 3. His work shows the influence of Frans Hals and Adrian van Ostade. His works are chiefly to be seen in the public and private collections in Holland. One example of his art, *The Music-master*, is in the National Gallery, London. W. J. STILLMAN.

**Steenstrup**, stān'stro͝op, JOHANNES JAPETUS SMITH: zoölogist; b. at Vang, Norway, Mar. 8, 1813; Professor of Zoölogy at the University of Copenhagen until 1885. His principal works, which are characterized by elegance of style as well as originality of thought, are *Om Forplantning og Udvikling, gjennem vexlende Generationsrækker* (Copenhagen, 1842), translated from the German version as *On the Alternations of Generations* (1845); *Undersögelser over Hermaphroditismens Tilværelse i Naturen* (Investigations in the Presence of Hermaphroditism in Nature, Copenhagen, 1846); and *Et Blik paa Natur- og Oldforskningens Forestudier* (A Glance at Previous Studies of Nature and Archæology, 1862). D. at Copenhagen, July, 1897. D. K. DODGE.

**Steenwyck**, stān'vīk, HENDRICK: architectural painter; b. at Steenwyck, in the province of Overyssel, Netherlands, about 1550; studied under Hans Vredeman de Bries; also at Antwerp in 1577, and then went in 1580 to Frankfort-on-the-Main, where he died in 1603. His son, named Hendrick, also an architectural painter, was born at Frankfort in 1580. Both painted interiors of churches, halls, and rooms. The younger Steenwyck worked in Antwerp, but went in 1629 to London, where Vandyke employed him to paint architectural backgrounds to some of his portraits. D. in London about 1649. The Louvre, the Belvedere at Vienna, and the National Gallery at London contain examples of the art of father and son. Herman Steenwyck, of Delft, and his brother Pieter are not to be confounded with the above mentioned—these were painters of still life. W. J. S.

**Steeple-chase**: See HORSE-RACING.

**Steevens**, GEORGE: Shakspeare scholar; b. at Stepney, London, May 10, 1736; was educated at King's College, Cambridge; devoted himself to Shakspearean studies, and in 1766 published, in 4 vols. 8vo, *Twenty of the Plays of Shakespeare, being the whole number printed in Quarto during his Lifetime*, etc., which led to his association with Dr. Johnson in an annotated edition published in 1773 under their joint names. Afterward, in conjunction with Isaac Reed, he prepared two new editions (1785 and 1793). His editions remained the standard for the text for almost fifty years. He also assisted in the preparation of the *Biographia Dramatica*, and furnished contributions to Nichols's *Biographical Anecdotes of Hogarth*. D. at Hampstead, Jan. 22, 1800. Revised by H. A. BEERS.

**Steffens**, HENRIK: philosopher; b. at Stavanger, Norway, May 2, 1773; educated in Denmark 1779–94, and studied theology and natural science at the University of Copenhagen; went in 1794 to Germany, and became, through the study of Schelling's writings and through personal intercourse with the author, a zealous adept of the new sensational science, the so-called philosophy of nature. He returned to Denmark (1802), where he exercised a decisive influence on his contemporaries. His principal works from this period are *Recension von Scheltings naturphilosophischen Schriften* (1800); *Grundzüge der philosophischen Naturwissenschaft* (1806); *Anthropologie* (2 vols., 1822); and *Polemische Blätter zur Beförderung der speculativen Physik* (1829–35). He continued his study of mineralogy and geology at Freiberg under Werner (*Geognostischgeologische Aufsätze* (1810) and *Handbuch der Oryktognosie* (3 vols., 1811–19)); was appointed Professor of Natural Science in 1804 at Halle, in 1811 at Breslau, and in 1831 at Berlin. D. in Berlin, Feb. 13, 1845. In religion he first turned from the stiff orthodoxy in which he was educated to the pietism of Spener, which he found at Halle; then he became an ardent preacher among the Old Lutherans at Breslau; and finally, at Berlin, he adopted Schleiermacher's religion of the feeling (*Von der falschen Theologie und dem wahren Glauben* (1824); *Wie ich wieder Lutheraner wurde und was mir das Lutherthum ist* (1831)). He was also the author of several novels of a marked didactic character. His autobiography, *Was ich erlebte* (10 vols., 1840–45), was translated into English by William L. Gage under the title *The Story of my Career as Student at Freiberg and Jena* (Boston, 1863), and republished under the title *German University Life* (Philadelphia, 1874); *Nachgelassene Schriften* (1846, with a preface by Schelling). Revised by D. K. DODGE.

**Steganop'odes** [Mod. Lat. pl. of *steganopus* < Gr. στεγανόπους, web-footed]: an order of birds containing those which have all four toes connected with a web; synonymous with *Totipalmatæ*. It contains the gannets (*Sulidæ*), pelicans (*Pelecanidæ*), cormorants (*Phalacrocoracidæ*), darters (*Plotidæ*), frigate-birds (*Tachypetidæ*), and tropic-birds (*Phaëthontidæ*). It is the equivalent of Huxley's *Dysporomorphæ*. See the articles on the various genera. F. A. L.

**Stegoceph'ala** [Mod. Lat., Gr. στέγειν, cover + κεφαλή, head]: a group of extinct batrachians, like the salamanders in general appearance, but differing from all recent forms in the well-developed armor of bony plates which covered the skull and which usually extended over the lower surface of the body, and sometimes also covered the back. They first appeared in the Carboniferous and died out with the Triassic age. Some were small, others were veritable giants. The group is interesting to the naturalist since its affinities are apparently with the ganoids, and at the same time it is the ancestor of the batrachians of to-day. J. S. K.

**Stein**, stīn, HEINRICH FRIEDRICH KARL, Baron von: statesman; b. at Nassau-on-the-Lahn, Oct. 26, 1757; studied jurisprudence at Göttingen 1773–77; entered the civil service of the Prussian Government in 1780, and was made chief of the department of commerce, manufactures, and indirect taxation in 1804. Strongly opposed to the policy adopted by the president of the cabinet, Count Haugwitz, and by the king himself, he was dismissed Jan. 4, 1807, but recalled immediately after the Peace of Tilsit (July 20, 1807), and made president of the cabinet. In this position he developed an astonishing energy. His internal reforms were a complete reorganization of the Prussian state. Serfdom was abolished, and universal obligation of military service introduced; the manorial estates of the nobility were taxed, all citizens made equal before the law, a liberal municipal system established, and on the crown lands the system of peasant proprietorship was introduced. His final aim was to elevate the peasant class and to create a powerful and intelligent middle class, and, with the nation reorganized on this basis, to renew the contest with Napoleon. He had also a clear idea of what a united Germany meant, and was averse to that division of the country into petty states which had given the history of the nation such a chaotic and anarchical aspect. But his career was suddenly stopped An incautious letter, in which he criticised the policy of Napoleon and spoke of his own hopes and plans, fell into the hands of the French police, and was published in the *Moniteur* Sept. 8, 1808. On Nov. 24 Stein was compelled to resign, and on Dec. 16 Napoleon sent a decree from Madrid which outlawed him and confiscated his property. He went to Austria, thence to Russia, but once again he was at the head of the political affairs of Germany during the period between Napoleon's disaster in Russia and the Peace of Paris, when he actually was the leader of the diplomatic coalition against France. After peace had been concluded, his influence soon became comparatively small. The German princes hated him for his ideas of a German unity; the absolutists hated him for his ideas of a representative form of government; and he himself was unwilling to adopt the impracticable views of the radicals. He retired to his estates, and died at Kappenberg, Westphalia, June 29, 1831. Monuments have been erected to him in Nassau and in Berlin. See the biography by Pertz, and Seeley's *Life and Times of Stein* (1879, 3 vols.). See also the *Erinnerungen* of von Boyen (1891). Collections of his letters have been published, and are of great importance for the history of that time.

Revised by F. M. COLBY.

**Stein'bok** [from Dutch *steenbok*, and Germ. *steinbock*; *stein*, stone + *bock*, antelope]: any one of several species of the family *Bovidæ*. (1) The German designation *Steinbock* (and hence the Dutch *steenbok*) was originally conferred on the ibex or bouquetin of Europe, a species of goat, and to that animal the name properly belongs. (See BOUQUETIN.)

(2) The Dutch settlers of Southern Africa applied the name to a species of antelope peculiar to and not uncommon in that region, and it is now incorporated in the English vocabulary of animals in connection with it. The species is the *Nanatragus tragulus* (*Pediotragus campestris* of Gray). The steinbok is an animal of graceful and symmetrical form, with the head well proportioned, having a bovine nose and large muffle; the horns, developed only in the male and over the orbit, erect, elongate, and subulate; the legs long and slender; the feet destitute of side-hooflets; and the tail very short. The color is a fulvous ash above and on the sides, and white beneath. The length is generally rather less than 3½ feet, and the height at the shoulder somewhat more than 1½ feet. The species is most abundant on stony plains and in valleys, and especially on open flats, where large stones and clumps of trees are found. It is very swift, and progresses by great bounds. It is also very timid, and readily alarmed. It is much esteemed for its flesh.

THEODORE GILL.

**Steinen**, KARL, von den: ethnologist and traveler; b. at Mülheim-on-the-Ruhr, Prussia, Mar. 7, 1855. He studied medicine at Zurich, Bonn, and Strassburg, and ethnology at Berlin and Vienna; made a voyage round the world 1879–81, and was artist and naturalist attached to the German expedition to the Antarctic island of South Georgia 1882–83. In 1884–85, with two companions and a detail of Brazilian soldiers, he penetrated the unknown regions of Northern Matto Grosso, Brazil, discovered the head waters of the river Xingú, and descended it to the Amazon. A second journey to the upper Xingú was made in 1887–88. Dr. von den Steinen's works include *Durch Central-Brasilien* (1886), describing the first Xingú exploration; *Unter den Naturvölkern Central-Brasiliens* (1894); and many scientific papers. HERBERT H. SMITH.

**Steinheil**, LOUIS CHARLES AUGUSTE: genre, still-life, and portrait painter; b. in Strassburg, June 26, 1814; d. in Paris May 17, 1885; pupil of Decaisne; third-class medals, Salons, 1847 and 1851; second-class 1848; Legion of Honor 1860. His *Mother* (1847) is in the museum at Nantes.

**Steinmetz**, KARL FRIEDRICH, von: b. at Eisenach, Saxe-Weimar, Dec. 27, 1796; entered the Prussian army in 1813 as a lieutenant; fought against the French; became a captain in the regiment of Kaiser Franz in 1829; fought at the head of two battalions of the Second Infantry Regiment in Mar., 1848, in the streets of Berlin; was subsequently made governor of the academy of cadets at Berlin, and made his name illustrious as commander-in-chief of the Fifth Army-corps in the campaign against Austria in 1866. On June 27, 28, and 29, 1866, he made a stand at Nachod, Skalitz, and Schweinschädel with his corps and one brigade against three corps of the enemy, defeated them, drove them back, and took eleven guns and 6,000 prisoners. By this victory he made it possible for the second army to debouch, on which manœuver the success of the Prussian battle-plan depended. He received immediately the highest order, that of the Black Eagle, and the Diet voted him a national dotation. In the war against France in 1870 he was appointed commander-in-chief of the First Army, consisting of the First, Seventh, and Eighth Army-corps, but he held this position only for a short time, as he came in conflict with the supreme command—in what manner is not exactly known, but it seems as if the advance of the First Army on Aug. 6, and the measures taken by the general during the advance toward and around Metz on Aug. 14, 15, and 16, did not agree with the plans of von Moltke. In reality, the general now lost his independent command, his army being united to that of Prince Friedrich Charles, and the supreme command given to the prince. Nominally, however, Steinmetz remained a commander, subject only to the orders of the king, and thereby, as well as from the stubbornness of his character, arose disagreements between him and the prince. The result was that in Sept., 1870, Steinmetz was appointed governor-general of Posen and Silesia, and removed from the theater of war. He handed in his resignation, which, however, the king did not accept. He was made a general-field-marshal Apr. 8, 1871, and placed *à la suite*. D. at Landeck, Prussian Silesia, Aug. 4, 1877.

**Stein'schneider**, MORITZ: bibliographer; b. at Prossnitz, Moravia, Mar. 30, 1816; studied in Prossnitz, Nikolsburg, Prague, Vienna, Leipzig, and Berlin; teacher in Prague 1842; teacher in Berlin 1845; since 1859 director of the Veitel-Heine-Ephraimsche Stiftung in that city, and from 1869 to 1890 head of the Israelitische Töchter-Schule. He received the degree of LL. D. from Columbia College 1887; the title of professor 1894. He has devoted himself especially to the non-theological literature of the Jews and Arabs during the Middle Ages. As a bibliographer and historian of Hebrew literature he is unsurpassed. Among his numerous works are *Catal. libr. hebr. in bibl. Bodleiana* (Berlin, 1852–60); catalogues of the Hebrew MSS. in the libraries of Leyden (1858), Munich (1875), Hamburg (1878), and Berlin (1878); *Jewish Literature* (London, 1857; *Index*, Frankfort, 1893); *Zur Pseudepigraph. Lit.* (Berlin, 1869); *Alfarabi* (Petersburg, 1869); *Polem. und Apologet. Lit.* (Leipzig, 1877); *Bibliograph. Handbuch* (Leipzig, 1859); and *Hebräische Uebersetz. des Mittelalters* (2 vols., Berlin, 1893). See Berliner *Die Schriften des Dr. M. Steinschneider* (Berlin, 1886). RICHARD GOTTHEIL.

**Steinthal**: See OBERLIN, JOHANN FRIEDRICH.

**Stejneger**, LEONHARD: See the Appendix.

**Stel'larton**, formerly ALBION MINES: town of Pictou County, Nova Scotia; 3 miles from New Glasgow and 39 miles N. E. of Truro, on the Intercolonial Railway (see map of Quebec, etc., ref. 2–C). It is a thriving but dingy town which has grown up about the Albion coal and iron mines, the center of the chief mining district of the province. Petroleum is obtained in the vicinity. The town is the chief destination of the French immigrants to the province. Pop. (1881) 2,297; (1891) 2,410. M. W. H.

**Steller'ida**: a group of echinoderms, including the STARFISH (*Asteroidea*) and OPHIUROIDEA (*qq. v.*), in which the body is star-shaped.

**Stellhorn**, FREDERICK WILLIAM: theologian; b. in the kingdom of Hanover, Germany, Oct. 2, 1841. Emigrated to the U. S. in 1854; graduated at the institutions at Fort Wayne, Ind., and St. Louis, Mo.; pastor in St. Louis and DeKalb co., Ind., 1865–69; Professor of Hebrew, Greek, and Latin, Northwestern University, Watertown, Wis., 1869–74, and in Concordia College, Fort Wayne, 1874–81; since 1881 has been Professor of Theology, Capitol University, Columbus, O. In the Predestination controversy he parted from the Missourians and entered the Joint Synod of Ohio. He has been active as editor of the *Theologische Zeitblätter* and *Lutherische Kirchenzeitung*, as well as a contributor to *The Theological Magazine*. He has published a *Lexicon of New Testament Greek* (Leipzig, 1886), and begun a commentary on the New Testament, of which the volume on the Gospels has appeared. H. E. JACOBS.

**Stel'lio** [Lat. *stel'lio*, a newt with starlike spots on its back, deriv. of *stella*, star]: a genus of lizards of the family *Agamidæ*. The best-known species is *S. cordylina* of the Levant. Strict Mohammedans kill it because they conceive that by the frequent bowing of the head it intends to insult their religion, mocking their own gestures at prayer. The Turks use its flesh and excrement in preparing a cosmetic.

**Stem** [O. Eng. *stemn*: Germ. *stamm*, a deriv. of Indo-Europ. root *stā-*, stand, and originally denoting the trunk of a tree]: a term of historical grammar denoting that part of a word which is left when the inflexional ending is removed. The stem may therefore be identical with the root; e. g. in Lat. *vōx*, Gr. ὄψ, or in the Gr. verb εἶ-μι, but the stem is more commonly formed by adding to the root a formative element called a suffix. Thus in Indo-Europ. *klutós* < Sanskr. *çrutás*: Gr. κλυτός: Lat. *in-clutus*, *s* is inflexional ending, *kluto-* is stem, *klu-* is root, and *-to-* is suffix. Similarly we divide φηγ-ό-s, *fāg-u-s*; γόν-ο-s, τόμ-ο-s, *unc-u-s*, *dol-u-s*; ἅγ-ιο-s, *stud-iu-m*; τέκ-νο-ν, *grā-nu-m*; πίσ-τι-s, *cu-ti-s*; αὐχ-έν-α, *hom-in-em*; Sanskr. *ján-as-as*, Gr. γέν-ε(σ)-os, Lat. *gen-er-is*, etc. The relation of stem to root in the verb is evidently parallel to that in the noun—an inheritance from a period prior to the development of a grammatical distinction between noun and verb; thus the φερε-, φερο- of φέρε-ται, φέρονται is to the ἐσ- of ἐσ-τι, or the εἰ- of εἶ-σί-, as the λογο- of λόγο-s is to the φλεβ- of φλέψ. Though the purposes of grammatical analysis are well served by this division of stem into root and suffix, it by no means follows that in every case the suffix was an originally independent word or element. The form of the stem is in many cases due to the influence of analogy, and in others to the retention of the fuller original form of the primitive word which has elsewhere suffered reduction by the loss of a vowel. (See ROOT.) The word stem as thus used in grammar is a translation or transfer of the German word *stamm*, meaning the trunk (of a tree) in distinction to the *wurzel* or root. BENJ. IDE WHEELER.

**Stembel**, ROGER N.: See the Appendix.

**Sten'dal**: town and railway junction; in the province of Saxony, Prussia; on the Uchte; 36 miles by rail N. by E. of Magdeburg (see map of German Empire, ref. 3-F). It has a Gothic cathedral, manufactures leather, tobacco, woolen, linen, and cotton stuffs, and trades in corn and cattle. Pop. (1895) 20,666.

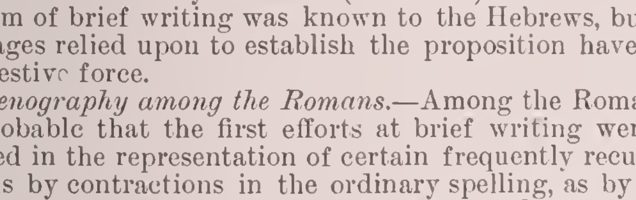
**Stenoglossa** [from Gr. στενός, slender + γλῶσσα, tongue]: a group of mollusks, embracing the *Rhachiglossa* and *Toxiglossa* of the *Gasteropoda*, in which the lingual ribbon is narrow.

**Stenog'raphy** [from Gr. στενός, narrow, close + γράφειν, write]: a generic term which embraces every system of shorthand writing, whether upon alphabetic, phonetic, or hieroglyphic principles. To those systems which are based upon the phonetic principle is given the name *phonography*, which therefore indicates a species of stenography. Some of the other names under which new stenographic systems have been introduced are *tachygraphy* (swift writing), *brachygraphy* (short writing), *semigraphy* (sign writing—that is, writing with signs), *cryptography* (secret writing), *hodiography*, *zeiglography*, *polygraphy* (writing much—that is, voluminous writing), *radiography* (easy writing), and *thoögraphy* (swift writing).

*Stenography among the Greeks.*—The great need of some method of representing in legible characters spoken words as fast as uttered was appreciated in the earliest times, and traces of shorthand writing may be found among the Greeks not many centuries later than the introduction and diffusion of the art of writing. The conclusion has been arrived at that among the Greeks Xenophon was the inventor of stenography, some method of which he employed in recording the *Memorabilia* of Socrates. Many references show that some style of writing briefer than that in common use was known at this time, though it is not clear that use was made of characters not found in the common alphabet. It has been suggested that certain references in the Bible to "ready writers" (Ps. xlv. 1) show that some system of brief writing was known to the Hebrews, but the passages relied upon to establish the proposition have only suggestive force.

*Stenography among the Romans.*—Among the Romans it is probable that the first efforts at brief writing were reflected in the representation of certain frequently recurring words by contractions in the ordinary spelling, as by their initial letters; thus: R. P. for *Res Publicæ*, P. R. for *Populus Romanus*, S. P. Q. R. for *Senatus Populusque Romanus.* The next step was the representation of certain frequently recurring terminations of words by arbitrary contractions or signs; and the next, the representation by arbitrary characters of words and phrases. Ennius the poet is said to have invented and used (239–169 B.C.) a series of 1,100 arbitrary characters for the ready representation of words. The first attempt at any system of stenographic writing is variously attributed to Cicero and to his freedman Tiro. Certain it is that Tiro, by the use of a system which he had mastered if not invented (and which is said to have been improved by Mæcenas), took down and thus secured the preservation of Cato's great oration against the proceedings of Cæsar respecting the Catilinarian conspiracy, as well as Cicero's own orations respecting the same. Julius Cæsar, Augustus, and Titus Vespasian are said to have been proficient in the art of shorthand writing; and this is clearly shown by many references in Horace, Ovid, and other writers. The following is an illustration of the Tironian system:

*Tironian Notes.*



*Translation.*

Cum petitionibus sacerdotum justis & rationabilibus divini cultus amore favemus, & eas cum Dei adjutorio

*Stenography among the French.*—There are said to be still extant, in the characters of the Tironian system, an inventory and fifty-four charters of Louis the Pious, successor of Charlemagne, copies of which were republished at Paris in 1747; but, whatever use was made of stenography during the Middle Ages, few traces are found of it previous to the end of the eighteenth century. The first work of importance to herald the revival of the art was an adaptation of Taylor's (English) system (1792) by Théodore Pierre Bertin. Since then half a dozen systems have been published, among which is that of Fayet, *Nouvelle Écriture et Sténographie* (1832), but those in use by most of the practical reporters (1895) are the systems of Duployé, de Prépean, Aimé-Paris, and Guénin.

*Stenography among the Germans.*—The credit of the first introduction of shorthand into Germany (1666) is given to one Marshof. His system was rapidly followed by others. The systems generally in use are those of Gabelsberger (1831) and Stolze, which have the merit of preserving to a great degree the slant of ordinary writing and the inclusion of many sharp angles, giving easy joinings, and distinguishing often by light and shaded characters.

*Stenography in Great Britain.*—Probably in no other nation have so many systems of shorthand been put forth as in England. The earliest of any prominence was that of Timothy Bright (London, 1588)—*Characterie, an Art of Short, Swift, and Secret Writing by Character.* Two years later appeared the system of Peter Bales, under the curious title *The Writing Schoolmaster, in three parts.* The more prominent of the succeeding systems were those of Willis (1602), Rich (1654–69), Mason (1672; republished with improvements by Gurney in 1753). Byrom published his first work in 1739, and his universal English shorthand in 1767. Taylor's book appeared in 1786, Lewis's in 1815, and Harding's in 1823. Harding's system was an adaptation of Taylor, and Isaac Pitman was induced to take up shorthand by seeing this book. Between the publication of Bright's work in 1588 and Selwyn's in 1847, about eighty different text-books appeared, nearly all of them of unphonetic systems. Isaac Pitman's system appeared in 1837. It was based upon phonetic principles; and, by reason of the simplicity of its consonants, and its copyright protection, made rapid strides in public use. He made use of Harding's pairing of the consonants and Good's use of hooks. Notwithstanding the general popularity of Pitman in England, the larger number of the legal and parliamentary official writers use (1895), with more or less modifications, the older systems, especially Gurney, Taylor, and Lewis. For his long and devoted service in advancing the phonographic art, Isaac Pitman was knighted in 1894.

*Stenography in the United States.*—About 1819 Phineas Bailey published *A Pronouncing Stenography*, a second edition in 1833, and a sixth, styled *Phonography*, in 1852. Keyes A. Bailey brought out his *Reporter's Guide* in 1845, and *A Practical Exposition of Phonography or Writing by Sound* in 1848. Several American editions of Isaac Pitman's (English) system, by Andrews and Boyle, Booth, Paterson, and Benn Pitman, also appeared, the latter in 1853. Day and Stetson brought out an unphonetic system in 1836, Thomas Towndrow a phonetic one in 1837, and Charles Saxton an unphonetic one in 1842. Lindsey's tachygraphy (which is slow, and has the feature of writing in the vowels, and the merit of lineality) was introduced 1864. Andrew J. Graham's adaptation was introduced in 1858, and rapidly found favor. The author undertook to provide a means of securing greater brevity by omissions, combinations, extended word and phrase signs, half-lengths, ticks, and other devices; and while many of his modifications and innovations were regarded as exceedingly valuable as time-savers, numerous practical writers believed that he had carried his ideas of abbreviation too far, and that a strict application of his system would result in the sacrifice of legibility to brevity. From the date of his first *Handbook of Standard Phonography* till his death in 1894 he published a large number of text-books and readers. Munson's system (introduced in 1866) is founded on that of Isaac Pitman, and has received a considerable degree of support. Its distinguishing features are the inversion of the original Pitman vowel scale and the use of small initial hooks on curved strokes for R and large ones for L, thereby avoiding the turning of a curved stroke for L and R hook, as in Fr, Vr, Thr, etc. Bishop (1887) employs a system of connectible, well-distinguished stroke vowels, treated in analogy with the treatment of the consonants, and claimed to give greater exactness and facility in representing any sound whatever used in speech, and to simplify the science by leaving less to mere memorizing and more to the application of fundamental principles. Other systems in the U. S. are Osgoodby's and Burnz's, both of which are adaptations from Pitman with considerable variations, the former exceedingly brief, and the latter being successfully practiced and taught by its author; and Longley's, a phonetic system. It is believed that Graham's modifications are used by more official court stenographers in the U. S. than all other adaptations of Pitman. The Benn Pitman, Graham, and Munson systems are probably more generally taught than any others, and each has a comprehensive dictionary.

Shorthand writers are employed as official reporters in both branches of Congress, in all the State Legislatures, and in nearly every important court in the country. Few newspapers now employ them for shorthand work alone, usually hiring an expert writer whenever a verbatim report of a lecture, sermon, trial, or other proceeding is wanted. The art of shorthand writing has become an invaluable promoter of general business activity, and has opened up a pleasant field of work for young men and young women. There is a constant demand for those possessing a knowledge of shorthand writing and a facility with the typewriter.

The more prominent systems in use in Germany, France, Great Britain, and the U. S. have proved equal, in the hands of experts, to the task of keeping pace with the most fervid oratory; but it must be acknowledged that the requirements of the art are so arduous that only those who have devoted years to the practice, and are, withal, specially adapted for the work, can ever hope to make themselves equal to the highest exactions of the profession. See PHONOGRAPHY.

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**Steph'anus**, or **Stephens** (Fr. *Estienne* or *Étienne*): a family of French printers, several of whom were also noted as scholars. HENRY STEPHENS, the founder of the house (b. about 1460; d. in 1520), established himself in 1502 as a printer in Paris, where his works became famous for the accuracy and beauty of their typography. He was aided, and afterward succeeded in business, by his three sons, the most distinguished of whom was his second son ROBERT (b. in Paris, 1503), who was eminent as a scholar, and in 1531 began the publication of his great *Dictionarium, seu Thesaurus Linguæ Latinæ*, of which he put forth three editions, the last in 1545, and which has been several times republished. He also published editions of the Bible, with notes which were censured by the Sorbonne because of their Protestantism, and indeed Stephens was a Protestant, but he was protected by Francis I., who had made him royal printer. After the death of the king the Sorbonne prohibited the sale of his Bibles, and he was obliged to take refuge in Geneva, 1551, where he continued printing and died Sept. 7, 1559. He published nearly a dozen complete editions of the Bible in Hebrew, Greek, Latin, and French, and numerous separate editions of the New Testament in various languages, besides many other very important works. The present division of the New Testament into verses was made by him and first introduced in his Greek-Latin Testament published at Geneva 1551. After he had taken refuge in Geneva, the business in Paris was conducted by his brother CHARLES (b. 1504; d. 1564), who was appointed printer to Henry II., and put forth numerous classical and scientific works.—HENRY, son of Robert (b. 1528; d. Mar., 1598), was especially eminent as a Greek scholar, and carried on his business at first in Paris, and afterward in Geneva. He almost ruined himself financially by the publication of his *Plato* (1578) and his immense *Thesaurus Linguæ Græcæ* (1572, 5 vols. fol., reprinted with additions, London (by Valpy), 1815–28, and again, Paris (by Didot), 9 vols. fol., 1831–65), for at that time Greek students were too few in number to afford purchasers for an edition. He subsequently traveled from place to place, visiting all the principal libraries, for the purpose of collecting materials for various works, which he procured to be printed by others. Among these works is his *La Précellence du Langage françois* (1579).—PAUL, the son of Henry (b. 1566; d. 1627), carried on the printing business at Geneva for many years.—ANTHONY, the son of Paul (b. 1592; d. 1674), removed from Geneva to Paris, where for nearly half a century he conducted a printing-house, but with ultimate ill success. He died at the Hôtel-Dieu in Paris in utter destitution, and with him was extinguished this line of famous scholars and printers. Revised by S. M. JACKSON.

**Stephen**, SAINT [*Stephen* is from Lat. *Ste'phanus* = Gr. Στέφανος, liter., crown]: the first of all Christian martyrs. He was one of the seven deacons in the Christian congregation of Jerusalem. Charged by the Jews with speaking against the law and against God, he was stoned to death by order of the Sanhedrin. His history is given in chapters vi. and vii. of the Acts of the Apostles. His festival is held on Dec. 26, both in the Eastern and Western Churches.

**Stephen I.**, SAINT: King of Hungary. See HUNGARY (*History*).

**Stephen**: the name of ten popes. Some historians, however, count but nine, from the circumstance that Stephen II. died three days after his election, Mar. 27, 752, before he had been consecrated. The following bearers of the name are the most noteworthy: STEPHEN I., Saint: pope from about 254 to 257 A. D.; is noted for his controversy with Cyprian as to the necessity of rebaptizing converted heretics. The councils of Carthage (255 and 256) having decided against the Roman practice of recognizing baptism by heretics as valid, Stephen broke off communion with the African Church.—STEPHEN III. (II.): pope from 752 to 757; suffered severely from the aggressions of the Lombards. After asking in vain for help against them from the Byzantine emperor, Constantine Copronymus, he went in person to Pepin le Bref, chief of the Franks, whom he crowned king on the condition that he should expel Aistulf, the Lombard king, from the exarchate of Ravenna and the Pentapolis and bestow these territories on the see of St. Peter. Pepin made two campaigns in Italy, but succeeded at last in forcing the Lombards to retreat from the above territories, which he then gave to the papal see, in spite of the protest of the Byzantine emperor, thereby laying the foundation of the temporal power of the pope.—STEPHEN VII. (VI.) (896–897) is most noticeable for his violence in respect to his predecessor Formosus, whose corpse he caused to be exhumed, stripped of the papal insignia, mutilated, and thrown into the Tiber, at the same time annulling all his ordinances, and even his consecrations.—STEPHEN X. (IX.) (1057–58) was a son of the Duke Gotelon of Lower Lorraine, and was elected pope through the influence of Cardinal Hildebrand, afterward Pope Gregory VII., who was the real master of the Church.

**Stephen**: King of England; b. in Normandy about 1100; son of Stephen, Count of Blois, by Adela, daughter of William the Conqueror. William, the only son of Henry I., was drowned in 1120, and the heir-presumptive to the crown was his daughter Matilda, who was married to Henry V., Emperor of Germany; but before the death of her father the emperor died, and she married Geoffrey Plantagenet, Earl of Anjou, without the royal sanction, which was held to invalidate her right to the succession. Upon the death of Henry I. (in 1135), Stephen claimed the succession, although he was not next in the line, even if Matilda was set aside, for he had an elder brother, Theobald, Count of Blois; he was, however, chosen by a party of the prelates and nobles, and his election was sanctioned by the pope. At first his government was fairly successful. He ingratiated the English by issuing a charter confirming the favorable laws of Henry I.'s reign. He made peace with the Scots, whose king, David, paid him homage, and when the war broke out again the English were victorious in the battle of the Standard. The entire reign, however, was filled with revolts and civil war. The cause of Matilda was taken up by a party in England, headed by her natural brother, Robert, Earl of Gloucester, and after a contest of several years Stephen was defeated and made prisoner at Lincoln Feb. 2, 1141. The rule of the empress was so unpopular that a revolt broke out, and her brother, the Earl of Gloucester, was defeated and captured, but was afterward exchanged for Stephen. The civil war now raged with varying fortunes for ten years. In 1153 Prince Henry Plantagenet, son of Matilda, arrived in England at the head of a considerable force; but before a decisive action took place, the barons on both sides entered upon an armistice, and finally concluded the treaty of Wallingford by which Stephen should retain the crown during his life, and that after his death Henry should succeed him. Stephen survived this treaty only a few months, and with him ended the line of Anglo-Norman kings of England. D. Oct. 25, 1154.

**Stephen**, Henry John: jurist; cousin of Sir James and Sir George Stephen; b. in England in 1787; was called to the bar at the Inner Temple 1815; became commissioner of bankruptcy; was a distinguished practitioner at the London bar, and became sergeant-at-law 1827. D. at Clifton, Nov. 28, 1864. Author of a *Treatise on the Principles of Pleading in Civil Actions* (1824; 8th American ed. Philadelphia, 1859); of a *Summary of the Criminal Law in its present State* (1834); and of *New Commentaries on the Laws of England* (4 vols., London, 1841–45). In the preparation of three subsequent editions of this great work the author enjoyed the assistance of his son, James Stephen, LL. D.; b. in England in 1820; called to the bar at the Middle Temple 1846; became Professor of English Law and jurisprudence at King's College, London; recorder of Poole, registrar of bankruptcy at Leeds, and circuit judge at Lincoln. He issued revised editions of his father's *Commentaries*, also *Questions* for the editions, and was author of treatises on *Bar Etiquette* (1851) and *The Common-law Procedure Act* (1860).

**Stephen**, Sir Herbert: See the Appendix.

**Stephen**, Sir James Fitzjames: jurist; b. at Kensington, London, Mar. 3, 1829; educated at Trinity College, Cambridge (B. A. 1852), and was called to the bar at the Inner Temple in 1854; traveled circuit, and became recorder of Newark-on-Trent 1859–68; succeeded Sir Henry J. S. Maine as legal member of the legislative council of India 1869; with the assistance of two others he drew up and passed through the council a code of criminal procedure, which, with considerable modifications, was re-enacted as the code of 1882; prepared, and finally passed, the Indian Evidence Act of 1872. He returned to England in 1872, where he undertook the codification of the English law of evidence (which he never completed), and of English substantive criminal law, the resulting code being reported too late for the code of 1879, and subsequently dropped from the Government measures; in Dec., 1875, was appointed Professor of Common Law by the Inns of Court, and a member of the council of legal education and law reporting; was made Knight Commander of the Star of India in 1877, and appointed a judge of the Queen's bench division, which office he retained until he was stricken with insanity in 1891. D. in London Mar. 11, 1894. He wrote besides his great work, *History of the Criminal Law of England* (which is far more than a mere legal treatise; 3 vols. 8vo, 1863), a *Digest of the Law of Evidence* (1876); *Essays of a Barrister* (1862); *Liberty, Equality, and Fraternity* (1873); *Digest of the Criminal Law* (1877); and many monographs on legal subjects. See *Law Times* (Mar., 1894). F. Sturges Allen.

**Stephen**, Leslie, LL. D.: author; b. at Kensington, London, Nov. 28, 1832; son of Sir James Stephen and brother of Sir James Fitzjames Stephen. He was educated at Eton, King's College, London, and Trinity Hall, Cambridge (B. A. 1854), of which last he was a fellow. In 1864 he went to London and engaged in literary pursuits; edited *The Cornhill Magazine* 1871–72, resigning to take charge of the important *Dictionary of National Biography*. The first twenty-six volumes of this (1885–91) were issued under his supervision, and he was then succeeded in the editorship by his collaborator, Sidney Lee. In 1883 he held the Clark lectureship on English Literature at Cambridge. He married Harriet Marian, younger daughter of William M. Thackeray. Among his writings are *The Playground of Europe* (1871); *Free Thinking and Plain Speaking* (1873); *Hours in a Library* (1874–79); *History of English Thought in the Eighteenth Century* (1876); *The Science of Ethics* (1882); *An Agnostic's Apology* (1893); besides biographies of Pope, Swift, Johnson, and Henry Fawcett, and an edition of Fielding in ten volumes (1882). H. A. Beers.

**Stephen Báthori**, -baa'tō-rē: King of Poland; b. in 1532, of a celebrated Hungarian family; was Prince of Transylvania, and in 1575, after Henry of Anjou's abandonment of the Polish throne, was elected King of Poland. He put the Jesuits at the head of the new university which he founded at Wilna, and gave them many other preferments, but their efforts to induce him to put down the Reformation in Poland were in vain. In military respects he was successful, and humiliated the Russians several times, forcing them out of Livonia, which was then reannexed to Poland. D. at Grodno, Dec. 12, 1586.

**Stephens**: a family of French printers. See Stephanus.

**Stephens**, Alexander Hamilton, LL. D.: statesman; b. near Crawfordsville, Ga., Feb. 11, 1812; graduated at the University of Georgia 1832; admitted to the bar 1834; entered upon political life 1836 as member for Taliaferro of the State House of Representatives; was successively re-elected to the same office until 1840; declined an election 1841; the next year was chosen State Senator by the same constituency. In 1843 he was elected member of the House of Representatives of the U. S. That office he occupied until 1859, when he voluntarily retired to private life. The compromise measure passed by the Congress of 1850 had no bolder, abler, or more eloquent champion than Stephens. He was chosen a delegate to the State convention of that year—the convention which established the celebrated "Georgia platform." In 1855 he united with the Democrats to defeat the Know-nothing party. In the presidential campagin of 1860 he was placed at the head of the Douglas-Johnson electoral ticket. He was a delegate to the State convention of 1861 which passed the ordinance of secession. That measure he earnestly opposed by speech and vote, but, while he advised against the policy of secession for existing grievances, he maintained the right of a State to secede peaceably from the Federal Union for sufficient cause. When a majority of the convention passed the ordinance of secession, he readily acquiesced in their decision. He was a member of the Confederate provisional congress; was chosen vice-president of the provisional government of the Confederate States; was appointed commissioner to the convention between their government and the State of Virginia; was elected by the people, without opposition, to the vice-presidency of the Confederacy under the permanent constitution, as it was styled; and, when in Feb., 1865, the fortunes of the Confederacy were desperate beyond the reach of hope, he was placed at the head of the commission on the part of the Confederate States government in the famous Hampton Roads conference. After the downfall of the Confederacy he was arrested and confined a prisoner of state in Fort Warren for five months; he was released on his own parole in Oct., 1865. In Feb., 1866, the General Assembly elected him, by a large majority, against his wishes, to the office of U. S. Senator, but Congress ignored the restoration of Georgia to the Union under the presidential proclamation of Andrew Johnson, and he was not allowed to take his seat in the Senate. He was elected to the 43d, 44th, 45th, 46th, and 47th Congresses, in each case without more than nominal opposition; inaugurated Governor of Georgia Nov. 4, 1882. He belonged to the Jeffersonian school of American politics, and among the cardinal articles of his political creed were State rights, State sovereignty, local self-government; he always advocated the largest liberty of the citizen compatible with the attainment of the two prime objects of government—viz., protection to property and preservation of order. He wrote a *Constitutional View of the War between the States* (2 vols., 1867–70); a *School History of the United States* (1870–71); and a *Compendium of the History of the United States* (New York, 1883). D. at Atlanta, Ga., Mar, 4, 1883.

Revised by C. K. Adams.

**Stephens**, Ann Sophia (*Winterbotham*): novelist; b. at Derby, Conn., in 1813; became the wife of Edward Stephens in 1831; soon after they went to Portland, Me., where in 1835–37 she edited *The Portland Magazine*, and in 1836 compiled *The Portland Sketch-book*, a volume composed of the writings of natives or residents of that city. In 1837 they removed to New York, her husband subsequently receiving an appointment in the custom-house. She edited and contributed to various periodicals, and wrote many tales and novels, and some fugitive poems. A uniform edition of her works has been issued (new ed. 23 vols., Philadelphia, 1886). Among her most successful novels are *Fashion and Famine* (New York, 1854); *The Old Homestead* (1855; 2 vols., Philadelphia, 1860); *Mary Derwent* (1860); *The Rejected Wife* (1863); *Silent Struggles* (1865); *Mabel's Mistake* (1868); *Wives and Widows* (1869); *Married in Haste* (1870); *The Reigning Belle* (1872); *Bellehood and Bondage* (1873); and *Phemie's Experience* (1874). D. at Newport, R. I., Aug. 20, 1886. Revised by H. A. Beers.

**Stephens**, George: archæologist; b. in Liverpool, England, Dec. 13, 1813. After spending several years in Stockholm he was in 1851 appointed acting Professor of the English Language and Literature at the University of Copenhagen, and four years later permanent professor; resigned in 1893. He was an honorary member of a number of scientific societies, and was decorated several times. His chief work is *The Old Northern Runic Monuments of Scandinavia and England* (London and Copenhagen, 3 vols. fol., 1866-84). As a collection of plates and transcriptions, this work is invaluable, but many of the readings and criticisms have since been effectually disproved by Wimmer and others. He has also published a number of monographs and texts, English and Scandinavian, a translation of Tegnér's *Frithiof's Saga*, and a melodrama, *Revenge, or Woman's Love*. D. in Copenhagen, Aug. 9, 1895. D. K. DODGE.

**Stephens**, JOHN LLOYD: jurist, traveler, and author; b. at Shrewsbury, N. J., Nov. 28, 1805; graduated at Columbia College 1822; studied law and practiced in New York. In 1834-36 he traveled in Europe and the East; published *Egypt, Arabia Petræa, and the Holy Land* (2 vols., 1837), and *Greece, Turkey, Russia, and Poland* (2 vols., 1838). In 1839 President Van Buren appointed him special commissioner to negotiate a treaty with Central America. The civil war in that country prevented him from accomplishing his purpose; but in company with an English artist, Frederick Catherwood, he traveled in Central America and Southern Mexico, making a special study of the ancient ruined cities. Returning to New York he published *Incidents of Travel in Central America, Chiapas, and Yucatan* (2 vols., with fine illustrations by Catherwood, 1841). The results of a second journey, also with Mr. Catherwood, were embodied in *Incidents of Travel in Yucatan* (2 vols., 1843). These two works attained a wide circulation, and gave for the first time good popular descriptions of the wonderful Central American cities. Mr. Stephens was a delegate to the convention for revising the constitution of New York, 1846. In 1847 he took an active part in the organization of the first Atlantic steam-navigation company. After the discovery of gold in California he entered, with characteristic energy, into the scheme for a rail route across the Isthmus of Panama; was one of the first presidents of the Panama Railway Company, and personally superintended the construction. From exposure on the isthmus he contracted a disease of which he died in New York, Oct. 10, 1852.
HERBERT H. SMITH.

**Stephens**, WILLIAM: president of the colony of Georgia; b. on the Isle of Wight, England, Jan. 28, 1671, son of Sir William Stephens, lieutenant-governor of that island; graduated at Cambridge; studied law at the Middle Temple; sat in Parliament 1696-1722; settled at Charleston, S. C., about 1730; was appointed secretary of the colony of Georgia 1737; became president of the county of Savannah 1741, and governor of Georgia 1743-50. D. in Georgia in Aug., 1753. He was the author of *A Journal of the Proceedings in Georgia* (London, 3 vols., 1742). His biography was written by a son under the title of *The Castle-builder, or the History of William Stephens of the Isle of Wight* (2d ed. London, 1759).

**Stephenson**, GEORGE: engineer; b. at Wylam, Northumberland, England, June 9, 1781, the son of a poor colliery laborer. He was in childhood an engine-boy; became a fireman, and in time was placed in charge of an engine, which he studied until he had mastered its construction so as to be able to take it apart and put it together again. Accident gave him an opportunity of putting in motion a steam-engine which needed repairs, and in 1812 he was made engine-wright at Killingworth Colliery. The problem of constructing a locomotive steam-engine was then engaging many minds, and he was in 1814 the first to construct one which proved satisfactorily operative. He originated the steam-blast, which was introduced into his second locomotive, built in 1815, and in that year devised a miner's safety-lamp, for which a large prize had been offered by colliery-owners; but Sir Humphry Davy having simultaneously invented his safety-lamp, this prize, valued at £2,000, was awarded to him, £100 being awarded to Stephenson by the committee; a separate subscription of £1,000 was raised in 1817, which was presented to Stephenson, and his lamp is still in use in some English collieries. Stephenson then turned his attention to improvements in railways as well as engines. The first railway built by him, opened in 1822, 8 miles long, was so successful that in the next year he was appointed engineer of the railway authorized to be constructed between Stockton and Darlington, and in 1825 of the Liverpool and Manchester line, which was begun in 1826. He had in the meantime set up an establishment at Newcastle-upon-Tyne for the manufacture of locomotives, and on Oct. 6, 1829, his engine, named the Rocket, attained an average speed of 14 miles an hour, and for a short distance was driven at the rate of 29 miles. (See RAILWAYS.) During the next fifteen years he was actively engaged as a railway engineer and contractor in England and on the Continent, still carrying on his great locomotive-factory at Newcastle, and also engaging in coal-mining and lime-works. He passed the closing years of his life at his seat, Tapton Park, Derbyshire. D. Aug. 12, 1848. He retained during all his life, in speech and manners, much of the rustic simplicity belonging to his early life, and declined the honor of knighthood. By common consent he has received the title of the father of railways, and in 1862 a colossal bronze statue was erected in his honor at Newcastle-upon-Tyne. See Smiles's *Life of George Stephenson* (1857; new ed. 1874). Revised by R. H. THURSTON.

**Stephenson**, ROBERT: engineer; son of George Stephenson, engineer; b. at Willington Quay, near Newcastle-upon-Tyne, Oct. 16, 1803. He had little opportunity to obtain an education when a boy, and in 1819 he was apprenticed to a coal-viewer; but as his father's circumstances improved he gave his son the best education within his means, and in 1822 sent him to the University of Edinburgh, where he remained six months studying chemistry, mathematics, and geology, after which he assisted his father in railway surveying and in the locomotive-works at Newcastle. In 1824 he went to South America, where for three years he superintended the working of the Columbian Mining Association. He then returned to England, where he aided his father, partly in laying down the line of the Liverpool and Manchester Railway, but more especially in the locomotive-works; and to him chiefly belongs the honor of the practical development of the details of the locomotive and the railway. He was appointed engineer of the London and Birmingham Railway, which, built almost wholly under his direction, was opened in 1838, and from this time he was employed in similar undertakings at home and broad. He constructed several of the most stupendous iron railway bridges in the world, including the high-level bridge crossing the Tyne at Newcastle, the viaduct over the valley of the Tweed at Berwick, the Conway tubular bridge, the Britannia tubular bridge crossing the Menai Straits, the Victoria tubular bridge over the St. Lawrence in Canada, and those crossing the Nile at Damietta, Egypt. In 1847 he was returned to Parliament for Whitby. He received the great gold medal of honor from the French Industrial Exposition of 1855, and was president of the Institute of Civil Engineers from 1855 to 1858. He published a *Description of the Locomotive Steam-engine* (1838); *Report on the Atmospheric Railway System* (1844); and *The Great Exhibition, its Palace and Contents* (1851). D. Oct. 12, 1859. He was buried in Westminster Abbey, where a memorial window has been placed to his memory. See Smiles's *Life of George Stephenson* (new ed. 1874), and *Life of Robert Stephenson*, by J. C. Jeaffreson and W. Pole (2 vols., 1864). Revised by R. H. THURSTON.

**Step'niak**, SERGIUS MICHAEL DRAGOMANOFF: author; b. at Gadjatch, government of Poltava, Russia, 1841; member of a semi-noble family descended from the Cossacks of Little Russia; studied at Kieff 1859-63; published in that time in the Little Russian dialect some works which were prohibited by the Government in 1862; became docent in ancient history in the University of Kieff 1865; professor 1870; removed from his chair 1873 by the Government; exiled in 1876 on account of his criticisms on the system pursued by Count Tolstoi, one of the Ministers of Justice; settled in Geneva 1877, and published a review, *Gromada*, in the Ukraine dialect; settled in London 1885. He labored to establish equal political rights for all people in Russia, but was opposed to both socialism and absolutism. Among his principal works are the *Turks Within and Without* (Geneva, 1876); *La Russia Sotterranea* (Milan, 1881; Eng. trans. *Underground Russia*, 1883); *Russia under the Tzars* (Eng. trans. 1885); *Tyrannicide in Russia* (1881); *Historical Poland and the Muscovite Democracy* (1881); and *The Career of a Nihilist*, a novel (1889). He was a frequent contributor to the magazines and reviews. Killed at a railway crossing near London, Dec. 23, 1895. C. H. THURBER.

**Steppe**: the name given by the Tartars to the plains of Central Asia. They are usually covered with grass, and correspond in their aspects and relations to the prairies of the U. S. and the llanos and pampas of South America. See PLAIN.

**Steppe-murrain**: See RINDERPEST.

**Sterculia'ceæ** [Mod. Lat., named from *Stercu'lia*, the typical genus, from Lat. *Stercu'lius*, the patron deity of manuring, deriv. of *ster'cus*, dung]: a family of exogenous trees, shrubs, and herbs, mostly tropical. Many of the trees are of prodigious size, such as the baobabs and those of the genera *Bombax* and *Ceiba*. Many produce abundantly a substance called silk-cotton, which resembles true cotton, but will not spin well. The wood is often very light and soft. The family contains medicinal plants, and produces some excellent fruits, some gums, a few valuable bark-fibers, and a number of useful timber-trees; but its most important product is chocolate, from the oily seeds of *Theobroma cacao*. The flowers or fruits of certain species are putrid, whence the botanical name. Revised by L. H. Bailey.

**Stere**: See Metric System.

**Sterelmin'tha** [Mod. Lat., Gr. στερεός, solid + ἕλμινς, ἕλμινθος, a worm]: a name given to some of the Plathelminthes (*q. v.*), in allusion to the absence of all cavities in the body.

**Stereo-chemistry**: a branch of chemistry that has to deal with the relations which the atoms bear to one another in space. The ordinary methods of investigation of chemical compounds lead to certain conclusions in regard to the connections existing between the atoms in a molecule. Thus when water is expressed by the formula H–O–H, no attempt is made to tell anything about the arrangement in space of the two atoms of hydrogen and the atom of oxygen. The formula expresses the view that each of the two atoms of hydrogen is linked to the atom of oxygen, but the question whether they are on the same side or on opposite sides, above or below, is not touched. Yet it is certain that if these atoms exist and are united in the molecule they must be arranged in space, and a formula that does not take into consideration the three dimensions of space is certainly incomplete. Up to within a comparatively short time no facts were known that justified any speculation concerning the space-relations of atoms, but it appears that the time has come when such speculation is profitable, and facts are constantly being brought to light that can not be explained without its aid.

The investigations of Pasteur on the different varieties of tartaric acid form the basis of stereo-chemistry. Pasteur found that racemic acid, which can easily be made, can be converted into ordinary tartaric acid and a new variety of tartaric acid, and when these two varieties of tartaric acid are mixed in solution they form racemic acid. Ordinary tartaric acid, when examined with the aid of a polarizing apparatus (see Polarization), is found to turn the plane of polarization to the right, while the new variety obtained by Pasteur turns the plane to the left, and racemic acid is optically inactive—that is to say, it has no effect on polarized light. No explanation of these facts was offered until many years later. Meanwhile other cases similar to that studied by Pasteur were discovered, and chemists came to see more and more clearly that their theory of chemical constitution required an extension in order to accommodate it to the facts. At about the same time, and independently, Van't Hoff and Le Bel made a suggestion with reference to these cases that has proved to be of great value. The main idea is this: The atom of carbon, which, as is well known, has the power to unite with four univalent atoms or groups, is supposed to exert its four affinities from a center toward the angles of a tetrahedron—that is, symmetrically in space. Suppose all four atoms or groups that are in combination with the carbon atom to be of one kind, then but one arrangement of them in space is possible. So also if three are of one kind and one different, or two of one kind and two of another, they can be arranged in but one way around the central carbon atom. When, however, all four atoms or groups are different, then two arrangements in space are possible. The difference between the two arrangements is that which is observed between either one and its reflection in a mirror. Imperfectly the two arrangements are shown in the accompanying figures, in which C represents the carbon atom and R, $R_1$, $R_2$, and $R_3$ represent four different radicals or atoms.

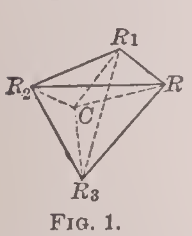



FIG. 1.

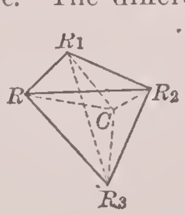



FIG. 2.

A carbon atom which is thus in combination with four different atoms or radicals is called an *asymmetrical carbon atom*. The proposition of Van't Hoff and Le Bel is that the presence of such an atom in a compound makes possible a kind of isomerism that is due to the arrangement of the constituents in space. In the case of the tartaric acids there are in fact two asymmetrical carbon atoms present. The constitution of these acids is represented by the formula

$$\begin{array}{l} CH(OH).CO_2H \\ | \\ CH(OH).CO_2H. \end{array}$$

It will be seen that each of the two carbon atoms that are represented as being in combination with each other is asymmetrical, a fact that is more clearly brought out by writing the formula thus:

$$\begin{array}{lll} & H & \\ & | & \\ (HO)- & C & -CO_2H \\ & | & \\ & CH(OH).CO_2H. & \end{array}$$

Accordingly, this compound presents the conditions necessary for the two arrangements in space—one right-handed, the other left-handed, corresponding to the action of the two varieties of tartaric acid on polarized light.

The same general statements hold true for the lactic acids, which are represented by the formula

$$\begin{array}{lll} & H & \\ & | & \\ (HO)- & C & -CO_2H \\ & | & \\ & CH_3. & \end{array}$$

There are two varieties of ordinary lactic acid which are apparently analogous to the two optically active varieties of tartaric acid, and, further, there is a third variety corresponding to racemic acid, and formed by the union of the two active varieties. The relations between the inactive racemic acid and the active tartaric acids, and between the inactive lactic acid and the two active varieties are not understood. It can only be said that in each case the molecule of the inactive substance must consist of at least one molecule of each of the two active varieties.

Investigation has shown that the asymmetrical carbon atom gives to the compounds in which it is present the property of optical activity and the power to form peculiar isomeric varieties which can not be accounted for by the ordinary theory of constitution. Much progress has been made of late years in the study of the phenomena of stereo-chemistry. Perhaps these phenomena are best illustrated in the field of the sugars, the remarkable studies of Emil Fischer in this field having led to the discovery of a large number of new sugars, the existence of which it appears to be impossible to explain without the aid of the principles of stereo-chemistry.

Werner and Hantzsch have extended the ideas of stereo-chemistry to some classes of compounds containing nitrogen, with interesting results. Ira Remsen.

**Stereornithes**: See the Appendix.

**Ste'reoscope** [from Gr. στερεός, solid + σκοπεῖν, to view]: an instrument to aid the eyes in obtaining binocular combination of two similar, or nearly similar, pictures. As long ago as the time of Euclid (B. C. 300) it was known that when a near object is regarded with both eyes the aspect is different to each eye separately. No practical application of this was made to the study of binocular vision until 1838, when Sir Charles Wheatstone constructed perspective drawings of a geometric solid as seen by each eye separately when held at a fixed distance in front of the face. The width of each drawing was made a little less than the distance between the pupils of the two eyes. In order that one of them should be seen only by the right eye and the other only by the left, Wheatstone looked through a pair of tubes; and the visual effect was found to be that of an apparently solid body in space. In order to obtain this effect more conveniently and to use larger pictures he constructed the first reflecting stereoscope. A pair of plane mirrors, *m p* and *m q* (Fig. 1), were fixed upon a frame at right angles to each other, one pair of edges being in contact at *m*. Light from the pictures, *a b* and *a' b'*, was reflected into the eyes, R and L, so that the combination appeared to be at A B.

Wheatstone's invention did not become popularized because of the difficulty of constructing accurate perspective drawings to use with it. If two such conjugate drawings be placed beside each other in the same plane, the corresponding edges, *a* and *a'* (Fig. 2), being on the right and representing one of the remoter points of the object pictured, while $c$ and $c'$ represent one of the nearer points, it can be easily proved geometrically or ascertained by careful measurement that the interval between $c$ and $c'$ is and must be less than that between $a$ and $a'$. The rays from $c$ and $c'$ after reflection appear to the eyes to have come from some point, C, nearer than A or B if the arrangement is such as to produce the least discomfort to the eyes. It was natural for Wheatstone to conclude that the localization of each point in the binocular field of view is determined by the intersection of the visual lines reflected into the eyes. This theory of binocular perspective was long held and is still frequently expressed or implied.

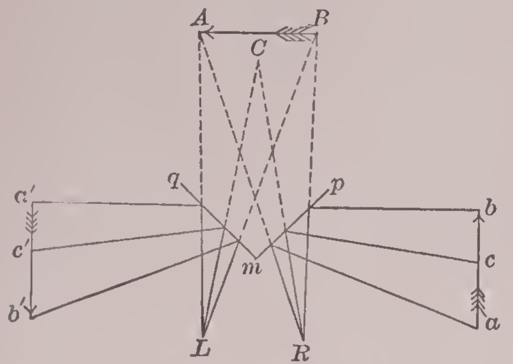


FIG. 1—Diagram of Wheatstone's stereoscope.

Prior to the invention of Wheatstone's stereoscope, James Eliot, of Edinburgh, constructed a pair of conjugate perspectives of a landscape, but not until 1839 did he construct an instrument for viewing it. This was merely a small box open at the two ends, with a partition along the middle, equivalent to a pair of tubes. About the same time the art of photography was introduced by Talbot and Daguerre. In 1849 Sir David Brewster improved upon Eliot's form of box stereoscope by putting at the eye end a pair of semi-lenses of glass with thin edges opposed. In connection with this he devised the double camera for taking photographically the pair of pictures composing the stereograph. The stereoscope and camera were carried by him to Paris during the following year. Here the stereoscope was popularized by Duboscq, who made these instruments and stereographs for it in great number and with various modifications.

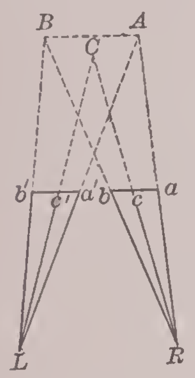


FIG. 2.

The form of open stereoscope commonly in use in the U. S. was devised in 1861 by Dr. Oliver Wendell Holmes. In this the box is discarded, but the pair of semi-lenses is retained, being fixed at one end of a shaft on which slides the stereograph-holder.

If the pair of conjugate pictures be transposed, that originally intended for the right eye being put on the left, the effect is reversion of relief, foreground points appearing in the background. Without such transposition or use of the stereoscope the same result may be attained by muscular crossing of the visual lines. By relaxing the muscles of the eyeball the right eye may be directed to the right picture and the left eye to the left. The visual lines then may often become divergent, but the localization in the field of view is perfect. This fact disproves the theory of stereoscopic perspective held by Wheatstone and Brewster. The apparent distance and size of the binocular image are much affected by the degree of strain imposed upon the muscles which control the eyeballs and the crystalline lens. The object of the stereoscope is to attain the binocular image with the least possible disturbance of the conditions of natural binocular vision.

The bibliography of this subject is included in that of VISION. W. LE CONTE STEVENS.

**Stereotyping and Electrotyping** [*stereotyping* is deriv. of *stereotype*, from Gr. *στερεός*, fixed + *τύπος*, impression, type]: the art or process of making metal plates, reproducing in facsimile the surface of engravings or type set up as for direct printing. Stereotypes are plates of type-metal of the same composition throughout; electrotypes have a facing, usually of copper, deposited by electricity.

I. STEREOTYPING.—Before the invention of stereotypes a work to be printed at intervals, as occasion demanded, had to be kept continually in type (at considerable risk of error creeping in) or else reset for each edition. About 1725 the plaster process of stereotyping was invented by William Ged, a goldsmith (b. in Edinburgh, 1690; d. 1749). In 1731 a company formed by Ged contracted with the University of Cambridge to print Bibles and prayer-books by stereotype, but after the printing of two prayer-books the contract was abandoned, owing partly to the hostility of pressmen to the innovation. Ged returned to Edinburgh, and in 1736 completed an edition of Sallust, which was printed in 1744. Few other attempts at stereotyping were made till 1793, when William Carey, the missionary, devised the method of letting the form of type fall face downward on a surface of hot lead at the point of solidifying, and then repeating this process with the matrix so formed, the result being a true reproduction of the original form in stereotype. Firmin Didot, of Paris, modified this plan by using types of a harder alloy, (30 parts of lead, 30 antimony, 30 tin, and 10 copper); a form of such type was pressed into a surface of pure lead, and the matrix thus obtained was attached to the hammer of a stamping-press and brought down upon a roll of type-metal about to solidify, thus flattening it out and forming a stereotype plate suitable for printing.

The method of Herhan, another French printer, was to set up the form in copper matrices in intaglio and take a cast in type-metal therefrom, thus procuring a cameo impression at one operation.

Stereotyping was introduced into the U. S. by David Bruce, of New York, in 1813. The first work stereotyped in America was the New Testament in 1814. The process of curving stereotype plates to adapt them to a cylinder printing-press was patented in England by Cowper in 1815, but was not very successful till applied to the Hoe perfecting-press. There are three leading methods of stereotyping—plaster, clay, and papier-maché; but only the last-named is now much employed. The metal used approaches type-metal in composition, and the plates after being used may be remelted and the metal used again.

*Plaster Process.*—For this the type is set up with shoulder-high spaces and quadrats. The surface is thinly and evenly oiled with a brush and the form is then inclosed in a rectangular frame termed a flask. Plaster-of-Paris mixed with water is poured upon it, forming a mould corresponding to the face of the form. When this has sufficiently hardened it is withdrawn and dried in an oven until all the moisture is driven off. The mould, laid face downward upon a casting-plate (floating-plate), is then placed within a casting-tray, which has a lid with openings at the corners. The whole is heated to about 400° F. while suspended by a crane over a pot of molten metal, and then gently lowered into the bath until the metal just flows into the corner openings, forming a thin plate which fills up all the cavities in the face of the mould. After being immersed eight or ten minutes the tray is lifted out and lowered upon a stone so arranged that the face of the plate is cooled first, and as shrinkage takes place more metal is added. The pan is then opened and the cast is separated from the mould and fitted to a block so as to make it type-high for printing.

*The Clay Process* (*or Clay-and-Plaster Process*).—For this the form is locked up with high furniture and slugs and placed on the bed of a special press, the face of the type being brushed over with benzine or naphtha and covered with a cloth. A plate covered evenly to the depth of ¼ inch with a mixture of equal parts of ground French clay and plaster-of-Paris moistened to the consistency of mortar is turned down over the type, and a partial impression taken; then, after opening the press to remove the cloth and any surplus clay, a complete impression is taken, imbedding the type in the plastic material to the desired extent. The mould is then removed and hardened by drying, and after being heated to the temperature of molten metal is inclosed on three sides by an iron wire, to which, over the face of the mould, a sheet of metal is clamped, as in a moulder's flask. The metal is poured into the open edge, and after cooling the mould is removed from the cast by washing. Curved plates for the Hoe press were cast from moulds made by using on the press a sheet of steel of the desired curvature spread flat and carrying the clay on what was its concave side. After the impression was taken the sheet was released and resumed its normal curvature, bending the plastic mould with it. The finished stereotype appeared as if taken from a type a little more condensed one way than that actually employed.

*The papier-maché process* was invented by Genoux in 1829 and introduced into Great Britain by Wilson, of Scotland, in 1832. It is far more expeditious than any other (by Hoe machines in 1895 plates could be made in six minutes), the type used suffers no perceptible injury, curved plates can be made with the same facility as flat, and a large number of plates can be cast from the same matrix; this process has therefore been adopted by all large daily papers. The material for a papier-maché matrix is formed by spreading paste over a sheet of moderately thick unsized paper and covering it with successive sheets of tissue-paper, each carefully rolled down smooth by means of a heavy iron roller. The whole is usually saturated with water, although some prefer using the matrix softened only by what moisture there is in the paste. The type matter is imposed in an ordinary chase and inclosed with type-high bearers, these having the inside top edge grooved out, making a bolster for the sheet of papier-maché which is then laid upon it, tissue side next the type. The face of the type is sometimes slightly oiled, and the surface of the sheet treated with powdered French chalk, but this is found to be unnecessary on most kinds of newspaper work. If the work is done by hand in the old way a linen cloth is moistened and laid on the back of the sheet, which is then thoroughly beaten into the form with a stiff brush. Much better and quicker work is done by machinery, however. In this method the form, covered by the sheet and a blanket, travels backward and forward under a large roller, and is then conveyed to a drying-press, where it receives strong pressure while resting on a large chest filled with steam under pressure. The matrix thus becomes dry and hard very quickly, and as it is held under pressure during the process, there is none of the roughness or distortion often produced in one taken from the form in a partially soft condition. After being taken from the drying-press and removed from the form, the matrix is exposed for half a minute to a strong heat, either in an oven or the flame of a gas-jet, to expel any remaining moisture. The edges of the matrix are then trimmed, and it is placed face up on the bottom of a casting-box, flat or cylindrical according to the shape of the plates to be made. It is inclosed on three edges by the sides of the box, which are as high as the stereotype plate is to be thick, and the fourth edge, over which the metal is to be poured, is covered by a thin sheet of steel or old matrix to prevent metal running under the matrix; the lid of the box is then fastened down and molten metal is poured in at the upturned open side, a two-handled ladle being usually employed in conveying it from the furnace. The plate is made considerably longer than the matrix at the open end in order to allow for the shrinkage as the metal cools. On being removed from the box this end is cut off, and the plate is trimmed and shaved down on the reverse side in order to bring it to the exact thickness required, all being very rapidly done by machinery.

*The chalk-plate process* is a method of producing drawings on plates to be used in a printing-press, and is similar in principle to stereotyping proper. A sheet of steel is covered thinly with a soft material, like chalk, about $\frac{1}{32}$d of an inch thick, and the drawing is transferred to this surface, after which the chalk is scraped away where the lines show, leaving the steel bare. The plate is then put in an ordinary casting-box, and used as a matrix. The cast is trimmed square, and made exactly type-high; it may then be locked in its place in the form, and treated just as an engraving, a papier-maché matrix being made from the whole.

II. Electrotyping.—The method of producing casts by means of electricity, as explained in the article Electrotype (*q. v.*), is much employed in making plates for printing, especially from engravings and for bookwork, as electrotype plates give a clearer impression and are more durable than stereotypes proper. A wax mould is first made from the engraving or type (set with shoulder-high spaces) and powdered graphite is spread over its surface so as to make it a conductor of electricity; copper may then be deposited on it by the ordinary process of electroplating. The first plates successfully used for printing were made by Joseph A. Adams, a wood-engraver of New York, who made casts from wood-cuts in 1839–41, some engravings being printed from his electrotype plates in the latter year. In his process finely pulverized tin was added to the graphite for facing the moulds. The effect of this in the sulphate of copper solution was to cause a rapid precipitation of the copper by the substitution of copper for the tin, the latter being seized by the oxygen of the solution while the copper was deposited upon the graphite. The film was afterward increased by the electric current. In Silas B. Knight's modification of this process, now in universal use, fine iron filings are dusted upon the wet graphite surface of the mould, and then a solution of sulphate of copper is poured upon it and gently stirred in with a brush. A film of copper is formed immediately over the entire surface, the acid leaving the copper and combining with the iron, forming a sulphate of iron, which floats away as copper solution is poured on. Machinery has been devised for increasing greatly the rapidity and accuracy with which electrotype plates can be made. The process in detail is as follows: Pure wax is melted in a kettle surrounded by a steam-chamber, and is then poured into a shallow moulding-case which has been previously heated so as to make the wax firmly adhere to it. As soon as the wax is firmly set it is run through a shaving-machine, which reduces it to a uniform thickness, and leaves a smooth surface, into which graphite dust is thoroughly rubbed in order to prevent it from sticking to the type or engraving. The impression is made by forcing the latter (also covered with graphite) into the wax to the required depth—an operation which was long performed on a hand-press, but which may now be done with great speed and perfect accuracy by power. The mould is taken from the press, the surplus wax removed with a sharp knife, and then with a hot iron new wax is melted and dropped on the surfaces between the lines and where there are large blank spaces. This avoids the necessity of later deepening the corresponding places on the cast plates, so as to prevent all possibility of their soiling the paper in printing. A piece of sheet-copper or lead is imbedded in the edge of the sheet of wax to facilitate electrical connection. The mould then receives a coating of graphite, and it is of the utmost importance that it should be thoroughly covered, and that the graphite should have a very high polish. The best work is done by a machine, which also obviates the great inconvenience of scattering the dust. The machine is entirely automatic. After washing the mould iron filings are sifted on, and a quantity of a weak solution of sulphate of copper is stirred in by means of a brush, a thin coating of copper being deposited upon the surface of the mould, as explained above. This operation is repeated, to make sure that every point is covered. The mould is then for one or two hours suspended as a cathode in a bath of sulphate of copper solution, and the coating is increased by the action of the electric current until it is about ·003 of an inch thick. After being detached from the mould and washed in boiling water, it is brushed on the back with a solution of chloride of zinc, and sheets of tinfoil are laid over it and melted, the face of the cast resting on a perfectly smooth surface. Molten metal is then slowly poured on, enough to give the plate the required thickness (about $\frac{1}{8}$ inch). It is cooled by an air-blast so diffused as to cause the entire plate to solidify at once, and is then subjected to pressure until quite cool and firm; if this is not done the plate is apt to become distorted, and needs to be straightened by skillful hammering. The plate is then finished to the exact size and thickness desired. Any blank spaces which are so high as to soil the paper in press are deepened, as also in stereotype plates, by a routing-machine. Plates to be used on a Hoe perfecting-press are passed through a machine which gives them the proper cylindrical curvature at one revolution. A special routing-machine is provided for such plates.

Electrotypes are sometimes faced with nickel by first placing the mould in a nickel solution and plating on a coating of the metal, and then removing to the copper solution and finishing in the regular way. Although these plates are attractive in appearance, and will not tarnish, the nickel is so liable to strip and the coating is so very thin that it is of little practical value.

Iron can be deposited by the electric current in the same manner as copper; electrotypes of iron have been made by Klein, of St. Petersburg, and the highest success is attributed to him in their application to the printing of bank-notes. The deposit is hard as steel and exceedingly durable.

*Glyphography*, another useful application of the art of electrotyping, is the invention of Palmer. A piece of ordinary copper plate is stained black on one side, and very thinly covered by a substance resembling white wax. The artist makes his sketch or drawing through this thin film, which wherever scraped away by his pencil exposes the black surface of the plate. The sketch when completed shows exactly what the print from an electrotype made from the plate will be. When the artist has finished his work the remaining wax is carefully built up in the regular way, and the plate is electrotyped in the same manner as a wax mould.

By what is known as electro-etching this process can also be reversed, and instead of making an electrotype from the prepared plate the plate can be immersed in the solution and connected with the positive pole of the dynamo, and the plate dissolved away where the lines expose it to the action of the solution. As the wax withstands the solution, the plate where covered by it will remain unchanged. When the lines are deepened by the action of the electric current and solution to the required depth, the plate is taken from the solution, and after the wax is cleaned off is mounted for printing. The drawing or sketch will appear in white lines on a black ground. O. B. BEACH.

**Sterility** [from Lat. *steri'litas*, deriv. of *ste'rilis*, barren, sterile]: an incapacity for procreation, whether in the male or female. A knowledge of the causes of sterility depends on an understanding of the laws of conception. (See EMBRYOLOGY, OVARIES, etc.) Sterility in the male is due either to impotency or to the absence of zoösperms (spermatozoa) in the semen, or to their lack of vitality when present. If by cause of old age, malformations of the genitals, or other influences, a man is incapable of performing the part allotted by the laws of nature, he is said to be impotent, and is therefore sterile. The male may be able, however, to perform the sexual act, and yet be incapable of procreation, because the semen may not possess zoösperms, without which fructification is impossible. This deficiency may be natural or acquired; it is normal only in extreme youth and in advanced old age. If a man is born with but one testis (monorchid), as a rule it does not secrete zoösperms; and if the testes are so imperfectly developed as to remain always in the cavity of the abdomen, as in the fœtus, then also the seminal fluid is deficient in the all-important property necessary for fecundation. Whatever produces an inflammation of the testes (orchitis) may bring about such a change in the secretory apparatus of these organs as to destroy the vitalizing power of the semen. A fall or a blow on these glands may do this, but the most common cause is inflammation communicated to them by continuity of surface from the urethra, neck of the bladder, and vesiculæ seminales, sequels of urethritis (gonorrhœa). Not unfrequently this happens as a consequence of parotitis (mumps), where from cold or other cause the inflammation is suddenly transferred from the parotid (salivary) gland to the testes. The seminal fluid may be emitted in a normal manner and may contain zoösperms or spermatic particles, but these may be dead or very feeble and incapable of surviving long enough to meet the ovule deep within the genital canal. This condition may be the result of some constitutional vice, drunkenness, syphilis, or excessive venery. It is estimated that 20 per cent. of sterile marriages are due to faults in the male. A man may be sterile or incapable of procreation at one time, and by appropriate treatment under favorable circumstances he may possibly regain the lost power; but the removal of incapacity in the male is not generally so successful as the removal of the obstructive causes in the female.

In the female, if competent for the married relation, and if the ovaries are functionally active, the cause of sterility is generally some obstruction to the entrance of zoösperms into the cervical canal (neck of the uterus), or a diseased condition of the mucous secretion of that canal, or some obstruction either to the exit of ovules from the ovary (periovaritis), or to the passage of zoösperms or ovules along the Fallopian tube or oviduct. If menstruation is normal, it may be taken for granted that ovulation is normal—that the ovum is at the regular time discharged from the ovary and starts on its way to the cavity of the womb; but some previous pelvic inflammation may have obstructed the Fallopian tubes or bound down their fimbriated extremities, so as to prevent them from fulfilling their functions in conducting the ovum to the cavity of the uterus. This state of things can usually be diagnosed with accuracy, but can not usually be relieved as far as sterility is concerned. Any marked and permanent deviation of the uterus from its normal position, whether anteriorly, posteriorly, laterally, or by descent, may interfere with conception. When the body of the uterus falls far forward, on the bladder, toward the pubes, it may so displace the os tincæ (outer orifice of the cervical canal) or produce such a degree of congestion in the whole organ as to prevent the zoösperm from reaching the cavity of the uterus; and if the uterus is bent on itself in this form of displacement (anteflexion), the obstruction is practically insuperable. When the body of the uterus falls far back under the hollow of the sacrum, pressing upon and obstructing the rectum, it may easily be restored to its normal position and kept there in a great majority of cases. Lateral malpositions and descent may require the same attention. A more frequent cause of the sterile condition, however, is found in the neck and cavity of the uterus. The cavity of the uterus may contain a tumor or polypus, which must be removed, or it may be in a state of inflammation (endometritis), which must be cured. Again, the mouth of the uterus (os tincæ) may be so small that the semen can not enter it; then it must be enlarged by forcible dilatation. Abnormal angulation of that portion of the womb just above the neck (lower uterine segment) is a frequent cause of sterility. It is often bent to an acute angle instead of being comparatively straight, but when this is not complicated with the presence of a fibroid tumor or other adventitious growth, it may be remedied, and is often easily and promptly cured, by surgical means. Another frequent cause of sterility is an abnormal condition of the secretions found in the utero-cervical canal. The mucus of the cervical canal from the third to the tenth day after the end of menstruation should be translucent, clear as the white of a new-laid egg, without any opaque or milky-looking spots. A drop of mucus taken from the cervical canal a few hours after sexual intercourse should be examined under the microscope. If living zoösperms are found in abundance twenty-four hours or more after coition conception is possible; but if the zoösperms are all dead or in a dying state, then there is some abnormal condition of the utero-cervical canal which gives rise to an abnormal secretion. The diseased condition of the utero-cervical canal (called endometritis) is often found in women whose general health is perfect, and is generally curable. See also the article HYBRIDISM.

Revised by B. C. HIRST.

**Sterilization**: See DISINFECTION.

**Sterlet** [= Fr. = Germ., from Russ. *sterlyadĭ*, sterlet]: the *Acipenser ruthenus*, a small species of sturgeon found in various Russian rivers and the Caspian and Black Seas, into which they empty, and esteemed for its flesh. It is characterized by a narrow, pointed snout, and the slightly fringed barbels; the dorsal shields, 11 to 17, are moderately developed, the lateral ones, 60 to 70, small, and the abdominal, 13 to 15, moderate; the skin is densely covered with minute denticulated ossifications of subequal size. It rarely or never attains a length of 3 feet, and a common size is 2 feet in length and 3 lb. in weight. It leaves the sea in May and June, and ascends the rivers, sometimes very high up, for the purpose of spawning. It has not only a superior reputation as a table-fish, but from its roes is made the best caviare, which constitutes a noteworthy article of trade in Russia. Its introduction into rivers of the U. S. has been strongly recommended, and it has been claimed that the Mississippi and Ohio rivers would be especially suitable for it. The Russian Government has introduced it into waters about St. Petersburg, and in 1870 a number of the fry were introduced into the waters of Sutherlandshire, Scotland, in apparently good condition. Their embryonic life is so short that it is difficult to transport the eggs with success. Revised by F. A. LUCAS.

**Sterling**: city; Whiteside co., Ill.; on the Rock river, and the Burlington Route and the Chi. and N. W. railways; 52 miles E. N. E. of Rock Island, 110 miles W. of Chicago (for location, see map of Illinois, ref. 2-D). It has excellent water-power; manufactures agricultural machinery, common and barbed wire, hearses, coffins, school furniture, gas-engines, and paper; and is in an agricultural region. There are 14 churches, 3 public schools, hospital, 2 national banks with combined capital of $175,000, a private bank, and a monthly, 2 daily, and 4 weekly periodicals. Pop. (1880) 5,087; (1890) 5,824; (1900) 6,309.

EDITOR OF "GAZETTE."

**Sterling**: city (founded in 1872); Rice co., Kan.; on the Atch., Top. and S. Fé and the Mo. Pac. railways; 252 miles W. of Kansas City, Mo. (for location, see map of Kansas, ref. 6-F). It is in an agricultural and stock-raising region; is principally engaged in farming, salt-mining, and milling; and contains 13 churches, 3 public-school buildings, Cooper Memorial College, a national bank (capital $50,000), a State bank (capital $50,000), a private bank, and 2 weekly papers. Pop. (1880) 1,014; (1890) 1,641; (1900) 2,002.

EDITOR OF "BULLETIN AND GAZETTE."

**Sterling, JOHN**: author; b. at Kames Castle, Isle of Bute, July 20, 1806, son of Edward Sterling, editor of the London *Times*; was educated at Glasgow and Cambridge; went to London in 1827; was a short time on the editorial staff of *The Athenæum*, and during a part of 1831-32 resided for his health in the West Indies. Returning to England, he took deacon's orders in 1834; was a curate at Hurstmonceaux, Sussex, but soon gave himself wholly to literary studies and pursuits. Among his works are *Arthur Coningsby*, a novel (1833); *Minor Poems* (1839); *The Election*, a poem (1841); and *Strafford*, a drama (1843). Two volumes of his *Essays and Tales* were edited, with a *Memoir*, by Julius C. Hare (1848), and Thomas Carlyle has written *The Life of John Sterling* (1851). D. in Ventnor, Isle of Wight, Sept. 18, 1843.

**Stern**, Daniel: See Agoult.

**Sternberg**, Constantine: See the Appendix.

**Sternberg**, George Miller: See the Appendix.

**Sterne**, Laurence: humorist; b. at Clonmel, Ireland, Nov. 24, 1713; son of a lieutenant in the British army; educated at Jesus College, Cambridge; graduated in 1740; entered into holy orders, and was presented by his uncle with the valuable benefice of Sutton, Yorkshire, to which that of Stillington, 1½ miles distant, was soon after added. Here he lived for nearly twenty years. In 1759 he published the first two volumes of *Tristram Shandy*, which became popular at once, and gained for him from Lord Falconbridge the additional curacy of Cotswold. He had been married nearly twenty years, and now, leaving his wife and daughter at York, he went to London, where or upon the Continent most of the remainder of his life was spent. He published several occasional sermons, and at intervals seven volumes entitled *The Sermons of Mr. Yorick, or Sermons by Laurence Sterne, A. M., Prebendary of York*, etc. (1760–69). His *Life and Opinions of Tristram Shandy, Gent.*, in all nine volumes, was published at intervals (1759–67). The *Sentimental Journey*, his best work, was written in France, but published in London, 1767. D. in London, Mar. 18, 1768. In 1775 appeared three volumes of his letters to his friends, edited by his daughter, and his *Letters to Eliza*. *Seven Letters by Sterne and his Friends*, edited by W. Durrant Cooper, was privately printed in 1844. Sterne was a subtle delineator of character, and a delicate artist of the pathetic and comic. His chosen province was the whimsical, and his great model in this kind was Rabelais. He was the cleverest of English sentimentalists. He was a minute philosopher, his philosophy is kindly, and he had the art of making much out of little; but his writings are morally corrupt, and his sentiment has a taint of insincerity. He was the most unclerical of clergymen, though his sermons were both witty and affecting. In character he was selfish, worldly, and vain. See the *Life of Sterne*, by Percy Fitzgerald (1864), and Thackeray's *English Humorists*.

Revised by H. A. Beers.

**Sterne**, Simon: lawyer and economic writer; b. in Philadelphia, Pa., July 23, 1839; graduated at the law school, University of Pennsylvania, 1860; removed to New York 1860; appointed in 1875 member of the commission to devise a plan for the government of cities in the State of New York, a report of which was presented to the Legislature, Feb. 24, 1887. He is the author of *Representative Government and Personal Representation* (Philadelphia, 1871); *Constitutional History and Political Development of the United States* (New York, 2d ed. 1888); and contributions to Lalor's *Cyclopædia of Political Science*. C. H. T.

**Sternhold**, Thomas: hymnologist; b. near Blakeney, Gloucestershire, England, about 1500; was educated at Oxford, but did not take a degree, and became groom of the robes to Henry VIII. and Edward VI.; with John Hopkins (d. Oct., 1570 (?); little is certainly known of him) was joint author of the first version of the Psalms into English meter. D. Aug., 1549. His first edition appeared in London in 1548, and contained nineteen Psalms; the second, *All such Psalmes of David as Thomas Sterneholde, late groome of the Kynge's Maiestie's roobes did in his lyfe tyme drawe into English metre* (1549), contained thirty-seven Psalms translated by Sternhold. A 3d ed., 1551, contains seven Psalms translated by John Hopkins. Other editions followed until 1562, when *The Whole Booke of Psalms collected into English Metre by T. Sternhold, J. Hopkins, and others, conferred with the Ebrue, with apt Notes to Sing them withal*, was annexed to the Book of Common Prayer. Of the entire number of Psalms, 40 were versified by Sternhold and 59 by Hopkins. Cf. art. *Old Version*, Julian's *Dictionary of Hymnology*. Revised by S. M. Jackson.

**Sternum**, or **Breast-bone** [*sternum* is Mod. Lat., from Gr. *στέρνον*, breast, chest]: a bony or semi-cartilaginous plate which serves as the anterior (or inferior) point of union of many of the ribs. It represents the blended hæmal spines of the dorsal vertebræ. In fishes, batrachians, and serpents it is absent. In tortoises it becomes the lower shell or plastron, and is much widened. In most birds it is strongly keeled in front, the keel serving as a point of attachment for the strong wing-muscles. In man it consists of three pieces, of which the uppermost is the *manubrium*; the next, the *gladiolus*; and the lowest, the ensiform or xiphoid cartilage. The sternum may be rendered very prominent in certain bone-diseases, as rickets, by the sinking in of the ribs, which thus push the sternum forward. The chicken-breast thorax results from such deformity. Contrariwise, the sternum is sometimes sunk below the rest of the front of the chest, especially in ill-formed phthisical persons.

**Sternutation**: See Sneezing.

**Sterrett**, John Robert Sitlington, Ph. D.: professor of Greek; b. at Rockbridge Baths, Va., Mar. 4, 1851; educated at University of Virginia, University of Leipzig, Polytechnic of Aix-la-Chapelle, and Universities of Berlin, Athens, and Munich (Ph. D.); secretary American School of Classical Studies at Athens; leader of various archæological expeditions to Asia Minor; member of the Wolfe expedition to Assyria and Babylonia; Professor of Greek in Miami University, Oxford, O., 1886–88, in the University of Texas, Austin, Tex., 1888–92, and at Amherst College, Amherst, Mass., since 1892; author of *Qua in re Hymni Homerici quinque majores inter se differunt* (Boston, 1881); *Inscriptions of Sebaste* (*Amer. Jour. Philol.*, 1883); *Inscriptions of Assos*, *Inscriptions of Tralleis*, *Preliminary Report of a Journey in Asia Minor* (all three Boston, 1885); *An Epigraphical Journey in Asia Minor*, *The Wolfe Expedition to Asia Minor* (both Boston, 1888); and numerous articles in *The Nation*, *The Independent*, *Classical Review*, etc. C. H. Thurber.

**Stesich'orus** [= Lat. = Gr. Στησίχορος; ἱστάναι (aorist, ἔστησα), station, establish + χορός, chorus]: Greek lyric poet of Himera, in Sicily; b. about 640; d. about 555 B. C.; of great reputation in antiquity, especially as an inventor of poetical forms. His true name was Teisias, but he was called Stesichorus, "arranger of choruses," from his choral odes, consisting of strophe, antistrophe, and epode, though this triple form is doubtless older. His themes were epic, and the Fourth Pythian of Pindar is supposed to give some notion of the way in which, according to Quintilian, "he sustained the weight of the epos with the lyre." On account of the poem in which he charged Helen with the woes of Troy he was fabled to have been smitten with blindness, which was removed when he withdrew his slanders in a *palinodia* or recantation. Stesichorus was also a fabulist, and to him is attributed the famous fable of the horse, the stag, and the man (Arist., *Rhet.*, ii., c. 20). Of this Homer of the lyric poets we have only scant fragments, to be found in Bergk's *Poetæ Lyrici Græci* (vol. iii., 4th ed., pp. 205–234).

B. L. Gildersleeve.

**Steth'oscope** [from Gr. *στῆθος*, chest + *σκοπεῖν*, view, examine]: an instrument employed by physicians for the physical exploration of the chest. (See Auscultation.) Laennec, the founder of methodical auscultation, introduced the solid stethoscope, a tube made from a single piece of wood (Fig. 1). It is from 10 to 12 inches long, has a flanging chest-piece to receive sound, an open canal to convey sound, the solid structure also serving to conduct it, and a broad flat ear-piece for apposition to the ear and the exclusion of extraneous sounds. The medical profession is indebted to Dr. Camman, of New York, for originating the "binaural" or "double stethoscope" (Fig. 2). For purposes of careful diagnosis, by concentrating local sound, conducting it to the exclusion of surrounding noise, and conveying a separate but similar and simultaneous impression to each ear, the stethoscope is invaluable. It is further valuable in hospital and other public service, preventing contact of the listener's head with unhealthy and uncleanly patients. It is particularly serviceable in

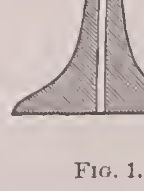


Fig. 1.

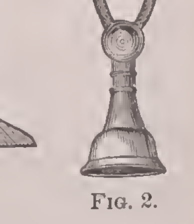


Fig. 2.

localizing the origin of sounds, as of small cavities in the lungs, valvular diseases of the heart, and in aneurism. The best auscultators prefer the unaided ear for habitual chest examination, reserving the stethoscope to aid in special and obscure cases. Revised by W. PEPPER.

**Stetson University**: See the Appendix.

**Stettin**, stet-teen′: town and railway center of Pomerania, Prussia; on the left bank of the Oder, at its entrance into the Stettiner-Haff, 83 miles N. E. of Berlin (see map of German Empire, ref. 2–G). Across the river, which is here from 12 to 16 feet deep, lies the suburb of Lastadie, connected with Stettin proper by three bridges. Outside and on the line of the old fortifications, removed in 1874, are the suburbs of Bredow, Grabow, and Züllchow. The site it occupies is hilly, and its streets are consequently uneven, but the houses are neat and substantial, and many buildings, such as the royal palace, the citadel and barracks, and the town-hall, are very handsome. Its sugar-refineries, oil-mills, glass-works, breweries, distilleries, and manufactures of anchors, sailcloth, rope, tobacco, soap, candles, hats, etc., are very important, and as a place of commerce Stettin is one of the leading ports of Germany. Only small vessels can reach it, however; its port on the Baltic is Swinemünde. It is the ancient *Sedinum*, afterward *Stettinum*, and is of Slavic origin. In the Middle Ages it was the residence of the Duke of Pomerania, and, having joined the Hansa, it soon became a flourishing commercial town. It forms the outlet for the rich products of Silesian industry. Pop. (1900) 210,-680. Revised by M. W. HARRINGTON.

**Steuart**, Sir JAMES DENHAM: political economist; b. in Edinburgh in 1712; was educated at the University of Edinburgh, and became an advocate. While traveling on the Continent he entered into relations with the Pretender, and when the rebellion of 1745 broke out he was forced to go into exile. He returned to Scotland in 1763, and was subsequently pardoned for any share he might have had in the rebellion. He published, among other works, *Apologie du Sentiment de Monsieur le Chevalier Newton sur l'ancienne Chronologie des Grecs* (1757) and *An Inquiry into the Principles of Political Economy* (1770), which preceded by several years Adam Smith's *Inquiry into the Nature and Causes of the Wealth of Nations*. Smith's work completely superseded Steuart's *Inquiry*, but the latter contains many valuable suggestions, and in some respects anticipates the ideas of later economists. Though he must be classed with the mercantilists, Steuart was free from many of the errors of that school of economists. D. in 1780.

**Steuben**, Germ. pron. stoi′ben, FRIEDRICH WILHELM AUGUST HEINRICH FERDINAND, Baron von: soldier; b. Nov. 15, 1730, in the fortress of Magdeburg, Prussia, where his father was an officer; entered the Prussian army as a cadet 1747; distinguished himself at the battle of Rossbach 1757; became adjutant-general 1758; was aide to Gen. Knoblauch in his brilliant march into Poland 1761; was taken prisoner and carried to St. Petersburg; won the favor of the Grand Duke Peter; was soon exchanged; was made captain (1762), and placed on the staff of Frederick the Great, from whom he received, with a few other selected officers, special instruction in tactics; was appointed in 1764 grand marshal to the court of the Prince of Hohenzollern-Hechingen, but resigned that post about 1775. In 1777 he was induced by Saint-Germain to offer his services to the American insurgents through the agency of Silas Deane, and was appointed inspector-general, with the rank of major-general, in the spring of 1778; took part as a volunteer in the battle of Monmouth in the following June; rendered memorable services in drilling the officers and men of the Continental army into efficiency; prepared a manual of instruction for the army, adopted by Congress and printed 1779; was a member of the court martial on Maj. André; took command of the forces in Virginia 1780, and rendered good services at the siege of Yorktown 1781. His greatest exploit, however, was his Virginian campaign. He had been left in Virginia by Gen. Greene to gather up and discipline the levies voted for the Southern army by that State when it was invaded by Arnold. On the appearance of this new danger the militia flocked to Steuben's standard. Arnold succeeded in burning Richmond, and then went down the James river on a marauding expedition; but when pursued and overtaken by Steuben with the militia, he fled up the Elizabeth river. Remaining as a citizen of the U. S. after the war, Steuben procured with difficulty an adjustment of his claims upon Congress. He was ultimately assigned a pension of $2,500 and received grants of land from several States. On the tract given him by New York, in Oneida County (the township of Steuben), he settled, accompanied by North, Popham, Walker, and others of his former aides, to whom he gave a large portion of his lands. D. at Steuben, Nov. 28, 1794. He was a man of great kindness and generosity, of ready wit and highly polished manners. A *Life* by Francis Bowen appeared in Sparks's series; another, containing much new material, was published by Friedrich Kapp (1860), and an epitome of the latter may be found in Greene's *German Element in the War of Independence* (1876).

**Steubenville**: city (site of a fort built in 1786, laid out as a town in 1798, incorporated as a city in 1851); capital of Jefferson co., O.; on the Ohio river, and the Cleveland and Pittsburg Div. of the Penn., the Pitts., Cin., Chi. and St. L., and the Wheeling and Lake Erie (Wabash) railways; 22 miles N. of Wheeling, and 43 miles W. of Pittsburg (for location, see map of Ohio, ref. 4–J). It is in a rich agricultural and mining region; is laid out on the second terrace of the Ohio, above danger from the floods for which the river is noted, and is nearly surrounded by hills from 300 to 500 feet high, which protect it from destructive winds. The city has excellent surface drainage, good sewerage, and a water-supply obtained from the river 2 miles above the city, with a system of high-pressure mains for fire and manufacturing purposes and one of low-pressure for domestic uses. The principal streets are paved with vitrified brick, and in the residence portions shaded by fine trees.

*Churches and Schools.*—Steubenville has 5 Methodist Episcopal churches, 3 Presbyterian, 2 Roman Catholic, 2 Lutheran, 2 Protestant Episcopal, and 1 each African Methodist Episcopal, Baptist, Congregational, Christian, Methodist Protestant, and United Presbyterian. The public-school system comprises 6 school buildings, 54 teachers, and over 2,200 pupils, and cost for maintenance $40,000 per annum. There are 2 Roman Catholic parochial schools, with over 500 pupils. There are several libraries and 3 daily and 4 weekly newspapers.

*Finances and Banking.*—In 1900 the receipts for municipal purposes were $167,216.95; expenditures, $95,185.13; the net debt was $34,875; assessed property valuation, $5,000,000. In 1900 there were 3 national banks with combined capital of $325,000, 2 private banks, and 2 building and loan associations.

*Business Interests.*—In the surrounding hills and underlying the city are extensive supplies of excellent coal. The seam beneath the city limits is worked by means of several shafts. Natural gas is abundant at distances of from 5 to 50 miles, and is piped into the city; petroleum-wells have been opened within 5 miles; and economic clays are easily mined in the hills. The principal manufactories are 3 blast furnaces, 2 rolling-mills, nail-factories, and tube-works, 2 foundries, 2 machine-shops, steel plant, boiler-works, 3 glass-factories, 2 flour-mills, glass-melting pot-works, paper-mill, white-ware pottery, and ice plant. Extensive fire-brick, paving-brick, and sewer-pipe works, N. of the city, form a part of the local industries, as do also numerous coal mines and quarries of building-stone in the vicinity, operated by local capital. The greater part of the coal product is shipped to the lakes. The city is the distributing point for a large area of country. Pop. (1880) 12,093; (1890) 13,394; (1900) 14,349.

JOSEPH B. DOYLE, EDITOR "HERALD-STAR."

**Stevens**, ABEL, LL. D.: minister and author; b. in Philadelphia, Pa., Jan. 19, 1815; studied at the Wesleyan University, Middletown, Conn.; joined the New England Conference of the Methodist Episcopal Church in 1834, was agent for the Wesleyan University one year, and in 1835 was stationed at Boston; in 1837 made a European tour, and after his return was stationed at Providence, R. I.; in 1840 became editor of *Zion's Herald* at Boston, and in 1852 of *The National Magazine*, an illustrated monthly, at New York, which was discontinued after two or three years. In 1856 he was elected by the general conference as editor of the New York *Christian Advocate and Journal*. From 1860 to 1874 he was joint editor of *The Methodist*, an independent journal published in New York. He published numerous books, including *Memorials of the Introduction of Methodism into New England* (1848); *Memorials of the Progress of Methodism in the Eastern States* (1852); *Church Polity*; *History of the Religious Movement called Methodism* (3 vols., 1858–61); *Life and Times of Nathan Bangs, D. D.* (1863); *History of the Methodist Episcopal Church*

*in the United States of America* (4 vols., 1864–67); *The Centenary of American Methodism* (1866); *The Women of Methodism* (1866); *Life and Times of Madame de Staël* (2 vols., 1882); *Character Sketches* (1882); and *Christian Work and Consolation* (1885). D. at San José, Cal., Sept. 11, 1897.
Revised by A. OSBORN.

**Stevens**, ALFRED: genre-painter; b. in Brussels, May 11, 1828; studied at the École des Beaux-Arts and under Roqueplan, Paris; third-class medal, Salon, 1853; second-class, Paris Exposition, 1855; first-class, Paris Exposition, 1867 and 1878; medal of honor, Paris Exposition, 1889; commander Legion of Honor 1878; commander in the Orders of Leopold of Belgium, Francis Joseph of Austria, and St. Michael of Bavaria. He is one of the ablest and most charming painters of modern life in the French school, to which, by residence and affinities, he belongs, and his works are especially fine in color quality. An excellent example of his style is *Five o'clock Tea*, in the collection of Mrs. W. H. Vanderbilt, New York. Studio in Paris.—His brother JOSEPH, born in Brussels, 1822, is distinguished as a painter of dogs and other animals. Among his works are *Taureau flamand poursuivi par un Chien* (1853) and *Chien regardant une Mouche* (1878). WILLIAM A. COFFIN.

**Stevens**, ALFRED GEORGE: sculptor; b. at Blandford, Dorsetshire, England, in 1817. He was the son of a house-painter and decorator, and was sent to Italy at the expense of a wealthy gentleman to study painting. He returned to England about 1842, and was made a teacher in the Government School of Design, then established at Somerset House, London, in which he remained about four years. During this time he made many designs for ornamental work of various kinds, such as the doorway of the Jermyn Street School of Mines, the doors themselves having been designed also by him but never carried further than the fine drawing in South Kensington Museum. As designer for the Green Lane works at Sheffield he made, about 1851, some remarkable fire-places and stoves, anticipating by many years the work of 1885–95 in modern adaptation of classical ornament. Of the years from 1850 to 1860 are some remarkable designs for pottery, daggers, and other small objects, and then, or at a later time, he designed the decorations of many very costly houses. He made designs, in competition, for the painted decorations of some of the halls of the new Houses of Parliament, for the decorations of the new Foreign Office, and for a memorial of the Exhibition of 1851. In 1857 he competed for a monument to the Duke of Wellington, and, among eighty-two competitors, was so far successful as to receive one of the minor prizes, and at a later time to be employed as designer of the work. His design was partly carried out, and the monument in a small chapel of St. Paul's Cathedral is what exists of it. The architectural design of the monument is fine and worthy of the occasion, but not very original. The sculpture is of very great merit. This was to consist of the equestrian statue on the summit, which, however, was never finished, and the following, which is all in place: A recumbent figure on a sarcophagus, a group of *Valor and Cowardice*, and one of *Truth and Falsehood*, besides decorative panels. D. in London, Apr. 30, 1875. RUSSELL STURGIS.

**Stevens**, CHARLES ELLIS, Ph. D., LL. D., D. C. L.: clergyman; b. in Boston, Mass., July 5, 1853; studied at Wooster University, Ohio, University of Pennsylvania, Yale College, Berkeley Divinity School, Middletown, Conn., Nashotah, Wis., and in Europe; ordained priest in the Protestant Episcopal Church 1875; assistant minister of Grace church, Brooklyn, N. Y., 1876; rector Church of the Ascension, Brooklyn, 1877; for many years from 1878 secretary of an auxiliary of the board of missions of the Protestant Episcopal Church and chairman of numerous committees of the diocese of Long Island; examining chaplain diocese of Long Island; archdeacon of Brooklyn 1888–91; president of League for Moral Instruction in Public Schools of New York 1890; rector Christ church, Philadelphia, 1891; lecturer on English and American constitutional law, Wooster University, 1888, at the University of the City of New York 1891, and at the University of Pennsylvania 1892; lecturer on constitutional law and English literature at St. Stephen's College, Annandale, N. Y., since 1890; received honorary degrees from Wooster University and King's College, Nova Scotia; fellow of Society of Antiquaries, Edinburgh, the Royal Geographical Society, and other learned societies; has in preparation a work entitled *Sources of the Constitution of the United States.*

**Stevens**, EBENEZER: soldier; b. in Boston, Mass., Aug. 22, 1751; was a member of Paddock's Company of Boston Artillery, and one of the famous "Boston tea-party" Dec., 1773; removed soon afterward to Rhode Island; raised two companies of artillery and one of artificers for the expedition against Quebec, in which he served as lieutenant, having been commissioned May 8, 1775; became captain of Knox's regiment Jan. 11, and brevet-major Nov. 9, 1776; commanded the artillery at Ticonderoga and at Stillwater; was appointed lieutenant-colonel Apr. 30, 1778; was assigned to Lamb's regiment; served under Lafayette in Virginia; was, alternately with Lamb and Carrington, in command of the artillery during the siege of Yorktown; was one of the founders of the Society of the Cincinnati, and became after the war a leading merchant of New York in the West India and Mediterranean trade; agent of the War Department, and a major-general of militia. D. at Rockaway, L. I., Sept. 2, 1823.

**Stevens**, EDWIN AUGUSTUS: inventor; b. at Hoboken, N. J., in 1795; son of John and brother of Robert L. Stevens; took part in their steamboat experiments and enterprises, and in conjunction with his brothers established passenger and tow boats on the Hudson and other rivers; also aided in the introduction of railways, and invented many appliances for use thereon. At the breaking out of the civil war he urged the Government to put in service the ironclad floating battery of which his brother had long before undertaken the construction, offering to complete it at his own risk, and to receive payment only in case it should prove successful; this offer being declined, he expended considerable sums on the vessel, and upon his death bequeathed it to the State of New Jersey, together with $1,000,000 for its completion; this, however, proved insufficient, and the battery was never finished, and was finally sold to dealers in old iron. He inherited a large fortune from his father and brothers, endowed the Hoboken High School, and bequeathed nearly $1,000,000 to establish at Hoboken the Stevens Institute of Technology. D. in Paris, Aug. 7, 1868. Revised by R. H. THURSTON.

**Stevens**, GEORGE BARKER, D. D.: clergyman and educator; b. at Spencer, N. Y., July 13, 1854; graduated at the University of Rochester, New York, 1877, and at the Yale Divinity School 1880; pastor of the First Congregational church, Buffalo, N. Y., 1880–83, of the First Presbyterian church, Watertown, N. Y., from 1883 to 1886, when he was appointed Professor of Criticism and Interpretation in Yale Divinity School. Besides reviews, essays, etc., he has edited Chrysostom's *Homilies on the Acts and the Romans* (1889), and published a *Commentary on the Epistle to the Galatians* (1890), *The Pauline Theology* (1892), and *The Johannine Theology* (1894). GEORGE P. FISHER.

**Stevens**, HENRY: bibliographer: son of Henry Stevens, antiquary; b. at Barnet, Vt., Aug. 24, 1819; studied at Middlebury College 1838–39; graduated at Yale College 1843, and at Cambridge Law School 1844; established himself in London 1845 (where he resided till his death) as agent for the British Museum in the purchase of North and South American books of all kinds, and was thus instrumental in placing in the British Museum a very complete collection of Americana. He also purchased for the Smithsonian Institution, the Library of Congress, and the chief libraries of the U. S., and for many private individuals. He published several valuable bibliographical treatises and catalogues, among which are *A Catalogue Raisonné of English Bibles* (1854); *A Catalogue of the American Books in the Library of the British Museum* (1856); a *Catalogue of the Crowninshield Library* (1860), and of the library of Baron Humboldt (1861), which latter collection he had purchased; *Bibliotheca Americana* (1861); *Historical Nuggets* (1862); *Bibliotheca geographica et historica* (1870), the latter book being the catalogue of the library of his father, of whom it contains a biographical sketch; *The Bibles in the Caxton Exhibition* (1878); *Historical Collections* (2 vols., 1881–86); and *Recollections of James Lenox* (1886). He also prepared indexes to the State papers in London relating to New Jersey (1858), Maryland (10 vols.), Rhode Island (6 vols.), and Virginia (1858), the three latter being in MS.; published a work on *The Tehuantepec Railway* (1869), and two small volumes of *Historical and Geographical Notes* (1869), relating to early explorations in America. He frequently wrote after his name the initials G. M. B. (= Green Mountain Boy). D. in London, Feb. 28, 1886.
Revised by S. M. JACKSON.

**Stevens,** Isaac Ingalls: soldier; b. at Andover, Mass., Mar. 28, 1818; graduated at the U. S. Military Academy July 1, 1839; promoted second lieutenant of engineers; was engaged upon construction and repairs of fortifications 1839–46; served in the war with Mexico as adjutant of engineers, participating in all the battles from Vera Cruz to the city of Mexico, and for gallantry at Contreras and Churubusco and at Chapultepec was breveted captain and major, and was severely wounded in the San Cosme suburb. From 1849 to 1853 he was principal assistant and in charge of the office of the U. S. Coast Survey at Washington; in Mar., 1853, resigned from the army to accept the governorship of Washington Territory; conducted the pioneer survey of the route for the Northern Pacific Railroad, an account of which he published; delegate to Congress from Washington Territory 1857–61; on the outbreak of the civil war was made colonel of the Seventy-ninth (Highlanders) New York Volunteers. Moving his command to Washington, he was made a brigadier-general of volunteers Sept. 28, and attached to the Port Royal expedition, which left Hampton roads a month later. He commanded the land forces in the actions at Port Royal Ferry, Coosaw river, and a division in the actions on Stono river and the assault on Secessionville. On July 4, 1862, he was made a major-general of volunteers, and a week later transferred to Newport News in command of a division; at the second battle of Bull Run his division (Ninth Corps) was hotly engaged. Near Chantilly, on the morning of Sept. 1, 1862, his division encountered the enemy, when Stevens, ordering a charge, placed himself at the head of his command, where he was shot through the head and instantly killed.

**Stevens,** James Gray: See the Appendix.

**Stevens,** John: inventor; b. in New York in 1749; graduated at King's (Columbia) College in 1768, and was admitted to the bar, but did not practice; became interested in the question of navigation by means of steam, and as early as 1789 presented a memorial to the New York Legislature stating that he had perfected his plans, and in 1804 launched a small vessel worked by steam with screws, and in 1807 built a steamboat which he called the Phœnix. Fulton had in the meantime built his steamboat, the Clermont, and obtained the exclusive right of navigating the Hudson by steam, and Stevens sent his vessel to the Delaware river. In 1812 he planned a revolving steam-battery, to be plated with iron, and involving essentially the principles afterward embodied in the monitors, and in the same year put forth an essay on railways, indicating the methods of operating them by steam, and suggested the construction of a railway from Albany to Lake Erie. The Camden and Amboy Railroad was planned by him. He once owned the entire site of Hoboken, N. J., and through profits in real estate and other enterprises amassed an immense fortune. D. at Hoboken, Mar. 6, 1838. Revised by R. H. Thurston.

**Stevens,** John Leavitt, LL. D.: writer and diplomat; b. at Mt. Vernon, Me., in 1820. He was educated in the schools and seminaries of his native State. In 1855 he became partner and coeditor with James G. Blaine of *The Kennebec Journal*, of which he subsequently was chief editor for many years; member of the Legislature 1865–70; U. S. minister to Uruguay and Paraguay 1870–73. In 1877 he was appointed minister to Sweden and Norway. During his official residence of six years in Stockholm he wrote the *History of Gustavus Adolphus*. In 1883 Tufts College conferred on him the degree of LL. D. In 1889 he was appointed minister resident to the Hawaiian islands, a title soon after changed, by act of Congress, to that of minister plenipotentiary and envoy extraordinary. He was recalled in 1893, his attitude during the revolution in the islands being condemned by President Cleveland as compromising the neutrality of the U. S. D. at Augusta, Me., Feb. 8, 1895.

**Stevens,** Robert Livingston: inventor; b. at Hoboken, N. J., Oct. 18, 1787; son of John Stevens, inventor; became early interested in the ideas of his father regarding steam navigation, and made many improvements in the construction of vessels, among which was that of giving concave water-lines to the hull. He subsequently engaged largely in the building of steamboats, improving the marine engine, and introducing the beam engine. In 1813 he invented and made for the Government elongated percussion shells for smooth-bore guns, and in 1822 used anthracite coal in a furnace, and soon after in his steamers; in 1836 introduced the T-rail on the Camden and Amboy Railroad, of which he was president, and in 1842 was commissioned to build for the U. S. Government an iron-plated floating battery, which remained uncompleted at his death. D. at Hoboken, Apr. 20, 1856. Revised by R. H. Thurston.

**Stevens,** Thaddeus: statesman; b. at Peacham, Vt., Apr. 4, 1792; graduated at Dartmouth College in 1814; went to Gettysburg, Pa., where he taught in an academy, at the same time studying law; was admitted to the bar in 1816, and soon acquired an extensive practice. In the presidential canvass of 1828 he was a strong opponent of the election of Gen. Jackson; in 1833 and several times subsequently he was a member of the State Legislature, in 1836 a member of the convention to revise the State constitution, and in 1838 canal commissioner. He was active in introducing the public-school system in Pennsylvania. In 1842 he removed to Lancaster; in 1848 was elected Representative in Congress; was re-elected in 1850, 1858, 1862, and thereafter to each Congress until his death, serving at various times as chairman of important committees, being one of the acknowledged leaders of the Republican party, and distinguishing himself for his earnest advocacy of measures in opposition to slavery, for the emancipation and enfranchisement of the colored race, and after the war for stringent proceedings against the seceding States. He was one of the most active managers in the impeachment trial of President Johnson. The degree of LL. D. was conferred upon him by Middlebury College in 1867. D. at Washington, Aug. 11, 1868.

**Stevens,** Walter Le Conte, Ph. D.: physicist; b. in Gordon co., Ga., June 17, 1847; graduated at the University of South Carolina 1868; instructor in chemistry, Oglethorpe College, Atlanta, Ga., 1870–72; teacher of physical science, Chatham Academy, Savannah, Ga., 1873–76. After a year at the University of Virginia he taught in New York until 1882, at the same time writing on physiological optics and acoustics in *The American Journal of Science*, *London Philosophical Magazine*, and other journals. He was Professor of Mathematics and Physics in the Packer Collegiate Institute, Brooklyn, N. Y., 1882–90; studied physics at Strassburg, Berlin, and Zurich from 1890 to 1892, when he became Professor of Physics in the Rensselaer Polytechnic Institute, Troy, N. Y. Besides contributions to various periodicals he wrote a large part of *Appletons' Physical Geography* (New York, 1887) and revised Steele's *Physics* (1888).

**Stevens Institute of Technology**: a school of mechanical engineering at Hoboken, N. J., founded in 1870 by a bequest from Edwin A. Stevens, and further assisted by donations by its president, Henry Morton. It prepares young men for employment in manufacturing establishments, on railways, and the like, where machinery is designed, constructed, and operated. Its course of studies comprises departments of mathematics, mechanical drawing, physics, general chemistry, analytical chemistry, mechanical engineering, experimental mechanics and shop-work, applied electricity, languages, belles-lettres, and engineering practice. Its course has been especially characterized by its large admixture of practical work in the line of workshop practice, in the handling of machine tools, and particularly in dealing with experimental problems, such as the operation of steam, gas, and hot-air engines, pumps, injectors, etc., with accompanying measurements of their efficiency by the use of indicators, dynamometers, calorimeters, etc. A department of applied electricity was established in 1883 and a chair of engineering practice was founded in 1888. The buildings include, besides lecture-rooms and drafting-rooms, chemical and physical laboratories, machine-shops, foundries, and other provisions for practical mechanical and electrical work. The faculty numbers thirty, many of whom are leaders in their departments as original investigators and authors. The students number upward of 250, and on graduation receive the degree of mechanical engineer.

Henry Morton.

**Stevenson,** Alan: engineer; son of Robert Stevenson (1772–1850); b. in Edinburgh, Scotland, 1807; educated at the University of Edinburgh; subsequently studied natural philosophy under Sir John Leslie, and for the profession of a civil engineer in the office of his father, with whom he entered into partnership. In 1843 he succeeded his father as engineer to the commissioners of northern lighthouses, to which his subsequent practice was confined. Among many other important improvements in lighthouse apparatus, he introduced the dioptric system in 1836. Of the many lighthouses designed and constructed by him, the Skerryvore was his chief work, an *Account* of which he published; also a *Treatise on Lighthouse Illumination*; contributed articles *Harbors, Lighthouses*, etc., to the *Encyclopædia Britannica*, and various scientific articles to the Edinburgh *Philosophical Journal*, etc. The Emperor of Russia and the Kings of Prussia and Holland bestowed medals upon him in recognition of his services as a lighthouse engineer. He was a fellow of the Royal Society of Edinburgh, member of the British Institution of Civil Engineers, etc. D. at Portobello, near Edinburgh, Dec. 23, 1865.

**Stevenson**, ROBERT LOUIS BALFOUR: author; b. in Edinburgh, Scotland, Nov. 13, 1850. He was grandson of Robert Stevenson, a distinguished engineer, and son of Thomas Stevenson, author of *Lighthouse Optics*. (See *Thomas Stevenson* in *Memories and Portraits*.) His ancestors for three generations had been civil engineers in the service of the board of northern lighthouses, and Robert, who was educated at the University of Edinburgh, was at first intended for the same profession. He was also admitted to the Scottish bar, but did not engage in practice. He first attracted attention as an author by two charmingly sketchy and vagabondish little volumes, *An Inland Voyage* (1878) and *Travels with a Donkey* (1879). These were followed by a series of romances, *New Arabian Nights* (1882); *Treasure Island* (1883), a tale of buccaneers and buried treasure and one of the best boys' books; *Prince Otto* (1885), a love story; *The Strange Case of Dr. Jekyll and Mr. Hyde* (1885), a psychological romance, and the most popular of Stevenson's fictions; *Kidnapped* (1886), a novel with historical elements and studies of Scottish character-types quite equal to Sir Walter Scott's; *The Merry Men and other Tales* (1887), a volume of short stories in a variety of keys; *The Master of Ballantrae* (1888); *The Wrecker* (1892, with Lloyd Osbourne); *David Balfour* (1893), a sequel to *Kidnapped*, etc. Stevenson's versatility is shown in his *A Child's Garden of Verses* (1885), a very imaginative, poetic representation of the world from the childish point of view, and in various volumes of travel, criticism, miscellaneous essays, and sketches, such as *Virginibus Puerisque* (1881); *Across the Plains* (1892); *The Silverado Squatters* (1883); and *Memories and Portraits*. He traveled much in search of health, and many of his books were written in a sick-bed, on railway journeys, or at sea. For a number of years he resided at Samoa and elsewhere in the South Sea islands, reporting his observations in *A Footnote of History* (1892), *Island Nights Entertainments* (1893), and other volumes. In an age of realism Stevenson brilliantly advocated the claims of romance both by practice and by theory. D. at Vailima, Samoa islands, Dec. 3, 1894. H. A. BEERS.

**Stevens Point**: city; capital of Portage co., Wis.; on the Wisconsin river, and the Gr. Bay, Winona and St. P. and the Wis. Cent. railways; 21 miles N. E. of Grand Rapids, 71 miles N. of Portage (for location, see map of Wisconsin, ref. 5–D). It is at the base of one of the most valuable pine districts of the West; has large lumbering interests and abundant water-power; and contains water, gas, and electric-light plants, numerous saw, shingle, and planing mills, foundries, railway machine and repair shops, flour-mills, 2 national banks with combined capital of $150,000, a State bank with capital of $60,000, and 4 weekly newspapers. Pop. (1880) 4,449; (1890) 7,896; (1900) 9,524.

**Stewardship of the Chiltern Hundreds**: See CHILTERN HUNDREDS.

**Stewart**, ALEXANDER TURNEY: merchant; b. near Belfast, Ireland, Oct. 27, 1802; distinguished himself at school, and was entered at Trinity College, Dublin, where he did not graduate. He emigrated to New York in 1823, bringing with him a few hundred pounds, a part of a small estate which he inherited, and for a time taught mathematics and the classics in a private school. Having invested his ready money in a small mercantile venture, he found himself unexpectedly left alone in the business with the rent of the shop on his hands and was forced to become a trader. Returning to Ireland, he sold his other property, invested the proceeds in Irish laces and similar goods, and in 1825 opened a small store in Broadway, and began the business which afterward grew to be the most extensive dry-goods establishment in the world, with branches in England, Scotland, Ireland, France, and Germany, besides large manufactories of woolens, carpets, and hosiery in the U. S. and Great Britain, the whole employing about 8,000 persons. At the time of his death it was said that only two men in the U. S. were more wealthy than he. Among his enterprises was the establishment of a town called Garden City, on Long Island, a few miles from Brooklyn. During the civil war he was an earnest upholder of the national Government, and in 1869 accepted from President Grant the nomination as Secretary of the Treasury. The nomination was withdrawn, it being found that he was rendered legally ineligible for that position on account of his being engaged in the importation of foreign merchandise. He was president of the honorary commission sent by the U. S. Government to the Paris Exposition of 1867. D. in New York Apr. 10, 1876, leaving no children. By his will his entire estate, with the exception of certain legacies, was devised to his wife. To Mr. Hilton, his legal adviser, was left a legacy of $1,000,000.

**Stewart**, BALFOUR, F. R. S.: physicist; b. in Edinburgh, Scotland, Nov. 1, 1828; educated at the Universities of St. Andrews and Edinburgh; settled in Australia, where he was engaged in business in Melbourne 1852–54; returned to Great Britain 1855; was for three years assistant to Prof. Forbes in Edinburgh in his lectures and experiments upon mechanics; was appointed director at Kew, July 1, 1859, and Professor of Natural Philosophy at Owens College, Manchester, 1870. He was the discoverer of the law of equality between the absorptive and radiative powers of bodies, for which he received the Rumford medal of the Royal Society, 1868; was author, jointly with Messrs. De la Rue and Loewy, of *Researches in Solar Physics*, and, with Prof. P. G. Tait, of papers giving the results of experiments on *Heating produced by Rotation in Vacuo*, and of a religio-scientific treatise, *The Unseen Universe* (1875); contributed numerous papers, chiefly on meteorology and terrestrial magnetism, to the *Transactions* of the Royal Society, and published *Elementary Lessons in Physics* (1870); *Elementary Treatise on Heat* (1871); the *Physics Primer* (1872); and the *Conservation of Energy* (1873) in the International Scientific Series. D. at Drogheda, Ireland, Dec. 19, 1887.

**Stewart**, CHARLES: rear-admiral U. S. navy; b. in Philadelphia, Pa., July 28, 1778; went to sea at the age of thirteen as cabin-boy in a merchant vessel, and before he was twenty had become captain of an Indiaman. In 1798 he entered the U. S. navy as lieutenant, and in July, 1800, was appointed to the command of the Experiment, a schooner of 12 guns, with which, Sept. 1, he captured the French privateer Deux Amis, 8 guns, and soon after the Diana, 14 guns, also recapturing several U. S. vessels which had been taken by the French. In 1804, in command of the brig Siren, he took part in the naval operations against Tripoli, aiding Decatur in the destruction of the U. S. frigate Philadelphia, which had fallen into the hands of the Dey of Tripoli. He was made captain in 1806; in the summer of 1813 took command of the frigate Constitution, 52 guns, and in December sailed from Boston for the West Indies, making several captures of British vessels. In Dec., 1814, he sailed on a second cruise, and on Feb. 20, 1815, captured the British ship Cyane, 34 guns, and the Levant, 21 guns. The action was fought at night, and lasted forty minutes; the Levant was, however, recaptured by a British squadron. In 1816–20 Stewart commanded the Mediterranean squadron, in 1821–23 that of the Pacific, subsequently serving on the board of navy commissioners, as commander of the home squadron, and of the naval station at Philadelphia. He was placed on the retired list in 1857, but resumed service in 1859, and was placed in command of the Philadelphia navy-yard with the rank of senior flag officer, and in 1862 was made rear-admiral on the retired list. D. at Bordentown, N. J., Nov. 7, 1869. Revised by C. BELKNAP.

**Stewart**, DAVID, Duke of Rothesay and Earl of Carrick: son of Robert III., King of Scotland; b. about 1377; became lieutenant of Scotland, subject, however, to the advice of his council, of which his uncle, the Duke of Albany, was a member. He defended Edinburgh against Henry IV. of England 1400, but was soon after seized by the opposite party and imprisoned in Falkland Castle, where he died by starvation 1401.

**Stewart**, DUGALD: philosopher; b. in Edinburgh, Nov. 22, 1753; son of Matthew Stewart, Professor of Mathematics in the University of Edinburgh; studied there and at Glasgow; was in 1774 appointed assistant professor to his father, whom he succeeded in 1785, in the same year receiving the chair of Moral Philosophy. In 1810 he resigned his chair on account of failing health, and passed the remainder of his life in literary labor at his seat on the Firth of Forth, the sinecure office of gazette-writer for Scotland having been created for him. The following are his principal works: *Elements of the Philosophy of the Human Mind* (1792); *Outlines of Moral Philosophy* (1793); *General View of the*

*Progress of Metaphysical, Ethical, and Political Philosophy*, prefixed to the supplement to the *Encyclopædia Britannica* (1816); *The Philosophy of the Active and Moral Powers of Man* (1828). He also wrote biographies of Adam Smith, Thomas Reid, and Dr. Robertson. The best edition of his collected works is that prepared by Sir William Hamilton (1856). D. in Edinburgh, June 11, 1828.

Revised by J. MARK BALDWIN.

**Stewart**, ESME: Lord of Aubigny, Earl and Duke of Lennox; b. in France about 1555; grandson of John, third Earl of Lennox; derived his French title from Sir John Stewart of Darnley, constable to the Scots army in France in the wars of Charles VII.; arrived in Scotland in Sept., 1579, and immediately became a favorite of his cousin, King James VI., who created him Earl of Lennox Mar. 5, 1580, Duke of Lennox and Earl of Darnley Aug. 5, 1581; took an active part in the political intrigues of the time, instituting legal proceedings against the ex-regent Morton, and secured his condemnation and execution for the murder of Darnley; quarreled with the Church, and was accused of treason, and expelled from Scotland Dec., 1582. D. in Paris, May 26, 1583.

**Stewart**, MATTHEW: Earl of Lennox, regent of Scotland; b. in Scotland about 1510; married Lady Margaret Douglas, and had by this marriage two sons, of whom the elder, Earl Darnley, married Mary Queen of Scots. He was prominent in the movement which resulted in the seizure and imprisonment of the queen at Lochleven Castle, June 15, 1570; was the next day declared lieutenant-governor of Scotland in behalf of his grandson, the infant Prince James VI.; was elected regent July 12; conducted the war against the partisans of Mary; took Dumbarton Castle Apr., 1571, but was unable to secure that of Edinburgh; held a Parliament at Leith May 9, 1571, and when on his way to hold a Parliament at Stirling was attacked and mortally wounded by a party of the queen's friends. D. at Stirling, Sept. 4, 1571.

**Stewart**, ROBERT: See CASTLEREAGH, VISCOUNT.

**Stewart**, WILLIAM, D. D.: minister and professor; b. at Annan, Dumfriesshire, Scotland, Aug. 15, 1835; educated at the University of Glasgow; minister in the parish of St. George's-in-the-Fields, Glasgow, 1868–75; in the University of Glasgow examiner in mental philosophy for degrees 1867–70, and since 1873 Professor of Divinity and Biblical Criticism. Dr. Stewart has published *The Divinely Established Connection between the Old Testament and the New* (1873); *The Plan of St. Luke's Gospel* (1873); a revised and edited translation of vols. xi. and xiv. of Meyer's *Commentary on the New Testament* (1879–80); *The Church of the Fourth Century* (1883); and *The University of Glasgow, Old and New, Illustrated* (1891). C. K. HOYT.

**Stewart Island**, also called **New Leinster**: the southernmost and smallest of the three chief islands of New Zealand. It is of triangular form, about 100 miles in circumference, with an area of 665 sq. miles; consists largely of hills, of which there are three ranges; the highest summit is Mt. Anglem in the northern part, 3,200 feet; is separated from New Zealand by Foveaux Strait, 20 miles wide, and forms a part of the province of Southland. It is well wooded and watered, has much mineral wealth, and some fertile valleys, and the waters surrounding it abound in fish and oysters. The population is sparse, mostly Maoris or half-castes.

Revised by M. W. HARRINGTON.

**Stewartry**: the name which was given in Scotland to a district governed by a steward, which officer was appointed by the king with jurisdiction over crown lands and powers similar to those of a lord of regality. While the civil jurisdiction of a steward was equivalent to that of a sheriff, his criminal jurisdiction was much more extensive. The only remaining trace of that jurisdiction exists in the term stewartry, which, in place of county, is applied to the district of Kirkcudbright. The reorganization of the office took place in 1747, but the name was continued until 1 Vict., c. 39, substituted the name sheriff for it.

**Stib'ium**: the Latin name of ANTIMONY (*q. v.*).

**Sticking-plaster**, or **Adhesive Plaster**: an article for surgeons' use, made of resin, lead plaster, and soap, melted together and spread by machinery upon stout muslin. It is of great value in practical surgery, but requires rather frequent renewal, as it loses its adhesive qualities. It has to be warmed before application, but is not loosened by wetting. Light adhesive plasters, court-plasters, and the like, are made of silk or goldbeater's skin, covered on the adhesive side with a solution containing isinglass and gum-benzoin, while the back of the plaster receives a varnish of Chian turpentine and benzoin. These plasters are wetted before application.

Revised by H. A. HARE.

**Stickleback** [M. Eng. *stickle*, prickle, spine + *back*]: a hemibranchiate fish of the family *Gasterosteidæ*, having the back armed with stout spines, whence the popular name. (See HEMIBRANCHII.) The form is more or less elongated; the body naked or covered with lateral plates; head compressed, more or less pointed; dorsal fin represented by a variable number of free stout spines (2–15) and an oblong fin with articulated rays; ventral fins represented by enlarged spines with an axillar ray each, and inserted more or

The stickleback (*Gasterosteus aculeatus*).

less behind the basis of the pectorals. The species with two or three free dorsal spines belong to the genus *Gasterosteus*, those with four to *Eucalia*, those with from seven to nine to *Pygosteus*, those without a bony cuirass between the ventrals to *Apeltes*, and the elongated salt-water species with fifteen spines to *Spinachia*. The species rarely exceed 6 inches, and are generally very much less. Although so small, they are nevertheless extremely pugnacious and voracious, and attack without hesitation animals many times larger than themselves. In the breeding season the males assume resplendent hues, which are very changeable. The males construct nests of particles of grass, roots, sticks, or leaves, which are united together by a viscid mucus or silk-like thread exuded from the body and wound round the material collected. The male seeks out a gravid female, conducts her to the nest, and she deposits a few eggs, and then escapes by an aperture already made or which she herself makes opposite to the one she entered by. This is repeated day after day until a considerable number of eggs is accumulated. Each time the male rubs himself against the female and passes over the eggs. For a month, while the eggs are maturing, the male watches over them with jealous care, and only leaves when the young are hatched and ready to care for themselves. The eggs are large in proportion to the size of the fish, and few in number, not much, if at all, exceeding 100 in the common two-spined sticklebacks.

**Stigma**: See PISTIL.

**Stigmatiza'tion** [from Lat. *stigmatiza'tio*, deriv. of *stigmatiza're*, from Gr. στιγματίζειν, to mark, brand, deriv. of στίγμα, στίγματος, puncture, brand, mark, deriv. of στίζειν, to prick, brand, mark]: a term employed in the literature of the Roman Catholic Church to denote the miraculous impression upon certain saints of marks similar to the five wounds of Christ (*stigmata*) or of the crown of thorns. Remarkable instances are those of St. Francis of Assisi (Sept. 15, 1224) and Veronica Giuliani (1694). Many persons, among whom was St. Catharine of Siena, are said to have felt at regular intervals the pain of such wounds, but without any external mark. See Görres, *Die Christliche Mystik* (1854), and Imbert-Gourbeyre, *Les Stigmatisées* (Paris, 1873). Revised by J. J. KEANE.

**Stiles**, EZRA, D. D., LL. D.: clergyman and author; b. at North Haven, Conn., Dec. 15, 1727; son of Rev. Isaac Stiles, minister at North Haven; graduated at Yale College 1746; studied theology; was ordained a Congregational minister June, 1749; was tutor at Yale College 1749–55; engaged in a series of researches with an electrical apparatus sent to the college by Dr. Franklin, and made the first electrical experiments in New England; preached for a short time to the Stockbridge Indians 1750; studied law; was admitted to the bar 1753, and practiced two years in New Haven; pronounced a Latin oration in honor of Franklin on the occasion of his visit to New Haven, Feb., 1755; was pastor of a church at Newport, R. I., 1755–77; was inaugurated president of Yale College June 23, 1778; acted also as Professor of Ecclesiastical History after 1780; delivered lectures on scientific subjects; was author of a *History of Three of the Judges of King Charles I.* (Hartford, 1794) and *An Account of the Settlement of Bristol, R. I.* (Providence, 1785), and an unfinished ecclesiastical *History of New England.* D. at New Haven, May 12, 1795. His daughter married Dr. Abiel Holmes, who published his *Life* (1798) and edited *The Family Tablet* (1796), containing poems by members of the Stiles family. Revised by G. P. FISHER.

**Stilicho**, stil'i-kō: general; son of a Vandal in the Roman service. He was born about 359; grew up in the camp, and developed such eminent talents that the Emperor Theodosius gave him his niece Serena in marriage, made him commander-in-chief of the whole military force of the Western empire, and appointed him guardian to the young Honorius. After the death of Theodosius in 395 A. D., Stilicho was the actual ruler of the Western Roman empire; he married his son to Placidia, the daughter of Theodosius, and his daughter, Maria, to the Emperor Honorius. The earlier part of his career was mostly occupied by rivalries with Rufinus, guardian of Arcadius, who had received the Eastern Roman empire, and the feuds ended with the assassination of Rufinus. In 403, when Alaric invaded Northern Italy, Stilicho brought together in haste the legions which were stationed in Britain, Gaul, and all along the northern frontier of the empire; defeated Alaric first at Pollentia, then at Verona, and drove him out of Italy. But on the withdrawal of the legions from the frontiers immense swarms of barbarians gathered under Radagaisus, invaded Italy in 406, and besieged Florence. Stilicho attacked them and routed them completely; Radagaisus was put to death and his troops were sold as slaves. At the court, Olympius, a eunuch, succeeded in turning the mind of the young emperor from his guardian. While Stilicho was encamped at Bologna, a number of his friends were put to death at Pavia. In the camp Stilicho's friends demanded that he should march immediately against Pavia and punish Olympius; and when he hesitated they rebelled against him. He fled from the camp and took refuge at Ravenna, where he was murdered Aug. 23, 408. The principal events of his life have been celebrated in verse by the poet Claudian.

**Still**, JOHN, D. D.: bishop; b. at Grantham, Lincolnshire, England, about 1543; educated at Christ's College, Cambridge; took orders in the Church of England; became Lady Margaret Professor of Divinity at Cambridge 1570; held livings in Suffolk and Yorkshire; became prebendary of Westminster 1573, master of St. John's College, Cambridge, 1574 and of Trinity College 1577; archdeacon of Sudbury 1577, prolocutor of the convocation 1588, and Bishop of Bath and Wells 1592. D. at Wells, Feb. 26, 1607. He was the author of *A Ryght Pithy, Pleasant, and Merie Comedie, intytuled Gammer Gurton's Nedle, played on the Stage not longe ago in Christe's Colledge in Cambridge. Made by Mr. S., Master of Arts*, etc. (London, 1575). This piece, abounding in low humor, supposed to have been written as early as 1565, was long considered the first extant English comedy, but that rank is now assigned to Udall's *Ralph Royster Doyster.*

**Stillingfleet**, EDWARD, D. D.: bishop and controversial writer; b. at Cranbourne, Dorsetshire, England, Apr. 17, 1635; educated at Cambridge; took a fellowship 1653; entered holy orders; became rector of Sutton in 1657; preacher at the Rolls, London, 1664; rector of St. Andrew's, Holborn, London, and lecturer at the Temple 1665; prebendary of St. Paul's 1667 and of Canterbury 1669; chaplain to Charles II. 1670; dean of St. Paul's 1677, and Bishop of Worcester 1689, holding also several other ecclesiastical preferments. He ranks among the foremost of English polemics, his life having been an almost uninterrupted controversy with Roman Catholics, Nonconformists, and Socinians. He was characterized by unrivaled learning and a sincere love of truth. Many of his works have been frequently republished in different forms. The most important are *Irenicum, a Weapon-salve for the Churches Wounds, or the Divine Right of Particular Forms of Church Government, Discussed and Examined* (1661); *Origines Sacræ, or a Rational Account of the Christian Faith as to the Truth and Divine Authority of the Scriptures and the Matters therein contained* (1663; 9th ed. 1797); *A Rational Account of the Grounds of the Protestant Religion* (1665); *Discourse Concerning the True Reason of the Sufferings of Christ* (1669); *Discourse Concerning the Idolatry Practiced in the Church of Rome* (1671); *Unreasonableness of Separation from the Church of England* (1681); *Origines Britannicæ, or Antiquities of the British Church* (1685); *The Doctrines and Practices of the Church of Rome Truly Represented* (1686; new ed. by W. Cunningham, Edinburgh, 1837; 3d ed. 1851—a standard work); and *Discourse in Vindication of the Doctrine of the Trinity* (1697). He was so handsome that he was wittily called the "beauty of holiness." D. at Westminster, Mar. 27, 1699. See memoir in his *Collected Works* (6 vols. fol., 1710). Revised by S. M. JACKSON.

**Stillin'gia** [Mod. Lat., named in honor of the English botanist Dr. Benjamin Stillingfleet (1702–71)]: a genus of euphorbiaceous trees, shrubs, and herbs. The U. S. has several species. *Stillingia sylvatica*, queen's-delight or queen's-root, is an herb of the Southern States whose root has a good reputation as an antisyphilitic remedy. The tallow-tree of China (*S. sebifera*) is naturalized in the southern parts of the U. S. It is a beautiful tree, and from its seeds the Chinese extract large amounts of a white tallow-like fat, very useful for candles. The wood is hard, and is a good substitute for box. The leaves give a black dye.
Revised by L. H. BAILEY.

**Stillman**, WILLIAM JAMES: painter, journalist, and critic; b. at Schenectady, N. Y., June 1, 1828; graduated at Union College, New York, 1848. He studied landscape-painting under Frederick E. Church and in France, exhibiting at the National Academy of Design in New York 1851–59. His most noted picture is the *Procession of the Pines*, painted in 1858. (See Emerson's *The Adirondacks.*) He was art editor of the New York *Evening Post* in 1853–54, and again thirty years later. In 1855 he founded, in connection with John Durand, *The Crayon*, a monthly art journal in sympathy with the views of Ruskin and the Pre-Raphaelite Brotherhood. In 1852 he visited Austria on a secret political mission for Kossuth. He was U. S. consul at Rome 1861–65, and in Crete 1865–69. Since then he has lived mainly abroad as correspondent of *The Times* in Greece and in Italy. He has given much attention to and has written controversially about Greek art and archæology, particularly the cyclopean (Pelasgic) constructions, which he has extensively explored. His principal works are *The Cretan Insurrection of 1866–68* (New York, 1874); *The Herzegovina and the Late Uprising* (London, 1877); *On the Track of Ulysses*, embodying also an essay on the so-called Venus of Melos (Boston, 1888); also *The Acropolis of Athens*, a valuable collection of photographs (London, 1870), and his autobiography (1901). D. July 6, 1901.

**Stills**: See DISTILLATION.

**Stillwater**: city (settled in 1843); capital of Washington co., Minn.; on the St. Croix river, at the head of Lake St. Croix, and on the Chi. and N. W., the Chi., Mil. and St. P., the Chi., St. P., Minn. and Om., the St. P. and Duluth, and the Wis. Cent. railways; 18 miles N. E. of St. Paul, 25 miles E. N. E. of Minneapolis (for location, see map of Minnesota, ref. 9–F). Originally the settlement was on a small plain, slightly above the level of the lake, and surrounded by graceful bluffs; but with the growth of the city the plain has been surrendered to business houses and manufactories, and the bluffs are adorned with handsome residences. The city is 30 miles above the junction of the St. Croix and the Mississippi rivers, and, with regular lines of steamers communicating with Dubuque and St. Louis, claims to be at the head of Mississippi river navigation. Stillwater is the business center of the great St. Croix lumber region, which extends north over large portions of Minnesota and Wisconsin. It contains many large sawmills, with an aggregate daily capacity of over 500,000 feet, and a capital of $3,000,000. During the summer several hundred million feet of logs are here formed into rafts to be towed by steamers to sawmills on the Mississippi. Although lumbering has always been the principal business, other industries have sprung up, and there are several flour-mills and feed-mills, grain elevators, foundries and machine-shops, carriage and wagon factories, and agricultural-implement works. There are 18 churches, 14 public schools, public library, 2 Roman Catholic convents, a hospital, 2 national banks with combined capital of $500,000, 2 savings-banks, 1 daily, 6 weekly, and 3 monthly periodicals, and the State penitentiary. Pop. (1880) 9,055; (1890) 11,260; (1900) 12,318. HARRY R. DANNER.

**Stilo**: See ÆLIUS STILO.

**Stilt**: any bird of the genus *Himantopus* (family *Recurvirostridæ*). They are related to the avocets, and are distinguished by the excessively long legs, the straight, slender bill, which is slightly compressed, the feet with the middle and outer toes connected by a small web and destitute of a hind toe, and projection of the tail beyond the wings. There are some half dozen species, inhabitants of various parts of the world. One is found in America, and ranges from the northern parts of the U. S. to Paraguay. Its total length is about 14 inches, of which the bill forms 3 inches, and the tail also 3 inches; the tarsi are about 4 inches in length, and rather longer than the tibiæ; the color is a glossy black on the head above, the neck behind, the back, and the wings; white on the head in front of and behind the eyes, and beneath; the bill is black, and the legs red. It not only dwells by the seacoast, but is found far inland, at least on the lakes and rivers of the western parts of the U. S. The stilts generally associate together in flocks of twenty or thirty. They prefer muddy flats with reedy margins. They breed in the U. S., and make nests of grasses, etc. They lay generally four eggs; these are relatively large and of a yellowish or ochraceous color, with dark-brownish blotches and lines. According to Coues, on the ground, whether walking or wading, they move gracefully and with measured steps; the long legs are much bent at each step (but only at the joint), and planted firmly and perfectly straight. When feeding, the legs are bent backward at an acute angle at the heel-joint, to bring the body lower. They feed mostly on aquatic insects, as well as the eggs and young of fishes, and small fishes. Revised by F. A. LUCAS.

**Stilton Cheese**: See CHEESE.

**Stimpson**, WILLIAM, M. D.: naturalist; b. at Cambridge, Mass., Feb. 14, 1830. He devoted himself principally to the description of invertebrates. He was naturalist of the Ringold and Rodgers expedition to the North Pacific Ocean, later was curator of the Chicago Academy of Science, and lost all his collections, MSS., etc., in the great fire of 1871. Later he superintended the dredgings of the U. S. Coast Survey in the Strait of Florida. Among his works are *Testaceous Molluscs of New England* (1851); *Marine Invertebrates of Grand Manan* (1854); *Prodromus Descriptionis Animalium Evertebratorum* (1857–61, containing a part of the invertebrates collected on the Ringold and Rodgers expedition); *Notes on North American Crustacea* (1859–71); *Crustacea and Echinodermata of the Pacific Shore* (1857); and *Crustacea Dredged in the Gulf Stream* (1871). D. at Ilchester Mills, Md., May 26, 1872. J. S. K.

**Stimson**, FREDERIC JESUP: novelist; b. at Dedham, Mass., July 20, 1855; graduated at Harvard in 1876; was admitted to the bar, and in 1882, under the pseudonym *J. S. of Dale*, published *Guerndale*, a novel of college life. In 1884–85 he was assistant attorney-general of Massachusetts. Other novels are *The Crime of Henry Vane* (1884) and *The Residuary Legatee* (1888). He has also published a number of law-books, the most important of which is perhaps *American Statute Law* (1886). H. A. B.

**Stimulants** [from Lat. *stimulans*, *stimulan'tis*, pres. partic. of *stimula're*, urge, goad on, deriv. of *sti'mulus*, a goad]: those agents which increase functional activity of the various organs of the body, more particularly in connection with the respiration, circulation, and nervous system. Such are, pre-eminently, strongly nourishing hot food if it can be digested; if it can not, then alcoholic or ethereal potions, ammoniacal solutions, heat, strychnine, etc.

**Stimulus**: that which excites or stimulates; used in physiology and psychology for any influence from outside which causes a reaction of the muscles in movement or of the attention.

**Sting-fish**: the greater weever (*Trachinus draco*). See TRACHINIDÆ.

**Sting-ray**: any ray of the genus *Trygon* (family *Trygonidæ*), a group of elasmobranchs belonging to the order *Raiiæ*. These fish have the body rhombic and moderately broad, the skin smooth and without tubercles, the nasal valves coalescent into quadrangular flaps, the teeth flattened, and the tail long, tapering, destitute of a true fin, and armed with an elongated spine (sometimes with two) compressed from before backward, and with teeth or serratures at each side directed downward. These spines are the "stings" which have insured the popular name to the forms in question. There are about thirty species found in almost all tropical and temperate seas, and much dreaded on account of the wounds which they inflict with their spine-bearing tail. They can whip the tail around with great ease and transfix the incautious intruder with the spines. Tetanus is sometimes the result, but the wound is a physical injury solely and not the result of poison. One species (*Trygon centrura*) is quite common along the eastern coast of the U. S. See also TRYGONIDÆ. Revised by F. A. LUCAS.

**Stinkhorn Fungi**: the *Phallaceæ*, a family of fetid gasteromycetous fungi numbering ninety-two species, most of which are tropical. The plants are filamentous saprophytes, growing in soil which is rich in decaying organic matter. The spore-fruits are roundish or egg-shaped bodies resembling PUFF-BALLS (*q. v.*), which develop at or beneath the surface of the ground and whose spore-bearing tissue (*gleba*) emerges from the peridium by the elongation of the sterile base (see figure). The fetid odor attracts flies and other insects, to which the spores adhere, thus securing their distribution. Several species occur in the U. S., one of the most common being the *Ithyphallus impudicus* (see figure), which is from 5 to 10 inches high, with a white or pinkish base (*volva*), a white, hollow, loosely cellular stalk, and a conical, reticulated pileus bearing black spores. Species of *Dictyophora*, *Mutinus*, and *Simblum* are common in the U. S. CHARLES E. BESSEY.

Stinkhorn (*Ithyphallus impudicus*) reduced one-half, with a young spore-fruit at the side.

**Stinkstone**: any one of certain marbles or limestones which on being struck emit the smell of sulphuretted hydrogen. The British islands abound in stones of this character and of various geological ages, some of them useful building-stones.

**Stinkwood**: the hard, durable wood of the *Ocotea bullata* (family *Lauraceæ*) and related plants, found in South Africa. The wood is handsome and valuable, but has a disagreeable smell even when seasoned. *O. fœtens*, a tree of the Canaries, has wood of a vile odor, but other members of this widespread genus are of pleasing fragrance. The name is also applied to a species of *Cassia*.

Revised by L. H. BAILEY.

**Stipple-engraving**: See ENGRAVING.

**Stirling**: town of Scotland; capital of Stirlingshire; on the Forth; 35 miles N. W. of Edinburgh (see map of Scotland, ref. 11–G). It contains a fine old castle, situated on a basaltic hill, with steep precipitous sides toward the W. and rising to a height of 340 feet above the plain. The town and its vicinity are rich in historic associations, and contain many objects of interest. Tartans, shawls, rope, soap, leather, and malt are extensively manufactured, and an important trade both on the river and by rail is carried on. Stirling unites with Dunfermline, Culross, Inverkeithing, and Queensferry in sending one member to Parliament. Pop. (1891) 16,974.

**Stirling**, JAMES HUTCHISON, M. D., LL. D.: philosopher; b. in Glasgow, Scotland, June 22, 1820; took the course in arts and medicine at Glasgow University; for a short time practiced as a surgeon in New South Wales; abandoned practice in 1851 and went to Germany to continue philosophical studies; is the author of *The Secret of Hegel, being the Hegelian System in Origin, Principle, Form, and Matter* (2 vols., 1865); *Sir William Hamilton, being the Philosophy of Perception* (1865); *Jerrold, Tennyson, Macaulay, and other Essays* (1868); *As Regards Protoplasm* (1869); *Philosophy and Theology*, Gifford lectures (1890); *Darwinianism: Workmen and Work* (1894); and the translator of Dr. Albert Schwegler's *Handbook of the History of Philosophy* (1867). Dr. Stirling is an opponent of Haeckel and Huxley on biological theories.

**Stirling**, Sir THOMAS, of Ardoch: soldier; b. in Scotland about 1735; became a captain in the Royal Highlanders July, 1757; served under Abercrombie at Lake George 1758, and Amherst at Lake Champlain 1759, at the siege of Niagara, and the invasion of Lower Canada 1760; was stationed in 1765 at Fort Chartres, Ill., whence he marched to Philadelphia 1766; became lieutenant-colonel 1771, colonel 1779, and major-general Nov., 1782; served throughout the war of the Revolution; took part in the battles of Long Island, Fort Washington, Red Bank, Brandywine, and Springfield; was made a baronet and lieutenant-general 1796, and full general Jan. 1, 1801. D. May 9, 1808.

**Stirling**, Sir WILLIAM: See MAXWELL.

**Stirlingshire**: a county of Scotland; bounded by the counties of Perth, Clackmannan, Linlithgow, Lanark, and Dumbarton, and forming the border-land between the Highlands and the Lowlands; area, 447 sq. miles, of which about two-fifths is under cultivation. The western part of the county is mountainous, and rich in iron, coal, and freestone. The highest peak is Ben Lomond, 3,192 feet above the level of the sea, near the foot of which lies the beautiful Loch Lomond. Agriculture, cattle-breeding, mining, and the manufacture of cotton and woolen goods, chemicals, etc., are pursued with success. The iron-works at Carron in this county are among the largest in the country. There are also extensive iron-works at Falkirk, where also three annual fairs, called trysts, the largest in Scotland, are held for the sale of horses, cattle, sheep, and wool. Stirlingshire is rich in historic associations, and boasts of many battle-fields, the chief of which are Stirling Bridge, Falkirk, Bannockburn, and Kilsyth. Pop. (1901) 141,894. The county sends one member to Parliament. County-town, STIRLING (*q. v.*).

**Stith**, WILLIAM: clergyman, educator, and author; b. in Virginia in 1689; educated in England, where he studied theology and took orders in the Church of England 1731; became in that year master of the grammar school of William and Mary College; chaplain of the Virginia House of Burgesses 1738, and president of William and Mary College and rector of Henrico parish from 1752 to his death at Williamsburg, Sept. 27, 1755. He was a brother-in-law of Peyton Randolph, and author of a *History of the First Discovery and Settlement of Virginia* (Williamsburg, 1747; 2d ed. 1753; new ed. New York, 1866). It traces the history only to 1624, has been by some critics censured as inelegant in style, but is admitted to be accurate and faithful, and the work is of the greater value since the materials on which it was based were destroyed by fire.

**Stjernhjelm**, styern'yelm, GEORG: statesman, scholar, and poet; b. in Dalarne, Sweden, in 1598. He was the son of a poor miner named Marqvardson, but on entering school assumed the name of Göran Lilje. His early education was obtained at Vesterås. After filling various Government positions he was appointed by Gustavus Adolphus lector in the school at Vesterås. Afterward he was ennobled by the king, and assumed the name by which he is known in literature. He was court poet to Queen Christina and high in favor, but afterward fell under suspicion and was disgraced. D. in poverty 1672. His principal works are the didactic poem *Hercules*, written in hexameters; *Bröllops besvärs ihugkommelse* (Remembrances of Wedding Vexations), a humorous lyric poem, also in hexameters; and three so-called ballets—*Parnassus triumphans*, *Den fångne Cupido* (The Captive Cupid), and *Freds Afl*—the first of which is like a modern opera, the others like the contemporary English masques. He is called the father of Swedish poetry. Before him there is a condition of absolute confusion in form. By his use of new meters, and particularly of the alexandrine, which he introduced into Swedish literature, he established a standard for his successors, who regarded him in form and language a model of artistic perfection. His poetical works were published at Upsala, 1856. See SWEDISH LITERATURE.

WILLIAM H. CARPENTER.

**Stoat**: See ERMINE.

**Stobæ'us**, JOANNES [so called from his birthplace, Stobi, in Macedonia]: an author assigned to the end of the fifth century of our era. For the instruction of his son, Septimius, he made a collection of sayings on various subjects from about 500 Greek authors, and these quotations have become of great interest, as in most cases the works from which they were taken have perished. They are arranged in two separate works—*Anthologion* and *Eclogæ*—both edited by Meineke, the former in 4 vols. (1855–57), the latter in 2 vols. (1860–62). There is a new critical edition of both, under the common title *Anthologion*, by Wachsmuth and Hense (Berlin, 1884), of which the third volume appeared in 1894.

Revised by B. L. GILDERSLEEVE.

**Stockbridge**: town; Berkshire co., Mass.; on the Housatonic river, and the N. Y., N. H. and Hart. Railroad; 8 miles N. of Great Barrington, 17 miles S. by W. of Pittsfield (for location, see map of Massachusetts, ref. 2–C). It is noted for picturesque mountain scenery, includes the beautiful Lake Mahkeenac, and has numerous villas, chiefly occupied during the summer by citizens of New York. Originally called Housatonic, the place was the chief residence of the tribe of Indians of the same name, also called Stockbridge Indians, who were Christianized in the eighteenth century by the labors of John Sargent, Timothy Woodbridge, and the celebrated Jonathan Edwards, to whose memory a monument has been erected here. The tribe, numbering 400, removed after the Revolution to Madison co., N. Y., afterward to the vicinity of Green Bay, Wis., and subsequently resided near Fort Leavenworth, Kan. Stockbridge was the native place of several eminent persons, including Catherine M. Sedgwick, Mark Hopkins, Cyrus W. Field, Henry M. Field, D. D., and Judge Henry R. Brown, of the U. S. Supreme Court. It contains the villages of Stockbridge, West Stockbridge Center, Curtisville, and Glendale, eight public schools, a public library (founded in 1862), an academy, woolen-mills, paper-mills, pulp-mills, grist-mills, and sawmills, and a national bank with capital of $200,000 and surplus of $150,000. It was incorporated in 1739, and in 1894 had an assessed valuation of $2,940,495. Pop. (1880) 2,357; (1890) 2,132; (1900) 2,081.

HENRY M. FIELD, EDITOR OF THE "EVANGELIST."

**Stockbridge**, HENRY: lawyer; b. at North Hadley, Mass., Aug. 31, 1822; graduated at Amherst College in 1845; studied law in Baltimore, and was admitted to the Maryland bar in 1848. During the civil war he took an earnest part in favor of the Union; in 1864 was a member of the Legislature, and drafted the act by which a constitutional convention was convened for the abolition of slavery in Maryland; was a member of that convention, took an active part in its proceedings, exerted himself to secure the adoption of the constitution framed by it, and defended it before the court of last resort. He instituted and conducted to a successful issue in the Federal courts proceedings by which were annulled the indentures of apprenticeship by means of which the effect of the emancipation clause was sought to be evaded, and thus secured the enfranchisement of more than 10,000 colored children in the State. He edited for years the Fund publications of the Maryland Historical Society, of which he was vice-president. D. Mar. 11, 1895.

**Stock-dove**: a European wild pigeon, *Columba œnas*, named from its habit of nesting in hollow stocks or tree-stumps, although it often builds in rabbit-burrows, etc. It is gray, with a purplish breast, scarlet eyes, orange bill, and red toes and legs. It is some 14 inches long. The young birds are prized as food.

**Stock Exchange**: an association of brokers in shares, bonds, or other securities of corporations, nations, states, counties, or municipalities, and in negotiable certificates representing commodities of trade. Until the decade 1880–90 the last-mentioned instruments were not regularly dealt in by stock exchanges. The Petroleum and Mining Exchange of New York city was, however, in 1885, expanded into an exchange for stocks, oil, and mining shares, and the older New York Stock Exchange shortly afterward admitted to regular trading on its board the so-called "pipe-line certificates" of the petroleum market, and later certificates of deposited silver bullion, through which the price of silver might be made a convenient speculation. Grain contracts for future delivery have also been dealt in regularly in the Consolidated Stock and Petroleum Exchange, but neither these nor the pipe-line certificates on the New York Stock Exchange became in any degree important features of the institutions.

*Membership Regulations.*—Membership in a stock exchange is usually limited, and as, in a number of exchanges, a "seat" is the property, not only of an active broker, but also of his heirs or assignees, the privilege represented by it possesses a marketable value. Memberships in the New York Stock Exchange have sold as high as $60,000 (price reached in 1901), and as low as $15,250, the record of 1893. Sales were made in the first quarter of 1895 at $18,000. The purchase of a seat from a previous incumbent does not of itself entitle the buyer to the privilege of trading on the floor. He becomes a member only after formal application, and by the approval of the committee on admissions. On the London Stock Exchange the applicant for membership must be recommended by three members of at least four years' standing, who severally bind themselves to pay £500 to the applicant's creditors, in case he be declared a defaulter within four years after his admission. No foreigner is eligible unless he shall have been naturalized for two years. In the Paris Stock Exchange the *agent de change* (see below) is ineligible unless a Frenchman. He must be proposed by his predecessor in membership (or that predecessor's heirs or proxies), and must be formally approved by the governing body of the exchange and the Minister of Finance.

Most stock exchanges place a limit on the number of members. On the New York Stock Exchange the limit is 1,100, a number reached after a considerable increase in 1869, when a successful rival, the Open Board of Brokers, was absorbed by consolidation of membership. In New York the Stock Exchange member frequently acts as solicitor of investment business—advertising extensively—as general banker and promoter, and as executor of orders on the floor. These functions are separated in London, where a customer usually gives his order to a broker in the exchange membership, through whom the "jobber," also a member of the exchange, is employed; the Stock Exchange forbids all its members to advertise. By the constitution of the Paris Bourse, its members, the *agents de change*, number only sixty; but stock-exchange business in Paris fell largely from the first into the hands of *coulissiers* or outside brokers, who frequented the outer corridors of the Bourse and traded as though members of a regular exchange. The strife between the *coulissiers* and the *agents de change* is bitter and historic. The *coulisse* was repeatedly suppressed by the courts and the police, and was driven at times to other quarters of the city. In 1859 individual *coulissiers* were heavily fined, but their business, under the generic name of the Petite Bourse, flourishes to this day. Trading on the larger Bourse in recent years has been also carried on by the head clerks of the *agents de change*, each agent being allowed two such clerks with privileges of the exchange.

*Discipline and Rules.*—Stock exchanges are invariably governed by strictly enforced by-laws, covering rules for general management, mutual arrangement and enforcement of contracts, and requirement of personal business honesty and good behavior. On the New York Stock Exchange an insolvent member is suspended until he has settled with his creditors, and may be readmitted only on proof of such settlement and on the formal vote of the committee on admissions or, if rejected by them, on appeal to the general governing committee. Suspension or expulsion is also fixed as penalty for (1) the making of fictitious sales; (2) the making of fictitious or trifling bids or offers; (3) the buying or selling of securities for a less commission than that fixed in the by-laws; (4) "obvious fraud"; (5) refusal to comply with any other regular provision of the by-laws. The London Stock Exchange's by-laws impose suspension or expulsion as penalty for violation of any Stock Exchange rules or regulations; for failure to comply with the committee's decisions; and for "dishonorable or disgraceful conduct." A declared insolvent also ceases to be a member. The *agent de change* in Paris is subject to discipline, under the institution's by-laws, whenever he "does not confine himself strictly to his duties," or if he "introduces into his operations or into the collection of his dues any innovations that may be injurious to the public weal or to the interests of the company." The penalty is left wholly discretionary with the governing board or "syndical chamber." It may fine, censure, or suspend a member, but for expulsion may only submit its recommendation to the Minister of Finance. This recommendation is, however, usually final.

"*Listing*" *of Securities.*—In nearly all stock exchanges no security can be dealt in on the floor unless it has been officially admitted by the committee appointed for the purpose. Securities may also be expressly excluded from trading by vote of this committee. The only exception to this privilege of exclusion, in European stock exchanges, is the public stock of the nation to which the exchange belongs. In London an explicit Stock Exchange rule forbids trading in public loans raised by nations at war with Great Britain. For the "listing" of new securities on the New York Stock Exchange certain formalities are prescribed. The applicant company must show to the committee on stock list that the shares or bonds in question were regularly issued, and that they have been actually marketed. A general financial statement at a date not too far distant must accompany the application. In the case of shares, the securities must be registered with a trust company satisfactory to the stock exchange. In the case of bonds, evidence must be submitted that the mortgage was properly drawn and properly recorded in every county touched by the enterprise. These stringent provisions were the result of numerous frauds and "over-issues" of securities in the earlier history of American stock speculation.

The competition of the Consolidated Exchange after 1885 led to some change in sentiment among the New York Stock Exchange authorities. A few years after that date the New York Exchange governors established a so-called "unlisted department," in which securities were admitted without the stringent provisions as to financial statement, registry of shares, etc. As a result, securities to an enormous aggregate value were admitted to official trading, when the investing public was left in total ignorance of the financial status of the enterprises. These securities soon became the chief center of active and reckless speculation. Although the Stock Exchange generally repudiates responsibility for the character and good faith of securities dealt in upon its floor, it has lately been generally admitted that the influence of these "unlisted securities" was demoralizing and harmful. Retroactive legislation against such securities was impracticable, but in Feb., 1895, the governing committee of the exchange adopted a resolution which marked an important change of policy. A very great amount of securities of insolvent companies were certain, later on, to be subject to reorganization. In such cases the new securities issued in the adjustment of the corporation's debt must apply for admission to the Stock Exchange. The governing committee's resolution stipulated that all such applications must be accompanied by a full and complete income report for the year preceding, by a detailed balance sheet, and by a civil engineer's report on the physical condition of the property. The resolution also went much further, and officially "recommended" to all corporations, whose securities were already admitted to trading, the publication, at least fifteen days prior to an annual meeting, of a faithful and detailed income account and balance sheet for the year. Although not mandatory, this declaration of general policy was regarded as highly important in the struggle of investors to obtain complete and frequent financial statements from corporation directors.

*Method of Business.*—All stock exchanges provide an open hall where brokers may personally buy from or sell to one another, for their own account or that of customers, such securities as are admitted to trading. A regular commission, which is a fixed percentage usually on the par value of securities bought or sold, is established for all such trading. Members are forbidden under penalty to accept a less commission. On the New York Stock Exchange the regular minimum commission is one-eighth of 1 per cent. on outside orders, one thirty-second of 1 per cent. on orders given by fellow members, and one-fiftieth of 1 per cent. where a member has merely employed a fellow member to make the bargain, delivery being made to or by the real purchaser or seller. All commissions are reckoned on a security's par value. In London the official Stock Exchange commissions vary according to the nature and face value of the security dealt in. On the stock of British and colonial corporations they range from 1*s.* to 5*s.* per cent.; on shares and bonds issued in the U. S. the commission is 1*s.* per $100; on British and foreign government funds it is 2*s.* 6*d.* per cent. In Paris the official commission of an *agent de change* is one-quarter of 1 per cent.

The bids and offers made on the floor of the exchange, though made only personally, become official. A broker is forbidden under penalty to sell stock at a price lower than the best bid made in his hearing for the amount in question, or to buy at a price higher than the lowest offer. This is to prevent unfair "manipulation." On the New York Stock Exchange the broker must deliver stock sold, and must pay for stock bought, by 2.15 P. M. on the day following the transaction. Since 1892 most of these transactions are settled through the Stock Exchange Clearing-house. (See below.) On the London Stock Exchange, and in the majority of exchanges in Europe, as well as some in the U. S., "settlements" between buyers or sellers are made at longer intervals. In London a contract made for purchase or sale of securities is settled by delivery of the securities and payment of the price at the next official settling day. These days occur at fortnightly intervals, or nominally twice a month, for general securities, and once a month for Government stocks. By mutual agreement, commonly on payment of a fixed percentage charge, the contract may be deferred or "carried over" to the next settlement. The Paris Stock Exchange and most other stock exchanges on the Continent deal "for the account" similarly to London. In all these exchanges cash transactions, closed on the spot, are admissible, though rare outside of British consols. In such cases, as may be seen by the daily quotations of British consols, the price for the "account" is usually higher than the price for "money" by a margin sufficient to cover the interest charge between the date of cash sale and the date of the next fortnightly or monthly settlement.

In all stock exchanges actual delivery of securities sold is required, the one apparent exception being in cases where mutually balanced contracts are canceled through the stock exchange clearing-house. The courts have in this case, however, decided that the cancelation in no respect affected the intent to deliver, the enforceability of delivery, and the actual delivery of stocks, so far as customers are concerned. The common assumption that trading on stock exchanges involves no real sale, purchase, or transfer, but is merely a species of gambling on differences, is wholly erroneous. This species of gambling is confined to the so-called "bucket-shops," private concerns with no stock exchange membership, and which neither receive nor deliver actual securities, merely paying to customers or receiving from them the money balance due between the stock exchange price at the time of the fictitious sale or purchase and at the time the contract is closed. In the U. S. these institutions are illegal by the statutes of most States, and are at intervals raided by the police as common gambling-houses.

*Stock-exchange Clearing-houses.*—The clearing-house for stocks is the most recent development in the machinery of stock exchanges. It is a natural outgrowth of the bank CLEARING-HOUSE (*q. v.*), and serves a similar purpose. Its fundamental principle is to offset contracts by one broker, to deliver securities, with contracts entered upon by the same broker to receive the same securities. If A has purchased 1,000 shares of stock from B, and has sold 1,000 shares of the same stock to C, the stock exchange clearing-house returns a balanced sheet to A, who thereupon neither receives nor delivers any of the stock, the double transaction being settled by the delivery of the 1,000 shares by B to C. Or if A has bought 1,000 shares from B and sold 600 to C, the clearing-house so arranges that B shall deliver 400 shares to A and 600 to C, no deliveries being made by A. By an ingenious book-keeping system, this principle is extended to the entire membership of the exchange, and as each active broker is apt to trade daily on both sides of the account in many securities, the economy in expense and labor is enormous. This system was first introduced in the Handelskammer at Frankfort in 1867. It was found that through its employment the necessary transfers of securities were reduced more than 90 per cent. The Berlin Exchange adopted the system in 1869, Hamburg in 1870, Vienna in 1873, London in 1876, some of the U. S. exchanges between 1880 and 1887, and the New York Stock Exchange in 1892. The last-named institution, following and perfecting the plan of the Consolidated Stock Exchange of New York, added a system of money clearings, through which the checks due by brokers in settlement were mutually offset, so far as the two sides of any broker's account balanced, at the clearing-house. It is estimated by officers of this clearing-house that the saving in checks drawn for brokers' settlements, under this system, has in the New York Stock Exchange alone averaged $400,000,000 per month. The system of money clearings has not been adopted in Europe, except, in a modified form, by the London Stock Exchange. The stock exchange clearing-house has received more full and complete discussion in *The Political Science Quarterly* for June, 1893.

*History.*—The trade of brokers, in the sense of professional buyers, sellers, and lenders on security, using for the purpose their own money or that of customers, is very ancient. Such trade was carried on in the Roman Forum during the days of the republic. The use for this purpose of the porticoes of the adjacent temples of Minerva and Mars Ultor is mentioned frequently by Martial, Juvenal, and other Latin writers, and their references assume a long-established institution. The brokers of that period, however, were hardly distinguishable from the bankers and money-lenders of the Middle Ages. The money-broker or money-changer, transacting much the same business as the money-brokers do to-day, was older as representative of a distinct profession, and indeed followed early international commerce as a necessary accompaniment. In the later Middle Ages exchanges for the transaction of general business were established, usually by national or municipal governments, and took the place of the temple porticoes and public markets commonly used at the beginning of the Christian era. The Royal Exchange in London, founded under Elizabeth by Sir Thomas Gresham, was of this character, and was suggested by similar institutions already established in some of the German commercial cities. But these were not stock exchanges, and were never used as such except when, in the infancy of stock-trading, a part of the general market space was used by brokers in securities.

The term broker is used in English statutory law as early as 1285, but apparently refers there to a species of pawn-broking business only. In 1604 an act of Parliament defines brokers only as dealers in "merchandise and wares." There is no evidence that the stock-broker in the modern sense became a factor in trade until the great movement for the creation of funded Government debts at the close of the seventeenth century, followed a few decades later by the incorporation of the East India Company and the South Sea Company in London, and of the Mississippi Company in Paris. The shares of these corporations were offered for public purchase, and advanced enormously in value. Before the South Sea Bubble burst in 1720 the stock-jobber had become a feature in English society, and both he and his peculiar professional slang occur frequently in the literature of the period.

The stock-broker's business was long conducted either in the Royal Exchange in London or, later, in the coffee-houses of the adjacent 'Change Alley. In 1801 the London Stock Exchange was founded in Capel Court, where it has continued ever since. A public exchange for brokers was established in Paris as early as 1304, but stock-jobbing began only with John Law's Mississippi Bubble of 1720. It was suppressed by governmental edict in 1720 and in 1793, both actions being provoked by the great demoralization in values caused by currency inflation. The present Bourse was founded early in the nineteenth century, and was first occupied in 1826. Contrary to usage elsewhere, the expense of its construction was paid by the city. As an organized body of brokers, the New York Stock Exchange seems to have originated as early as 1792, solely "for the purchase and sale of public stock." Its meetings, however, were held only in coffee-houses, or in rooms of private buildings; first in an office at No. 47 Wall Street, and later in the old *Courier and Enquirer* buildings. In 1827 an upper room was chartered in the Merchants' Exchange, Wall and William Streets; from 1854 to 1857 a room over the Corn Exchange Bank was used, then a hall in a building on Beaver Street, the present exchange being completed and first occupied in Dec., 1865. The list of celebrated names among the speculators in the membership of the New York Stock Exchange includes Jacob Little, Samuel Ward, Cornelius Vanderbilt, William R. Travers, Charles Woerishoffer, Daniel Drew, James Fisk, Jr., William H. Vanderbilt, and Jay Gould. Of these only the first mentioned, who flourished in the decade 1825–35, antedated the days of railway-share speculation. The Philadelphia Stock Exchange was founded at the opening of the century, and was for some time a more important institution than its New York rival. It has not kept pace with the New York Exchange, however, and, though trading actively in many of the securities dealt in at New York, devotes itself largely to specialties, notably, since 1890, to stocks and bonds of street-railways in various quarters of the Union. Philadelphia is the headquarters for the so-called traction stocks of New York, Baltimore, Philadelphia, and other cities. The Boston Stock Exchange—a much more recently founded institution—deals especially in securities of railways in New England. The Chicago Stock Exchange is dwarfed by the much larger concentration of grain-dealing in that city. Its dealings are chiefly restricted to shares and bonds of the elevated and surface railways of Chicago. Baltimore, New Orleans, and other cities possess also stock exchanges doing a still more limited business in securities of local enterprises. There are stock exchanges in all the principal commercial cities of Europe, and in many of the smaller municipalities. The most important institutions, outside of those already mentioned, are the stock exchanges of Berlin, Hamburg, Frankfort, and Vienna.

*Stock-exchange Phraseology.*—Trading in stocks has for nearly two centuries been characterized by a set of terms and phraseology peculiar to itself. Of these the most familiar are the following: A "bear" is a market operator working to cause lower prices. A "bull," conversely, is working for higher prices. Both of these terms occur in colloquial literature at least as old as England's South Sea speculation of 1720. The bear is usually said to be "short" of stocks. The origin of this more modern term is plain, and signifies that the operator has sold stocks which he does not yet own, for delivery at a fixed future date. The price may or may not be lower than previous recorded quotations. Usually he receives his payment, at current prices, on the spot, and in modern stock exchanges he also makes his delivery of stocks on the spot. But the stock thus delivered is borrowed from real holders, to be repaid when the "short" seller "covers"—that is to say, when he buys outright in the market to close his contracts. The bull is commonly "long" of stocks in a speculative way. This term signifies that he buys the stock and pays for it in money on the spot, but borrows the money for payment. When he sells his stock, at a profit or otherwise, he repays the loan. It often happens, therefore, that when the bear is borrowing stocks and the bull borrowing money, the one is simply lending to the other. Sales by the bulls are currently called liquidation. Stocks are said to be "carried" when a banker advances money to the bull speculator, retaining the stocks as security for the loan. The "carrying rate" naturally varies, therefore, with the rate of money and the demand for stocks. "Pools" are combinations of operators devoting their joint resources to the manipulation of a single security or group of securities. The manipulation is usually directed by one member of the pool. Contracts for such purpose have in some cases been recognized as legal by the courts, but appeal to law is rarely made, and bad faith, such as the "selling out on his associates" by one member of a "bull pool," is not easily proved against the offender. A "put" is a contract drawn by a capitalist or broker and sold at a specified sum to a speculator, in virtue of which the speculator may, within a fixed period, deliver the stock to the issuer of the put and be paid for it at a stipulated price. The buyer of a put is of course usually a bull, and buys the put to guard himself against losses on a possible decline. A "call" is the converse of a put. Its issuer contracts to sell to the buyer of the call, at or before a stipulated date, a certain amount of a certain stock at a fixed price. The bear buys this to guard against unexpected advances. A "spread" or "straddle" combines the features of both put and call, contracting at the option of its buyer to deliver to him or receive from him a fixed amount of securities named, the limits of price being set as many points apart as the situation, in the view of the issuer, will justify. All of the contracts described are generally classed as "options" or "privileges." A "wash sale" is a transaction in stocks wherein buyer and seller do not permanently transfer the securities at all, but work in a common interest to create semblance of activity and affect prices. In most stock exchanges "wash sales" are forbidden under heavy penalty, but they are difficult of detection and undoubtedly play a large part in current stock transactions. Two expressions in stock-exchange dialect, frequently used in cable dispatches, are peculiar to London. "Contango," a word probably derived from the continental expression for "contingent," refers to the rate or percentage charged an operator long of stocks for carrying over his account to the next fortnightly settling day. (See above, under *Methods of Business.*) "Backwardation" is an etymological barbarism describing the premium, if any, charged to a short operator for permitting him to defer delivery from one settling day to the next. Its equivalent on the New York Stock Exchange is the premium charged in the "loan crowd," where actual owners of stocks are lending the shares to bear operators desirous of making present deliveries.

*Statistics.*—Transactions on the New York Stock Exchange are more carefully recorded and tabulated than in any other similar institution. The statistics of its business will therefore give a fair idea of the trading which passes annually on a great stock exchange. For the calendar year 1894 the following figures of actual sales have been compiled:

| STOCKS AND SHARES. | Par value. | Market value. |
|---|---|---|
| Shares* | $4,821,876,020 | $3,094,942,769 |
| Railway bonds | 339,950,250 | 248,987,506 |
| U. S. Government bonds | 4,345,400 | 5,220,460 |
| State bonds | 10,929,900 | 4,441,015 |
| Bank stocks | 527,985 | 924,507 |

* Total number of shares sold, 49,075,032.

The year 1894, however, being a period of great financial depression, is not a fair year to select as representative of investment and speculation. Even in 1893 the shares sold on the New York Exchange aggregated 80,977,839, of a par value of $7,550,440,205, and a market value of $4,550,260,916. The maximum year's record of the Stock Exchange in the several kinds of securities is as follows: Shares (number), 116,307,271 in 1882; railway bonds, $660,659,400 in 1885; Government bonds, $112,571,850 in 1879; State bonds, $26,571,260 in 1882. It is generally estimated by brokers that sales of 200,000 to 300,000 shares a day are a fair average in active times. In a period of market excitement trading runs far beyond this average. The extreme high point was touched in the summer of 1887, when one day's total ran above 1,000,000 shares, the volume of business being so great that the Stock Exchange authorities were never able to compile its figures, even approximately.

LITERATURE.—The literature of this subject is not rich. The most complete legal and historical discussion will be found in J. R. Dos Passos's *Treatise on the Law of Stockbrokers and Stock Exchanges* (New York, 1882). The *Report* of the British Royal Commission on the origin and methods of the Stock Exchange (London, 1878) is full of valuable data. G. R. Gibson, of New York, has written several light but readable monographs on the various European exchanges. Various memoirs, chiefly of little value, have been published to narrate episodes of stock-exchange adventure. The most thorough and philosophical discussion of the financial questions involved in the subject is that of Robert Giffen, statistician of the British Board of Trade, in his *Stock Exchange Securities* (London, 1877). The numerous books and pamphlets on *How to Avoid Losses in Wall Street*, etc., are worthless and mischievous. Annual reports of the exchanges are usually limited to lists of officers, committees, and members. Valuable information as to the functions of stock exchange trading at earlier periods may be obtained from Walter Bagehot's *Lombard Street* (London and New York) and Clement Juglar's *Crises commerciales* (Paris).

ALEXANDER D. NOYES.

**Stockfish** (from the German *stockfisch*): a name for codfish and related species salted and dried. The fishes are split from head to tail, and the vertebral column in part taken out; they are then thoroughly washed and rid of the blood; after the water has been drained off, they are put in large vats, salted, and heavy weights are imposed; they are next washed and brushed, and laid out on the sandy shore and rocks. Finally, they are combined in small heaps, and become ready for the market, this stage being indicated by the assumption of a floury whitish appearance, technically designated as the "bloom." Revised by F. A. LUCAS.

**Stock'holm**: the capital of the kingdom of Sweden; beautifully situated at the outlet of Lake Mälar in the Baltic (see map of Norway and Sweden, ref. 11–G). It is divided into (1) Staden, the inner city, consisting of the islands of Stadsholmen, Riddarholmen, and Helgeåndsholmen; (2) Norrmalm, the northern part, connected with the inner city by a magnificent bridge of granite; (3) Ladugårdslandet, now Östermalm, communicating W. with Norrmalm; (4) Kungsholmen, communicating E. with Norrmalm; (5) Södermalm, the southern suburb, connected with the inner city by two drawbridges; and (6) Saltsjö-öarne, comprising the islands of Skeppsholmen, Djurgården, Kastellholmen, and Beckholmen, which complete the picture of an island city cut up and traversed in all directions by water. In Staden, the most prominent building is the royal palace, one of the most beautiful in Europe (built 1697–1754), containing a rich library, the palace of the stadtholder, the mint, the townhouse, the church of St. Gertrude, Storkyrkan, the Finnish church. In the island of Riddarholmen stand the Riddarholm church, containing the royal tombs, among which are those of Gustavus Adolphus and Charles XII.; the new house of deputies, and the statue of Birger Jarl. The bridge which leads from the inner city across the Helgeåndsholmen to Norrmalm is 380 feet long and 64 feet broad; on its eastern side extend the most beautiful promenades of the city, Strömparterren. This part of the city contains the Brunkeberg Place, the Hay Market, and the Place of Charles XIII., surrounded on three sides by rows of linden-trees, on the fourth by the sea, and ornamented by the statue of Charles XIII.; the palace of the princes, the royal theater, the Hammer museum, the academy of fine arts, the academy of science with rich collections, the observatory, the national museum, and the Fersen Terrace, which offers a magnificent prospect. Ladugårdslandet contains the arsenal, the barracks, the veterinary school, the academy of arboriculture, and the Hedwig Eleonora church; the Kungsholmen, the Seraphim hospital the Carolinian institute, the garrison hospital; and close by are Mariaberg, the military high school, and Carlberg, the cadet school. In Södermalm are Mosebakken, which presents the finest view of the city, and the Catharine and Maria Magdalene churches. Södermalm and Norrmalm are connected by a railway which for boldness in construction hardly has any equal in the world. The central dépôt in Norrmalm is a fine building, and, next to the royal palace, the largest in the city. Djurgården is a very fine park of considerable size, the general resort for amusement and recreation of the city, occupying a peninsula—2 miles long and 1 mile broad—whose natural beauty has been much improved by art. Communication between the various parts of the city is generally carried on by small steamboats which traverse the waters in all directions, with fixed routes and a cheap fare. The surroundings are rich in beautiful points, palaces, and villas, of which the royal summer palace, Drottningholm, is the most noticeable. The city possesses excellent water-works. The industry is considerable, especially in manufactures of tobacco, leather, linen, and cotton fabrics, iron, sugar-refining, etc. Commerce is also considerable, though navigation is closed each year for about five months, during which the harbor is covered with ice.

The town was founded toward the end of the twelfth century by King Knut Erikson, and given the rank of city in 1255 by Birger Jarl. In 1389 it was taken by Margrethe, Queen of Denmark. On Oct. 14, 1471, the Swedes under Sten Sture defeated the Danes at Brunkeberg, close by Stockholm, and drove them out of the country; but in 1520 they again took the city under Christian II., and the Stockholm massacre took place; by the general rising which the massacre caused throughout the kingdom Gustavus Vasa succeeded in establishing himself on the throne. During the peaceful times of the nineteenth century the prosperity of the city, like that of all Sweden, has much increased. Pop. (1896) 279,860. Revised by M. W. HARRINGTON.

**Stock'mar**, CHRISTIAN FRIEDRICH: diplomatist; b. at Coburg, Aug. 22, 1787; studied medicine, and became physician and confidential adviser to Prince Leopold of Coburg, and was very active in various diplomatic negotiations. He was the intimate friend of Prince Albert and Queen Victoria; received the title of baron. D. at Coburg, July 9, 1863. The *Denkwürdigkeiten aus den Papieren des Freiherrn Christian Friedrich von Stockmar,* edited by his son (Brunswick, 1872), was translated into English, with the title *Notabilia from the Papers of Stockmar*, and contains many interesting illustrations of the interior working of English politics in its relations with the court. See Juste, *Le Baron Stockmar* (Brussels, 1873), and Catherine von Bauer's *Memoirs* (Eng. trans., 1884).

**Stockport**: town; in Cheshire, England; at the confluence of the Mersey and the Tame; 6 miles S. S. E. of Manchester (see map of England, ref. 7–G). It is irregularly built on rugged and uneven ground across a gorge spanned by a viaduct of the London and Northwestern Railway; has a number of fine modern buildings, including a market-hall and a technical school, etc. It is an important seat of the cotton industry, and has also breweries, brass-foundries, iron-foundries, machine-shops, etc. Stockport was the site of a Roman station, and afterward of a Norman castle which was destroyed during the parliamentary war. It returns two members to Parliament. Pop. (1901) 78,871.

**Stocks**: a wooden apparatus formerly much used in different parts of continental Europe and Great Britain for punishing petty offenders and vagrants. It consisted of two heavy timbers placed one above the other, with corresponding notches made in each, and so arranged that when the upper timber, which was movable, was shut down in place and fastened, holes were formed in which the ankles of the offender were secured. There were sometimes other holes for the hands, and in some cases a hole for the neck. Stocks were first introduced into England probably about the time of the Statute of Laborers, 23 Edw. III. (1350), which provided that they be erected in every town, and by subsequent statutes this punishment was inflicted for minor offenses of various kinds down to very recent times. In the U. S. they were used to punish slaves. Stocks may still be seen in some villages in England.

F. STURGES ALLEN.

**Stocks and Stock Certificates**: in the U. S., the collective name for the shares or a number of shares of a concern (usually a corporation), or the fund employed in the carrying on of its business or enterprise. In Great Britain the aggregate amount of the capital invested in a concern is called stock when it is not divided into shares, but, with certain limitations, into any such amount as a purchaser desires. In Great Britain the term stock is also applied to money lent to a government, or the fund or obligation consisting of a capital debt by the Government to individual holders who receive interest at a fixed rate. This latter kind of stock, however, is a variety of public bonds.

*Method of issuing Stock.*—A concern, to issue stock, need not necessarily be a corporation, but most of the stock in existence is issued by corporations. The capital stock of business corporations is usually divided into equal parts, called shares, the ownership of which confers a proportional right in the management of the company and to its profits, and in its assets upon dissolution. The amount of the capital itself, the number of its shares, and the par value of each are entirely arbitrary, and are fixed by the charter. The par value of shares is usually fixed at $100, and otherwise, with very few exceptions, either at $25, $50, $500, or $1,000. This matter is often regulated by statute. The ownership of shares is usually evidenced by a stock certificate issued to each stockholder, certifying in substance that he is the holder of a designated number of shares. These stock certificates are not essential to the ownership of the shares or to their transfer, but they are merely the tangible evidences of the ownership of the shares and of the rights and duties attaching to the ownership. They are repleviable, as are other physical chattels.

*Kinds of Stock or Shares.*—The stock of a corporation is frequently divided into two or more classes, with different rights and liabilities. The most common kinds are *common stock*, which is stock which entitles the owners to an equal proportionate dividend of the corporate profits and assets, with one shareholder or class of shareholders having no advantage, priority, or preference over another; and *preferred stock*, which is stock which entitles the owners to dividends out of the net profits before, or in preference to, the holders of common stock.

Other less common forms of stock are *deferred stock*, the payment of interest upon which is expressly postponed until some other class of shareholders are paid a dividend; and (under Massachusetts law) *special stock*, which is a legal statutory kind limited to two-fifths of the actual capital of the corporation, subject to redemption at par after a fixed time, and upon which the corporation is bound to pay a fixed half-yearly sum or dividend as a debt. The holders of this stock are in no event liable for debts beyond the amount of their stock.

The term *watered stock* does not designate any special class of stock issued, but is used to designate any stock issued as fully paid up when any amount less than the whole amount has been paid; that is, it is stock which purports to represent, but does not represent in good faith, money paid into the treasury of the corporation or money's worth actually contributed.

In Great Britain and France there is frequently issued a class of stock called *founders' shares*, the ownership of which entitles the holders to take the profits after certain other dividends are paid. They are a sort of deferred stock, and sometimes acquire great value. The term *scrip* is there in common use to designate a written acknowledgment by a corporation that the holder will be entitled to certain shares of stock and a certificate thereof when unpaid installments are paid. Another kind of stock issued in Great Britain and unknown in the U. S. is *debenture stock*, the issue of which is provided in the Companies Act, and which is a charge on the net earnings and profits of the corporation.

*Issue of Stock.*—It is not essential to the existence and continuance of a stock corporation that any stock certificates should be issued, but when the right is exercised it must generally be exercised for the benefit of all. The two general methods of issuing stock are (*a*) in pursuance to an agreement of subscription, and (*b*) by way of disposing of a surplus, or, as it is commonly called, by way of a stock dividend. A subscriber need not necessarily pay his subscription before he becomes entitled to his stock certificates. The issue of stock, the amount of the shares, the terms upon which it may be issued, the capitalization of the corporation, etc., are generally regulated by statute. Stock must be issued in strict conformity to the provisions of the corporation charter, and the unanimous consent of the stockholders will not validate either an over-issue of stock or reduction of the capital stock, except in strict compliance with the provisions of statutes.

*The Legal Nature of Stock as Property.*—With few exceptions, the English courts and the courts of the U. S. have held shares of stock to be personalty, and in the nature of a chose in action. Shares of stock at the common law are therefore not subject to attachment or execution; and under the English doctrine they are held not to be goods, wares, and merchandise, within the meaning of the clause of the Statute of Frauds, which requires delivery, payment, or a memorandum in writing to make valid a contract for the sale thereof. The contrary doctrine is held in the U. S.

*Transfer of Stock.*—The right of transferring stock is incidental to its ownership; and, although the officers of a corporation can not take away the right of reasonable transfer, they may make reasonable regulations governing it. The mode in general use, and often prescribed by statute, is as follows: A book is kept by some designated officer, in which is registered each certificate of shares, and the name of the person to whom it is issued. In order to complete a legal transfer, the holder of the certificate must surrender it up to this officer, who thereupon issues a new one for a like amount to the assignee, and registers it in the transfer-book, and cancels the old record. To obviate the necessity of the personal appearance of the assignor to surrender his certificate, it is the universal practice to print upon the back of the certificate a power of attorney to be signed by the assignor, constituting the assignee an agent to make the surrender, and perform such other acts as may be necessary to procure the cancellation and receive a new certificate. This power of attorney is often made out with a blank left for the name of the agent, and the instrument signed or indorsed in this form is passed from hand to hand through many successive owners, until some one inserts his own name, surrenders the certificate, and takes a new one.

Most corporations require, either in their charters or by-laws, that stock shall be transferable only on the books of the company. It is generally settled that a transfer otherwise regular but not registered as required is valid, and passes the interest of the transferrer as between the parties. Where the rights of third parties are involved, the decisions vary as to the effect of the transfer. Except in a few cases, as where the transferrer is indebted to the corporation and holds stock which is subject to a lien, or where no surrender has been made of the certificate, a corporation can not refuse to register a transfer of the stock upon the demand of the proper party; and in case of refusal, the registration of transfer may be enforced by either of several remedies—an action in equity; according to the same authorities, mandamus to compel registration; and an action at law for damages.

In the case of forged transfers, a corporation is liable to the real owner, and must make good any loss which he has suffered, and the same is true in various other cases, where the facts of the case are such as to charge the corporation with notice of the equity of the real owner.

*Negotiability of Stock Certificates.*—Stock certificates are not, strictly speaking, negotiable instruments; but they are practically treated in great financial centers as though they possessed the quality of negotiability. They are pledged as well as sold, and are thus used to a very great extent as collateral security for loans. Although the by-laws of a corporation may require a surrender, cancellation, and re-issue to complete a transfer and to create a perfect legal title, in the U. S. the doctrine of estoppel is applied to such an extent as to protect a *bona-fide* purchaser of stock, in almost every instance, where he would be protected if he were purchasing a promissory note or other negotiable instrument; and the courts are constantly extending this application of the law of estoppel.

In Great Britain an entirely different rule prevails, and certificates of stock there are mere evidences of ownership of stock, and are not negotiable or quasi-negotiable. The purchaser is not protected against equities involved in the title of prior owners of the certificate, and can shut them off only by a transfer on the books of the company; and this rule is applied to certificates of stock issued by U. S. corporations and held by British subjects.

In the U. S., if the holder of a certificate signs a power of attorney in blank, then delivers the certificate into the possession of some person for a specific purpose, as for safe-keeping, and this person in violation of his duties fills up the blank and fraudulently surrenders the certificate, and procures another one to be issued to a *bona-fide* purchaser, it is very generally held that the real owner would be estopped by his act of indorsing in blank from setting up a claim against a *bona-fide* purchaser. In this way the substantial benefits of negotiability are secured.

For further information, see Cook on *Stocks and Stockholders.* F. STURGES ALLEN.

**Stockton**: city; capital of San Joaquin co., Cal.; at the head of Stockton channel, which connects it with the San Joaquin river, and on the Southern Pac. Railroad; 50 miles S. by E. of Sacramento, the State capital, and 100 E. by N. of San Francisco (for location, see map of California, ref. 7–D). The entire San Joaquin valley, the richest and most prolific section of country in the world, 300 miles long and 100 miles wide, with its numerous cities and towns, is tributary to the city as a commercial and shipping point. Stockton is well laid out; has paved streets, four public squares, embellished with semi-tropical plants and flowers, excellent transportation facilities by rail and water, electric street-railway, gas and electric lights, thorough sewerage, and a water-supply from artesian wells; and contains 20 natural gas-wells, with a daily flow of over 500,000 cubic feet. The average temperature is 40° in winter and 75° in summer, and the death-rate is the lowest in the State. The public buildings include a granite court-house, which cost $300,000; the Hazleton Public Library, of marble, cost $65,000; the State Insane Asylum, which cost $600,000; and the county jail.

*Churches and Schools.*—The principal religious denominations are represented by substantial church edifices. The public-school system has a high school and 12 grammar-school buildings, property valued at about $270,000, enrollment about 3,000, and annual expenses over $67,000. St. Agnes's convent and St. Joseph's Primary School, under the Sisters of St. Dominic, are model institutions, with buildings and grounds covering an area of three blocks. There are also a business college and normal institute and several private schools of high grade.

*Finances and Banking.*—The annual revenue is about $245,000; tax-rate, $1.75 per 100; bonded indebtedness, $370,000. There are 5 banks: the First National, with capital and surplus of $436,000; Farmers' and Merchants', $400,000; Stockton Savings, capital and reserve $475,000; Stockton Savings and Loan Society, capital $500,000, deposits $1,600,000; and San Joaquin Valley, capital and surplus $250,000.

*Business Interests.*—Stockton is an important manufacturing city, containing extensive flour, woolen, lumber, and paper mills, agricultural-implement works, foundries, shipyards, machine-shops, and terra-cotta works. It is the wheat center of the State and one of the principal wheat-markets on the Pacific coast.

*History.*—The city was laid out in 1849 by Charles M. Weber, who owned a large tract of land under a Mexican grant; first became important as a point of departure for gold-mining parties, and has since prospered as a commercial and wheat-distributing center. Pop. (1880) 10,282; (1890) 14,424; (1900) 17,506. J. M. REUCK.

**Stockton**, ALFRED AUGUSTUS, Q. C., LL. D.: Canadian publicist; b. at Stockholm, King's County, New Brunswick, Nov. 2, 1842; graduated at Mt. Allison College in 1864; admitted to the bar in 1868. He is an examiner in arts in Mt. Allison College, an examiner in law at Victoria University, president of the New Brunswick Historical Society, and registrar of the court of vice-admiralty of New Brunswick. He has been a member of the New Brunswick House of Assembly since Aug. 23, 1883. He has edited, with copious notes, Berton's *Reports of the Supreme Court of New Brunswick.* NEIL MACDONALD.

**Stockton**, FRANCIS RICHARD: humorist; b. in Philadelphia, Apr. 5, 1834. After graduating from the Philadelphia high school, he applied himself to wood-engraving and to literature, contributing illustrations to *Vanity Fair* and other periodicals, and issuing a number of stories for children, such as *The Ting-a-Ling Stories* (1869); *Tales Out of School* (1875), etc. He was employed successively upon the Philadelphia *Post*, the New York *Hearth and Home* (1872), *Scribner's Monthly* (afterward *The Century Magazine*), and *St. Nicholas* (1873). The first of his books to attract general notice to him, as a humorist of a new and original vein, was *Rudder Grange* (1879). This was followed by *The Lady or the Tiger?* (1884); *The Late Mrs. Null* (1886); *The Casting Away of Mrs. Lecks and Mrs. Aleshine* (1886); *The Dusantes* (1888); *The Merry Chanter* (1890); and many others. H. A. BEERS.

**Stockton**, RICHARD: jurist; b. near Princeton, N. J., Oct. 1, 1730; graduated at the College of New Jersey in 1748; admitted to the bar in 1754; became member of the executive council in 1768, and judge of the Supreme Court of the province of New Jersey in 1774. He attempted to effect a reconciliation between the colonies and Great Britain, and to this end submitted to Lord Dartmouth in 1774 "an expedient for the Settlement of the American Disputes," in which he proposed a plan of self-government for the colonies; but in 1776 he was chosen a delegate to the Continental Congress, and was one of the signers of the Declaration of Independence. In Nov., 1776, he was captured by a party of royalists, who threw him into prison in New York, where he was treated with great severity; his library was destroyed, and his lands laid waste; he was finally exchanged, but never fully recovered from the effects of the ill usage which he had received. D. at his home near Princeton, Feb. 28, 1781. In 1888 his statue was placed by the State of New Jersey in the Capitol at Washington.

**Stockton**, Robert Field: naval officer; son of Richard (1764–1828), jurist and U. S. Senator; b. at Princeton, N. J., Aug. 20, 1795; studied at the College of New Jersey, but left to enter the navy as a midshipman Sept. 1, 1811; became a lieutenant 1814; negotiated in 1821 the purchase from African native chiefs of the territory constituting the republic of Liberia; took part in the extermination of piracy in the West Indies; surveyed the Atlantic coast of the Southern States 1823–24; became commander 1830 and post-captain Dec. 8, 1838; was flag-officer of the Ohio in the Mediterranean 1838–39; declined the secretaryship of the navy 1841; was an early advocate of a steam navy; superintended the construction of the sloop Princeton, the first successful war-steamship, 1842; was chosen to carry to Texas the resolution of annexation 1845; proceeded to the Pacific as commodore of the U. S. squadron on the coast of California Oct., 1845; took possession of California for the U. S. Government, and formed a provisional government 1846; resigned from the navy May 28, 1850; was U. S. Senator 1851–53; was nominated in 1856 for the presidency by the newly formed "American party," but the ticket was withdrawn before the day of election. D. at Princeton, Oct. 7, 1866. See his *Life, Speeches, and Letters* (1856).

**Stockton-on-Tees**: town; in the county of Durham, England; on the left bank of the Tees, 4 miles from its mouth, 11 miles E. N. E. of Darlington (see map of England, ref. 5–H). A new town which has sprung up on the right bank of the river is known as South Stockton, the two being connected by an iron bridge of three arches built in 1887. The Tees is navigable for vessels of large tonnage up to the town, and the navigation of the river has been much improved. The town is well built, and has flour-mills and spinning-mills, breweries, blast furnaces, foundries, engine-works, and building-yards for iron ships, and carries on a considerable trade in wheat, coal, iron, and timber. The Stockton and Darlington Railway, opened Sept. 27, 1825, was the first railway to begin passenger traffic. Pop. of the parliamentary borough, returning one member, (1891) 68,895.

**Stoddard**, Charles Augustus, D. D.: editor; b. in Boston, Mass., May 28, 1833; educated at Williams College, New Church College, Edinburgh, Scotland, and Union Theological Seminary; pastor of Washington Heights church, New York, 1859–83; and since 1883 editor of *The New York Observer*. Dr. Stoddard has published *Across Russia* (New York, 1891); *Spanish Cities* (1892); *Beyond the Rockies* (1894); and many sermons and pamphlets. C. K. H.

**Stoddard**, Charles Warren: poet and traveler; b. at Rochester, N. Y., Aug. 7, 1843; educated at New York and California. In 1864 he visited the Hawaiian archipelago, where he has since resided at various times, and to which his writings largely relate. These include *Poems* (1867); *South Sea Idyls* (1873); *Mashallah: a Flight into Egypt* (1881); and *The Lepers of Molokai* (1885). In 1873–78 he traveled extensively as foreign correspondent of *The San Francisco Chronicle*. In 1885–86 he was Professor of English Literature at the University of Notre Dame, Indiana, and subsequently lecturer on English literature at the Catholic University of Washington, D. C. H. A. Beers.

**Stoddard**, Richard Henry: journalist and poet; b. at Hingham, Mass., July 2, 1825; was taken to New York when a child; attended the public schools of that city; became a mechanic in an iron-foundry; contributed poems to various periodicals, and in 1849 privately printed *Footprints*, a small volume of poems, followed in 1852 by a larger volume. From 1853 to 1873 he held appointments in the New York custom-house and dock department; was literary editor of *The New York World* in 1860–70, and in 1880 became literary editor of the New York *Mail and Express*. Besides numerous contributions in prose and verse to periodicals, he has published *Adventures in Fairy Land* (1853); *Songs of Summer* (1856); *Town and Country* (1857); *Life, Travels, and Books of Alexander von Humboldt* (1860); *The King's Bell* (1862); *Little Red Riding Hood*, in verse (1865); *The Children in the Wood*, in verse (1865); *Abraham Lincoln, a Horatian Ode* (1865); *Putnam the Brave* (1869); *The Book of the East* (1871); *Poems* (1880); and *The Lion's Cub*, poems (1890). He has also edited many volumes. See Stedman's *Poets of America*, pp. 57–59.

**Stoddard**, William Osborn: See the Appendix.

**Stoeckel**, Gustav J.: See the Appendix.

**Stoe'ver**, Martin Luther, Ph. D., LL. D.: educator and editor; b. at Germantown, Pa., Feb. 17, 1820; graduated at Pennsylvania College, Gettysburg, 1838; was tutor in Pennsylvania College 1839–40, afterward principal of its preparatory department, and Professor of Latin, History, and Political Economy until his death July 22, 1870. He was for many years secretary of the General Synod of the Lutheran Church and editor of *The Evangelical Quarterly Review*, in which he published an interesting series of *Reminiscences of Lutheran Ministers*; edited *The Literary Record* (1847–48); wrote biographies of Dr. Henry M. Muhlenberg (1856) and of Dr. Philip F. Mayer (1859), and a *Brief Sketch of the Lutheran Church in the United States* (1860), and had made extensive preparations for a fuller history of the same subject. Revised by H. E. Jacobs.

**Sto'ics** [from Lat. *Sto'icus* = Gr. Στωικός, liter., belonging to the Porch, deriv. of Στοά Ποικίλη, the Painted Porch at Athens in which the Stoics were wont to gather]: an ancient philosophic school founded about 310 B. C. by Zeno of Citium in Cyprus (flourished about 350–258). He numbered among his immediate disciples Persæus of Citium, Ariston of Chios, Herillus of Carthage, and Cleanthes of Assos, who succeeded his master. Cleanthes was succeeded by Chrysippus of Soloi, who reduced the Stoic doctrines to something like a system, and he by Zeno of Tarsus. Other celebrated Greek Stoics were Diogenes of Babylon, Antipatrus of Tarsus, Panætius of Rhodes, and Posidonius of Apamea. Owing mainly to Panætius, Stoicism found numerous disciples among the Roman nobility, and for centuries exercised a great and good influence upon the stronger minds of the empire. Among the Roman Stoics may be mentioned Q. Mucius Scævola, L. Annæus Cornutus, A. Persius Flaccus, L. Annæus Seneca, C. Musonius Rufus, Epictetus, and the Emperor Marcus Aurelius.

Stoicism was an offshoot from Cynicism, Zeno having been at first a disciple of Crates the Cynic; but it dropped some of the most objectionable elements of Cynicism, and became a civilized philosophy. It was divided by its adherents into three parts—logic, ethics, physics—of which the last was held to be most important, although the second received by far the most attention. Indeed Stoicism, like all the post-Aristotelian philosophies of antiquity, was essentially ethical.

(A) Under *logic* the Stoics included dialectic and rhetoric, the former of which was in reality a theory of cognition. They attached great importance to what they called a criterion of truth, although they were never able to fix upon any that would satisfy them as absolute. Their theory of sense-perception was essentially the same as that of Locke, the sentient soul being considered as a *tabula rasa*, impressed or otherwise affected by external objects. Perception was followed by memory and conception. Their highest concepts (τὰ γενικώτατα), by which they replaced Aristotle's ten categories, were (Trendelenburg, *Kategorienlehre*, p. 220, *seq.*)—

1. Ὑποκείμενα....................substrata.
2. " ποιά.................... " qualified (essentially).
3. " " πως ἔχοντα....... " " accidentally.
4. " " " " πρός τι. " " " thro' relation.

The Stoics, in the matter of general terms, were nominalists, or, more strictly, conceptualists. Under *dialectic* they included grammar, in the development of which they did some very good work. See Lersch, *Die Sprachphilosophie der Alten*, pt. ii., pp. 25, *seq.*; Steinthal, *Gesch. der Sprachw. bei den Griechen u. Römern*, pp. 277–363.

(B) Under *physics* the Stoics included theology. They replaced Aristotle's quaternity of cause by a duality, viz., force and matter, inseparable, and conceived very much as they are by modern physicists. Everything, even God, contains both. Their physical theory was in the main that of Heraclitus (*q. v.*), even down to the notion of a periodical ἐκπύρωσις or return of the universe to primeval fire. At the base of all lies necessity or providence—a tenet perhaps borrowed from Empedocles (περὶ φύσεως, line 1). With periodical conflagration, individual immortality (resurrection of the body) was of course incompatible. The individual, a mere temporary emanation, returns at last to his source.

(C) In their *ethics* the Stoics, if not what is now called altruistic, were essentially unselfish—that is, they rigidly maintained that the end of life was virtue for virtue's sake. What virtue was they found it difficult to define, their "living agreeably to nature" being very vague, not to say that they sometimes made nature mean human nature, sometimes universal nature. Man exists for society, for only in that is virtue possible. Virtue is sufficient for happiness; and pleasure, which naturally accompanies activity, is not to be sought for its own sake. The cardinal virtues are practical wisdom, courage, self-restraint, and justice (φρόνησις, ἀνδρία, σωφροσύνη, δικαιοσύνη), and it requires the possession of them all to constitute the truly wise man, who is free and the equal of Jupiter himself. The Stoics drew a broad distinction between acts and motives, and made the moral quality of acts depend entirely upon motives. Man shall do that which is good independently of surrounding influences and circumstances, and, having done that which is good, he shall feel happy independently of the sufferings and misery which may result from his acts. Of the works of the Stoics only fragments remain, the most important of which is Cleanthes's splendid *Hymn to Zeus*, of which there is an English rendering in Francis Newman's *The Soul, its Sorrows and Aspirations*, and another in *The Radical* (Boston, 1867). The best and most complete presentation of the Stoic philosophy is in Zeller's *Philosophie der Griechen* (vol. iv., pp. 26–340). English translation, *The Stoics, Epicureans, and Skeptics* (London, 1869). See also Ravaisson, *Essai sur le Stoicisme* (Paris, 1856); W. W. Capes, *Stoicism* (London, 1880); H. W. Benn, *The Great Philosophers* (2 vols., London, 1882).

Thomas Davidson.

**Stokes**, Sir George Gabriel, F. R. S.: mathematician and physicist; b. at Skreen, Sligo, Ireland, Aug. 13, 1819; educated at Bristol College; graduated 1841 as senior wrangler at Cambridge, and was elected to a fellowship in Pembroke College; and in 1849 was elected Lucasian Professor of Mathematics in that university; was elected to the Royal Society in 1851, and was awarded the Rumford medal of that society 1852; was secretary 1854–85, and was president 1885–90. From 1886 to 1893 he was member of Parliament for Cambridge, and in 1889 he was made a baronet. He contributed a report on hydrodynamics to the British Association in 1846, and several memoirs to the *Philosophical Transactions* on the dynamical theory of diffraction and the theory of fluorescence and phosphorescence, and has written papers in several scientific journals. In 1884–86 he delivered popular lectures on light at Aberdeen, which were published in 3 vols. (1887). His mathematical and physical papers have been reprinted (2 vols., 1880–83).

**Stokes**, Henry Newlin: See the Appendix.

**Stokes**, Whitley: Celtic scholar; b. in Dublin, Ireland, Feb. 28, 1830; educated at Trinity College, Dublin; barrister in London; barrister in Madras 1862; connected with the law department of the Government of India 1864–82, rendering important service in the codification of the Anglo-Indian laws. His chief activity has been in the field of Celtic philology, where he is a scholar of great accuracy and wide acquaintance with the materials involved. He is the author of *Irish Glosses* (1860); *The Play of the Sacrament, a Middle English Drama* (1862); *Three Irish Glossaries* (1862); *Gwreans an Bys, the Creation of the World, a Cornish Mystery, with a Translation and Notes* (1864); *The Indian Succession Act* (1865); *Hindu Law-books, edited with Notes and an Index* (Madras, 1865); *A Cornish Glossary* (1870); *Goidelica* (2d ed. 1872); *The Old Welsh Glosses on Martianus Capella* (1872); *Life of St. Meriasek, a Cornish Drama* (1872); *Three Middle Irish Homilies* (1877); *On the Calendar of Oengus* (1880); *Togail Troy* (1881); *The Anglo-Indian Codes*, editor (2 vols., 1887–88); *Urkeltischer Sprachschatz*, in vol. ii. of Fick's *Vergl. Wörterb.* (1894).

Revised by Benj. Ide Wheeler.

**Stokes' Law**: See Fluorescence.

**Stoke-upon-Trent**: town; in Staffordshire, England; on the Trent; 16 miles N. of Stafford (see map of England, ref. 8–G). It is the capital of the Potteries district, producing earthenware, porcelain, encaustic tiles and pavements. Coal-mining and brick-making are also carried on, and engines, machinery, etc., are manufactured. Pop. of the parliamentary borough, returning one member, (1891) 75,352.

**Stolz**, stōlts, Friedrich: philologist; b. at Hall, in the Austrian Tyrol, July 29, 1850; studied at the gymnasiums of Hall and Innsbruck, and at the Universities of Innsbruck and Leipzig; teacher successively in the gymnasiums of Görz, Klagenfurt, and Innsbruck; since 1887 professor in the University of Innsbruck. He is the author of *Die zusammengesetzten Nomina in den homerischen und hesiodischen Gedichten* (1874); *Die lateinische Nominalcomposition in formaler Hinsicht* (1877); *Beiträge zur Declination der griech. Nomina* (1880); *Studien zur lateinischen Verbalflexion* (1882); *Lateinische Laut- und Formenlehre* in Müller's *Handbuch der Alterthumswissenschaft* (1885; 2d ed. 1889); *Die Urbevölkerung von Tirol* (1886; 2d ed. 1892); *Historische Grammatik der lateinischen Sprache*, vol. i., *Einleitung, Lautlehre, und Stammbildungslehre* (1894).

Benj. Ide Wheeler.

**Stomach** [from Lat. *sto'machus* = Gr. στόμαχος, throat, gullet, stomach, deriv. of στόμα, mouth]: the chief organ of digestion; the expansion of the anterior portion of the alimentary canal for the reception of food, its disintegration and solution, and the digestion of albuminoid matter. The stomach is situated on the left side of the body, below the diaphragm, behind and beneath the free ribs. Its lower extremity extends across the median line. It is a membranous bag or sac, capable of great distension by food and gas, but often flaccid and collapsed when empty. When full it is 12 inches long and 4 high. The stomach receives food from the œsophagus through its upper or cardiac (Gr. καρδία, the heart) orifice, so termed because adjacent to the heart. The body of the stomach is beneath the ribs on the left side, and is termed the *fundus, cul de sac*, or *great pouch*. The *greater curvature* of the stomach is the lower, convex surface; the *lesser curvature* is concave and above. Food leaves the stomach through its lower orifice, the *pylorus* (Gr. πυλωρός, from πύλη, a gate), and enters the duodenum, the first section of the small intestine. The stomach has four coats: (1) The external serous layer, a reflection of the peritoneum, covering it at all points except the entrance of the nutrient vessels and nerves in the great and small curves. (2) The muscular layer, which has three separate sets of fibers—the longitudinal, the circular, and the oblique. These muscular bands, acting in different directions, propel the contained food from side to side of the cavity, aiding in its chemical disintegration by thorough admixture with gastric juice. This spiral movement is termed *vermicular* (worm-like), and also *peristaltic* (Gr. περιστέλλειν, to surround or wrap up). (3) The cellular coat, consisting of loose areolar tissue, connects the muscular to the internal mucous coat. It is called also the sub-mucous coat and the vascular coat, as it contains the blood-vessels which supply the elaborate capillaries beneath the secreting glands of the mucous membrane. (4) The mucous coat is thick, especially at the lower or pyloric end, presents large longitudinal folds when the stomach is but partially filled or empty, which disappear when it is distended. Closely inspected, the mucous surface is found to

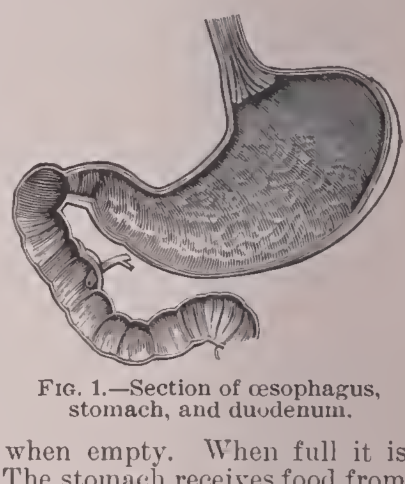


Fig. 1.—Section of œsophagus, stomach, and duodenum.

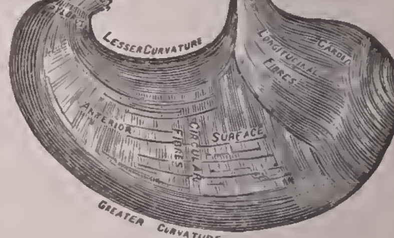



Fig. 2.—The muscular coat of the stomach.

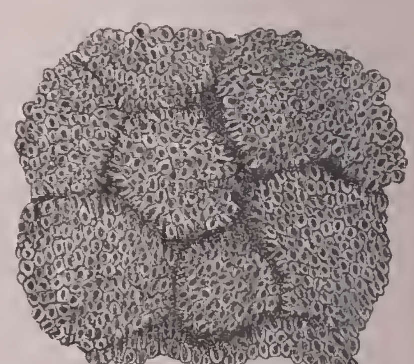


Fig. 3.—The mucous membrane of the stomach, orifices of the glands; magnified 20 diameters (*Sappey*).

be perforated by innumerable closely aggregated orifices of the gastric tubules. These are of two kinds: (1) the peptic glands situated in the cardiac and central parts of the organ, and (2) the pyloric situated at the pyloric end. The stomach is constantly lubricated by secreted mucus, which may become excessive in digestive disorders. Gastric juice is chiefly secreted after the ingestion of food. (See DIGESTION.) The stomach is intimately related to important adjacent viscera by both vascular and nerve connections. Its main artery, the gastric, springs from a common root with the hepatic and splenic arteries, and it also receives two branches of each of them. By branches of the sympathetic nervous system its functional activity is influenced by the health of each organ and part of the body; it receives the terminal branches of the pneumogastric nerve, which gives off branches controlling the action of the heart, lungs, and in a measure the larynx and pharynx. It is by these connections that gastric indigestion may cause palpitation of the heart, difficult and sighing breathing, irritability of the larynx, and hoarseness, and by reflex influence many morbid sensations in various parts of the body.

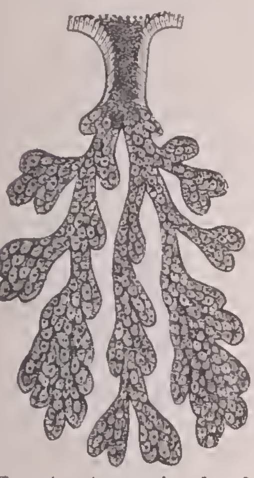


FIG. 4.—A peptic gland, magnified 100 diameters (*Sappey*).

The most frequent diseases of the stomach are its functional disorders. (See DYSPEPSIA.) In addition to these milder and chronic conditions, the stomach is liable to acute and organic disease. Acute inflammation or gastritis is of rare occurrence, the result of violent mechanical or chemical irritation, swallowing corrosive poisons or putrid and acrid food. It is characterized by violent ejection of all food, gastric mucus, traces of blood and bile, by sense of local burning pain, feeble pulse, cold extremities, and collapse. Perforating ulcer of the stomach is a not infrequent disease in young women of anæmic character. The symptoms are pain in the stomach upon reception of food, its rejection, and occasional hæmorrhage when the ulcerative process has eroded a blood-vessel. Hæmorrhage from the stomach is termed *hæmatemesis*, and must be carefully discriminated from *hæmoptysis*, the spitting of blood from the lungs. Cancer of the stomach is a relatively common affection of old persons, particularly of the male sex. It often occurs in persons of cancerous family history, in others with no hereditary taint. When at the pylorus, food is detained in the stomach, and after a time is ejected in great quantity, mixed with mucus, blood, and many fungous products of fermentation. There is a local darting pain, and often a local indurated tumor felt at the epigastrium through the emaciated abdominal wall; the face is cachectic, the body wasted, strength fails, death comes by exhaustion. Extreme neuralgia of the stomach—gastralgia or gastro-dynia—may occur, dependent on deranged nerve-centers or rheumatic or gouty vice of the blood.

Revised by W. PEPPER.

**Stomach-pump**: a form of syringe which has a flexible tube, designed to be passed down the œsophagus into the stomach, after which water is injected through it into the stomach and then withdrawn by reversing the action of the syringe. The operation may be repeated until the stomach is thoroughly washed clear of its contents. The instrument is especially useful in removing poisons from the stomach. In case of insane persons, or where some disease of the mouth or œsophagus exists, artificial feeding is required, and is usually accomplished with a simple rubber tube. The same is used in the treatment of diseases of the stomach for the purpose of washing out that organ.

Revised by W. PEPPER.

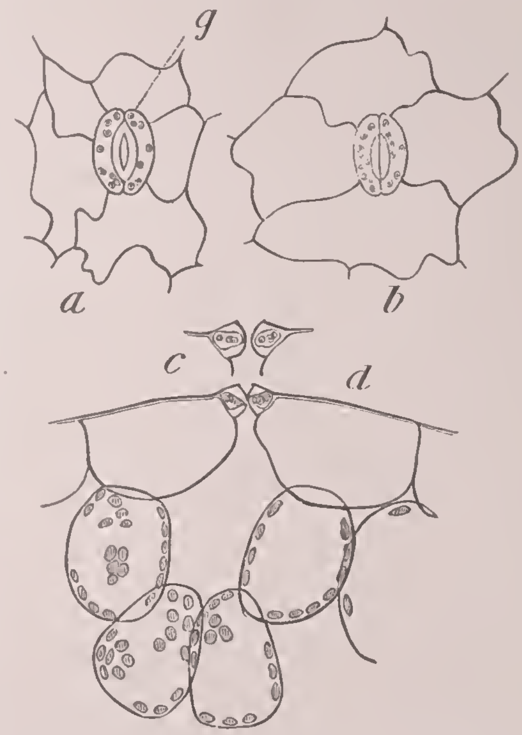
**Stomap'oda, Stom'apod**, or **Stomatop'oda** [Mod. Lat.; Gr. στόμα, στόματος, mouth + πούς, ποδός, foot]: a group of malacostracous crustaceans, embracing about sixty species of marine forms with elongate loose-jointed bodies. The carapax is small, having the last three thoracic rings free; the stalked eyes have a distinct ring; five pairs of feet are modified for maxillipeds, the second of these forming a strong pincer; and three pairs of thoracic feet, each of which is two-branched. The gills are borne on the abdominal feet. These characters mark the group off strongly from all other forms. They further differ from most crustaceans in that they deposit the eggs in their burrows. The young, though large, are thin and transparent, and were long regarded as

Mantis shrimp.

belonging to different forms. The species, which are known as Mantis shrimps, and which belong to the single family *Squillidæ*, are all inhabitants of the warmer seas, a single species occurring as far north as Massachusetts. See Miers, *Ann. and Mag. Nat. Hist.* (1880); Brooks, *Challenger Expedition.*

J. S. KINGSLEY.

**Sto'mate** [from Gr. στόμα, mouth]: a breathing-pore in the epidermis of plants, consisting of two elongated, somewhat curved cells, the guard-cells (*g* in figure), between which is a definite opening. When the guard-cells curve away from one another, as they do when the atmosphere is moist, the slit between them is opened, permitting the free ingress and egress of gases. The stomates are always placed over intercellular spaces of the underlying tissues, an arrangement which permits an interchange of gases throughout the plant.




Stomates of beet: *a*, top view, open; *g*, guard-cell; *b*, same closed; *c*, vertical transverse section, open; *d*, same closed, highly magnified.

Stomates are found in some liverworts, where they are curious chimney-like structures, but in the nearly related mosses (where they are confined to the capsules) they have essentially the same structure as in the flowering plants. In the fernworts they occur on the leaves and stems, and do not differ in any essential respect from those in the flowering plants. They rarely occur on submerged parts of plants, and in leaves which lie upon the surface of the water they are confined to the upper side. In ordinary leaves they are usually more abundant upon the lower side. In some, as in the compass-plants, they are about equally abundant upon both sides. The number of stomates on leaves varies very greatly. Weiss determined the number per square millimeter for the leaves of many species, and published the results in Pringsheim's *Jahrbücher für wissenschaftliche Botanik* (1865). A few of these are given below:

Olive (*Olea europea*), 625; hackberry (*Celtis occidentalis*), 616; black walnut (*Juglans nigra*), 461; lilac (*Syringa vulgaris*), 330; barberry (*Berberis vulgaris*), 229; golden currant (*Ribes aureum*), 145. In the foregoing, stomates occur on the upper side only; in the following they occur on both sides: sunflower (*Helianthus annuus*), upper, 175, lower, 325; cabbage (*Brassica oleracea*), u. 219, l. 301; pea (*Pisum sativum*), u. 101, l. 216; Indian corn (*Zea mays*), u. 94, l. 158; cottonwood (*Populus monilifera*), u. 89, l. 131; oats (*Avena sativa*), u. 48, l. 27.

In the development of stomates an epidermal cell undergoes division, usually into two unequal portions, and the smaller part is again divided in like manner. This may occur a third or even fourth time, when a last division into two equal parts (the guard-cells) takes place. These soon become somewhat rounded and separate at the center by the splitting of the partition between them.

CHARLES E. BESSEY.

**Stomati'tis**: See MOUTH, DISEASES OF THE.

**Stomatopoda**: See STOMAPODA.

**Stomiat'idæ** [Mod. Lat., named from *Sto'mias*, the typical genus, from Gr. στομίας, having a large mouth, deriv. of στόμα, mouth]: a family of isospondylous fishes. The species are elongated and of a club-shaped form, tapering from before backward; the skin is naked, or covered with very thin and readily deciduous scales; opercular apparatus imperfectly developed and very oblique; mouth with a very deep lateral cleft; upper jaw with its margin formed by the supramaxillary as well as intermaxillary bones; teeth on the jaws acute, and often barbed; gill openings very deep and continuous below; branchiostegal rays numerous (twelve to seventeen); anal fin very far behind and small; caudal distinct; pectoral fins low down on the scapular arch, and narrow; ventral fins inserted far backward. The ovaries have oviducts, and consequently the eggs are discharged directly through them into the water. The family is composed of a few species, which are rather small (all being considerably less than a foot in length), and inhabitants of the open sea and deep water.

**Stone** [O. Eng. *stān*: O. H. Germ. *stein* (> Mod. Germ. *stein*): Goth. *stains*; cf. O. Bulg. *stěna*, wall, and Gr. στία, στῖον, pebble]: in engineering, either natural or artificial rock suitable for use in foundations, walls, and piers. The natural sandstones, limestones, and granites furnish the greater part of all stone used in architecture and engineering. The essential qualities of a rock which renders it a good building-stone are strength and durability, while beauty and cheapness are desirable. The Egyptians quarried many very large stones for obelisks and for use in their temples, while from the earliest times stone-cutting has been a well-understood art. The cutting of dimension stones in the quarry by means of channeling-machines, introduced about 1870, has materially lowered the cost of many varieties of natural stone. See BUILDING-STONE for an account of the properties and methods of testing natural stone, and MASONRY for a description of the manner in which stones are laid together in buildings and engineering constructions.

Artificial stone consists of blocks or monolithic masses formed of materials which cement together. It is a combination of hydraulic cement, sand, crushed stone, pebbles, etc. Some varieties are of great value in districts where durable and cheap building-stone is not supplied by nature. The strength and durability of all varieties of artificial stone vary directly with the ultimate strength and hardness attainable by the hydraulic ingredients employed. An obvious means of improving their quality, therefore, is the employment of the highest grades of cement. Artificial stone may be made into blocks to be used as cut stone, or it may be built up into immense masses of any desired shape by moulding the different parts in place. The more important artificial stones are briefly described below. Most of these bear the names of their inventors.

CONCRETE (*q. v.*) is composed of hydraulic cement, sand, and broken stone or pebbles, and is much used in engineering construction. *Granolithic* is a trade-name for a combination of hydraulic cement and crushed granite (a granitic concrete), frequently employed for sidewalks and curbs, and for floors in stables, cellars, breweries, etc. *Béton-Coignet* is a combination of hydraulic cement, hydraulic lime, and sand, much used in France. The peculiarities are the substitution of hydraulic lime instead of part of the more expensive and stronger cement, and the small quantity of water used, and the thoroughness of the mixing. *Portland stone* is a name frequently given to a mixture of Portland cement and sand. The term Portland as applied to the stone, and also as applied to the cement of which it is made, was derived from the similarity of the artificial stone to the natural stone derived from the island of Portland, off the south coast of England. *McMurtrie stone* consists essentially of the Portland stone described above, in the pores of which are formed compounds of alumina with the fatty acids by the double decomposition of alum and a potash soap. The peculiar merit of this stone is that its power of absorbing water is decreased by the use of the alum and the soap. Absorbed water dissolves the salts of magnesia, lime, soda, and potash (of all of which there is always more or less in cement), and on evaporating leaves a white efflorescence on the surface which injures the appearance of the wall. For this reason the ordinary artificial stones are in disfavor for architectural purposes. The McMurtrie stone has been used in Washington, D. C., to a limited extent, the window-trimmings of the National Museum and also the fronts of a few stores and dwellings being of this stone. *Frear stone* is composed of sand and Portland cement, to which gum shell-lac is added. The shell-lac adds to the early strength of the stone, but it is not certain that it adds to the ultimate strength. It was for a time much used in architectural work in the western parts of the U. S., but did not give satisfaction. *Ransome stone* is made by forming in the interstices of sand, gravel, or any pulverized stone a hard and insoluble cementing substance, by the natural decomposition of two compounds in solution. Sand and the silicate of soda are mixed in the proportion of a gallon of the latter to a bushel of the former and rammed into moulds. At this stage of the process the blocks or slabs may be easily cut into any desired form. They are then immersed, under pressure, in a hot solution of chloride of calcium, after which they are thoroughly drenched with cold water to wash out the chloride of sodium formed during the operation. In Great Britain grind-stones are frequently made by this process. *Sorel stone* has as its basis a cement formed by adding a solution of chloride of magnesium to the oxide of magnesium. The strength of this stone as well as its hardness exceeds that of any other artificial stone yet produced. This process was formerly used in making emery-wheels. Owing to the great strength of the cement only a comparatively small proportion is required. *Medusaline* is an artificial stone combining the peculiarities of the McMurtrie and Sorel processes. In one variety the inert material is sawdust and the product is used as fire-proofing.

IRA O. BAKER.

**Stone**: in Great Britain, legally a weight of 14 lb. avoirdupois; but other stones are in use, such as 24 lb. of wool and 8 of butcher's meat. In other European countries there are weights called stone differing in pounds avoirdupois, and chiefly employed for weighing wool, hemp, flax, and feathers, the stone for flax containing twice as many pounds as the one used for wool or feathers. In all the principal commercial states of Germany the stone (of flax) is the fifth of a hundredweight (centner = 100 or 112 lb.)—i. e. 20 lb. in Prussia and the Zollverein, Hamburg, Lübeck, and Bremen, 22 lb. in Austria, while in Sweden it is equivalent to 32 lb. The origin of this peculiar method of weight-measuring is rather obscure, and still more so is that of the different forms into which it has branched.

**Stone** (in pathology): See CALCULUS.

**Stone**, CHARLES POMEROY: soldier; b. at Greenfield, Mass., Sept. 30, 1824; graduated at the U. S. Military Academy in 1845; appointed a brevet second lieutenant of ordnance; served in the war with Mexico, and was breveted captain; constructed the arsenal at Benicia, Cal., and performed the duties of chief of ordnance of the division of the Pacific 1851–56; engaged in the banking business for a year in San Francisco; in 1857 was appointed by the Mexican Government chief of a commission to survey and explore its lands in Sonora and Lower California; was appointed Jan. 1, 1861, to organize and drill the District of Columbia militia for defense of the capital. Appointed colonel of the Fourteenth U. S. Infantry May 14, and a brigadier-general of volunteers May 17, he served under Gen. Patterson during the latter's operations in the Shenandoah in July. In Feb., 1862, he was placed in confinement in Fort Lafayette, New York harbor, and held until Aug. 9, when released, not only without charges being preferred against him, but without explanation of the cause of his arrest. In 1863 he served in the department of the Gulf; in 1863–64 was chief of staff to Gen. Banks; mustered out of volunteer service Apr. 4, 1864. He commanded a brigade of the Fifth Corps before Petersburg from Aug. 21 to Sept. 13, 1864, when he resigned from the army. He was in the military service of the Khedive of Egypt 1870–82; brigadier-general and chief of staff 1870: Ferik-Pasha 1873–83, a grade next below field-marshal; received numerous decorations and orders, and filled various confidential positions under the khedive. He was chief engineer for the erection of the Bartholdi statue of Liberty, New York. D. in New York, Jan. 24, 1887.

**Stone**, DAVID MARVIN: journalist and author; b. at Oxford, Conn., Dec. 23, 1817; was a merchant in Philadelphia 1842–49; obtained his earliest reputation as an author of poetry and light literature contributed to newspapers and magazines; became commercial editor of *The Journal of*

*Commerce*, New York, 1849; with William C. Prime purchased the paper in 1861, and later was its editor-in-chief until 1893; author of *Frank Forrest*, which passed through more than thirty editions. D. in Brooklyn, N. Y., Apr. 2, 1895.

**Stone,** Frederick Dawson: See the Appendix.

**Stone,** John Seely, D. D.: clergyman; b. at West Stockbridge, Mass., in 1795; graduated at Union College in 1823; studied at the General Theological Seminary, New York, and took orders in the Episcopal Church 1826: was rector of churches at Litchfield, Conn., Frederick, Md., New Haven, Conn., Brooklyn, N. Y., Brookline, Mass., and of St. Paul's, Boston; lecturer in the Philadelphia Divinity School 1862–67; dean of the faculty of the Massachusetts Theological Seminary 1867–75. Besides several sermons and articles in periodicals, he published *Life of Bishop Griswold* (Philadelphia, 1844); *The Mysteries Opened* (New York, 1844; republished with title *The Christian Sacraments*, 1866); *The Church Universal* (1846; revised and enlarged as the *Living Temple*, 1868); *Life of James Milnor* (1848); *The Contrast, or the Evangelical and Tractarian Systems Compared* (1853); *Lectures on the Christian Sabbath* (1867). D. at Cambridge, Jan. 12, 1882.—His son, James Kent Stone, b. in Boston in 1840, graduated at Harvard in 1861; was ordained deacon and priest in the American Episcopal Church; professor (1863–67) and president (1867) of Kenyon College, Gambier, O., from which he received the degree of D. D. He was president of Hobart College, Geneva, 1868–69, but in 1870 entered the Church of Rome, becoming a Paulist Father. Revised by W. S. Perry.

**Stone,** Lucy: reformer; b. at West Brookfield, Mass., Aug. 13, 1818; graduated at Oberlin College 1847; began to speak on woman's rights and anti-slavery in the same year; lectured through the U. S. and Canada to large audiences; helped organize the first national woman's rights convention at Worcester, Mass., in 1850; married Henry B. Blackwell in 1855; helped organize the New England Woman Suffrage Association in 1868 and the American Woman Suffrage Association in 1869, and was chairman of the executive committee of the latter for twenty years; established *The Woman's Journal* in Boston in 1870, and was its editor till her death, which occurred at Dorchester, Mass., Oct. 18, 1893.

**Stone,** Thomas: a signer of the Declaration of Independence; b. at Pointon Manor, Charles co., Md., in 1743; was educated by a private tutor; studied law at Annapolis, and in 1764 began practice at Frederickton. He was a member of the Continental Congress 1775–79, and advocated the establishment of an independent government, although at first instructed by the Legislature of Maryland to oppose it; the State receding from its opposition, he was one of the signers of the Declaration of Independence; was again elected to Congress in 1783, and was a member of the committee to draft a plan of confederation, and was appointed a delegate to the convention of 1787, but was unable to attend. D. at Port Tobacco, Md., Oct. 5, 1787.

**Stone, Age of**: an archæological term denoting the stage of development in which people used tools and weapons made of stone. It does not refer to general chronology, but to a period in the development of each race. Thus certain races of the South Sea islands and extreme north have belonged to the stone age in the nineteenth century. It seems probable that in all parts of the world men have passed through this stage before making use of metals. (See Bronze, Age of.) In Europe the Stone Age is divided into two periods—the Palæolithic and the Neolithic. The remains of the former consist exclusively of flint, and roughly shaped by chipping into rude forms. The Neolithic implements include axes, hammers, knives, etc. These are made of various stones, some finer specimens being of jade, and are often highly polished. See Celt and Lake-dwellings. R. A. R.

**Stone, Artificial**: See Stone.

**Stone-borer**: any one of several bivalve molluscs belonging to several distinct families (*Pholadidæ*, *Gastrochænidæ*, *Saxicavidæ*, *Veneridæ*, *Petricolidæ*, and *Mytilidæ*) which have the faculty of perforating stone. The boring is accomplished by the shell and by the rubbing of the foot charged with sand. Besides these molluscs, species of worms and echinoids also excavate stone, and to that extent may be called stone-borers. E. A. B.

**Stone-chat**: a bird, the *Pratincola rubicola*. The male, in the breeding season, has the head, neck above, and back nearly black; the chin and throat black, and the neck on the sides white; breast chestnut in front and lighter backward; the wing-coverts of the tertials white, but partly hid by the other coverts, which are blackish brown, edged with lighter brown; upper tail-coverts white, and tail-feathers blackish; bill and legs black. (*Yarrell.*) The female is duller. The species is common in most parts of Middle Europe and Northern Africa. It is resident throughout the year in Great Britain, though mostly migratory in corresponding latitudes on the Continent. It feeds on insects.

**Stonecrop**: the wall-pepper (*Sedum acre*). See Wall-pepper.

**Stone-fly**: any plecopterous insect of the family *Perlidæ*. See Entomology (*Plecoptera*).

**Stone-fruits**: a popular name for those fruits which are known in botany as drupes. Most of them belong to the genus *Prunus*, which includes plums, prunes, apricots, peaches, nectarines, and cherries. See Drupe.

**Stoneham**: town (incorporated in 1725); Middlesex co., Mass.; on the Boston and Maine Railroad; 12 miles N. by W. of Boston (for location, see map of Massachusetts, ref. 2–H). It is noted for its manufactories of shoes and leather, and contains a national bank with capital of $50,000, a savings-bank, 6 churches, high school, 23 district schools, a public library, box-factory, machine-shop, and 2 weekly papers. Assessed valuation in 1894, $4,018,157. Pop. (1880) 4,890; (1890) 6,155; (1900) 6,197. Editor of "Independent."

**Stone'henge** [from Saxon *Stanhengist*, hanging stones]: a group of remains of rude stone structures, standing on Salisbury Plain, 2 miles from Amesbury, Wiltshire, England. It is at present much defaced, but was composed somewhat as follows: At the center was a large slab of blue limestone, 15 feet in length, supposed to be an altar. Around this were nineteen granite posts, over 20 feet in average height, set in an ellipse. Around this was another ellipse of sandstone posts, bearing a transom or lintel of sandstone across the top. There seem to have been six of these triliths. Outside this ellipse was a circle of thirty rough pillars of granite, some 6 feet high. Outside of this there was a circle, about 100 feet in diameter, of thirty sandstone posts, 4 feet apart and 13 feet high. A horizontal course of stone, dovetailed and mortised to the tops of the uprights and to each other, ran around this circle. Seventeen pillar-stones and six imposts retain their original positions. Without this circle there were a ditch and double mound of earth inclosing an area of about 120 yards in diameter. Many sepulchral barrows are found in the vicinity. It was first mentioned in the twelfth century by Henry of Huntingdon and Geoffrey of Monmouth, whose account may be considered as giving the earliest beliefs with regard to the origin of Stonehenge. Numerous theories have been propounded, and Stonehenge has been attributed to the Phœnicians, Druids, Saxons, and Danes; but it is mostly regarded by later archæologists as a burial-place of the people of the Bronze Age.

**Stone Implements**: See Stone, Age of; and Indians of North America.

**Stone-lily**: a crinoid having the form of a lily. See Encrinite.

**Stoneman,** George: soldier; b. at Busti, N. Y., Aug. 8, 1822; graduated at the U. S. Military Academy in 1846, and entered the First Dragoons, which he joined at Fort Leavenworth, whence he conducted a supply-train to Santa Fé, N. M., where he became acting quartermaster of the Mormon battalion, which he accompanied to California in 1847. In Mar., 1855, he became a captain in the Second Cavalry, and served until 1861 mainly in Texas; was in command at Fort Brown in February, when he was ordered by Gen. Twiggs to surrender to the State forces, but refused to do so, and evacuated the fort. He was promoted to be major First Cavalry, May, 1861; served on the staff of Gen. McClellan in West Virginia; Aug. 13 was appointed brigadier-general of volunteers and chief of cavalry of the Army of the Potomac, which he organized and commanded during the Virginia Peninsular campaign of 1862; succeeded to command of Kearny's (first) division, Third Corps, on the death of the latter, and of the Third Corps Nov. 15, 1862; was promoted major-general of volunteers Nov. 29, 1862, and led his corps at the battle of Fredericksburg; commanded cavalry raid to Richmond Apr.–May, 1863; was chief of cavalry bureau July, 1863–Jan., 1864; in command of Twenty-third Corps Jan.–Apr., 1864; of cavalry corps department of Ohio Apr.–July, 1864, participating in the Atlanta campaign May–July, 1864; conducted a raid for the capture of Macon and Andersonville and liberation of prisoners, but was compelled to surrender July 31, and held prisoner until Oct. 27; in temporary command of the department of Ohio Nov., 1864; in command of various districts and departments until mustered out of volunteer service Sept. 1, 1866; became colonel Twenty-first Infantry July 28, 1866; breveted colonel, brigadier, and major-general for gallant conduct; retired from active service Aug. 16, 1871. Resigned Sept. 15, 1882; Governor of California 1883–87. D. in Buffalo, N. Y., Sept. 5, 1894.

**Stone-pine, Swiss**: See CEMBRA PINE.

**Stone River, Battle of**: See MURFREESBORO.

**Stoneware**: See POTTERY AND PORCELAIN.

**Stoneworts**: the *Characeæ*, an order of lower plants, allied to the RED SEAWEEDS (*q. v.*) on the one hand and the

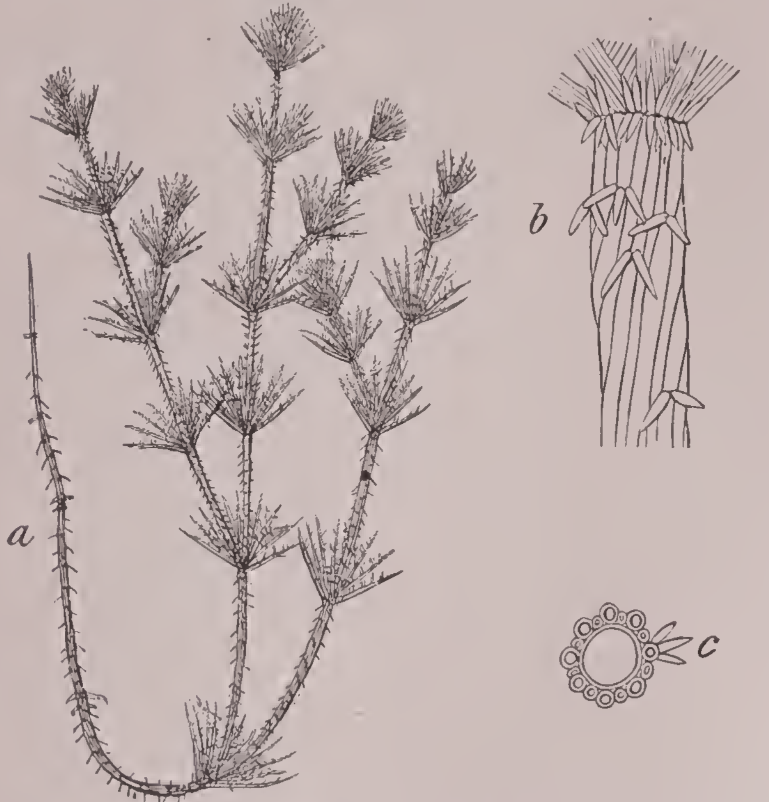



FIG. 1.—*a*, a stonewort (*Chara intermedia*), half the natural size; *b*, portion of stem, × 15; *c*, cross-section of stem, × 15.

MOSSWORTS (*q. v.*) on the other. They are small, green aquatic plants with jointed stems, bearing whorls of leaves

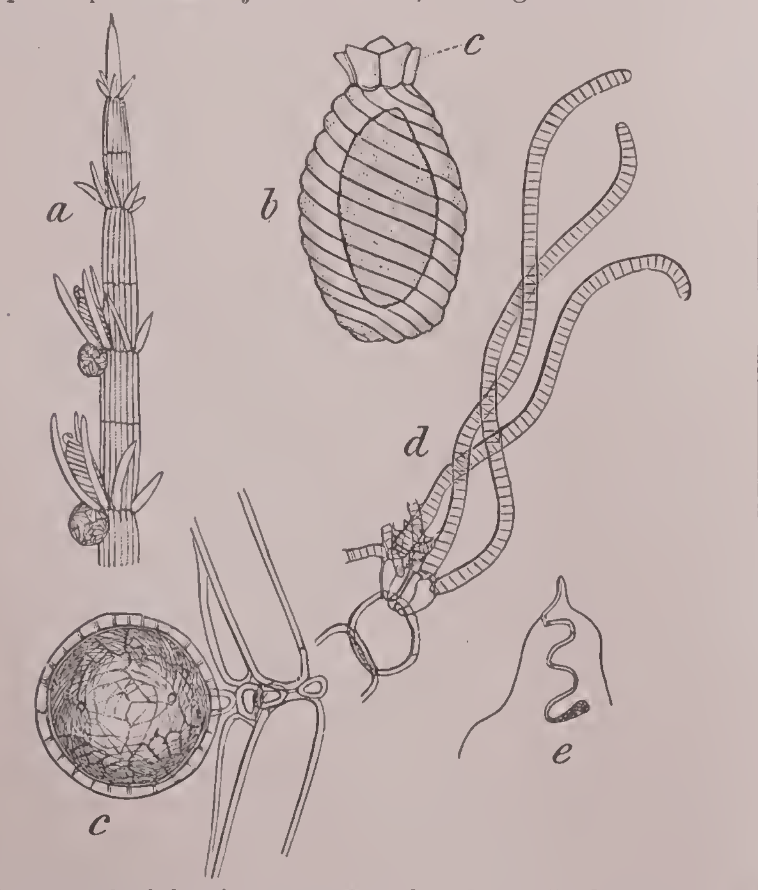



FIG. 2.—*a*, leaf, bearing young sexual organs, × 15; *b*, carpogone; *c*, coronula, × 30; *c*, antherid; *d*, threads from interior of antherid, × 200; *e*, antherozoid, × 600.

(Fig. 1). Both stems and leaves are very simple, being often no more than a row of cells, but sometimes a cylindrical mass of cells. The sexual organs, which occur upon the leaves, consist of antherids and carpogones. The former are globular bodies (Fig. 2), which at maturity are hollow and contain a number of short-celled threads. Each cell contains a spiral antherozoid, which, escaping into the water, swims actively with a rotating motion. The carpogone consists of a central cell, the oösphere, which soon becomes covered by a layer of spirally twisted cells, the pericarp, surmounted by one or two rows of short cells, the coronula (Fig. 2, *b*, *c*). Fertilization takes place by the entrance of the antherozoid through the opening in the coronula, and its fusion with the oösphere, which then acquires a thicker wall. This ripened spore-fruit soon falls to the bottom of the pond, and after a period of rest germinates by sending out a jointed filament, which eventually gives rise to a branching plant again.

The stoneworts number about 150 species, which are distributed among five genera and two families, viz., *Nitella* and *Tolypella*, constituting the family *Nitelleæ*, and *Lamprothamnus*, *Lychnothamnus* and *Chara*, constituting the family *Chareæ*. In North America there are about sixty-two species, widely distributed in ponds and slow streams.

The best works on the *Characeæ* are T. F. Allen's *Characeæ of America* (New York, 1888); W. Migula's *Die Characeen* in Rabenhorst's *Kryptogamen Flora von Deutschland, Oesterreich und der Schweiz* (Leipzig, 1890); and A. Braun's *Fragmenta einer Monographie der Characeen*, edited by O. Nordstedt (Berlin, 1882). CHARLES E. BESSEY.

**Stonington**: town (incorporated in 1658); port of entry; New London co., Conn.; on Long Island Sound, and the N. Y., N. H. and Hart. Railroad; 12 miles E. of New London, one of the county-seats (for location, see map of Connecticut, ref. 11–L). It includes the borough of Stonington, the villages of Old Mystic, Mystic, and Pawcatuck, and the farming region known as the Road district. The town has an excellent harbor, protected by a breakwater, and is in daily steamboat communication with New York. The principal industries are the manufacture of silk and cotton machinery, cotton and woolen goods, printing-presses, paper-cutters, spools for silk and thread, velvet and thread, boilers, and iron and brass goods. Stonington has a national bank with capital of $200,000, a savings-bank, and a weekly newspaper. In Aug., 1814, the town was bombarded by a British fleet, but the people successfully resisted occupation. Pop. (1880) 7,355; (1890) 7,184; (1900) 8,540, borough 2,278. EDITOR OF "MIRROR."

**Stony Point**: town; Rockland co., N. Y.; at the head of Haverstraw Bay; on the west side of the Hudson river, and on the N. J. and N. Y., the N. Y., Ont. and W., and the W. Shore railways; 42 miles N. of New York (for location, see map of New York, ref. 8–J). It is on a rocky promontory, which was fortified early in the Revolutionary war, was captured, strengthened, and garrisoned by the British, was retaken by the U. S. forces under Gen. Wayne in a night attack July 16, 1779, and soon afterward the fortifications were destroyed and the place abandoned. The summit contains a lighthouse and fog-bell tower. The house in which Benedict Arnold held his treasonable interviews was destroyed by fire in 1892. Remains of the fortifications are still preserved. Pop. (1880) 3,308; (1890) 4,614; (1900) 4,161.

**Stop**: in the organ, a series or set of pipes of similar tone and quality, tuned in regular gradation according to the order of the scale, and corresponding with the key-board either in the whole or a part only of its range. These stops are either simple or compound. A simple stop (as a diapason, flute, or trumpet) has only one pipe allotted to each key on the keyboard, but in a compound stop (as the sesquialtera or mixture) there are from two to five pipes for each key. The stops in a large organ are not only of various qualities of tone—soft, loud, delicate, bold, shrill, and the like—or imitations of the trumpet, violin, flute, etc., but are also distinguished by peculiarities of pitch, some stops giving the sound represented by the finger-keys to which they belong, others the octave or double octave below or above, while others are tuned in triple octaves above, and even in double and triple thirds and fifths, the whole combining and blending together with united effect, as if each key sounded only one richly toned pipe. The theoretical basis of this latter class of stops is explained in the article HARMONIC STOPS (*q. v.*). Organ-pipes are of two classes—flue-pipes and reed-pipes. The former are either metallic cylinders of various forms and proportions, with a mouth and lip resembling those of the ordinary pitch-pipe, or are square wooden tubes producing sound on the same principle. The latter are chiefly metallic tubes of tapering form, provided with flexible reeds of brass or other metal, the vibrations of which produce a sound richer and more penetrating than that of the flue-pipe. Among the flue-stops are the diapasons, principal, twelfth, fifteenth, tierce, and the compound stops; also the gamba, keraulophon, and the various flute-stops. In the class of reed-stops the most prominent are the trumpet, trombone, horn, bassoon, clarion, cremona, hautboy, and vox humana. See ORGAN and FOOT (in music).

Revised by DUDLEY BUCK.

**Stoppage in Tran'situ** [*in transitu* = Lat., in passage]: in law, stopping goods while they are in transit, and resuming possession of them by an unpaid seller, who has parted with their possession. The seller is allowed to exercise this right upon discovering the insolvency of the buyer, on the ground "that the goods of one man should not be applied in payment of another man's debts." The rule originated in chancery cases decided during the latter part of the seventeenth century, and was adopted by the common-law courts "for the benefit of trade." *Bohtlingk* vs. *Inglis*, 3 East 381.

*By whom Exercised.*—This right has been regarded with such favor by the courts that they have permitted not only sellers, but persons in the position of sellers to exercise it; for example, an agent of the seller to whom the bill of lading has been indorsed, or a consigner, or an agent of the buyer who has himself paid, or is directly responsible for, the price. (British Sale of Goods Act, 1893, § 38.) A seller is deemed unpaid when he has not been paid in full, or when he has received a negotiable instrument as conditional payment, which has been dishonored or has been discredited by the insolvency of the parties liable thereon to the seller. Nor does it matter that the buyer has negotiated such paper. A buyer upon credit is bound to keep his credit good, if he would prevent the unpaid seller from exercising his right of lien or of stoppage *in transitu.*

*Buyer's Insolvency.*—This is the basis of the right in question. If the seller knew of the buyer's insolvency when the sale was made on credit, there would be no equity in permitting him to stop the goods after deliberately parting with their possession in favor of the insolvent (*Fenkhausen* vs. *Fellows*, 20 Nev. 312); but the fact that the buyer was insolvent when the sale was made, if unknown to the seller, does not affect the latter's right. (*Benedict* vs. *Schaettle*, 12 Ohio St. 515.) A buyer who disputes the rightfulness of a particular stoppage of goods, by an unpaid seller, must prove that he was not insolvent when the goods reached their destination, and that he had not "afforded the ordinary apparent evidences of insolvency." A person is insolvent, within the meaning of the word in this connection, who has ceased to pay his debts in the ordinary course of business, or who is unable to pay his debts as they fall due, whether he has committed an act of bankruptcy, or become subject to insolvency proceedings or not.

*Transit.*—The rule upon this head was stated by Lord Esher, as follows: "When the goods have not been delivered to the purchaser or to any agent of his to hold for him otherwise than as a carrier, but are still in the hands of the carrier as such and for the purposes of the transit, then, although such carrier was the purchaser's agent to accept delivery so as to pass the property, nevertheless the goods are *in transitu* and may be stopped. There has been a difficulty in some cases where the question was whether the original transit was at an end, and a fresh transit had begun. The way in which that question has been dealt with is this: Where the transit is a transit which has been caused either by the terms of the contract or by the directions of the purchaser to the vendor, the right of stoppage *in transitu* exists; but if the goods are not in the hands of the carrier, by reason either of the terms of the contract or of the directions of the purchaser to the vendor, but are *in transitu* afterward in consequence of fresh directions given by the purchaser for a new transit, then such transit is no part of the original transit, and the right to stop is gone. So, also, if the purchaser gives orders that the goods shall be sent to a particular place, there to be kept till he gives fresh orders as to their destination to a new carrier, the original transit is at an end when they have reached that place, and any further transit is a fresh and independent transit." (*Bethell* vs. *Clark*, 20 Queen's Bench Division 615.) Whether the delivery of goods on board a ship, chartered by the buyer, puts them into the master's possession as carrier, or amounts to a final delivery at their place of destination, depends upon the intention of the parties, as disclosed by all the circumstances of the case. Goods are still subject to the right in question while in the carrier's or other custodian's possession, although they have reached the end of their transit, provided the buyer has not taken actual or constructive possession of them. For example, where the carrier retains or warehouses them subject to his lien for freight and charges; or where the buyer has rejected them; or where he has obtained delivery of a part only. If the delivery of part is made under such circumstances as to show an agreement to give up possession of the whole, or if the carrier wrongfully refuses to deliver the goods to the buyer, or if the carrier attorns to the buyer, that is, acknowledges that he holds the goods for the buyer, the transit is at end.

*Defeating the Right during Transit.*—The buyer may defeat it by obtaining delivery of the goods before their arrival at the appointed destination. In Great Britain it seems to be immaterial whether delivery is obtained rightfully or wrongfully (*Whitehead* vs. *Anderson*, 9 M. & W. 518; Sale of Goods Act, § 45 (2)); but there is authority in the U. S. for the view that this premature delivery must be obtained in good faith. (*Poole* vs. *Ry.*, 58 Tex. 134.) He may also defeat it by a sale of the goods accompanied by the delivery of actual or constructive possession, but a sale without delivery will not affect it. A creditor of the buyer can not defeat the right by levying an attachment or execution upon the goods while in transit. Such a levy gives him no greater claim to the property than the debtor had; and, besides, the object of the right—to prevent the application of one man's goods to the payment of another's debts—is decisive against such a creditor. Constructive possession of the goods may be given by the transfer of the bill of lading. It follows that a transfer of the bill of lading to a *bona-fide* purchaser of the goods for a valuable consideration will defeat the right of stoppage *in transitu*. It has even been held that such a transferee will get a clear title to the goods, although the right of stoppage had been exercised before the transfer, the goods being in transit still. (*Newhall* vs. *Ry.*, 51 Cal. 345.) If the bill of lading is transferred by way of pledge, instead of by way of sale, the right of stoppage is subject to the rights of the pledgee.

*How Exercised.*—Either by taking actual possession of the goods or by giving notice of his claim to the carrier or other bailee in possession of the goods. When it is given not to the person in actual possession, but to his principal, as a ship-owner or a transportation company, it must be given at such a time and under such circumstances that, by the exercise of reasonable diligence, it may be communicated to the one in actual possession in time to prevent delivery to the buyer.

*Consequences.*—The seller does not rescind the sale by stopping the goods *in transitu*, but restores his vendor's lien. Upon his giving due notice to the carrier or other person in possession, it becomes the duty of the latter to redeliver the goods in accordance with the seller's directions, but at the seller's expense. After the goods are stopped, the purchaser or his assignee may regain them by paying or tendering the price. Under the British statute (§ 48), if the goods are perishable, or if the seller notifies the purchaser of his intention to resell, and the latter does not within a reasonable time pay or tender the price, the goods may be resold, and the original seller may recover from the original buyer any loss thereby occasioned. This seems to be the common-law rule. (*Tuthill* vs. *Skidmore*, 124 N. Y. 148.) The right of the seller who has stopped goods *in transitu* is similar to that of a pledgee, with power to sell at private sale in case of default.

FRANCIS M. BURDICK.

**Storage Batteries:** See the Appendix.

**Storer**, DAVID HUMPHREYS, M. D.: naturalist; b. at Portland, Me., Mar. 26, 1804; graduated at Bowdoin College in 1825; devoted himself especially to natural history, and, besides contributions to scientific periodicals, published a translation from the French of Kiener's *Genera, Species, etc., of Recent Shells* (Boston, 1837); *Ichthyology, etc., of Massachusetts* (1839); *Fishes of North America* (Cambridge, 1846); and *History of the Fishes of Massachusetts* (Boston, 1853, and, with plates, 1866). D. in Boston, Sept. 10, 1891.

**Storer**, FRANCIS HUMPHREYS: b. in Boston, Mass., in 1832; graduated at the Lawrence Scientific School in 1855; was Professor in the Massachusetts Institute of Technology 1865–70; since 1870 Professor of Agricultural Chemistry in

Harvard University, and dean of the Bussey Institution; has contributed to scientific periodicals; was the American editor of Barreswill's *Répertoire de Chimie appliquée*, and has published *Alloys of Copper and Zinc* (1859); *Manufacture of Paraffin Oils* (1860); *First Outlines of a Dictionary of the Solubilities of Chemical Substances* (1863–64), and with Charles W. Eliot, *Manual of Inorganic Chemistry* (1869); *Manual of Qualitative Chemical Analysis* (1870); and *Agriculture in some of its Relations with Chemistry* (2 vols., New York, 1887).

**Storer**, Horatio Robinson, M. D.: surgeon; b. in Boston, Mass., Feb. 27, 1830; educated at Harvard, where he received A. B. 1850, and M. D. and A. M. in 1853; was Professor of Obstetrics and Medical Jurisprudence in the Berkshire Medical College; has contributed largely to medical literature, and has published *Why not? A Book for every Woman*, which received the gold medal of the American Medical Association (1866); *Is it I? A Book for every Man* (1867); *Decrease of the Rate of Increase of the Population in Europe and America* (1867); *Nurses and Nursing* (1868); with F. F. Heard, *Criminal Abortion, its Nature, its Evidence, and its Law* (1868) and *Volunteer Sanitary Organizations as an Aid to Official Boards of Health* (1890). He was coeditor of *The Journal of the Gynæcological Society* of Boston from 1869 to 1872. He is a high authority on medals, jetons, and tokens illustrative of the science of medicine. S. T. A.

**Stork** [O. Eng. *stork*: O. H. Germ. *storah* (> Mod. Germ. *storch*): Icel. *storker*. Cf. Gr. *τόργος*, vulture]: any bird of the genus *Ciconia* and of the family *Ciconiidæ*, which contains half a dozen species, all—save *Ciconia magnari*—inhabitants of the Old World. In general appearance they resemble the European stork (*Ciconia alba*). This is a large bird, about 3½ feet long; the head, neck, and body above, as well as below, are white, the wings partly black, and the bill and legs red. It is a migratory species, which in the warm season extends into Northern Europe, and in winter (as well as other seasons) is found in Northern Africa and Asia. It has no cry, but claps its bill together with a loud noise.


White or European stork.

Storks are great favorites with the people, who conceive that their presence brings good luck. They often build upon the roofs of houses. They devour offal, reptiles, and other vermin. The stork displays remarkable affection for its young, and is of old a popular emblem of filial piety and conjugal faithfulness. See also Shoebill and Shadow-bird.

Revised by F. A. Lucas.

**Stork**, Charles Augustus, D. D.: clergyman; b. at Jefferson, Md., Sept. 4, 1838; graduated at Williams College, Massachusetts, 1857; Professor of Greek Language and Literature, Newberry College, South Carolina, 1859–60; pastor Philadelphia, 1861–62, Baltimore, Md., 1862–81; Professor of Didactic Theology, Gettysburg, Pa., 1881–83. D. in Philadelphia, Dec. 17, 1883. After his death a selection from his writings was published, with the title *Light on the Pilgrim's Way* (Philadelphia, 1885), with a biographical sketch by his brother, T. B. Stork. See also *The Stork Family in the Lutheran Church* (Philadelphia, 1886).

H. E. Jacobs.

**Storm**: an intense atmospheric disturbance, which may be general or local, and may be characterized by high winds, when it is of especial importance to navigators, or by heavy precipitation of rain or snow, when it is most important inland, or by both wind and precipitation. General storms are areas of low pressure ("lows," or cyclones) of intense action, which travel eastward in temperate latitudes, but westward in the tropics. In summer very few of the "lows" are sufficiently intense to deserve the name of storm; in winter, perhaps, half of them are stormy, and in spring and autumn the ratio is still larger.

Stormy weather increases in frequency from the tropics toward the poles. The ocean in the vicinity of Cape Horn has the reputation of being the stormiest sea in the world, but the North Atlantic is the stormiest frequented ocean. The Pacific Ocean deserves its name only in lower latitudes. About the Aleutian islands and S. of Australasia it is very stormy. In the U. S. the storm frequency is greatest in New England and the region of the Great Lakes. Next come the extreme northwest, and the Atlantic coast. The most destructive general storms in the U. S. are of tropical origin (see Hurricanes), but they affect only the eastern part of the country, and occur only in late summer and autumn. The general storms which enter the U. S. from the western Gulf coast or Mexico in the colder seasons bring warmer weather with abundant precipitation, sometimes torrential rains. Most of the general storms which affect the eastern part of the U. S. appear first in sight on the plains E. of the Rocky Mountains, in Alberta or Assiniboia. The general storms from the Pacific come from the N. W., and enter on the coast of British Columbia, Washington, and Oregon. General storms are unknown on the Pacific coast from Lower California to Panama, but are more common over the West Indies, and occasionally pass far enough westward to affect Spanish Honduras, Yucatan, and, to a less degree, British Honduras. The western portion of the Gulf of Mexico is subject to severe winter gales from the N. The American storms which last long enough to cross the Atlantic usually pass northward of the British islands. A few pass over Great Britain, or sometimes pass farther S., over France, or even Spain. The most of the European storms, however, do not previously appear on the American weather-map. Manchuria and Central and Northern Japan are crossed by many storms, and the Sea of Japan, on which Russia has established her Pacific ports, is very stormy. The typhoons of the China Sea bring stormy weather to the Chinese coast S. of Shanghai, to the Philippine islands, Formosa, and Southern Japan. Similar typhoons occur about the Samoan and Fiji islands and about the Mascarenes, and Southern New Zealand and Tasmania have stormy coasts. The general storms of South America enter from the Pacific on the coasts about Chiloe, then pass northeastward, affecting Patagonia, Southern Argentina, Uruguay, and the coasts of Southern Brazil.

The approach of a general storm is heralded by a falling barometer, a rising thermometer (generally), and a sheet of clouds ascending from the W. and preceded by long filmy streaks of cirrhus. These signs usually give a day's notice, and the weather-map a notice of two or three days. The storm lasts from one to three days; the maximum of rainfall and wind usually precede by a few hours the minimum of air-pressure; and the retreat of the signs of the storm is more rapid than their advance with the approaching storm. The official forecasts of general storms can be made with more accuracy than those of moderate changes of weather, and their approach is heralded by storm-signals and warnings at the ports likely to be affected. (See Weather Signals.) A general storm occupies an area of about 500 miles in diameter on the average, and may live from three days to a fortnight.

While the advance of the general storm can be forecasted with fair accuracy a day or two beforehand, the same is unfortunately not true of local storms. They are small, are not of long duration, travel but short distances, occur usually in warm weather, and only in the hottest part of the day. The individual storms give but brief warning of their approach, and though the conditions under which they develop are known and can be predicted, yet the individual storms will be only sparsely scattered over the area in which these conditions exist. Tornadoes and squalls are forms of local storms especially characterized by high winds, and thunder-storms and cloudbursts those characterized by heavy precipitation. In the U. S. local storms usually occur in the warm season a few hundred miles to the southward of a large, moist, and warm "low;" especially when this is closely followed by a sharp fall of temperature. In the tropics they have no association with general areas of low pressure, but have a marked diurnal periodicity. For instance, at San José, Costa Rica, in the rainy season there is rain two days in three, and the rain is always after noon. Nine-tenths of the rain there falls between 2 P. M. and 7 P. M. See also Squalls, Cloudburst, Meteorology, and Ocean.

Mark W. Harrington.

**Storm**, Johan Frederik: philologist; b. at Lom, Norway, Nov. 24, 1836; educated at the University of Christiania; Professor of Romanic and English Philology in the University of Christiania since 1873; author, among other works, of *Practical Course in English* (1862, in Norwegian); *The Romance Nations and Languages* (1871, in Norwegian); *Selections of Phrases for Tourists Traveling in Norway* (4th ed. 1881); *English Philology* (1879, in Norwegian); *Englische Philologie, die lebende Sprache* (revised translation of preceding, 1881; 2d ed. 1892); *Det nynorski Landsmaal* (1888, concerning the attempt to create a new standard Norse on the basis of the Old Norse and the Norwegian dialects); *Romance Languages* (article in *Encycl. Britannica*, vol. xx.); *French Dialogues, a Systematic Introduction to the Grammar and Idiom of Spoken French* (Norwegian ed. 1887; Danish, 1887, 1889; Swedish, 1887, 1891; German, 1888; Dutch, 1888, 1892; Finnish, 1892; English, 1892); also many articles in scientific journals. B. I. W.

**Storm**, Theodor: poet and novelist: b. at Husum, Schleswig, Sept. 14, 1817; studied jurisprudence at Kiel and Berlin; practiced law in his native city and later in Prussia; was appointed judge at Husum in 1874; retired from his position in 1880. D. July 3, 1888. In 1843 he published with Theodor and Tycho Mommsen his first collection of poetry, mostly lyric poems of exquisite simplicity and great depth of feeling. His great popularity he gained, however, by his famous *Novellen* or short stories, of which he wrote a great many. The best known of these are: *Immensee*, *Im Sonnenschein*, *Ein grünes Blatt*, *Ein stiller Musikant*, *Viola tricolor*, *Pole Poppenspäler*, *Aquis submersus*, and *Der Schimmelreiter*. His *Erinnerungen an Mörike* (1882) show how deeply he was influenced by the latter poet, whose fine lyric talent and graceful humor he frequently attained in his own writings. See Jacob Bächtold, *Mörike-Storm Briefwechsel* (1891); Feodor Wehl, *Theodor Storm* (1888).

Julius Goebel.

**Storm-area**: an area on the weather-map over which the wind is high or the precipitation heavy, or both—a low of higher than average intensity. It can be at once distinguished by the crowding of the isobars and rain-symbols. The wind is the higher the closer the isobars are together. Heavy winds and torrential rains do not usually go together, though the former may follow the latter. The progress of a storm area is usually more uniform than that of gentler areas of low pressure. Western storm-areas usually increase in intensity as they pass eastward, but southern ones decrease in intensity and increase in size as they gain in northing. M. W. H.

**Storm Lake**: city; capital of Buena Vista co., Ia.; on Storm Lake, and the Ill. Cent. Railroad; 53 miles W. of Fort Dodge, 81 miles E. by N. of Sioux City (for location, see map of Iowa, ref. 3–E). It is in an agricultural and dairying region, and contains a national bank with capital of $50,000, 2 State banks with combined capital of $100,000, an incorporated bank, and 3 weekly newspapers. Pop. (1880) 1,034; (1890) 1,682; (1900) 2,169.

**Stormy Petrel**, or **Storm-petrel**: See Mother Carey's Chicken.

**Storrs**, Richard Salter, D. D.: clergyman; b. at Longmeadow, Mass., Feb. 6, 1787; descended from a long line of ministers, his father, who bore the same name, having been thirty-three years pastor at Longmeadow; studied at Yale and at Williams, where he graduated in 1807; was licensed to preach by the Suffolk, Long Island, presbytery in 1808; preached at Islip and Smithtown, Long Island, 1808–09; spent a year at Andover Seminary, graduating in 1810; was ordained pastor of the First Congregational church at Braintree, Mass., July 11, 1811, and, with the exception of a period of five years spent as agent of the Home Missionary Society, remained there until his death Aug. 11, 1873, after a pastorate of sixty-two years. He was the editor of *The Boston Recorder* (1817–25) and senior associate editor of *The Congregationalist* (1850–56): contributed to *Panoplist* and other periodicals; published a number of sermons.

**Storrs**, Richard Salter, D. D., LL. D., L. H. D.: clergyman; son of Rev. Richard S. Storrs (1787–1873); b. at Braintree, Mass., Aug. 21, 1821; graduated at Amherst College 1839; studied law and afterward theology at the Andover Seminary, where he graduated in 1845, and after serving for a year as pastor of a Congregational church in Brookline, Mass., became in 1846 pastor of the Church of the Pilgrims, Brooklyn, N. Y., a position which he still occupies. The completion of the fiftieth year of his pastorate was celebrated Nov. 18, 1896. Eminent as a preacher, he also contributed much to current literature, and was from 1848 to 1861 one of the editors of *The Independent*, a religious weekly. He had a part in the *Report on the History and Recent Collation of the English Version of the Bible*, undertaken by the American Bible Society, and the *Statement and Documents* in defense (1858); is the author of *The Graham Lectures on the Wisdom, Power, and Goodness of God, as manifested in the Constitution of the Human Soul* (1856); a series of lectures on *The Conditions of Success in Preaching without Notes* (1875); *The Divine Origin of Christianity indicated by its Historical Effects* (1884); *Bernard of Clairvaux* (1892); besides numerous historical and literary, as well as religious, discourses. He was president of the American Board of Commissioners for Foreign Missions 1887–97. D. June 5, 1900. Revised by G. P. Fisher.

**Story**, Joseph, LL. D.: jurist; b. at Marblehead, Mass., Sept. 18, 1779; graduated at Harvard College in 1798; studied law, and in 1801 began practice at Salem; was a member of the State Legislature 1805–08, and the acknowledged leader on the Republican side, defending Jefferson's proclamation of embargo as the only measure, short of war, by which American commerce could be protected from the restrictions of the belligerent European powers. In 1808 he was elected a representative in Congress, where he urged a repeal of the Embargo Act, on the ground that it was a temporary measure, the purpose of which had now been attained. Having declined a re-election to Congress, he was in 1810 again chosen a member of the State Legislature, of which he was elected speaker. In 1811 he was appointed associate justice of the Supreme Court of the U. S.; in 1820 was a member of the convention for the revision of the State constitution. In 1829 he was chosen Dane Professor of Law in Harvard College, a position created for him, and which he held for the remainder of his life. D. at Cambridge, Mass., Sept. 10, 1845. In 1804 he published a volume of poems entitled *The Power of Solitude* (most of the copies of which he bought up and destroyed), and in 1806 *Memorial of the Inhabitants of Salem*, a pamphlet addressed to President Jefferson relating to the infringements by foreign powers upon the neutral trade of the U. S. He also published many addresses, literary discourses, and reviews, etc., but his fame rests mainly upon his decisions, and especially upon his legal *Commentaries*, of which the following are the principal, all of which have passed through several editions, and most of which have been translated into German: *On the Law of Bailments* (1832); *On the Constitution of the United States* (1833); *On the Conflict of Laws, Foreign and Domestic* (1834); *On Equity Jurisprudence, as administered in England and America* (1835); *On Equity Pleadings* (1838); *On the Law of Agency* (1839); *On the Law of Partnership* (1841); *On the Law of Bills of Exchange* (1843); *On the Law of Promissory Notes* (1848). He also edited Chitty *On Bills of Exchange* and Abbott *On Shipping*, and left in MS. a *Digest of Laws*, supplementary to that of Comyns. As a constitutional lawyer he belonged to the school of Marshall, and supported the Federal authority. He was untiring in his work, and a great case lawyer. His commentaries and written decisions in his circuit comprise twenty-seven volumes, and his judgments in the Supreme Court an important part of thirty-four volumes more. A collection of his *Miscellaneous Writings* was published in 1852, and his *Life* has been written by his son, William W. Story (2 vols. 8vo, Boston, 1851).

Revised by F. Sturges Allen.

**Story**, Robert Herbert, D. D.: minister; b. at Rosneath, Dumbartonshire, Scotland, Jan. 28, 1835; educated at the Universities of Edinburgh, St. Andrews, and Heidelberg; assistant minister at St. Andrew's, Montreal, Canada, 1859–60; in Rosneath, as his father's successor, 1860–87; since 1887 Professor of Church History in the University of Glasgow, second clerk of the General Assembly of the Church of Scotland, and chaplain to the Queen; editor of *The Scottish Church* (a monthly magazine) since its foundation in 1885; the first lecturer on the Lee foundation, St. Giles, Edinburgh, 1886. Besides many contributions to various periodicals Dr. Story has published *Robert Story of Rosneath, a Memoir* (London, 1862); *Christ the Consoler, or Scriptures, Hymns, and Prayers for Times of Trouble and Sorrow, selected and arranged* (Edinburgh, 1865); *Life and Remains of Robert Lee, D. D.* (London, 1870); *William Carstares* (1874); *Creed and Conduct: Sermons* (1878); *Health Haunts in the Riviera* (Paisley, 1881); and *Nugæ Ecclesiasticæ* (Edinburgh, 1884). C. K. Hoyt.

**Story**, William Wetmore: sculptor; son of Joseph Story, LL. D.; b. at Salem, Mass., Feb. 19, 1819; studied law; was admitted to the bar, and published several legal books—*Report of Cases* (1842–47); *Treatise on the Law of Contracts* (1844); *The Law of Sale of Personal Property* (1847); edited the *Life and Letters of Joseph Story* (1851). About 1848 he abandoned law for sculpture, and from that time on he resided chiefly in Rome, where he died Oct. 7, 1895. Besides the practice of his art he was a somewhat prolific writer. He published *The American Question* (1862); *Roba di Roma* (1862); *Proportions of the Human Figure* (1866); *Graffiti d'Italia* (1869); *A Roman Lawyer in Jerusalem* (1870); *The Castle S. Angelo and the Evil Eye*, being a second volume of *Roba di Roma*, in 1877; and five volumes of poems. As a sculptor he is known chiefly by his large allegorical statues, *Medea, Cleopatra, The African Sibyl*; by the statue of George Peabody executed for the corporation of London; the statue of Edward Everett in the Boston Public Garden; the monument at San Francisco of Francis Scott Key; and busts of his father, James Russell Lowell, William Cullen Bryant, Josiah Quincy, and Theodore Parker. He was made Chevalier of the Legion of Honor at the Paris Exposition of 1878.

**Stothard**, Charles Alfred: painter and architectural draughtsman; son of Thomas Stothard, painter; b. in London in 1786; early distinguished himself by his skill as an artist. His best-known painting, *The Death of Richard II.*, was exhibited in 1810, and in the following year he began the publication of the *Monumental Effigies of Great Britain*, a series of etchings with descriptions, completed (1811–23) after his death by others, and valuable for its accuracy. He was selected by the Antiquarian Society to make drawings of the famous Bayeux tapestry, and in 1819 made sketches from the newly discovered old pictures on the walls of the Painted Chamber of the House of Lords. D. at Bere Friars, in Devonshire, England, May 27, 1821.—His widow, Anne Eliza (d. 1883), who assisted her brother, Mr. Kempe, in the completion of the *Monumental Effigies*, afterward married the Rev. Edward Bray. She was the author of several creditable novels and other works written during her second marriage. Revised by Russell Sturgis.

**Stothard**, Thomas, R. A.: painter and designer; b. in London, Aug. 17, 1755; was apprenticed to a designer of patterns for the silk trade, but soon became an illustrator of books, and finally a painter. He illustrated the set of *The Novelists' Library*, begun about 1780, and other popular works, and became known as a most prompt and useful workman, so that he was constantly employed. He was elected fellow of the Royal Academy in 1794, and its librarian in 1812. His illustrations for books number more than 4,000, among them being those for *Robinson Crusoe* and *The Pilgrim's Progress*, 1788, the *Rape of the Lock*, 1798, the works of the German poet Gessner, 1802, Cowper's *Poems*, 1825, and Rogers's *Italy* and *Poems*, of which he illustrated not only the splendid octavos of 1830 and 1834, but also the small 12mo editions with wood-cuts. His work as an illustrator of books is graceful and pure, not very realistic nor careful about costume and architecture or other matters where historical accuracy is thought necessary, but artistic in a very high degree. Among his best paintings are the *Canterbury Pilgrims*, the *Flitch of Bacon*, and *Four Periods in a Sailor's Life*. Besides his work in pure art he made many designs for goldsmiths and other decorative workers. D. in London, Apr. 27, 1834. See the *Life* by Mrs. Bray (1851). Revised by Russell Sturgis.

**Stoughton**, stō'tŭn: town; Norfolk co., Mass.: on the N. Y., N. H. and Hart. Railroad; 17 miles S. of Boston (for location, see map of Massachusetts, ref. 5–I). It contains the villages of Stoughton, North Stoughton, and West Stoughton; is principally engaged in the manufacture of boots, shoes, and rubber and woolen goods; and has 4 hotels, a public high school, 17 district schools, public library (founded in 1874), a co-operative bank, and 2 weekly newspapers. The assessed valuation in 1894 was $2,819,252. Pop. (1880) 4,875; (1890) 4,852; (1900) 5,442.

**Stoughton**: city (founded in 1847); Dane co., Wis.; on the Yohara river, and the Chi., Mil. and St. Paul Railway; 14 miles S. S. E. of Madison, the State capital (for location, see map of Wisconsin, ref. 7–D). It is in the center of the great tobacco belt; and contains 8 churches, high school, academy, 4 public-school buildings, water-works, electric lights, manufactories of carriages and wagons, cigars, harness, and flour and feed mills, 2 State banks with combined capital of $55,000, and 3 weekly newspapers. The city is an important tobacco-market. Pop. (1880) 1,353; (1890) 2,470; (1900) 3,431. Editor of "Courier."

**Stoughton**, John, D. D.: clergyman and author; b. at Norwich, England, Nov. 15, 1807; educated at Highbury College, Islington, and University College, London; pastor of Congregational churches at Windsor 1832–43, at Kensington, London, 1843–75; Professor of Historical Theology and Homiletics in New College, St. John's Wood, London, 1872–84. He was Congregational lecturer 1855, and chairman of the Congregational Union 1856. He edited for many years *The Evangelical Magazine*, and published many very popular as well as scholarly volumes, including *Lectures on Tractarian Theology* (London, 1843); *Windsor: a History and Description of the Castle and the Town* (1862); *Homes and Haunts of Luther* (1875); *Italian Reformers* (1881); *Spanish Reformers* (1883); but chiefly the series of Church histories of England from the opening of the Long Parliament (1640) to 1800, issued in revised form in 1881 under the title *History of Religion in England* (6 vols.); supplement carrying the story to 1850, 1884, 2 vols. He issued his autobiography, *Recollection of a Long Life*, in 1894. D. at Ealing, Oct. 25, 1897. Revised by G. P. Fisher.

**Stourbridge**, stėr'brij: town; in Worcestershire, England; on the Stour, 12 miles W. by S. of Birmingham (see map of England, ref. 9–G). It manufactures iron, glass, earthenware, and fire-bricks, the latter from a peculiar kind of clay called Stourbridge clay, on which fire has only a small effect. Pop. (1891) 9,386.

**Stout**: See Beer.

**Stove** [from Dutch *stoof*, foot-stove, drying-room: Germ. *stube* < O. H. Germ. *stuba*, room that can be heated, bathroom. The original meaning was "heated room." How the Romanic words: Fr. *étuve*, Ital. *stufa*, Span. *estufa*, cf. Fr. *étouffer* are related is still a question]: an apparatus for retaining and diffusing heat, as for warming and ventilating or cooking. In the Middle Ages stoves, constructed of brick or tiles and sometimes of slate or steatite, were used for warming dwellings. They were large, often filling the side of a room, and in Scandinavia their broad flat surfaces were sleeping-places. The fire was kindled at the bottom, and the heat and smoke passed through flues before making their exit into the chimney. Some of these stoves had ovens and flues for cooking, and when once thoroughly heated required feeding but once in twenty-four hours. An early attempt at making a stove or closed fireplace of iron was made by Cardinal Polignac in France. He published a description of this in *La Mécanique du Feu, ou l'Art d'en augmenter les Effets, et d'en diminuer la Dépense* (1709). The Polignac fireplaces were constructed with hollow backs, hearths, and jambs of iron to economize the heat. Des Aguliers translated Polignac's treatise (London, 1716), and modified his fireplaces so as to use them for coal. Neither these nor the Holland stoves, which were introduced soon after (plain box stoves with a small smoke-pipe or flue at the top, and a single door into which the wood or coal was thrown), became popular in England, owing to the prejudice of the people in favor of open fires. Dr. Franklin, writing of stoves after his invention in 1745, refers to a German stove recently introduced into England, consisting of an iron box made of five plates fastened together with screws, one side of which was left open, but when the stove was set, this open side, with the smoke-pipe, was in an ante-room, while the body of the stove projected through the partition to warm a larger room, the fire being fed and the smoke conducted off in the ante-room. Franklin's stove was a great advance. Although, in its ordinary use, a fireplace, it was capable of being closed, and had a downward draught, distributing the heat through the air-boxes in its sides, till at last the remainder of the heat escaped with the smoke through a flue leading into the base of the chimney. A register or "damper" of sheet-iron was introduced into the descending flue, which checked and controlled the fire. In 1771, and later, Franklin invented other stoves—one for burning bituminous coal which would consume its own smoke and had a downward draught, and another intended for the same purpose, having a basket grate or cage, with movable bars at the top and bottom, supported by pivots at its center. The latter, after being filled and kindled at the top, could be inverted and so made to burn from the base. Between 1785 and 1795 Benjamin Thompson, Count Rumford, devised several improvements in stoves, intended to economize fuel and heat.

In the U. S. before 1825 the use of stoves, generally of the box pattern and very rude, was confined to shops and offices, public rooms, and churches in cities and larger villages. In the country the churches were seldom warmed, but the women carried foot-stoves, and the men protected their feet by stout overshoes called "boxes." Among the wealthy in cities cannel and other English coal ("sea coal") was burned in imported grates or in the Rumford stove lined with fire-brick. A greater number in cities and larger villages used the Franklin stove, burning wood and making an open fire-place of it. The rest of the world used the old open capacious fireplace, burning wood logs. A huge brick oven adjoined the kitchen fireplace, and required a large quantity of wood to heat it. Until 1835 stoves in the U. S. were made almost exclusively at blast furnaces and directly from the ore, instead of being made in foundries by cupola furnaces from pig iron, as they were later, and they were consequently much heavier and ruder than now and had loose and imperfect joints. Most of them were made in New Jersey, Pennsylvania, and Ohio, though a few were cast quite early in the furnaces at Cold Spring and Warwick, N. Y., and at Salisbury and Canaan, Conn., and from 1820 to 1835 considerable stove-making was done in Rutland co., Vt. From 1795 to 1825 no material progress was made in the construction of stoves. Those for heating purposes were either box stoves made on the old German plan, an oven being sometimes added, placed directly over the fire, or portable and partly open fireplaces made on Franklin's plans. For cooking purposes Count Rumford's cooking-stoves or ranges lined with fire-brick or soapstone, and with a ventilating oven, which had been introduced in New York as early as 1798 and into Boston about 1800, were gradually coming into use. After the opening of the Erie and Champlain Canals, the introduction of steamboats on rivers, and the first beginnings in railway travel, the facilities for transportation for heavy goods were so increased that the manufacture of stoves, and especially of cooking-stoves, became an important industry. As yet these were universally wood stoves, but the anthracite coal was destined to create a revolution in stoves. Jordan L. Mott and James Wilson, both of New York, made self-feeding stoves between 1827 and 1831 that would burn the British coals, and were an improvement on previous inventions; but it was not until 1833, when Mr. Mott had demonstrated that an anthracite fire could be made successfully from nut and pea-sized coals, and that the depth of the column of coal in his self-feeders must be in direct proportion to its size, the largest coal requiring the highest column, that anthracite coal stoves became salable. Early in 1835 he built a small cupola furnace and cast his stove-plates from pig iron of the best quality, fluting them to prevent their cracking. This was among the first attempts to make stove-plates from pig iron and to make the plates light, even, and smooth. The first cooking-stoves made in Albany (1835) were of the old ten-plate oval pattern, with oven above the fire and a single hole on the top. These were followed by the saddle-bag pattern, having the oven in the middle over the fire and the stove-collar and pipe over it, while on either side was an oval projection with a boiler-hole on a level with the stove-top, these projections resembling very closely an inverted pair of saddle-bags. The next pattern was the horse-block (so called from the rear portion of the stove, which contained the oven, being a step higher than the front). The rotary stove, having a movable top revolved by means of a crank so as to bring any desired vessel directly over the fire, was a later invention. Then came the Buck stove, both for wood and coal, having the fire above the oven and reversible flues which carried the heat and flame around, behind, and below the oven before reaching the smoke-pipe, which was nearly on a plane with the oven-floor. There have been hundreds of modifications of this pattern, but in all of them the reversible flue has been the predominating feature. In heating-stoves there has been a great variety of forms and some new principles have been introduced, though many of these seem to have been anticipated by the inventions of Dr. Neil Arnott. The problem of adapting the heating-stove to the use of anthracite coal and utilizing its great heat-producing power economically was solved by President Nott, of Union College, who spent years and much money in perfecting his stove. The self-feeder had previously been made both in England and in France, but one of its applications was a device of Dr. Nott, which he applied to several stoves, and others were not slow to follow. Samuel Pierce, of Troy, and Anson Atwood, of Brooklyn, introduced the hot-air current to facilitate combustion and radiation of heat, or at least are believed to have improved upon that idea.

In cooking-stoves and fixed and portable ranges the number of inventors and manufacturers is large. One of the most ingenious inventors of cooking-stoves was P. P. Stewart, of Troy, N. Y., whose stoves were, and with some modifications still are, very popular. Dr. Nott also invented several excellent cooking-stoves. Albany, Troy, New York, Buffalo, Philadelphia, Pittsburg, Cleveland, Cincinnati, Chicago, Quincy, St. Louis, Milwaukee, Boston, Providence, Wheeling, and Detroit have each a number of manufactories engaged in the production of stoves, ranges, and heaters. The efforts of the stove-makers since 1850 have been directed rather toward completing the adaptation of the principles of base-burning, hot-air feeding, and the anti-clinker arrangement to stoves, and greater accuracy and perfection of the castings than to the discovery of any new principles. Portable and brick-set ranges in great variety are now produced, with similar arrangements for heating water as in the cooking-stoves. They are well constructed, have all the improved facilities for labor and fuel saving, and are particularly noteworthy for the perfection of their castings and finish. A few manufacturers make stoves entirely of steatite or soapstone. Such stoves retain the heat for a long time and require but a small amount of fuel, which they consume entirely.



While the use in the U. S. of cast iron has continued for heating-stoves and the majority of cooking-stoves, there has been a growing application of steel in the construction of cooking-ranges. Since 1885 an important development has been in the use of gasoline as a fuel—a practice that began in the West and has extended eastward. At first such stoves were made so as to burn the gasoline direct, but in the newer forms called process stoves the gasoline is first changed into gas. Kerosene has also been used as a fuel. The employment of illuminating gas as a fuel is steadily growing, and in cities improved burners and cheapened gas have led to the introduction of many forms of gas stoves for use in apartments. In Great Britain slot meters are employed by means of which a given amount of gas for a penny is turned on and automatically turned off when the amount has been consumed. The use of electricity as a heat-producer is recognized, and forms of heating apparatus for it were shown at the World's Columbian Exposition held in Chicago in 1893, but as yet its employment is slight. All the stoves used in the U. S. are of domestic manufacture. The National Association of Stove-manufacturers reported in May, 1894, that there were 274 firms engaged in that business in 1893, whose sales during that year amounted to $30,035,700. There is an export trade of gas and gasoline stoves to South America, Mexico, etc., and a slight exportation of anthracite stoves to Europe. Revised by MARCUS BENJAMIN.

**Stow**, BARON, D. D.: clergyman and author; b. at Croydon, N. H., June 16, 1801; graduated at Columbian College, District of Columbia, in 1825; edited *The Columbian Star* 1825–27; became pastor of the Baptist church at Portsmouth, N. H., in 1827, of the Baldwin Place church, Boston, in 1832, and of the Rowe Street (now Clarendon Avenue) church in 1848. He was prominent in the missionary enterprises of the denomination, and president of the trustees of Newton Theological Seminary. Besides numerous contributions to religious periodicals, he published *Memoir of Harriet Dow* (1832); *Helon's Pilgrimage* (1835); *History of the English Baptist Mission to India* (1835); *The Danish Mission on the Coast of Coromandel* (1837); *Question-book of Christian Doctrine* (1848); *Christian Brotherhood* (1859); *First Things* (1859); and, in conjunction with Rev. Samuel F. Smith, *The Psalmist*, a collection of hymns largely used by Baptists (1849). D. in Boston, Dec. 27, 1869. See *Life*, by R. H. Neale (1870). Revised by W. H. WHITSITT.

**Stowe**, CALVIN ELLIS, D. D.: clergyman, educator, and author; b. at Natick, Mass., Apr. 6, 1802; graduated at Bowdoin College in 1824, and in 1828 at Andover Theological Seminary; was Assistant Professor of Sacred Literature at Andover, and assistant editor of *The Boston Recorder* 1828–30; Professor of Languages in Dartmouth College 1830–33, of Biblical Literature in Lane Seminary, Walnut Hills, near Cincinnati, 1833–50, and of Natural and Revealed Religion in Bowdoin College 1850–52. In 1852 he became Professor of Sacred Literature in Andover Seminary, but resigned in 1864 and removed to Hartford, Conn. In 1836 he married Harriet Elizabeth Beecher. In the same year he was sent by the State of Ohio to examine the public-school systems of Germany. Upon his return he published a report on *Elementary Education in Europe*, which was distributed at the public expense to every school district in Ohio and was also adopted by the Legislatures of several other States. He translated from the German Jahn's *History of the Hebrew Commonwealth* (Andover, 1828; 2 vols., London, 1829); prepared from the *Prælectiones* of Lowth a volume of *Lectures on the Sacred Poetry of the Hebrews* (1829); began an *Introduction to the Criticism and Interpretation of the Bible*, of which only vol. i. was published (Cincinnati, 1835); and the *Origin and History of the Books of the Bible* (part i., containing the New Testament, Hartford, 1867). He also published several addresses and educational reports, and contributed largely to religious periodicals. D. at Hartford, Conn., Aug. 22, 1886.

**Stowe**, HARRIET ELIZABETH (*Beecher*): author; daughter of Lyman Beecher; b. at Litchfield, Conn., June 14, 1811. At the age of thirteen she was sent to the school kept by her sister Catherine at Hartford, where she studied and taught until 1832, when she removed with her father to Cincinnati; was married in 1836 to Rev. Calvin E. Stowe, then professor at Lane Seminary, Cincinnati. In 1849 she published *The Mayflower, or Sketches of the Descendants of the Pilgrims*, and in 1851 began in *The National Era* of Washington a serial story designed to illustrate the horrors of African slavery, which was published separately in 1852 under the title *Uncle Tom's Cabin*, and attained a rapid and almost unparalleled success at home and abroad. Within five years 500,000 copies were sold in the U. S.; within ten years there had been made from it two or three French versions and more than a dozen German ones. It was also translated into Danish, Swedish, Portuguese, Spanish, Italian, Welsh, Russian, Polish, Hungarian, Wendish, Wallachian, Armenian, Arabic, Romaic, Chinese, and Japanese. It did more than any other literary agency to rouse the public conscience against slavery, and has been repeatedly dramatized. In 1853 she put forth a *Key to Uncle Tom's Cabin*, in which were set forth the main facts upon which the story was based, together with many incidents in corroboration of its truthfulness. In 1850 Mrs. Stowe removed to Brunswick, Me., where her husband had been appointed to a professorship in Bowdoin College. In 1852 they went to Andover, Mass., where he had accepted a chair in the theological seminary. In 1853 she accompanied her husband and her brother to Europe, and upon her return published *Sunny Memories of Foreign Lands* (2 vols., 1854). Her subsequent writings, which were mostly inferior, usually first appeared in periodicals, especially in *The Atlantic Monthly* and in the *Hearth and Home*, of which she was for a time one of the editors. Among these, as published separately, are *Dred, a Tale of the Great Dismal Swamp*, subsequently published under the title *Nina Gordon* (1859); *The Minister's Wooing* (1859); *The Pearl of Orr's Island* (1862); *Agnes of Sorrento* (1863); *Oldtown Folks* (1869); *Pink and White Tyranny* (1871); *My Wife and I* (1872); *Bible Heroines* (1878); *Poganuc People* (1878); *A Dog's Mission* (1881); and a volume of religious poems. Her paper in *The Atlantic Monthly* in 1869, *The True Story of Lord Byron's Life*, started an unfortunate scandal, and she replied to her critics with *Lady Byron Vindicated, a History of the Byron Controversy* (1869). In 1864 Mrs. Stowe removed to Hartford, Conn., where she died July 1, 1896. See the *Life* by her son (Boston and New York, 1889). HENRY A. BEERS.

**Strabismus**: See SQUINTING.

**Stra'bo**: Greek geographer; b. at Amaseia, in Pontus, 63 B. C.; d. in the reign of Tiberius after 21 A. D. He received an excellent education under eminent masters in philosophy and in literature, went to Rome about 29 B. C., and undertook extensive travels in Asia Minor, Egypt, Greece, and Italy. At a mature age he wrote a history, which is lost, and a geography in seventeen books, which has come down to us, and is especially valuable for its historical notes, which are the more abundant as Strabo looks at geography from an historical point of view, and shows that he is a disciple of Polybius. His work is unequal, and it is a natural inference that where his descriptions are meager and incorrect his information is derived from books, and that where they are full and accurate we have before us the result of personal observation. His style is simple, and the grouping of the heterogeneous materials shows something of the Greek feeling for proportion. The first two books of his works form an introductory to geography; with the third the description begins. Eight books are devoted to Europe, six to Asia, and the seventeenth and last to Egypt and Libya. Editions by Kramer (3 vols., 1844–52) and Meineke (3 vols., 1852–53). English translation by Falconer and Hamilton (3 vols., 1854–57). The French translation, made by La Porte du Theil, Coray, and Gossellin, at the command of Napoleon I. (5 vols., 1805–19), is very rich in notes. There is a valuable German translation, with notes, by Groskurd, 1831–34. On Strabo, see Bunbury, *History of Ancient Geography*, vol. ii., 209, *seq.*; and also the introduction to Tozer's *Selections from Strabo* (1893).

Revised by B. L. GILDERSLEEVE.

**Strabo**, WALAHFRID (*Walafridus Strabus*, "the Squinter"): ecclesiastic and author; b. in Suabia about 809; educated in the Benedictine abbey school of Reichenau, on the island in Lake Constance; then at Fulda, 54 miles S. E. of Cassel, under Rabanus Maurus (826–829). From Fulda he went to Aix-la-Chapelle and became tutor to Charles, son of the Emperor Louis the Pious. The latter made him abbot of Reichenau 838. He was driven from his post by Louis the German 840, but restored 842. He died while crossing the Loire, Aug. 18, 849. He was a very prolific writer. His principal work, the so-called *Glossa ordinaria*, is a huge exegetical compilation, the oldest printed edition of which —without date and place, but about 1480—comprises four volumes in folio. It was for several centuries the principal source and the highest authority of biblical science in the Latin Church, being in use, indeed, to the seventeenth century. His *De exordiis et incrementis rerum ecclesiasticarum*, printed in Hittorp's *De officiis divinis* (Cologne, 1568), and in several later editions, best by A. Knoepfler (Munich, 1890), is an interesting handbook in ecclesiastical archæology. To him we owe the authentic lives of St. Gall (ed. R. Shute, St. Gall, 1890) and St. Othmar. He was a poet and not a mere monastic rhymer. The most curious of his poems is his *Vision of Wettin*, which relates his journey to hell, purgatory, and paradise. He has the hardihood to introduce Charlemagne in purgatory suffering for incontinence. Another poem is *Hortulus*, on the plants in the convent garden. See his works in Migne, *Pat. Lat.*, cxiii., cxiv., and his poems separately in Dümmler, *Poet. Lat. ævi Carolini II.*, 259–473.

**Strachey**, JOHN ST. LOE: See the Appendix.

**Strachey**, WILLIAM: historian; b. in England about 1585; was the first secretary to the colony of Virginia 1610–12, having been shipwrecked on the Bermudas 1609 with Gates, Somers, and Newport; wrote *A True Repertory of the Wracke and Redemption of Sir Thomas Gates, upon and from the Islands of the Bermudas*, in *Purchas's Pilgrims* (vol. iv., lib. ix., cap. vi.), upon which Shakespeare appears to have drawn in his description of a storm in the *Tempest*—an inference strengthened by the reference in the same drama to the "still-vexed Bermoothes"; compiled *For the Colony in Virginia Britannia, Lawes Divine, Morall, and Martiall* (London, 4to, 1612); and was author of *Historie of Travaile into Virginia Britannia*, written as early as 1618, and first published by the Hakluyt Society from an original MS. (No. 6, 1849)—a quaint and valuable work which supplies the means of correcting the false details of the early history of Jamestown (especially in relation to Pocahontas) which have been so often repeated upon the authority of Capt. John Smith. Strachey projected a larger work, of which this volume forms but "the first and second books of the first decade." The time and place of his death are unknown. See *A History of American Literature*, by Moses Coit Tyler (1878), vol. i., pp. 41–45.

**Strack**, HERMANN L.: See the Appendix.

**Stradiva'rius**, ANTONIO: maker of musical instruments; b. at Cremona, Italy, in 1644; learned the art of making violins and other string instruments from Nicolo Amati, under whom he worked for several years; in 1668 began to make violins marked with his own signature, and by degrees not only rivaled but even outshone his master. His best instruments were made in the period between 1700 and 1725, and command from $1,000 to $3,000. D. Dec. 17, 1737.

**Strafford**, THOMAS WENTWORTH, Earl of: minister of Charles I.; b. in London, Apr. 13, 1593; studied at Cambridge; traveled on the Continent; sat in Parliament, and was at first active in opposition to the court, though unwilling to go to radical lengths, and had no sympathy with the religious policy of the Parliament. In 1628 he went over to the king's side; was created Baron Wentworth, then viscount, lord president of the council of the North, a privy councilor in 1629, and lord deputy of Ireland in 1633. His rule in Ireland was harsh and despotic, aiming at the establishment of his system of "thorough" or the absolute power of the king, and he acquired the designation of "the wicked earl." In Jan., 1640, he was created Earl of Strafford, and soon afterward prepared an army in Ireland to aid against the Scots. Upon his return to England he supported the harshest measures of the crown. The famous Long Parliament convened Nov. 3, 1640, and within eight days Pym appeared before the bar of the House of Lord and in the name of the House of Commons impeached him of an attempt to overthrow the public liberties and subvert the public rights. He defended himself personally and with such ability that the Commons abandoned their original impeachment and passed a bill of attainder. The Peers were fairly overawed by the fierce attitude of the Commons and dared not refuse their assent to the bill, which was sent to Charles for his sanction. The king wished to save his minister, for whose safety he had pledged himself, but fearing a violent revolution he reluctantly gave his assent, and Strafford was brought to the block on Tower Hill, May 12, 1641. That he had been proved guilty of no crime which by the strict letter of the law was a capital one is certain, and the bill of attainder was in fact a retrospective law, justifiable only on grounds sufficient to warrant any other revolutionary proceeding. The act of attainder was reversed in 1662 after the restoration of Charles II., and the estates of Strafford were restored to his son. His *Letters and Dispatches*, edited by Dr. Knowles, were printed in 1739; his *Life* has been written by Elizabeth Cooper (1874) and by H. D. Traill (1889). The circumstances of his life have occasioned much controversy. Macaulay's account censures him most severely, while Gardiner takes a more favorable view of his political career. Revised by F. M. Colby.

**Straight University**: a coeducational institution at New Orleans, La.; founded by Seymour Straight and incorporated in 1869. It is for Negroes exclusively, and is under the care of the American Missionary Association. It has classical, normal, manual-training, theological, and four other departments, a faculty numbering 22, and 600 students.

**Strain**: the force applied to a rope or bar, or the amount of change of shape produced by the force, the word being generally used by practical engineers in the first sense and by scientific writers in the second. See Stresses.

**Straits**: See Physiography.

**Straits Settlements**: a British crown colony in the East Indies, including Malacca, Penang or Prince of Wales island, with the province of Wellesley on the continent, and Singapore. The Settlements were made a separate dependency of the British crown in 1853, and placed under the Governor-General of India. On Apr. 1, 1867, the connection with India ceased, the province became a crown colony, and is administered by a governor residing at Singapore. In 1887 the Cocos or Keeling islands were attached to the colony, and in 1889 Christmas island. The British possessions of 1,472½ sq. miles were inhabited (1891) by 512,342 persons, of whom 213,073 were Malays, 227,989 Chinese, and 53,927 natives of India. The protected Malay states of the peninsula (Perak, Selangor, Johor, Sungei Ujong, Negri Sembilan, and Pahang) comprise about 34,660 sq. miles. Pop. (1891) 418,-527, not including Johor, which has an estimated population of 300,000. The internal administration of these states is in the hands of the British residents. Mining is actively carried on, and large supplies of tin are exported from Perak and Selangor. Fifteen hundred British troops and a few vessels are sufficient in time of peace to maintain order and punish piracy. Revised by M. W. Harrington.

**Stralsund**, straal'sōōnt: town; in the province of Pomerania, Prussia; on the narrow strait which separates the island of Rügen from the mainland; has a good harbor and is strongly fortified (see map of German Empire, ref. 2–G). It is an old town (founded in 1209), and played a conspicuous part—first as a member of the Hanseatic League, then during the Thirty Years' war as a fortress. It has manufactures of paper, tobacco, oil, spirits, and mirrors, and an extensive export trade in grain, wool, cattle, and horses. Pop. (1895) 30,097. Revised by M. W. Harrington.

**Stramo'nium** [Mod. Lat., the thorn-apple, also the drug contained in its seeds and leaves]: a drug consisting of the seeds and leaves of *Datura stramonium*, an annual plant of the family *Solanaceæ*, growing rankly as a weed throughout almost all the temperate and warmer countries of the world. The herb, called thorn-apple, and in the U. S. also Jamestown weed, is a hardy plant, found mostly in rank soil near dwellings. Its average height is about 3 feet. It has an erect stem, with many branches beset with large triangular leaves, irregularly sinuate and dentate. The flower is large, white, solitary; the fruit a large, fleshy, four-celled capsule, thickly covered with sharp spines. The seeds are flat and of a dark-brown color. Both leaves and seeds contain an alkaloid, *daturine*, closely analogous both in chemical properties and poisonous character to *atropine*, the alkaloid of belladonna. Medicinally, stramonium is a duplicate of belladonna, and is used for similar purposes. One of its most frequent employments is for the relief of asthmatic attacks, for which purpose the dried leaves or powdered roots are smoked. Stramonium is a powerful poison, the effects being identical with those of belladonna.

**Stranahan**, James S. T.: See the Appendix.

**Strandberg**, Karl Vilhelm August (*Talis Qualis*): poet; b. in Södermanland, Sweden, Jan. 16, 1818. While a student at the University of Lund he wrote a number of songs, chiefly under the influence of the German political poetry of the period. From this he later freed himself entirely. His principal collection of poems is *Sångar i Panser* (Songs in Armor), which glow with patriotic fire. He was the author of a number of occasional poems and translated Byron and Molière. D. in Stockholm, Feb. 5, 1877. *Samlade Vitterhets Arbeten* (2 vols., Stockholm, 1877–78).

D. K. Dodge.

**Strange**, Sir Robert: engraver; b. on Pomona, one of the Orkney islands, July 14, 1721; studied painting, but in 1745, having joined the army of the Pretender, was obliged to conceal himself; afterward went to Paris, where he became a pupil of Le Bas, the famous engraver, and in 1751 established himself in London as an historical engraver, in which department of art he acquired great eminence. He was knighted in 1787. He published *A Descriptive Catalogue of Pictures, etc., collected and drawn by Sir Robert Strange* (1769) and *An Inquiry into the Rise and Establishment of the Royal Academy of Arts* (1775; new ed. 1850). A collection of fifty of his principal engravings has been issued in a magnificent atlas, and his *Memoirs*, by James Dennistoun, appeared in 1855. D. in London, July 5, 1792. Revised by Russell Sturgis.

**Strangles**: in the horse, an abscess which occurs between the branches of the lower jaw. If possible, the animal should be induced to eat. The throat should be thoroughly fomented, and as soon as the sore comes to a head it should be opened, whereupon recovery will generally follow. Sometimes, however, the lymphatic glands appear to be inflamed, and occasionally metastatic abscess appears in distant parts of the body. This disease is considered contagious, and there is a similar infectious disease, also called strangles, among swine.

**Strangulation** [from Lat. *strangula'tio*, deriv. of *strangula're* (whence Eng. *strangle*), from Gr. στραγγαλᾶν, strangle, deriv. of στραγγαλᾶν, strangle, deriv. of στραγγάλη, halter]: primarily, the mechanical closure of the air-passages of the neck, so as to prevent respiration. Death by strangulation is speedy, but there may be a chance of recovery for a considerable period. Artificial respiration, stimulant applications to the extremities and chest, and of ammonia to the nostrils, should be tried. When other means have failed the galvanic battery may be employed. After apparent recovery, death may speedily ensue from secondary causes. Revised by W. Pepper.

**Stran'gury** [from Lat. *strangu'ria* = Gr. στραγγουρία; στράγξ, στραγγός, drops + οὐρεῖν, make water]: a suppression of the urine. The name is especially applied to such suppression when it depends on the presence of spasm or tenesmus of the urethra. It may be caused by the too free use of Spanish-fly blisters or of oil of turpentine, or it may attend the presence of calculi in the bladder. The warm bath, hot fomentations, mucilaginous drinks, bland enemata, and the like will usually relieve the untoward symptom.

**Strassburg**, Germ. pron. straas'boorch (anc. *Argentoratum*; Fr. *Strasbourg*): important fortified town of Alsace, on the Ill, the Breusch, and the Rhine-Rhône and Rhine-Marne Canals; 2 miles W. of the Rhine; junction of the railways of Southern Germany and France (see map of German Empire, ref. 7–D). It is ill built, with narrow streets and high houses, but is improving. The most remarkable of its public buildings is the cathedral, with a tower 466 feet high, founded in 510 by Chlodwig, but the older structure was destroyed by lightning in 1007. In 1015 Bishop Werner, of Hapsburg, laid a new foundation, and in 1275 the main building was finished. The tower was begun in 1277 by Erwin von Steinbach, and completed in 1439 by J. Hültz, of Cologne. In this building is the famous clock (made 1547–80), representing our planetary system and its constellations. The Church of St. Thomas, founded in 1031, and containing a monument of Marshal Saxe, and the New

Church are also noticeable. A German university was opened May 1, 1872, and numerous educational and benevolent institutions exist. Commerce and industry flourish in consequence of the favorable situation on the river. Important tobacco-factories are in operation, numerous breweries, printing establishments, oil and saw mills, wool-spinning establishments, manufactures of oilcloth, straw hats, gloves, paper-hangings, chocolate, mustard, goose-liver pies, soap, candles, chemicals, musical instruments, furniture, jewelry, etc. The cultivation of vegetables, fruits, and flowers is considerable. Under French dominion the city had a strong bastioned circumvallation, but since it has become part of the German empire a new system of fortification has been applied, consisting of a number of large, strong forts surrounding the inner fortifications, so that an army can encamp between the city and the forts, while the city is entirely protected from the enemy's fire by the outer forts.

During the Middle Ages Strassburg was one of the most powerful free cities of the German empire, and during the period of the Reformation it played a prominent part as one of the centers of the Protestant movement. Sept. 30, 1681, Louis XIV. captured it, and by the Peace of Ryswick he retained it. It continued, however, a completely German city down to the time of the Revolution, when French gradually gained the ascendency. By the Peace of Frankfort (1871) it returned to Germany, and is the seat of the civil and military government of Alsace-Lorraine. Pop. (1900) 150,268. Revised by M. W. HARRINGTON.

**Strat'egy** [from Gr. *στρατηγία*, office of a general, deriv. of *στρατηγός*, general; *στρατός*, army + *ἄγειν*, lead]: that branch of the art of war which has for its object the initiation and conduct of wars, campaigns, and battles in such a manner as (1) to take advantage of all available means for securing success, and (2) to cause the greatest benefits to result from victory and the least injury from defeat. The scope of strategy was formerly considered as restricted to the movements of organized armies after they were placed in the field and before they came within cannon-range of the enemy. Modern wars, however, are conducted on so grand a scale and with such rapidity that they involve all the functions of a government, and definite plans for their conduct must be prepared in advance. Consequently questions of statesmanship and diplomacy are frequently the leading factors in planning campaigns and battles, and thus become strictly strategical considerations. The domain of strategy must therefore be extended to include the methods of organizing and stationing active armies and reserves so that without unintentionally threatening or irritating neighboring countries they can be immediately mobilized for campaign when necessary. Financial and commercial considerations have the greatest possible weight in this connection, and frequently fix the time for beginning hostilities and determine the plan of campaign. In a country with a popular government, in order to arouse enthusiasm and lead the people to make necessary sacrifices, strategy, as defined above, sometimes requires a plan of campaign which, under other circumstances, might not be desirable.

An army in campaign seeks to obtain possession of some point which is known as its objective, which is selected with a view to the injury inflicted upon the enemy by its loss, and the advantages resulting from its capture. The first may be material, moral, or political; the second generally consist in facilities for further advance, better communications, and greater ease in supplying the army. Hence objectives are frequently capitals, large commercial or manufacturing cities, arsenals, river crossings, or railway centers.

The base of operations is that part of a country from which an army draws its supplies. The portion of country between the army and its base which contains the railways, wagon-roads, and water-routes, by which the army advances and receives its supplies, is called its line of operations or its communications. Since the combatants of an army can not be expected to carry with them more ammunition, provisions, etc., than are needed for one battle, the necessity for securing its line of operations from being broken is manifest. Strategical movements very frequently are directed with a view to threatening the enemy's communications and protecting one's own.

A large army covering a very extended front may, by a skillful attack, have one wing destroyed before the other can come to its support. To accomplish or prevent this is another problem in strategy of frequent application. Similar problems arise when a small but concentrated army tries to beat in detail the parts of a larger one which attempts to concentrate upon a point at or near that occupied by the smaller force, and also in manœuvering to strike a hostile force in flank, in the larger or even in the smaller operations of war.

The guiding principles of strategy consist in so conducting the preliminary operations and movements as to force the enemy to fight at a disadvantage either in numbers, in position, or in the relative results which will follow victory or defeat. The best strategical combinations, however, will not secure victory unless supplemented by the proper handling of the troops in the battle, which is the climax of military operations and which is the field of TACTICS (*q. v.*).

The principles of strategy are best studied in the critical histories of the campaigns of great leaders. See also the *Commentaries* of Napoleon; Hamley's *Operations of War*; Jomini and Clausewitz on the *Art of War*, *La Stratégie Appliquée Fixe*, etc. JAMES MERCUR.

**Stratford**: town; in the county of Essex, England; on the Lea; 4 miles E. N. E. of London (see map of England, ref. 12–J). It has a fine town-hall (1869), several breweries, and manufactories of chemicals and carriages. Pop. (1891) 42,982. On the other side of the Lea is the parish of Stratford-le-Bow. Pop. (1891) 40,378.

**Stratford**: post-village; capital of Perth County, Ontario, Canada; on the river Avon, at the crossing of Grand Trunk Railway and its Buffalo and Goderich Division (see map of Ontario, ref. 4–C). It has extensive repair-shops, a fine railway-station, good water-power, extensive manufactures, and a town-hall. It is an inland port of entry. Pop. (1891) 9,501.

**Stratford de Redcliffe**, STRATFORD CANNING, Viscount: diplomatist; b. in London, Nov. 4, 1786: was educated at Eton and Cambridge; in 1807, while still an undergraduate, received diplomatic appointments and did not take his degree till 1812. In 1814 he was sent as minister to Switzerland, in 1820 on a special mission to the U. S., in 1824 to Russia, and in 1825 as ambassador to Turkey. Diplomatic intercourse having been interrupted by the naval battle of Navarino, he returned to England and subsequently sat in Parliament for Government boroughs until 1842, when he was again sent as ambassador to Turkey, retaining that position till 1858, during which time his influence at the Ottoman court was very great, and always exercised in favor of reforms, especially those involving the amelioration of the condition of the Christian population of Turkey. The most interesting point of his whole career was the contest between him and Prince Menchikoff, in 1853. The question was whether British or Russian influence should prevail in Constantinople—or, rather, whether Russia should be allowed to settle the future destinies of Turkey to her own advantage and without paying any regard to the views of the other European powers. The keenly contested diplomatic struggle between Lord Stratford and the Russian ambassador extraordinary—the result of which was the Crimean war—is narrated with dramatic power by Mr. Kinglake in his *Invasion of the Crimea*. Canning was raised to the peerage in 1852 by the title of Viscount Stratford de Redcliffe, and made Knight of the Garter in 1869. He published an essay, *Why am I a Christian?* (1873), and a drama, *Alfred the Great in Athelney* (1876). D. Aug. 15, 1880. See his *Life*, by Stanley Lane-Poole (1888).

**Stratford-on-Avon**: town; in Warwickshire, England; 8 miles S. W. of Warwick; on the Avon, which is here crossed by a bridge with fourteen arches built in the fifteenth century (see map of England, ref. 10–H). The house in which Shakspeare was born is still preserved; that in which he died has been razed. The former, which is a Shakspeare Museum, and Anne Hathaway's cottage, are national property. In the chancel, restored 1890–92, Shakspeare was buried. Pop. (1891) 8,318.

**Strathclyde'**: an independent kingdom formed in Southwestern Scotland at the dissolution of the ancient Britannic confederacy, and consisting chiefly, as its name imports, of the broad valley or dale of Clyde. The annals of its sovereigns are involved in deep obscurity, little more than their names being known. It fell to the crown of Scotland early in the twelfth century, was held for some years by Prince David as an independent kingdom, and was permanently united to Scotland on his accession to the throne in 1124.

**Strathcona and Mount Royal**, Sir DONALD A. SMITH, Earl of: See the Appendix.

**Strathmore′**, or **The Great Valley**: the most extensive plain in Scotland; stretches across the country from Dumbartonshire, in the S. W., to Stonehaven, in Kincardineshire, in the N. E. It is bounded N. by the great mountain rampart of the Highlands, and S. by the Lennox, the Ochil, and the Sidlaw Hills, and is drained for the most part by the Tay, the longest and largest river of Scotland. The whole tract, which is highly cultivated, is about 100 miles long, and from 5 to 10 miles broad. Perth stands near its center, and to this central part the name is more particularly applied.

**Strathnairn′**, Hugh Henry Rose, Baron: soldier; b. in Berlin, Mar. 8, 1803 (his father being British minister there), and entered the British army as ensign in 1820; served in the Syrian campaign 1840–41; was Queen's commissioner at the headquarters of the French army in the Crimean war, and was wounded before Sebastopol. Throughout the Indian mutiny (1857–58) he commanded the Central India field force. His rapid marches and successful actions in the field won for him the thanks of Parliament and promotion to the rank of lieutenant-general 1860. He subsequently succeeded Lord Clyde as commander-in-chief in India, and during his term the Queen's forces were united with those of the East India Company. He commanded the British forces in Ireland 1865–70; was raised to the peerage in 1866 as Baron Strathnairn of Strathnairn, in the county of Nairn, and of Jhansi, East Indies; was promoted to be general in 1867, and in 1869 was appointed to succeed Lord Gough in the command of the Royal Horse Guards. He became field-marshal in June, 1877. D. in London, Oct. 16, 1885. F. M. Colby.

**Strathpef′fer** (i. e. valley of the Peffery): village of Ross and Cromarty, Scotland; 20 miles by rail N. W. of Inverness. Here are cold sulphur and iron water springs, which are much frequented and are useful in gout, rheumatism, scrofula, and diseases of the skin, kidneys, stomach, and liver. The climate is very favorable for the latitude (57° 34′ N.), and the surrounding region is picturesque and interesting. See Fox, *Strathpeffer Spa* (1889). M. W. H.

**Strathroy′**: town of Middlesex County, Ontario, Canada; on the river Sydenham, and on Great Western Railway; 40 miles E. of Sarnia and 20 miles W. of London (see map of Ontario, ref. 5–B). It has manufactures of woolens, castings, steam-engines, agricultural tools, etc. Pop. (1891) 3,316.

**Stratification and Stratum**: See Geology.

**Stratig′raphy**: See Geology.

**Stratus**: See Clouds.

**Strauss**, strows: the name of a noted family of composers.—Johann, the elder, was born in Vienna, Mar. 14, 1804, and in early childhood showed great talent for the violin. After study and experience, became deputy conductor to Lanner. In 1826 he had his own orchestra, and then began writing the waltzes which have since made the name of Strauss known everywhere. It was in 1840 that he conducted for the first time in the Imperial Volksgarten, Vienna. D. Sept. 25, 1849. He had five children.—Johann, the eldest son, b. in Vienna, Oct. 25, 1825, succeeded his father as a conductor, and in 1863 became conductor of the court balls. He composed nearly 400 waltzes, and a number of operettas which have had great success. He retired from the conductorship in 1870 to devote himself wholly to composition. D. June 3, 1899.—Joseph, the next son, b. in Vienna, Aug. 22, 1827, became also a conductor and composer. His works number upward of 283. He died July 22, 1870.—Eduard, the third son, b. in Vienna, Feb. 14, 1835, made his first appearance as a conductor in 1862; in 1865 conducted at St. Petersburg, and in 1870 succeeded his brother Johann in Vienna. He has composed over 200 dance pieces. Both Johann and Eduard visited the U. S. and conducted concerts. D. E. Hervey.

**Strauss**, David Friedrich: theologian; b. in Ludwigsburg, Würtemberg, Jan. 27, 1808. His parents lived in moderate circumstances; his chief talent seems to have been inherited from his mother. As a child he was retiring and of weak constitution, but fond of study and thorough in his acquisitions. At an excellent school in Blaubeuren and at the University of Tübingen he pursued his classical and theological course with zeal and independence; Baur was one of his teachers in both places. In philosophy he was at first repelled by Kant, but attracted by Schelling, Jacobi, and the famous German mystic Jacob Böhme, following also with eagerness the new revelations of Kerner and others on "the dark side of nature" and in the sphere of the so-called animal magnetism. In the latter part of his course he was strongly influenced first by Schleiermacher, but chiefly by Hegel, whose severe and comprehensive system, sufficient, as was supposed, for all things, was just coming into general notice. Schleiermacher's lectures on the life of Jesus, which Strauss heard in Berlin in 1831, and Hegel's logic, were the preludes to the *Leben Jesu* of Strauss, which, published in 1835 and 1836, 2 vols., in Tübingen, made an epoch in the history of German theology. This work was written in the course of a year, while he was *Repetent* at Tübingen (since 1832), when the author was only twenty-seven years of age. In the learned world of Germany it brought matters to a crisis, both in respect to biblical criticism and the relations of faith to speculation (4th ed. 1840; translated from the 4th ed. into English by Mary Ann Evans (George Eliot), 3 vols., London, 1846; n. e., 1 vol., 1893; New York. 1850; into French, from the 3d ed., by Littré. 4 vols., Paris, 1840). Strauss lays down in the preface the general principle that nothing which is supernatural, neither prophecy nor miracle, can be historical. The force of his criticism of details rests on this assumption. He resolves all the supernatural elements of the gospel story into myths; his hypothesis is known as the "mythical theory"—that is, the transforming of popular religious beliefs into facts supposed to have been realized in the life of Christ. The work had the merit of bringing together all the scattered objections to the life of Christ, and shaping them into a theory. But unless the supernatural can not be manifested, the underlying theory falls to the ground. In his concluding essay he applies the Hegelian logic to the life of Christ in such a way that, though he denies the facts as historical, he yet admits that there are certain essential ideas at their basis. Historical Christianity is true, not as history, but as idea. The Hegelian philosophy is to be substituted for Christianity. The work was written in a clear and trenchant style, at once popular and scientific. It was replied to by some of the most eminent divines in Germany (such as Neander and Tholuck) and in other countries. In 1837–38 Strauss replied to his critics in several *Streitschriften*, and in *Zwei friedliche Blätter* (Altona, 1839). He lost his theological position at Tübingen (a full account of the ecclesiastical proceedings, including the letters of Strauss, is given by Weizsäcker in the *Jahrbücher f. deutsche Theologie*, 1875, 4th part), and became a teacher in Ludwigsburg and Stuttgart. He was called to be professor of dogmatics and church history in Zurich in 1839, but was deprived of his chair by a popular insurrection, though retaining for life half his salary. In 1839 he published in Leipzig a volume of *Charakteristiken und Kritiken*, embracing essays on Schleiermacher, Daub, and Kerner, on animal magnetism and modern possessions, etc. In 1841 he was married to a once-celebrated singer, Agnese Schebest, but their characters, says Zeller, were so incompatible and the marriage so unhappy that they separated by mutual consent after five years. The wife lived in Stuttgart until her decease Dec. 22, 1870. In 1840–41 Strauss attempted to do for theology what he supposed he had accomplished for the life of Christ. Under the title *Die christliche Glaubenslehre in ihrer geschichtlichen Entwickelung, und im Kampfe mit der modernen Wissenschaft dargestellt* (2 vols., Stuttgart, 1840–41) he tried to resolve the whole of theology into philosophy. But this work, though learned and acute, made a comparatively slight impression. Having thus, in his opinion, disposed of historical and dogmatic Christianity, he betook himself for twenty years to general literature, interspersed with political speeches and action, leading the life of a wanderer from city to city. In 1847, at Mannheim, he published a pamphlet, *Der Romantiker auf dem Throne der Cäsaren, oder Julius der Abtrünnige*, an ingenious parallel between Julian the Apostate and King Frederick William IV. of Prussia, made up chiefly of apt and sharp citations. In the revolutionary period of 1848 he failed in an attempt to be elected to the noted Frankfort Parliament, but he was chosen to represent his native town (Ludwigsburg) in the diet of Würtemberg, where, to the surprise of his adherents, he denounced democracy, and in his very latest work he takes special pains to disparage republican institutions. His political views are contained in *Sechs theologisch-politische Volksreden* (Stuttgart, 1848). In 1849 he published *C. F. D. Schubarts Leben in seinen Briefen* (2 vols.). In 1851, at Mannheim, appeared a memorial of one of his friends, Christian Märklin; in 1855, at Frankfort-on-the-

Main, the *Leben und Schriften des Dichters und Philologen Nikodemus Frischlin*, representing the German culture of the sixteenth century. In 1857 he produced at Leipzig in a more important work, the *Life of Ulrich von Hutten* (2 vols.; an abridged ed. 1871; Eng. trans., London, 1874), prepared for Böcking's edition of Hutten's works; and in 1860 a volume of Hutten's *Conversations*. It was here first that he so highly eulogized and vindicated the German nationality, which he afterward advocated in such a brilliant style in his correspondence with Renan, *Krieg und Friede* (1870). In 1862 he revived the memory of a German rationalist of high critical attainments—a forerunner of Lessing—Hermann Samuel Reimarus. These and other literary and biographical works, all wrought out with æsthetic care, added to his reputation for general scholarship. In 1864 he returned to theology in the attempt at writing another life of Christ under the title *Das Leben Jesu für das deutsche Volk bearbeitet* (Eng. trans., London, 1865). The school of Baur of Tübingen and the progress of historical criticism had effectually supplanted the mythical theory of Strauss's first *Leben Jesu*. His object in the second work is, in general, to show what remains of Christ for the people after German criticism has had its full course; and he still grants that "Christianity is a moral and spiritual power in the earth"; that "we can not do without it, nor can it be lost"; that Jesus "stands foremost among those who have given a higher ideal to humanity." In 1865 he reviewed Schleiermacher's *Life of Christ*, then first published, in a work entitled *Der Christus des Glaubens und der Jesus der Geschichte* (Berlin). In 1866, under the title *Die Halben und die Ganzen*, he criticises the semi-rationalistic theology of Schenkel even more severely than he does the unbending orthodoxy of Hengstenberg. His essays on *Voltaire* (Leipzig, 1870; 3d ed. 1872) were prepared for the Princess Alice, and are praised for their critical skill and elegant diction as standing by the side of Goethe's *Wahrheit und Dichtung*. His last work, *Der alte und der neue Glauben, ein Bekenntniss*, appeared in Oct., 1872. It is intended to give the result of his life's thought and work. It rapidly went through seven editions in Germany, was published in French, and in an English version by Mathilde Blind in London and in New York (1873).

Strauss founded no school, either in philosophy or theology. He was a critic, learned, sagacious, yet without any well-defined ultimate system. His life is a reflex of the most extreme anti-Christian theory of human life. He began as an idealist and ended as a materialist. He gave up his early Hegelian pantheism to the latest theory of atheistic evolution. D. at Ludwigsburg of cancer, after long and patient suffering, Feb. 8, 1874, and was buried, by his own direction, without any church service. His *Gesammelte Schriften*, edited by E. Zeller, appeared at Bonn (12 vols., 1876–78). See his *Life*, by E. Zeller (Bonn, 1874; Eng. trans., London, 1874), and by A. Hausrath (2 vols., Heidelberg, 1876–78). Revised by S. M. Jackson.

**Straw and its Manufactures** [*straw* is O. Eng. *strēaw*: O. H. Germ. *stroh*, > Mod. Germ. *stroh*, connected with *streuen*, Eng. *strew*]: The stalk or stem of certain grains, chiefly wheat, rye, oats, barley, and buckwheat, and sometimes of peas and beans, called straw, finds large use in the manufacture of textile fabrics, paper, and braid for hats and trimmings. Originally, the employment of straw was one of the primitive arts, and it is still practiced among the rudest tribes known. Mats for sleeping on are perhaps the earliest objects that were made from straw. Baskets and bags of braided straw are still common among many aboriginal peoples. Those made in the South Sea islands are so close in texture, though quite flexible, as to be impervious to water, and are used to carry liquids. A higher development of the art is shown in the so-called Panama hats and cigar-cases that are made in South and Central America from the straw of the *Carludovica palmata*. The leaves of this plant, which resemble a palm, are gathered before they unfold, and, after the ribs and coarser veins have been removed, are cut into shreds. These are exposed to the sun and then tied into a knot and immersed in boiling water until they become white, when they are hung up in the shade and afterward bleached. The finest of these Panama hats take several months to make, and come from Ecuador, while commoner kinds are made in a few days. In certain of the U. S., as Florida and Georgia, a domestic straw from some varieties of hair grass was formerly used in making women's hats. Other uses to which straw in its natural state is put include its employment as littering in stables; as fodder; as filling for mattresses; as thatching for roofs; as packing material for delicate articles, such as crockery, glass, etc.; as bottle-covers; as stuffing, as in saddles; as "straws" in fancy drinks; as sandals; for decoration and ornamentation, as in kindergarten work; or fancy straw frames and baskets. Its use as a fuel has been suggested in the event of the coal-supplies becoming exhausted. It is the fiber from the straw of the flax plant that is largely used in the making of linen. The most important application of straw is probably in paper-making. The crude straw is cut and put into vats with lime. It is then cooked and worked into pulp in a beating-machine. This pulp is run off in a web machine into straw-paper, used in wrapping, etc., or into straw-board, used in making boxes, etc. When bleached it is white. The tissue-paper used in the making of cigarettes is commonly made from straw. The rye straw yields the best qualities of paper. In the form of braid, straw is largely used in the making of hats, and as trimming in millinery. Straw hats were worn by the Romans, but the industry remained in a primitive condition until toward the end of the sixteenth century. It is said that Mary, Queen of Scots, engaged a company of Lorraine straw-plaiters to return with her to Scotland in order to instruct her countrywomen in their art; and thus "was the first straw-hat manufactory established in Scotland under the kind auspices of a female sovereign of eighteen." Notwithstanding her inability to care for the little colony she brought from France, they struggled on until her son James became King of England, and then they were transferred to Luton, Bedfordshire, England. In Italy the chief seat of the industry was in Tuscany, and the Leghorn hats have acquired a high reputation. A grand ducal decree of 1575 enumerates the dealers in straw hats among the Tuscan traders liable to a matriculation tax; but, according to a monumental inscription in the Church of San Miniato at Signa, near Florence, Sebastiano Michelacci di Bologna, who died in 1739, was the first to export straw hats to England, and he is hence regarded as the founder of this branch of national commerce. In Italy, as the making of straw plaits grew, certain straws, methods of treatment, and patterns gave rise to characteristic varieties of bonnets with special braids, as the Tuscan and Leghorn hats which were typical and fashionable. Foreign wars prevented their importation into England, and the Dunstable bonnet of home manufacture was the result. On the restoration of peace unplaited straws, imported from Tuscany, resulted in the Tuscan grass bonnet, one of which was publicly worn by Queen Adelaide. Thus the industry, originally that of the finished product, passed in England into one where various straws, both native and imported, were manufactured into the desired article. This result was somewhat due to the efforts of the British Society of Arts, which made great efforts to sustain the industry. In 1822 it awarded a silver medal and twenty guineas to Miss Sophia Woodhouse, of Connecticut, for a new material for fine plaits, the *Poa pratensis*, then supposed to be equal to the Italian straw for making fine straws. For some time the industry had been in existence in the U. S., and the first straw bonnet braided in the U. S. is said to have been made in 1798 by Miss Betsey Metcalf, of Providence, R. I., but the industry has followed the practice of Great Britain, and now the crude braid is chiefly imported and made up into the various finished products as hats (of which there are 103 factories in the U. S. and Canada). The principal sources of the straw imported into the U. S. are China, Italy, England, Switzerland, Germany, Japan, Belgium, and France. For braids wheat straw is preferred, but rye straw has longer stems and can be braided into more delicate and even tissues. It is, however, less durable, and does not wash as well as wheat. In Tuscany the preferred straw is from a variety of spring wheat, thickly sown, best on a sandy, hilly ground, in February or March, according to season and local climate, and harvested by pulling the bearded wheat while the ear is in a soft milky state. The straw is left spread upon clean ground or grass for some days for the sake of the action of the dew in bleaching it; it is then gathered into sheaves, from which the laborers draw out the stalks, breaking them at the joints and breaking off the heads. They are then sorted by a species of sieve composed generally of sixteen tin plates pierced with holes and briskly moved by a wheel. They are then plaited and, if for straw hats, are shipped in bales of 240 pieces of 50 meters each. English straws are made into lengths of 20-yard pieces, although sometimes 14 and 12 yard pieces are made. Originally, the "whole straw" was used in plaiting, but in England the splitting of the straw with a knife led to the production of a lighter variety, and, about 1815, machines were introduced for cutting. This invention is one of the causes of the great success that has attended the manufacture of straw plait in England. Originally, the varieties of straw plait were few, but in recent years an almost endless number of patterns have come into existence, many of which are colored. Notwithstanding the foreign competition, especially that from China, whence the so-called Canton plaits come, London continues to be the chief market of the world, and regular sales are held there. In the U. S. the crude braids are used chiefly for straw hats, and they are bleached and sewed into shape. The hats are then blocked and sized, after which they are finished by putting on bands, sweatbands, tips, etc. The fancy straw plaits are used in millinery, and are imported ready for use. According to the census returns of 1890 there were six manufactories of straw goods other than those of hats and caps in the U. S., with an aggregate capital of $106,750, and employing 433 hands. During the fiscal year 1899–1900 there were imported into the U. S. 5,495 tons of straw, valued at $15,750, also manufactures of straw not specially provided for, valued at $336,287. Materials for hats, bonnets, hoods, etc., including straw, chip, and other braids, amounting to $2,092,801, were imported during 1900.

MARCUS BENJAMIN.

**Strawberry** [O. Eng. *streawberige* < primitive Teutonic *strawa-* < Indo-Europ. *sraghwo-*; cf. Lat. *fragum*; Gr. ῥάξ. The association of the Eng. word with *straw* is false]: any species of the genus *Fragaria*, family *Rosaceæ*. The genus is a small one, comprising under a liberal estimate about a dozen species, and it is confined to temperate climates of both the northern and southern hemispheres. The species are all low herbs with thrice-divided leaves, propagating by runners, and bearing the flowers and fruits upon short scapes. Botanically considered, the strawberry fruit is a fleshy receptacle or stem, upon which the true fruits or akenes—generally called seeds—are borne. The strawberry is a fruit of comparatively recent cultivation, the first named garden variety having appeared in 1660. At the present time it is largely grown, and in North America it exceeds in importance any other of the small fruits. Commercial strawberry-culture began in the U. S. about 1830. The first important variety of American origin was the Hovey, which first fruited in 1836 or 1837 in the garden of the originator, Charles M. Hovey, Cambridge, Mass. This was followed in importance by Boston Pine. About twenty years after the Hovey appeared, the Wilson, or Wilson's Albany, was introduced from the garden of James Wilson, Albany, N. Y., and this variety is still the most popular market berry in many parts of the Northern States. These varieties, and all other commercial strawberries of North America, are offsprings of the old Pine strawberries, a class which sprung from the Chilian berry (*Fragaria chiloensis*). This species was first introduced into Europe about 1712, by Capt. Frazier. The evolution of the garden strawberries from this type has taken place mostly within the nineteenth century. The wild strawberry of the eastern parts of the U. S. (*Fragaria virginiana*) was early introduced into Europe, and it was once the leading type of garden strawberries, but it is now practically lost to cultivation. The Hautbois strawberry (*Fragaria moschata*), and the Alpine and Perpetual types (*F. vesca*), both of Europe, are occasionally cultivated by amateurs.

In the U. S. the strawberry succeeds in a great variety of soils, but, in the North at least, the best soil is thought to be a rich sandy loam, particularly one which resists the effects of drought. The methods of planting and cultivation are various, but all strawberry-growers agree that the plants are not profitable after they have born three crops. There is an increasing tendency to allow the plantation to bear but a single crop, for, if the ground is good and the treatment generous, the first crop is the best which can be obtained; and the frequent rotation prevents the land from becoming foul, and it effectually prevents serious mischief from the leaf-rust fungus and from various insects. Early spring is the time usually preferred for setting the plants, and the first crop is borne a year from that time. If the plants bloom to any extent the year they are set, the blossoms should be removed, in order to allow the plants to become thoroughly established for the following year's crop. Strawberries are commonly planted in rows from 3½ to 5 feet apart, and the plants are set from 1 foot to 2 feet apart in the row. It is customary to allow the plants to form a matted or continuous row a foot or 2 feet wide, although, in private gardens, hill-culture is sometimes practiced for the purpose of securing finer fruit. In the northern parts of the U. S. the plants are generally covered late in fall with a light mulch of straw or marsh hay, as a protection against frost. Most persons leave this mulch upon the ground until the crop is harvested, drawing it off the plants into the spaces between the rows as soon as growth begins in spring. Some varieties of strawberries have flowers without stamens, and these must be planted near pollen-bearing varieties to insure fruitfulness. The exact method of planting so as to insure perfect pollination, varies with the varieties and with the grower, but it is generally thought that at least one-third of the plants should be strong pollen-bearers. An average good yield of strawberries may be considered to be from 150 to 250 bush. per acre. There are various insect depredators and other troubles, for an account of which the reader should consult the bulletins of experiment stations. The varieties in favor change so frequently that no list of them can be recommended here. There are many good writings upon the strawberry. The fullest account of American varieties is to be found in Merrick's *Strawberry and its Culture* (1870). A philosophical discussion of the origin of the cultivated strawberries, by Bailey, occurs in *The American Naturalist* (xxviii. 293, Apr., 1894). The reader should consult Fuller's *Strawberry Culturist*, and Terry and Root's *How to Grow Strawberries*.

L. H. BAILEY.

**Strays**: See ESTRAY.

**Streator**: city (laid out in 1868, incorporated as a city in 1882); La Salle co., Ill.; on the Vermilion river, and the Atch., Top. and S. Fé, the Burl. Route, the Chi. and Alton, the Ind., Ill. and Ia., and the Wabash railways; 93 miles S. W. of Chicago (for location, see map of Illinois, ref. 3–E). It is built on the river bluffs, and has adequate sewerage, gas, electric-lighting, street-railway, water, and fire services, and an improved public park of 11 acres in the heart of the city. It is surrounded by a rich agricultural country, and is underlaid by several seams of coal, two of which are being worked, and also by valuable strata of shale, fire-clay, and other clays, which are used in making paving-brick, sewer-pipe, and other clay products. The city contains 23 churches, including a Greek Catholic church and the unique Church of Good Will toward Men, 17 public schools, a high-school building (the gift of a private citizen, cost $45,000), 2 kindergartens, 4 private and parochial schools, 2 convents, public library, Y. M. C. A. building with hall, gymnasium, and free reading-room, Plumb Opera-house, 3 national banks with combined capital of $250,000, 3 building and loan associations, 32 fraternal societies, and 3 daily and 8 weekly newspapers. In 1894 the estimated property valuation was $12,000,000. The industrial establishments include 8 clay-working factories, producing building and paving brick, sewer-pipe, and tile; several manufactories of glass bottles, window glass, rolled plate-glass, flint and Bohemian ware, and glass specialties; foundries and machine-shops, and flour and planing mills. Pop. (1880) 5,157; (1890) 11,414; (1900) 14,079.

J. E. WILLIAMS.

**Street**, GEORGE EDMUND, R. A., F. S. A.: architect; b. at Woodford, Essex, England, June 20, 1824; was educated at Camberwell, and afterward studied architecture under Gilbert Scott. In 1850 he was appointed architect for the diocese of Oxford, and subsequently for those of York, Ripon, and Winchester. His predilection was mainly for the Gothic style, and he was recognized as one of the leaders in the GOTHIC REVIVAL (*q. v.*). His architectural structures are very numerous and important: among them are SS. Philip and James, Oxford; the Crimean Memorial church, Constantinople; and the Synod House in Dublin. Among his restorations are Jesus College chapel, Cambridge, and the nave and choir of Christ Church Cathedral, Dublin. In 1847 he won one of the £100 prizes for a design for a new Foreign Office, and in 1868 was appointed architect of the buildings for the new courts of law, but his original design was afterward considerably modified. Besides numerous essays and lectures upon architecture, he published *The Brick and Marble Architecture of North Italy in the Middle Ages* (1855) and *Some Account of Gothic Architecture in Spain* (1865), which latter work is of peculiar value as being the only connected account of the interesting cathedrals and other churches of the Peninsula. D. Dec. 18, 1881.

Revised by RUSSELL STURGIS.

**Street-railways**: railways constructed wholly or chiefly in the streets of cities or towns, and designed especially for local passenger traffic. The first application of the railway to the facilitation of short-distance passenger traffic in towns was made by John Stephenson in New York in 1831. A track of flat iron bars spiked to timbers resting on stone blocks was laid on the Bowery and Fourth Avenue from Prince Street to the Harlem river. An omnibus car, with flanged wheels and built in three compartments entered from the side and each holding ten persons, and with seats on the roof for thirty more passengers, was drawn by horses. Commercially this enterprise was not successful, and was abandoned after four years, but was resumed in 1845 with cars of the form used at present, entered from the ends. In 1852, the Second, Third, Sixth, and Eighth Avenue lines in New York were begun. Boston began the construction of horse-car lines in 1856, Philadelphia in 1857, and New Orleans in 1861, using for the first time the one-horse small car usually known as the "bob-tail." In France a line was constructed in Paris in 1853. In Great Britain George Francis Train, after three years of earnest endeavor, succeeded in 1860 in building a road at Birkenhead and one in London, which was removed in a few months, and not until 1870 were horse-cars permitted in that city. In 1866 a number of horse-car lines were built in South America.

The passage of the General Tramways Act by Parliament in 1870 gave an impetus to street-railway construction in Great Britain, and during the following twelve years 671 miles of lines were laid.

In 1894 there were in operation in the U. S. 12,500 miles of street-railway track, in the United Kingdom 1,000 miles, and on the continent of Europe 1,200 miles. There were also lines in Africa, Japan, Australia, New Zealand and Ceylon, and South America.

Prior to 1873 all street-cars were drawn by horses. In that year Andrew Hallidie constructed a road in San Francisco, Cal., on which the motive power was provided by a stationary steam-engine which drove a drum, around which passed an endless wire cable which was carried in pulleys in a conduit underneath the surface of the street on which the rails were laid. Through a slot in the top of the conduit a flat bar passed from the car to the cable, fitted with apparatus for grasping the cable tightly or releasing it at will, which could be controlled from the car. After several years of successful operation of this mode of propulsion in San Francisco, it was introduced in Chicago in 1881, in Philadelphia in 1883, on the Brooklyn bridge in the same year, on Tenth Avenue and 125th Street in New York in 1886, and on Broadway and Third Avenue in 1894, and in Baltimore in 1893. A cable road was built in New Zealand in 1883 and one in London in 1884. In 1894 there were 662 miles of cable road in operation in the U. S., and 20 miles in England.

The first commercially successful application of electricity to the traction of street-cars was made at Lichterfelde, near Berlin, by Siemens and Halske in 1881. On July 27, 1884, the first operation of an electrically propelled line in direct competition with horse-cars was begun at Cleveland, O., on the Bentley-Knight system. In the same year the first practical system of conveying the electricity from wires overhead to a motor on the car by a trolley, or small grooved pulley on the end of a flexible pole extending above the roof of the car, was made in Kansas City, Mo. Improvements in the apparatus made by Sprague in 1888 led to the construction of the first installation on a large scale of an electrically propelled street-car system at Richmond, Va., in that year. The greater economy and efficiency of electric roads was quickly recognized, so that while in 1888 there were 89 miles of roads so operated, there were in 1894 9,008 miles in the U. S. and 195 miles in Europe. For description of the system, see ELECTRIC RAILWAYS.

In 1881 Mekarski applied compressed air with success as a motive power to street-cars at Nantes, France, and the same method has since been applied in Paris and in Berne, Switzerland.

The desire for more rapid transit between distant points in large towns than is safe in a street used by pedestrians and vehicles drawn by horses has led to the construction of lines of travel above and below the surface of the ground. The first effort in this direction was in London in Jan., 1863, when a 3-mile section of underground railway was opened for traffic. Its success led to the extensions of the line until 1884, when 15 miles of line were completed. In Dec., 1890, another underground road, the City and South London, 3 miles long and operated by electricity, was opened for travel. In Berlin a viaduct carrying railway tracks above the street-level for 7½ miles through the center of the city was opened in 1882. In New York an elevated railway, 4 miles long, supported on columns on the sidewalk of streets, was put in operation in June, 1869, operated by a cable. This was unsuccessful, and locomotive engines were substituted on Apr. 9, 1871. In 1877 additional lines were built, until in 1879 there were 32·4 miles in operation on Manhattan Island. Between 1886 and 1891 the system was extended 3·7 miles N. of the Harlem river, and introducing improved methods of construction and heavier rolling stock. In Brooklyn, in 1885, an elevated road was put in operation, and in 1895 there were 25 miles in operation. In 1893 an elevated railway, 5 miles long, was opened in Liverpool, England, operated by electricity. See UNDERGROUND RAILWAYS.

The relative cost of building and equipping each mile of double-track railway for the different methods of traction, the rate of speed attained, and the expense of running a car a mile, are approximately as follows:

| MOTIVE POWER. | Cost per mile. | Speed, miles per hour. | Operating expenses per car-mile. |
|---|---|---|---|
| Horses | $71,000 | 6 | 18 cents. |
| Cable | 300,000 | 10 | 14 " |
| Electric surface | 115,000 | 12 | 13 " |
| Steam elevated | 500,000 | 13 | 13 " |
| Underground | 1,500,000 | 13 | 15 " |

J. J. R. CROES.

**Streitberg**, strīt'bărch, WILHELM: comparative philologist; b. at Rüdesheim, Germany, Feb. 23, 1864; educated at the gymnasium in Wiesbaden and at the University of Leipzig; docent at Leipzig 1889, and in autumn of same year Professor of Indo-European Philology in the University of Freiburg in Switzerland. He is one of the most aggressive of the younger generation of comparative philologists. He is the author of *Die Abstufung der Suffixe io und ieu im Germanischen* (1888); *Perfective und imperf. Actionsart im Germ.* (1889); *Die germ. Komparativa auf -ōz* (1890); *Zur germ. Sprachgeschichte* (1892); *Entstehung der Dehnstufe* (1894); joint editor with K. Brugmann of *Indogermanische Forschungen* since 1891. BENJ. IDE WHEELER.

**Strength of Materials**: the resistance of materials to forces which tend to change their form; often called the elasticity and resistance of materials. The science of the strength of materials is sometimes called the mechanics of materials. The subject is partly experimental and partly theoretical, the experiments furnishing the fundamental facts, while the application of theory to these deduces the rules and formulas for practical use.

The materials used in engineering constructions are more or less elastic when the applied forces are not too great, that is, they spring back to their original form upon the removal of these forces. For elastic materials it is found that the change of form is proportional to the applied force; this law holds until a point called the elastic limit is reached, after which the change of form increases more rapidly than the force, and rupture finally occurs. It is a fundamental rule in engineering that materials should not be strained beyond the elastic limit, since then the elasticity is impaired and a permanent deformation results.

The molecular resistance which is developed by an applied force is called stress. Stresses are tensile when the forces tend to pull a body apart, compressive when they tend to crush it, and shearing when they tend to cut it across. In bending a beam stresses are produced often called flexural, but they can always be resolved into those of tension, compression, and shear; in twisting a shaft stresses are produced often called torsional, but they can also be resolved into the three kinds of simple stress.

*Tension.*—When two equal forces are applied at opposite ends of a bar or rod a tensile stress equal to one of the forces is produced at every cross-section of the bar. If $P$ be the intensity of each of the forces then the internal stress is also $P$. If $A$ be the area of the cross-section of the bar the unit-stress is $P \div A$, and this is represented by $S$. Unit-stresses are usually expressed in pounds per square inch or in kilogrammes per square centimeter. If the force $P$ be gradually applied the unit-stress $S$ also gradually increases, and is accompanied by an elongation of the bar. When $P$ is large enough to cause the rupture of the bar the unit-stress $S$ is called the ultimate tensile strength of the material. The elastic limit is reached for some materials when the unit-stress is about one-half the ultimate strength; when $S$ is less than this elastic limit the bar springs back to its original length upon the removal of the applied forces; when it is greater it does not entirely spring back, but a permanent set remains.

If $l$ be the original length of the bar and $\lambda$ the elongation produced at any stage of the test, $\lambda \div l$ is the unit-elongation. Within the elastic limit the ratio of the unit-stress to the unit-elongation is called the coefficient of elasticity, or sometimes the modulus of elasticity. Let $s$ be the unit-elongation, and $E$ the coefficient of elasticity; then

$$E = \frac{S}{s} = \frac{Pl}{A\lambda},$$

and the value of $E$ is sensibly a constant for any simultaneous values of $S$ and $s$, provided that $S$ is less than the elastic limit.

The following are average values of the tensile elastic limit, ultimate strength, coefficient of elasticity, as also the elongation at the elastic limit and the ultimate elongation, for four principal materials used in engineering:

| MATERIAL. | POUNDS PER SQUARE INCH. | | | ELONGATION, PER CENT. | |
|---|---|---|---|---|---|
| | Elastic limit. | Ultimate strength. | Coefficient of elasticity. | At elastic limit. | At rupture. |
| Timber | 3,000 | 10,000 | 1,500,000 | 0·20 | 1·5 |
| Cast iron | 6,000 | 20,000 | 15,000,000 | 0·04 | 0·5 |
| Wrought iron | 25,000 | 55,000 | 25,000,000 | 0·10 | 25·0 |
| Steel | 50,000 | 100,000 | 30,000,000 | 0·17 | 15·0 |

These values are subject to much variation, particularly for steel, which may range from 60,000 to 300,000 lb. per square inch in ultimate strength. Iron wire has an ultimate strength of nearly 100,000 lb. per square inch, and cast iron has been made with a tenacity of 46,000 lb. The strongest kinds of timber, as box, ash, and beech, reach nearly 20,000 lb., while weaker kinds, like poplar and white pine, may be only 4,000 or 5,000 lb. per square inch in ultimate strength.

The diagram in Fig. 1 gives graphical representations of the average tensile properties of these four materials. The stresses per square inch are laid off as ordinates and the percentages of elongation as abscissas, and for any point on one of the curves the approximate values of these two quantities are seen by inspection. The curve for each material is a

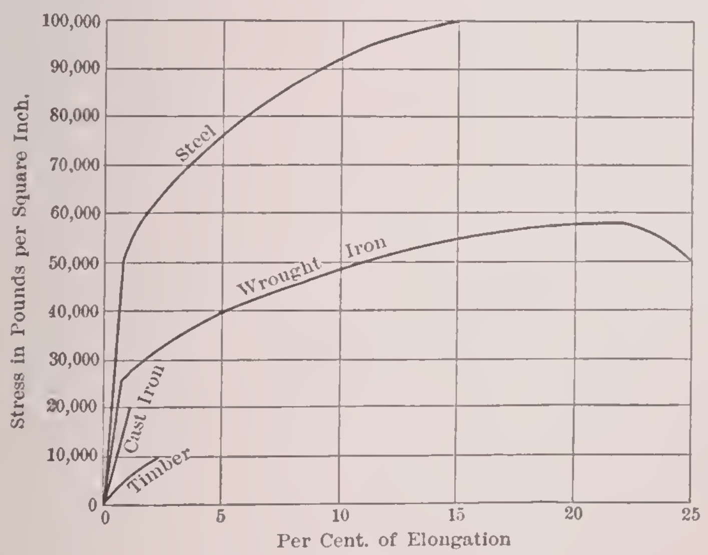


FIG. 1.

straight line from the origin until the elastic limit is reached, the unit-stresses being proportional to the elongations. At the elastic limit a sudden change in the curve is noted, and then the elongation increases more rapidly than the stress. The area between the curve and the base is a measure of the work required to rupture a cubic unit of the material.

As the elongation of a bar increases under tension a lateral contraction ensues, the unit-contraction being about one-third of the unit-elongation until the maximum strength is reached, and then, for ductile materials, the contraction increases very rapidly owing to the flow of the metal. The amount of ultimate contraction of area, which often amounts to 50 per cent. of the original area, is regarded as a valuable index of ductility and toughness.

*Compression.*—The phenomena of compression are similar to those of tension, provided that the elastic limit be not exceeded, and that the length of the bar does not exceed about five times its least diameter. Rupture usually occurs by cracking and shearing, or sometimes by lateral bulging. The following are average values of the compressive elastic limit, ultimate strength, and coefficient of elasticity for the six principal materials used in engineering constructions, all in pounds per square inch:

| MATERIAL. | Elastic limit. | Ultimate strength. | Coefficient of elasticity. |
|---|---|---|---|
| Timber | 3,000 | 8,000 | 1,500,000 |
| Brick | ...... | 4,000 | .......... |
| Stone | ...... | 6,000 | 6,000,000 |
| Cast iron | 6,000 | 90,000 | 15,000,000 |
| Wrought iron | 25,000 | 55,000 | 25,000,000 |
| Steel | 50,000 | 150,000 | 30,000,000 |

It should be noted that these average values are subject to much variation in different qualities of materials. For instance, the strength of some kinds of brick may be as low as 1,000 and of others as high as 15,000 lb. per square inch; that of some kinds of building-stones may be as high as 20,000 lb. Cast steel has been made with an ultimate compressive strength of nearly 400,000 lb. per square inch. The figures given hence should be used with caution in particular cases.

When the length of a bar or column is less than ten times its least diameter the compressive force $P$ may be regarded as uniformly distributed over the cross-section $A$, so that the unit-stress $S$ is simply $P \div A$; but for greater lengths a lateral flexure of the column occurs so that the compressive stress on the concave side is greater than that on the convex side. If $C$ denote the greatest unit-stress on the concave side, $l$ the length of the column, $r$ the least radius of gyration of the cross-section, then

$$C = \frac{S}{1 - \dfrac{nSl^2}{\pi^2 E r^2}},$$

in which $S$ is the mean unit-stress $P \div A$, and $n$ is a number depending on the arrangement of the ends of the column, being 1 when both ends are round, $\frac{4}{9}$ when one end is round and the other fixed, and $\frac{1}{4}$ when both ends are fixed.

*Shearing.*—A shearing stress occurs whenever two equal forces, acting like a pair of shears, tend to cut a body apart. When a hole is punched through a plate the ultimate shearing strength of the material must be overcome over the cylindrical surface of the hole. When a rivet connects two plates that are in tension the plates tend to shear the rivet across.

The ultimate shearing strength of timber is about 3,000 lb. per square inch across the grain and only about 500 lb. parallel with the grain; for cast iron it is about the same as the tensile strength; for wrought iron and steel perhaps one-fifth less than the tensile strength. Little is known regarding the elastic limit in shearing, but the coefficient of elasticity is between one-half and one-third of that for direct tension.

A shearing stress is always developed in an oblique section of a bar which is subject to direct tension or compression. If $S$ be the tensile or compressive unit-stress the maximum shearing unit-stress is $\frac{1}{2}S$, and this occurs in a direction making an angle of 45° degrees with the axis of the bar. Shearing stresses also occur in all cases of the bending of beams and the torsion of shafts.

*Working Stresses.*—The unit-stresses which should be used in the design of structures are much less than the ultimate strength of the material, and indeed less than the elastic limit. The ratio of the ultimate strength to the working unit-stress is called the factor of safety, and the following are average values of the factors of safety usually employed in cases of design:

| | Timber. | Brick and stone. | Cast iron. | Wrought iron. | Steel. |
|---|---|---|---|---|---|
| For steady stresses | 8 | 15 | 6 | 4 | 5 |
| For varying stresses | 10 | 25 | 15 | 6 | 7 |
| For shocks | 15 | 30 | 20 | 10 | 15 |

Steady stresses occur in buildings, varying stresses in bridges, while shocks are liable to occur in machinery and on railway wheels and rails. The injurious nature of shocks requires a high factor of safety, and hence a low working stress. A load suddenly applied theoretically produces twice the stress caused by the same load when applied gradually, and the elongation is also double. When a load drops upon a bar the resulting stresses and deformations are often more than double those caused by a gradually applied load. In all cases it is desirable that such a factor of safety should be used that the maximum working unit-stress may not exceed one-half the elastic limits of the material.

Repeated stresses beyond the elastic limit cause a change of molecular structure, or as commonly expressed, the material becomes fatigued. The greater the range of stress the less should be the working unit-stress used in the design. Stresses alternating from tension to compression require almost double the material that is necessary when the range is in tension alone, and nearly four times as much as for the case of steady stress.

*Testing-machines.*—The most common method of testing is by tension, the quantities determined being the elastic limit, maximum or ultimate strength, ultimate elongation, and contraction of area. Fig. 2 shows the form of specimen generally used, the heads being clamped in blocks to which the pulling force is applied. Marks are made at regular intervals along the specimen, and measurements made between these, both before and after the test, give the data for computing the elongation. The diameter of the specimen is usually about half an inch, and its length between the heads about 8 inches.

FIG. 2.

The numerous forms of testing apparatus may be classified as screw machines and hydraulic machines, the power being applied in the former by a screw and wheel, and in the latter by pressure transmitted through oil by means of a pump. Fig. 3 shows a machine of the latter class for testing wire and small rods. The wire clamped in position is seen in the foreground. The handle of the pump is worked by hand-power, and the pressure thus produced is transmitted through the oil by means of a small tube to the cylinder above the specimen, where it acts upon a piston which causes the cross-head to move up, and thus brings tension upon the specimen. A scale and weights are provided for reading the tensile stress applied. This machine is 4 feet high, nearly 4 feet long, weighs 890 lb., and can exert a tension of 10,000 lb.

Probably the best and most precise testing-machine in the world is that constructed for the U. S. Government by

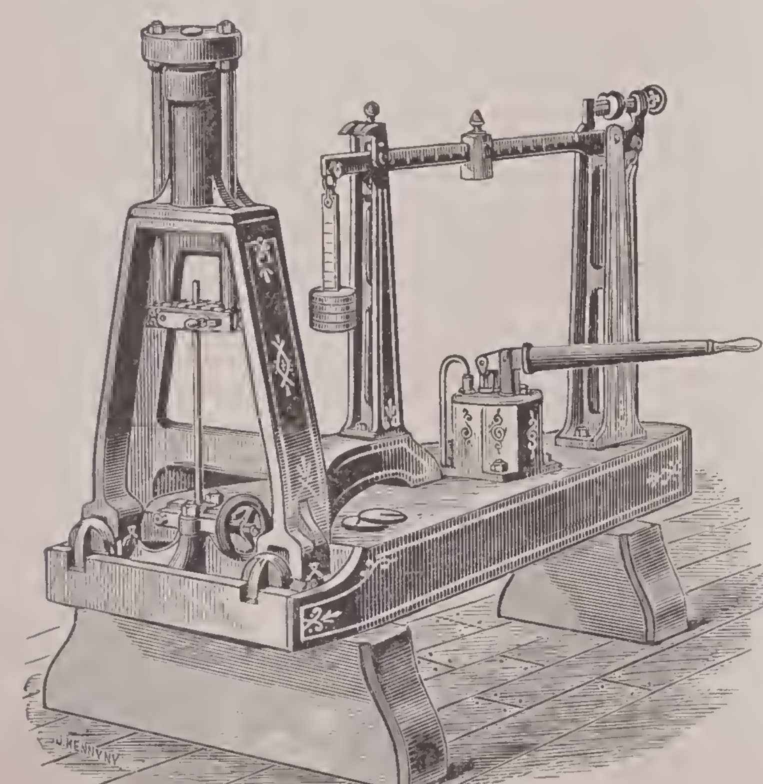


FIG. 3.

A. H. Emery, and now at the Watertown arsenal; it has a capacity of 1,000,000 lb., and can break a bar 30 feet long. Special machines of greater capacity have been constructed for testing eye-bars and other bridge members. The machine of the Union Bridge Company, at Athens, Pa., has a capacity of 1,224,000 lb., and it can break a bar 40 feet long. That of the Phœnix Bridge Company, at Phœnixville, Pa., built in 1893, has a capacity of 2,160,000 lb., and it can break a bar 45 feet long.

Compressive tests are more difficult to make than tensile ones, on account of the greater labor of preparing the specimens, and of insuring a uniform distribution of pressure over the surfaces. Even for a material like cement, which is always used in compression, the tensile test is preferred. Flexural tests of beams are often made to determine the modulus of rupture. (See FLEXURE.) Tests for the resistance of specimens to twisting are easily made by the machine devised by Thurston in 1873, which furnishes an autographic record of the stress and deformation, and thus renders possible a thorough study of the properties of materials under TORSION (*q. v.*).

*Resilience of Materials.*—When a body falls from a height upon a bar or beam it expends an amount of energy equal to the product of its weight and height of fall. This energy is resisted by the work of the internal stresses in the bar or beam. All the work of these internal stresses is called resilience, which is thus a measure of the capacity of the bar or beam to resist shock. Resilience is proportional to stress and deformation jointly. Elastic resilience is the work that can be resisted up to the elastic limit, and ultimate resilience is the total work up to the point of rupture, the latter being far greater than the former. The elastic resilience for different materials in tension can be compared by taking half the product of the elastic limits by the corresponding elongations; this quantity is often called the modulus of resilience. The ultimate resilience of materials can be roughly compared by the areas included between the curves in Fig. 1 and the base. The following mean-values of these quantities for tensile resilience are in inch-pounds per cubic inch of material:

| MATERIAL. | Elastic resilience. | Ultimate resilience. |
|---|---|---|
| Timber | 3 | 100 |
| Cast iron | 1 | 70 |
| Wrought iron | 13 | 13,000 |
| Steel | 42 | 12,000 |

The laws of elastic resilience show that the total resilience of a bar or beam is proportional to its volume, and independent of the form of cross-section, so that a beam resists shock with equal efficiency whether struck on the narrow or broad side; also the effect of a blow at the middle of a beam is no greater than at any other point. These conclusions are approximately true for ultimate resilience only in the case of cast iron; for other materials the laws are yet to be determined.

*History and Literature.*—The study of the strength of materials began with the announcement by Robert Hooke in 1678 of the law of proportionality between stress and elongation. Few experiments of value were made, however, until after the beginning of the nineteenth century. The work of Tredgold and Hodgkinson, prior to 1850, has since been extended by Kirkaldy, Bauschinger, Wöhler, Thurston, Howard, and others, so that volumes would be required to give even a fair summary of the properties of the numerous qualities of iron and steel. The strength of alloys of copper, zinc, and tin has been fully investigated by Thurston. Most valuable work was done by the British Government in 1848, and by a U. S. board in 1876. Numerous testing-laboratories have been established by manufacturers and by technical schools, and progress in the knowledge of materials is rapid and continuous.

The theory of the resistance of materials is intimately associated with that of beams, columns, and shafts. Beams were first discussed by Galileo in 1638, and during the nineteenth century the theory of all branches of the subject has been developed by Navier, Poncelet, Saint-Venant, Lamé, Weyrauch, Rankine, and many others. Todhunter and Pearson's *History of the Mathematical Theory of Elasticity and of the Strength of Materials* (London, 1893) gives a full account of these researches. Thurston's *Materials of Engineering* (3 vols., New York, 1884) and Burr's *Elasticity and Resistance of Materials* (New York, 1888) may be consulted for experimental results; Unwin's *Testing of Materials* (London, 1890) and Abbott's *Testing-machines* (New York, 1885) for the methods of conducting tests. Concerning beams and columns, reference is made to the article FLEXURE, and concerning shafts to the article TORSION. See also BRICK, BUILDING-STONE, CEMENT, CONCRETE, and FATIGUE OF MATERIALS. MANSFIELD MERRIMAN.

**Strepsip'tera** [Mod. Lat.; Gr. στρέψαι, aorist of στρέφειν, twist + πτερόν, wing]: a group of insects, formerly considered a separate order, but now classed with the *Coleoptera* as a family, called *Stylopidæ*. The elytra are very short, the wings of the male large and folded like a fan (whence the name); the females are wingless. The eyes are large; the tarsi two to four jointed. They are parasitic on various species of bees and wasps, and are found between the joints of the abdomen. The female never leaves the host, but the winged males become free when mature. E. A. BIRGE.

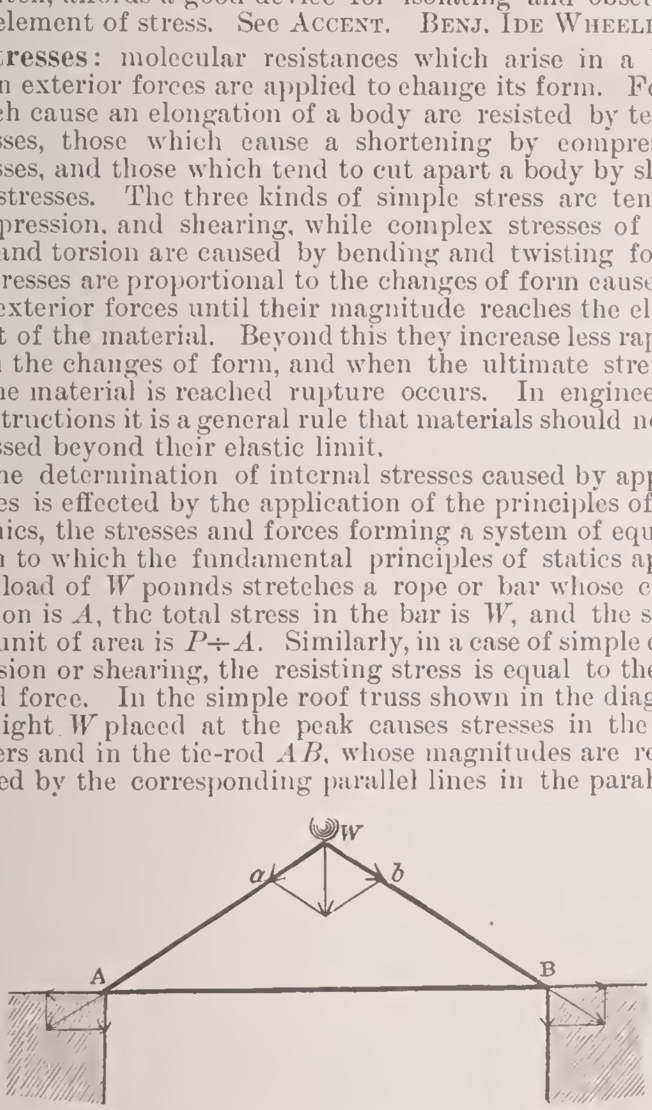
**Streptoneu'ra** [from Gr. στρεπτός, twisted + νεῦρον, nerve]: a term sometimes employed for a group of molluscs, including the *Prosobranchiata*, in which the pleurovisceral nerves have been crossed in the general twisting of the body. See GASTEROPODA.

**Stress** [M. Eng. *stresse*, probably abbrev. of M. Eng. *destresse* > Eng. *distress*]: a term of phonetics denoting the force in the outpush of breath accompanying the production of one syllable as compared with others; i. e. relative force. It is commonly attended in English by elevation of pitch, and these two features are often confused under the name accent. Whispering, inasmuch as it admits of no variation of pitch, affords a good device for isolating and observing the element of stress. See ACCENT. BENJ. IDE WHEELER.

**Stresses**: molecular resistances which arise in a body when exterior forces are applied to change its form. Forces which cause an elongation of a body are resisted by tensile stresses, those which cause a shortening by compressive stresses, and those which tend to cut apart a body by shearing stresses. The three kinds of simple stress are tension, compression, and shearing, while complex stresses of flexure and torsion are caused by bending and twisting forces.

Stresses are proportional to the changes of form caused by the exterior forces until their magnitude reaches the elastic limit of the material. Beyond this they increase less rapidly than the changes of form, and when the ultimate strength of the material is reached rupture occurs. In engineering constructions it is a general rule that materials should not be stressed beyond their elastic limit.

The determination of internal stresses caused by applied forces is effected by the application of the principles of mechanics, the stresses and forces forming a system of equilibrium to which the fundamental principles of statics apply. If a load of $W$ pounds stretches a rope or bar whose cross-section is $A$, the total stress in the bar is $W$, and the stress per unit of area is $P \div A$. Similarly, in a case of simple compression or shearing, the resisting stress is equal to the applied force. In the simple roof truss shown in the diagram a weight $W$ placed at the peak causes stresses in the two rafters and in the tie-rod $AB$, whose magnitudes are represented by the corresponding parallel lines in the parallelo-




grams of forces. The vertical reaction of each support is $\frac{1}{2}W$, and the moment of the stress in the tie-rod with respect to the peak is equal to the moment of the reaction with respect to the same point, or if $S$ be the stress, $l$ the length of $AB$, and $h$ the height of the peak, then $S \times h = \frac{1}{2}W \times \frac{1}{2}l$, whence $S = \frac{Wl}{4h}$, which is a tensile stress. The stress in each rafter is compressive, and its value is $\frac{W\sqrt{l^2 + 4h^2}}{4h}$. These expressions show that the stresses increase when $h$ decreases. See MECHANICS, MOMENT, STATICS, STRENGTH OF MATERIALS, and TRUSS. MANSFIELD MERRIMAN.

**Stretton**, HESBA: See SMITH, HANNAH.

**Strickland**, AGNES: biographer and historical novelist; b. at Reydon Hall, Suffolk, England, Aug. 19, 1806; with her four sisters was carefully educated under the care of her father, and commenced her career of authorship at an early age, in most of her works being assisted by one or the other of her sisters. Her first work, in conjunction with her sister Susannah, was a volume of *Patriotic Songs*, which was followed by *Worcester Field*, an historical poem. Her next work, also a poem, was *Demetrius: a Tale of Modern Greece* (1833), followed by *The Pilgrims of Walsingham*, an historical romance (1835), and at intervals by many other volumes of biography, poetry, and fiction, among which are *Queen Victoria, from her Birth to her Bridal* (1840); *Historic Scenes and Poetic Fancies* (1850); *Lives of the Bachelor Kings of England* (1861); *Lives of the Seven Bishops* (1866); and *Lives of the Tudor Princesses* (1868). Her most important works, both prepared in conjunction with her sister Elizabeth, whose name, at her own desire, did not appear as author, are *Lives of the Queens of England* (12 vols., 1840–48; new ed. 6 vols., 1864–65; abridged ed. 1867) and *Lives of the Queens of Scotland* (8 vols., 1850–59)—works based wholly upon original documents. She also put forth a collection of the *Letters of Mary, Queen of Scots*, with an historical introduction and notes (1842–43; new ed., with considerable additions, 5 vols., 1864). In 1870 she received a pension of £100 in consideration of her long and valuable literary services. D. at Reydon Hall, July 8, 1874. See *Life* by her sister Jane (1887).—Her sisters, SUSANNAH (Mrs. Moodie) and CATHARINE (Mrs. Traill), removed to Canada, and published works illustrative of life in the Dominion. Revised by H. A. BEERS.

**Stricture** [from Lat. *strictu'ra*, a compression, deriv. of *strin'gere*, *stric'tum*, draw tight, squeeze]: a constriction or compression of some tubular passage of the body, as the œsophagus, the larynx, the windpipe, the intestines, the anus, the urethra, the lachrymal ducts, and others. Strictures are produced either by new formations on the inside of the tubes, or by pathological changes in the walls and coatings of the same (cicatrization), or by the pressure of new formations or of atrophies outside. Examples of the first class are croup and diphtheria, which by deposition of fibrinous masses on the interior of the larynx and the windpipe narrow these organs sometimes to suffocation. A stricture of the third class is frequently produced in the œsophagus by a neighboring cancer, which may compress it to impermeability. The most frequent strictures are those of the urethra; they are generally produced by pathological changes in the coatings of the organ. Injuries of the perinæum and the penis, with or without rupture of the urethra, may originate them, but their most general cause is inflammation of the mucous lining of the urethra, gonorrhœa. Inflammation, if it spreads a little beyond the mucous lining, gives rise to new formation of connective tissue, which either directly compresses the urethra, forming a callous ring around it, or contracts it by atrophic cicatrization around the tube. The immediate consequences of urethral stricture are symptoms of impediment to free micturition. The urethra behind the stricture is dilated by the pressure of the accumulated urine. The bladder is not thoroughly emptied, and undergoes inflammatory irritation by chemical decomposition of its contents. The urine becomes alkaline, with a putrid and pungent smell of ammonia. The desire to urinate is very great, and never ceases. In more advanced stages the urine sometimes breaks through the wall of the urethra behind the stricture, and either makes a fistula by breaking also through the skin, or infiltrates the surrounding tissue, and so causes uræmia, and often death. In other cases, inflammation of the bladder extends to the kidneys, and there produces pyelitis and inflammation of the kidney proper. Strictures sometimes close up the urethra entirely, or become so narrow that the urine can be passed only in single drops by the strongest and most painful efforts. Speedy relief by operation is necessary in such cases to save the life of the patient. The treatment of stricture consists either in gradual dilatation or in external or internal urethrotomy. Gradual dilatation is effected by inserting bougies, or catheters, or sounds of increasing sizes. Every day or less frequently a larger instrument is passed through the stricture to the bladder, until the normal size of the urethra is attained. After this the last bougie is used occasionally for some time to prevent a relapse. The majority of authorities now consider dilatation with simultaneous division or incision of the constricting band the best, surest, and safest treatment of stricture. In cases where no instrument can be passed through the stricture, or where for other reasons the above method can not be resorted to, external urethrotomy is indicated. The operation is performed by cutting into the urethra from the perinæum, thereby opening the stricture lengthwise. It is kept open by regular catheterization, so that the healing wound leaves a canal of normal size. Internal urethrotomy is only applicable in cases where at least a small instrument can still be passed through the narrowed passage large enough to guide a small knife, which cuts and opens the stricture from inside. Revised by ROSWELL PARK.

**Stri'ges** [Lat. *strix*, *strigis*, a kind of owl; possibly akin to Gr. στρίξ, a screeching bird]: an order or other group of birds embracing the owls. The eyes are directed forward, and are surrounded by a more or less completely formed facial disk of radiating feathers; the plumage is very soft and lax and the feathers are without an aftershaft; the toes are four, the outer reversible; the claws are long, sharp, and decurved; the external ear is very large, often with a movable flap. The bones inclosing the cerebral cavity have a spongy diploë; the maxillo-palatines are spongy, the latter separated by an interval wide throughout or reduced to a cleft below, and basipterygoid processes are developed. This group has been placed with the *Raptores*, but recent authorities remove it from this association and place it near the *Caprimulgidæ* or goat-suckers. See STRIGIDÆ.

**Strig'idæ** [Mod. Lat., named from *Strix*, the typical genus, from Lat. *strix*, *strigis*; possibly akin to Gr. στρίξ, a screeching bird]: a family of birds variously limited and defined. In the restricted and generally accepted sense, the *Strigidæ* are owls having the breast-bone entire behind, with a central emargination, the furculum ankylosed, and the inner and middle toes of nearly equal length, the latter with its claw pectinate. It thus embraces the barn-owls, which are mostly of the Old World, though *Strix pratincola* is North American. The correlated *Bubonidæ* have the sternum notched behind, the furculum free, the inner toe shorter than the middle, and the middle claw not pectinate. The feathers on the sides of the head are often elongated into ear-tufts in this family, which includes the common owls of the U. S. When the *Strigidæ* are regarded as embracing all the species the groups above defined have sub-family rating. Revised by F. A. LUCAS.

**Strike** (in geology): See FAULTS.

**Strikes and Lockouts**: As defined by Carroll D. Wright, commissioner of labor for the U. S., a strike is the refusal of "the employees of an establishment to work unless the management complies with some demand." A lockout occurs when "the management refuses to allow employees to work except under some condition dictated by the management." Strikes and lockouts, therefore, are both warlike measures, and are declared to effect a specific object.

*Antiquity of Strikes.*—The first great strike of which we have record was that of the Hebrews in Egypt. There was a prolonged labor agitation, lasting many years, which the Egyptians endeavored to repress by imposing severer tasks upon the Hebrews. This was resisted, and many bloody encounters between serfs and masters occurred. Finally the labor forces were organized by Moses, with a general strike so thorough and well-arranged that the whole labor population marched out in a body and left their employers to their own devices. The employers were also said to be glad to get rid of their turbulent workmen. Ancient and mediæval history furnishes numerous examples of labor agitations of the nature of strikes, since inequalities of condition resulting from differences of ability in individuals keep a perpetual ferment in societies which issues in ill feeling and resentful strife between classes. Contention has characterized the history of all civilized nations, and where the industrial classes have been content to submit to unfavorable conditions the least advance has been made in civilization. The last half of the nineteenth century has seen the machinery and system of strikes brought to such perfection as to throw into the shade all previous movements of the same kind. The extension and generalization of trades-unions have led to such organization that strikes have become a recognized evil in social progress as much to be expected as changes of weather. They amount to a kind of inherent civil war.

*Objects of Strikes.*—A strike may be declared for one or more of the following objects: 1. To secure an advance or resist a reduction in wages. 2. To effect a reduction or oppose an increase of the hours of labor. 3. To resist the discharge of union men and hinder the employment of non-union men. 4. To regulate methods of work, materials used, number of apprentices, kind of work done by each branch of laborers, and the like. 5. To support a strike in some other industry or in some other branch of the same industry, as when pavers strike to help granite-cutters, or brakemen to help switchmen on a railway. These are known as sympathetic strikes. Strikes are wisely held by workmen to be the last resort of a contest, and never to be risked until it is clear that the desired object can not be reached without them. They are expensive, arduous, and uncertain, and if rashly undertaken end in disaster after much suffering.

*Boycotts.*—To the earlier weapons of strikers, modern ingenuity has added the boycott, by which all markets are closed against the goods of the employer against whom a strike is ordered. Even his household business is interfered with, so that his grocer and butcher are forbidden to supply his necessities under pain of being cut off from most other customers. This has proved a very effective weapon in the hands of laborers.

*Strikes in Great Britain.*—Philip Bevan gives the number of strikes in Great Britain from 1870 to 1880 as 2,352, or 235 per annum. In 1888 they had risen to 504 for that year; in 1889, 3,164; in 1890, 1,028, involving 4,382 establishments. Strikes would seem, therefore, to be on the increase.

*Strikes in the U. S.*—The first recorded strike in the U. S. was that of the journeymen bakers in 1741. The leaders were tried for conspiracy. Next came the shoemakers of Philadelphia in 1796, 1798, and 1799; then the sailors in Philadelphia in 1803, who struck for $14 against $10 a month. They were arrested, and the leaders imprisoned. In 1809 the New York cordwainers struck, and used the term "scab" to denote non-strikers of their association. Printers struck in 1821, using the word "rat" for non-union men against whom they struck. In 1834 the first women's strike took place at Lynn, Mass., in the shoe-trade It was unsuccessful. In 1848 the workmen of Allegheny city struck for ten hours, and carried their point after eight weeks of rioting, though with 16 per cent. reduction of wages. In 1850–51 1,300 workmen at Fall River were idle for six months at a loss of $140,000 in wages. A strike at Pittsburg in 1850, marked by violence, resulted in sentences of fines and imprisonment to many, afterward pardoned. In 1852 mill-hands in Salisbury, Mass., struck for fifteen minutes' recess at lunch. In 1868 Pennsylvania passed a law making eight hours a legal day; much striking resulted among the coal-miners, resulting in less hours of work and more wages. In 1877 occurred the great railway strikes on the Baltimore and Ohio, the Pennsylvania, and the Erie systems, resulting in the destruction on July 21–23 of 1,600 cars, 126 locomotives, and $5,000,000 worth of property, $2,000,000 of which loss fell on the railways. In 1880 there were 762 strikes and lockouts together, 617 of which related to wages. Up to 1881 1,491 strikes and lockouts had taken place. Of these 1,089 were about wages, and 583 failed. From 1880 to 1890 there were 7,114 strikes, which involved 2,268,272 persons.

According to statistics of Carroll D. Wright, the strikes of 1882 affected 2,105 establishments; those of 1883, 2,759; 1884, 2,367; 1885, 2,284; 1886, 9,861. The average duration of strikes was twenty-three days. Loss in wages is estimated at $51,814,723, and to employers over $30,000,000; 1,323,-203 employees were striking or involved, and 487,615 days were lost in all. Nearly four-fifths of these strikes were ordered by labor organizations. From 1881 to 1886 strikes affecting over 10,000 establishments succeeded, while strikes affecting about 9,000 failed. The trades represented were building, 6,075 establishments; tobacco, 2,959; mining, 2,060; clothing, 1,728; metallic goods, 1,570; transportation, 1,478. The lockouts were 2,214, of which 1,753 were ordered by organizations; 564 of these succeeded and 190 partially, and 1,339 failed. See *Third Annual Report of the Commissioner of Labor*, 1887.

In 1890 there were 798 strikes and 201,682 strikers. In the spring of 1892 occurred the granite-cutters' strike, which extended finally to pavers in New York, and arrested for a time the whole stone industry. This was, however, quite eclipsed by the famous strike in the Carnegie iron-works at Homestead, which was attended with such bloodshed and violence as to attract general attention. The Carnegie works were kept in a state of siege for several days, and the town presented the appearance of a military camp. Eight thousand soldiers were required to subdue the rioters, and though the strike apparently failed, yet it had a profound effect upon the industrial situation, and probably minimized the willingness of both laborers and capitalists to enter upon future battles. In the summer of 1894 a railway strike in Chicago and other Western cities, although a failure, threatened for a time the commercial interests of the whole country. It was ordered by E. V. Debs as president of the American Railway Union, in sympathy with striking employees of the Pullman Car Company, and resulted in the calling out of U. S. troops to protect the mails and restore order.

*Expenses of Strikes.*—The cost of strikes is often figured out by statisticians, and runs into enormous sums—enough to intimidate the boldest striker. Mr. Wright calculates that $60,000,000 was sunk in strikes and lockouts from 1881 to 1886. No doubt the funds of the unions—although now amounting to millions of dollars altogether—are often strained by the expenses of a great strike, and strikers and their families are subjected to extreme privations and distress before the contest is ended. Employers, also, are put to the greatest nervous strain, and their business is often imperiled to the verge of bankruptcy. One lockout on the Clyde, in Scotland, was reckoned to have cost the unions $750,000, while $1,560,000 was lost in wages. A strike in Manchester, England, cost the unions $400,000 and the employers $1,500,000. These figures convey a sharp warning. They indicate what the strike in Chicago (1894) and the disastrous street-railway strike in Brooklyn (1895) combine to teach—that strikes, like war, may easily cost more than they come to. It must be remembered, however, that, on the whole, strikes have seemed profitable to workmen; otherwise they must have ceased long ago.

*Why Strikes are believed Necessary.*—Strikes result largely from men's ignorance of their true interests and well-being. False economic theories are responsible for a large part of the enmity between capital and labor, out of which strikes and lockouts are born. The false notion that profits must fall as wages rise—a notion contradicted flatly by history, which shows high wages and large profits inseparably yoked together—is partly responsible for the striking spirit. Really the antagonism of capital and labor is an inheritance from an ignorant past. It is also an inference of short-sighted reasoning which regards wages as outgo and does not see that they immediately turn about and become income to the capitalist, since they are used to buy goods produced by labor, so that the higher the wages the larger the market becomes, and the greater the gross profits. On the other hand, also, the greater profits become the more capital stands ready to employ labor, and the stronger becomes the tendency in wages to rise in consequence. From the time when laborers were arrested and punished as conspirators, to the present day when they are regarded as disturbers of the peace and troublers of society, they and the upper classes have progressed together, often fighting but advancing most when co-operating rather than contending, and wages and profits have both risen greatly. The laborers get more wages, and their increased consumption increases the amount of goods needed, which enlarges the business of the capitalist and multiplies his profits. If this were not so, strikes would have ruined all parties long ago, impoverishing laborers and bankrupting capitalists.

*Increasing Magnitude of Strikes.*—The interests involved in strikes are constantly enlarging. The disturbances of 1892 at Homestead and New York and of 1894 and 1895 in Chicago and Brooklyn showed the whole nation to be, as it were, engaged in these industrial convulsions, and that nothing but a scientific adjustment of difficulties involved could bring about a condition of harmony and progress. A recognition of the economic principles involved alone will resolve the situation; and the main principle is the above law that wages and profits advance together, since profits are always largest in countries where wages are highest, and markets therefore largest. Lord Brassey, who has made a special investigation of the subject, has stated as a general truth that the higher-priced workmen are in reality the cheaper on account of the quantity and quality of the work done. Low-priced labor is found to be dearest. Of course it would be but a visionary business policy to favor increasing wages were it not that wage advance means larger demand, increased consumption, and ultimately larger profits, out of which, again, further advances of wages may be made, as they will certainly be demanded by strikes.

*Violence in Strikes.*—The Buffalo switchmen's strike of Aug., 1892, called out 785 men, affected twelve railways, and lasted two weeks. There was some violence, and many cars were burned. It was declared hastily by Grand-master McSweeny to secure ten instead of eleven hours' work, and 27 cents per hour instead of 25 cents. Eight thousand soldiers were sent to Buffalo to put it down, and it failed, as strikes generally do unless carefully prepared. This appeared especially clear in the Chicago strike of 1894 and the Brooklyn strike of 1895. Violence nearly always condemns the strikers in public regard and defeats their ends, while it cripples their resources. It is of no advantage to workmen striking for wages to destroy the property out of which wages come, and the impolicy of violence toward property is now becoming clear to strikers themselves; but toward workmen seeking to take the place of strikers there is still a very ready spirit of violence, which seriously threatens personal liberty and social order.

*Success and Failure.*—According to Carroll D. Wright's figures, about 60 per cent. of strikes succeed and about 60 per cent. of lockouts fail, as if the workmen were 20 per cent. wiser than the masters. This success, however, is rather apparent than real. As a matter of fact wages are seen to rise and fall from general causes just the same whether men strike or not.

*Arbitration.*—The great strike of the Shearers' Union in New South Wales in 1891, which finally involved so many industries, capitalists and workmen, skilled and unskilled, was made the subject of an elaborate examination by a parliamentary commission. The result was a recommendation of conciliation as a remedy, and if that failed arbitration without compulsory power. The same outcome resulted from a commission appointed to examine the Chicago strike and report. The idea is that such discussions and examinations as these measures necessitate tend to assuage ill feeling and promote reasonable conclusions sufficiently to carry force enough to settle disputes without other means. Doubtless there is truth in this position. Arbitration is also much valued as a means of preventing strikes and lockouts, by obviating the necessity for them. Doubtless as a temporary expedient it has value, as giving time for the adjustment of new departures before they are definitely formulated; but arbitration is at least a broken reed to lean upon, inasmuch as the causes of strikes are new desires and new demands, which the rules of the past can not satisfy. The elements of the problem are usually whether a given business can afford to pay its employees more, or give them shorter hours or more privileges than they have been having. Evidently this is a question which only the employer can answer. He is the only one who knows, and therefore what a board of outsiders may say about the matter is liable to be totally irrelevant. If he can grant the laborers' demands, he will finally be willing to do it, because it is the more profitable alternative. If, however, he can not grant these demands, owing to the fact of an already depleted margin of profit, he will no more be able to do so because advised by a board of arbitration than without such advice.

STARR HOYT NICHOLS.

**Strindberg**, AUGUST: writer; b. in Stockholm, Sweden, Jan. 22, 1849. In 1879 he went to Paris, where he remained ten years. His first important works were the powerful drama *Mästar Olof* and the social satire *Röda Rummet* (The Red Room), which was followed by dramas, novels, and tales, all displaying great originality and descriptive power. Among these may be mentioned *Gillets Hemlighet* (The Secret of the Club); *Hr. Bengts Hustru* (Mr. Bengt's Wife); *Fröken Julie* (1889); and *Himmelrikets Nycklar* (The Keys to the Kingdom of Heaven, 1892); and the novels *Utopier i Verkligheten* (Utopias in Real Life, 1885) and *I Hafsbandet* (In the Offing, 1891). Many of his works, especially the later ones, have aroused much controversy on account of the extreme social and moral views advanced in them. He is the leading apostle of naturalism in Sweden. D. K. DODGE.

**Stringy Bark**: See EUCALYPTUS.

**Strobilation** [= Gr. στρόβιλος, anything twisted, pine-cone, etc.]: a process of reproduction occurring among certain jellyfishes (*Discomedusæ*), in which the larva becomes transversely divided into a series of disks (*Ephyræ*), each of which later develops into a medusa. The partially divided larva was formerly regarded as an adult, and was called *Strobila*, in allusion to its appearance. A process akin to this occurs in the growth of the mushroom corals (*Fungia*) as well as in many tapeworms, in the latter resulting in the formation of the "joints" or proglottids. See TAPEWORM. J. S. K.

**Stro'boscope** [from Gr. στρόβος, rotation + σκοπεῖν, to view]: an instrument for examining the motion of a body by intermittent sight. It was invented in 1832, independently, by Plateau in Belgium and Stampfer in Germany. In its simplest form it consists of a disk perforated near the circumference with a series of equidistant radial openings, through which the body is viewed while the disk rotates uniformly. Suppose, for example, that the body is vibrating, and that the time of one complete vibration is equal to that required for the disk to rotate through the angular distance between two successive openings. The body will be seen in succession at the same phase of its motion, and will hence appear stationary. If the vibration period be slightly greater or less, the body will be seen successively in slightly different phases, and the visual impression is that of slow motion, the rate of which is calculable if the rate of rotation of the disk, the number of openings, and the period of the body be known. If the interval of time between the successive momentary views of the body be equal to or less than the duration of the retinal impression produced by it, the perception is uninterrupted. This duration decreases with increase of time of exposure of the retina and with increase in intensity of the light. The law determined experimentally by E. S. Ferry (see *American Journal of Science*, Sept., 1892, p. 204) is that retinal persistence varies inversely as the logarithm of the number which expresses the brightness. This means that if the intensity is increased by multiplying it by the second, third, or fourth power of some constant number, the corresponding duration will be one-half, one-third, or one-fourth of its original value. Under the conditions of ordinary daylight this duration varies from one-fiftieth to one-tenth of a second.

The principle of the stroboscope is applied in instruments to which a variety of names have been given, such as thaumatrope, phenakistoscope, vibroscope, zoetrope, zoöpraxiscope, kinetoscope, etc. If a succession of photographs of a rapidly moving body be taken at intervals of less than one-tenth of a second, and these be appropriately arranged for examination by the stroboscopic method, the resulting perception is that of the body in actual motion. With the development of instantaneous photography the preparation of such series of pictures has been brought to a high degree of perfection. See VITASCOPE. W. LE CONTE STEVENS.

**Strom'bidæ** [Mod. Lat., named from *Strom'bus*, the typical genus, from Lat. *strom'bus* = Gr. στρόμβος, a kind of spiral snail, also top, pine-cone, deriv. of στρέφειν, twist]: a family of gasteropod molluscs. The shells vary considerably in superficial character, but all have a more or less conic spire, and in most the outer lip is expanded and deeply notched anteriorly. Species are generally diffused in all tropical seas, and between seventy and eighty are known. They are distinguished by the peculiar form of the foot, which is fitted for leaping rather than the crawling progression common to most gasteropods, and by the pedicles bearing the eyes and tentacles. They are quite active, but are reputed to be chiefly carrion-feeders. The shells are often employed as ornaments, and especially is this the case with the *Strombus gigas*, often known as the fountain-shell. This is the largest of the family, and sometimes weighs 4 or 5 pounds. It is also largely employed for the manufacture of cameos. Revised by J. S. KINGSLEY.

**Strom'boli**: northernmost of the Lipari islands, in the Mediterranean, off the north coast of Sicily; area, 8 sq. miles. It is wholly of volcanic formation, and has a constantly active volcano 3,040 feet high with an extinct crater on top, but an active one on the side at the height of about 2,150 feet. Cotton, wine, and fruit of superior quality are produced, and sulphur and pumice-stone are largely exported. On the east side lies the small town of Stromboli. Pop. of island, 500. M. W. H.

**Strong**, AUGUSTUS HOPKINS, D. D., LL. D.: minister, educator, and author; b. at Rochester, N. Y., Aug. 3, 1836; graduated at Yale College 1857, and at Rochester Theological Seminary 1859; became Baptist pastor; pastor at Haverhill, Mass., 1861, Cleveland, O., 1865; president and Professor of Biblical Theology, Rochester Theological Seminary, 1872. He has published the following works: *Systematic Theology* (Rochester, 1886; 3d ed. New York, 1890); *Philosophy and Religion* (1888). W. H. W.

**Strong**, GEORGE CROCKETT: soldier; b. at Stockbridge, Vt., Oct. 16, 1832; graduated at the U. S. Military Academy in July, 1857; assigned to the ordnance, and in 1861 took temporary command of the Watervliet arsenal, West Troy. He was ordnance officer on Gen. McDowell's staff at Bull Run, and was then attached successively to the staffs of Gen. McClellan and of Gen. Benjamin F. Butler, whose chief of staff he became. He aided in the organization of the expedition for the capture of New Orleans 1861; in Apr., 1862, commanded the successful expedition from Ship island to Biloxi, Miss., and in September that to Ponchatoula, which destroyed a large amount of property belonging to the Confederates. In Nov., 1862, he was appointed a brigadier-general of volunteers, and in June, 1863, assigned to command of the brigade which, in the operations about Charleston, effected the landing on Morris island, July 10, 1863, Gen. Strong leading the successful assaulting column, as also the ineffectual assault on Fort Wagner the following morning. Again, a week later (July 18), his brigade led the second assault on that work, at the head of which Strong fell wounded. His commission as a major-general bore the date of the assault, July 18, and the name of Fort De Kalb, on the southern side of the Potomac, was changed to Fort Strong in his honor. D. of his wounds in New York, July 30, 1863.

**Strong**, JAMES, S. T. D., LL. D.: educator and author; b. in New York, Aug. 14, 1822; graduated at Wesleyan University in 1844; taught in Troy Conference Academy, Poultney, Vt., 1844–46; in 1847 removed to Flushing, Long Island; projected and built the Flushing Railroad, of which he was president; gave private lessons in Greek and Hebrew. In 1856, although not a clergyman, he received the degree of doctor of sacred theology from Wesleyan University, which institution also made him LL. D. in 1881; in 1858–61 was Professor of Biblical Literature and acting president of Troy University, and in 1868 became Professor of Exegetical Theology in Drew Theological Seminary at Madison, N. J. He was a member of the Anglo-American commission for the revision of the English version of the Bible. In 1873 he was chosen chairman of the archæological council of the Oriental Topographical Society, and in 1874 made an extended tour in the East; prepared for Lange's *Commentary* the English translation of the part on the book of Daniel, and published *Harmony and Exposition of the Gospels*, in English (New York, 1852), *Harmony of the Gospels*, in Greek (1854), and brief manuals of the Gospels and of Greek and Hebrew grammar. About 1853 he projected, in association with Rev. John McClintock, D. D., a *Cyclopædia of Biblical, Theological, and Ecclesiastical Literature* (10 vols., 1867–81, 2 supplementary vols., 1884, 1887, with later addenda, bringing the work down to 1891), Dr. Strong taking the department of biblical literature, including sacred geography, antiquities, and natural history. On Dr. McClintock's death, Mar. 4, 1870, Dr. Strong assumed the supervision of the whole work. He also published *Irenics* (1886); *The Tabernacle of Israel* (1888); *Sacred Idyls* (1889); *Future Life* (1891); *Jewish Life* (1891); *Our Lord's Life* (1892); *Commentary on Ecclesiastes* (1893); and an exhaustive *Concordance of the Bible* (1894), on which he labored more than thirty years. D. at Round Lake, N. Y., Aug. 7, 1894.

**Strong**, JOSIAH, D. D.: clergyman and author; b. at Naperville, O., Jan. 19, 1847; graduated at Western Reserve College, Hudson, O., 1869; studied theology at Lane Theological Seminary 1869–71. He was successively pastor of several Congregational churches (at Cheyenne, Wyo., 1871–73, at Hudson, O., 1873–76, at Sandusky, O., 1876–81); secretary of the Ohio Home Missionary Society 1881–84; pastor in Cincinnati 1884–86, when he became general agent of the Evangelical Alliance of the U. S. of America. He is the author of *Our Country* (1885, reissued in revised form 1891); *The New Era, or the Coming Kingdom* (1893). G. P. F.

**Strong**, Sir SAMUEL HENRY: See the Appendix.

**Strong**, WILLIAM, LL. D.: jurist; b. at Somers, Conn., May 6, 1808; graduated at Yale in 1828; admitted to the bar in 1832, and practiced at Reading, Pa.; Representative in Congress 1849–54; judge of the Supreme Court of Pennsylvania 1855–68, resumed practice, and in 1870 was appointed associate justice of the Supreme Court of the U. S. Retired 1880. D. at Lake Minnewaska, N. Y., Aug. 19, 1895.

**Strong**, WILLIAM L.: See the Appendix.

**Strongyl'idæ** [Mod. Lat., named from *Stron'gylus*, the typical genus, from Gr. στρογγύλος, round, spherical]: a family of parasitic round worms (nematodes) in which the mouth is usually surrounded by six papillæ or with a cup-like toothed expansion of these. Frequently in the male the end of the body has a bell-like expansion. Some species are parasitic in man, one, *Dochmius duodenalis*, causing the "tunnel disease" among the workers on the St. Gothard tunnel, or "Egyptian chlorosis" in Africa, a disease occasionally fatal. Other species live in domestic animals, the "gapes" of fowl being caused by the presence of *Syngamus trachealis* in the windpipe. J. S. KINGSLEY.

**Stron'tium** [Mod. Lat., deriv. of *Stron'tia*, from *Strontian*, in Argyleshire, Scotland, where strontia was first found]: the metallic basis of strontia, one of the alkaline earths, first obtained from native carbonate of strontium by Sir Humphry Davy in 1808. It is a pale yellow, burns with a crimson flame, emitting sparks, decomposes water, liberating hydrogen gas, is hard, ductile, and malleable, and is obtained from the anhydrous chloride by electrolysis. Specific gravity, 2·54; atomic weight, 87·5; symbol, Sr. Its most important compound is the oxide called strontia, a grayish-white, porous mass, which combines with water to form a white powder, the hydrate of strontium ($SrO.H_2O$). This compound has acquired considerable importance in Germany for its use in extracting sugar from beetroot molasses. The nitrate $Sr(NO_3)_2$ is much employed in the manufacture of the crimson lights in fireworks. The sulphate ($SrSO_4$) is found native, and is known as a crystalline mineral by the name of CELESTINE (*q. v.*). Revised by IRA REMSEN.

**Strophan'thus**: a genus of apocynaceous plants. From certain African climbing shrubs of this genus is prepared a poison locally known as kombo, inee, and onaye, and used for the purposes of the chase and war. It has been shown by Prof. T. R. Fraser to contain a crystalline principle, strophanthin, which has a powerful influence upon the muscular system, first stimulating, but if in sufficient dose finally causing a general paralysis, ending in death through failure of the respiration. It affects not only the voluntary muscles but also the muscle-fibers in the heart and in the walls of the blood-vessels; and since its first action, and indeed its entire action when in minute doses, is stimulating, it has become a very valuable remedy in the treatment of failure of the heart from any cause. It resembles digitalis in its use in disease, but differs from that drug in being much more prompt and fugacious in its action, and in affecting more powerfully the kidneys. Though less powerful than digitalis, it may be often substituted with advantage for that drug, especially when promptness of action is required, or when it is necessary to rapidly relieve dropsical exudations. The active principle, strophanthin, has been given in doses of 0·0002 to 0·0003 grammes, but the drug is chiefly used in the form of tincture, of which the dose is 5 to 10 drops. H. C. WOOD.

**Stro'phe** [viâ Lat. from Gr. στροφή, a turning]: unlike the Latin equivalent *versus*, a group of lyric cola, sometimes comprising several periods, combined into a symmetrical whole. In the Lesbian melic poetry it was a stanza (usually of four lines, some of which were alike) which was repeated *ad libitum* with the same music. In the choric poetry of the drama and the lyric poets the cola are more varied in form and usually more numerous, and the strophe was followed by another just like it, called the antistrophe, sung to the same music, the two being regarded as a complex unit, and the chorus executing a movement with the one and a counter-movement with the other, hence the names a "turning" and a "counter-turning." To this pair or syzygy was often (as always in Pindar) added another strophe without antistrophe, different in form, called epode (ἐπῳδός, sung after), the three constituting the lyric "triad." See PROSODY. MILTON W. HUMPHREYS.

**Stroud**: town; in Gloucestershire, England; on the Frome; 10 miles S. S. E. of Gloucester (see map of England, ref. 11–G). It is an important seat of woolen manufactures and dye-works, the water of the Frome being well adapted for dyeing. Pop. (1891) 9,818.

**Stroudsburg**: borough; capital of Monroe co., Pa.; on Broadhead creek, and the Del., Lack. and West. and the N. Y., Susq. and West. railways; 4 miles N. W. of the Delaware Water Gap, 24 miles N. of Easton (for location, see map of Pennsylvania, ref. 4–I). It is in an agricultural region, has excellent water-power, and is surrounded by attractive scenery. It contains 2 national banks with combined capital of $150,000, a building and loan association, local and serial, and 3 weekly newspapers. Pop. (1880) 1,860; (1890) 2,419; (1900) 3,450.

**Stru'ensee**, JOHANN FRIEDRICH, Count of: minister to Christian VII. of Denmark; b. at Halle, Prussian Saxony, Aug. 5, 1737; studied medicine; and was appointed personal physician to Christian VII., over whom he gained a complete ascendency. In 1771 he was made Minister of State, and a royal decree gave full authority to any orders he might issue, whether they were signed by the king or not. Struensee used his great influence to introduce sweeping reforms, some of which were beneficial to the people as tending to restrict the power of the nobles. Among other innovations he demanded the enfranchisement of the peasants, the introduction of examinations for public offices, the establishment of complete religious toleration and of liberty of the press. The suddenness of these reforms and their radical nature aroused violent opposition, which culminated in a conspiracy against him. The story of an intrigue between him and the young queen Caroline Matilda was employed by the queen dowager to induce the king to order his arrest, and Christian, whose enfeebled mind made him scarcely responsible for his actions, finally gave his consent. On Feb. 20, 1772, Struensee and the queen were arrested. No proof was advanced of his unfaithfulness as a minister, but the threat of applying the torture extorted from him a confession of guilty relations with the queen, and he was beheaded Apr. 28, 1772. See Wraxall, *Life and Times of Queen Caroline* (1864); Jenssen-Tusch, *Die Verschwörung gegen die Königin Karoline Mathilde und die Grafen Struensee und Brandt* (1864); and Wittich, *Struensee* (1878). F. M. COLBY.

**Struggle for Existence**: See EVOLUTION.

**Struma**: See SCROFULA.

**Strümpell**, GUSTAV ADOLF, M. D.: clinician; b. at Neu-Autz, Courland, Russia, June 28, 1853; educated in part at the University of Dorpat, where his father was Professor of Philosophy, and at the University of Leipzig, where he graduated M. D. in 1875; from 1876–82 assistant at the Leipzig clinic; in 1883 appointed Extraordinary Professor of Internal Medicine at Leipzig University and director of the polyclinic; in 1886 appointed to the chair of Special Pathology and Therapeutics at the University of Erlangen. His most important work is *Lehrbuch der speciellen Pathologie und Therapie der innern Krankheiten* (Leipzig), which has passed through seven editions and has been translated into French, Spanish, and English. S. T. ARMSTRONG.

**Struthiin**: See SAPONIN.

**Struthio'nes**: an order of birds characterized by the structure of the palate, in which the vomer does not articulate with the pterygoids. The sternum is devoid of a keel. The group contains the South American ostriches (*Rheidæ*), ostriches (STRUTHIONIDÆ, *q. v.*), cassowaries (*Casuriidæ*), and emus (*Dromaiidæ*). F. A. L.

**Struthion'idæ** [Mod. Lat., named from *Stru'thio*, the typical genus, from Lat. *stru'thio* = Gr. στρουθίων, ostrich]: a family of ratite birds. The bill is rather elongated, nearly straight, gradually depressed forward and narrowed toward the extremity, which is rounded, and the culmen is flattened; the nostrils are elongate-ovate, and in a broad membranous groove near the middle of the bill; the feathers are destitute of after-shafts; the wings are imperfect, and furnished with long curving soft plumes; the tail is moderate, and consists of curved pendent feathers; the tarsi are elongated, robust, and mostly covered with hexagonal scales, but in front toward the toes with transverse ones; the toes are two in number, with pad-like under surfaces, the inner (third) large, the outer (fourth) small; the claws short, curved, and blunt.

A number of osteological characters support the differentiation of the family from the others of the group, and have been formulated by Prof. Huxley—viz., the maxillo-palatines are thickened at their inner edges, and articulate with facets upon the sides of the vomer; the vomer is quite short, and does not articulate with either the palatines or pterygoids behind; the prefrontal processes of the primordial cranium are deficient in ossification; the sacral vertebræ are united by their bodies with the anterior ends of the pubes and ischia; the sternum has two shallow notches on each side at the posterior margin; the manus possesses the ordinary three digits, and of these the radial and middle have claws; there is a union of the pubes in a symphysis; the hallux is not only aborted, but also the distal end of the metatarsal bone and the phalanges of the second digit of the foot. See OSTRICH. Revised by F. A. LUCAS.

**Strutt**, JOHN WILLIAM, third Baron Rayleigh, F. R. S.: physicist; b. in England, Nov. 12, 1842. He was educated at Cambridge, and graduated 1865; became fellow of Trinity College 1866; succeeded to the title 1873; Professor of Experimental Physics in the University of Cambridge 1879–84; and Professor of Natural Philosophy in the Royal Institution of London since 1887. He is a member of numerous scientific societies and a correspondent of the Institute of France. He is the author of several memoirs relating to acoustics and electricity in the *Philosophical Transactions* of the Royal Society, of numerous papers in scientific journals, and of *The Theory of Sound* (2 vols., 1877–78; 2d ed., 1894). In 1894, in conjunction with Prof. Ramsay, he discovered, and has since prepared in quantity, a new element in the atmosphere, which he has called argon. For this discovery the trustees of Columbia College, New York, on the recommendation of the National Academy of Sciences, awarded Lord Rayleigh in 1895 "the Barnard medal for meritorious service to science." The discovery originated from the fact that the supposed nitrogen of the atmosphere was always found to be heavier than the nitrogen obtained by chemical means—from ammonia, for instance—the explanation being given by the admixture of the heavier gas, argon, with the former. The atomic weight of argon is 19·9, as compared with 14 of nitrogen, if it is assumed to be a single element. It would thus come between fluorine and sodium in the series of elements. It is believed that the gas was obtained in 1892 from the mineral uraninite by the American chemist W. F. Hillebrand, who by not applying sufficient tests concluded that it was nitrogen. Argon has since (1895) been found by Ramsay in the Norwegian mineral cleveite in conjunction with the solar element helium. (See SPECTRUM.) It differs in a remarkable way from all other known elements in its inertness or absence of chemical properties, whence its name (Gr. ἀργόν, neut. of ἀργός, lazy). Lord Rayleigh, however, believes that it has some affinity with certain of the hydrocarbons, and Prof. Berthelot, of Paris, has induced it to combine with the vapor of benzine, the product formed being a yellow resinous substance. In the course of his experiments in passing electric currents through argon mixed with benzine, Berthelot has obtained splendid displays of colors similar to those of the aurora borealis, which phenomenon, it is thus suggested, may be due to the action of electric currents upon the argon in the atmosphere. Its spectra have been studied by Crookes; they are of two kinds, with bright lines conveniently named red and blue, which are obtained under different conditions of pressure and electric current. The gas has been liquefied and solidified by Olszewski of Cracow. It dissolves in water under the ordinary pressure at 14° C. in the proportion of 4 volumes to 100, and is thus about three times as soluble as nitrogen. The critical temperature under 50 atmospheres is — 121. The density of liquid argon at its boiling-point is about 1·5. R. A. ROBERTS.

**Strutt**, JOSEPH: antiquary; b. at Springfield, Essex, England, Oct. 27, 1742; was apprenticed to an engraver, but early devoted himself specially to the study of British antiquities. His principal works in this department are *The Regal and Ecclesiastical Antiquities of England* (1773; new ed. by Planché, 1842); *Horda-Angel-Cynnan*, being a view of the customs, arms, etc., of the inhabitants of England from the arrival of the Saxons till the reign of Henry VIII. (1774–76); *The Chronicle of England*, completed only to the time of the Norman Conquest (1777–78); *Complete View of the Dress and Habits of the People of England from the Establishment of the Saxons to the Present Time* (1796–99; new ed. 1875); *The Sports and Pastimes of the People of England* (1801; often republished). He also published a *Biographical Dictionary of Engravers* (1785–86), and left several tales, one of which, *Queen Hoo Hall*, was edited after his death by Sir Walter Scott. D. in London, Oct. 16, 1802.

**Struve**, stroo've, FRIEDRICH GEORG WILHELM, von: astronomer; b. at Altona, Holstein, Apr. 15, 1793; studied first philology, and afterward astronomy, at the University of Dorpat; received an appointment at the observatory in 1813, and became its director in 1817. From 1834 to 1839 he planned and superintended the construction and erection of the observatory at Pulkowa, near St. Petersburg, which he has described in his *Description de l'Observatoire central de la Russie* (1845), and of which he was director to his death Nov. 23, 1864. This observatory became the most noted of the world. The earlier part of his career was mostly occupied by studies of double stars and of the construction of the Milky Way—*Observationes Dorpatenses* (8 vols., 1817–39); *Catalogus novus stellarum duplicium* (1827); *Stellarum duplicium mensuræ micrometricæ* (1837); *Stellarum fixarum, imprimis compositarum, positiones mediæ* (1852); and *Études d'astronomie stellaire* (1847). Subsequently he undertook several great geodetic works, such as the triangulation of Livonia (1816–19) and the measurement of a meridian arc in the Baltic provinces (1822–27), which he continued to the North Pole in connection with Hansteen, and to the Danube in connection with Gen. Tenner, and which he has described in his *Arc du méridien entre la Danube et la Mer Glaciale* (1861). Revised by S. NEWCOMB.

**Struve**, GEORG ADAM: jurist; b. at Magdeburg, in what is now Saxony in Prussia, Dec. 27, 1619; studied law at Jena and Helmstedt; held the offices of court assessor, privy councilor to the Duke of Weimar, and Professor of Law in the University at Jena; and in 1680 was appointed president of the regency of Weimar, the then duke being a minor. Of his numerous elaborate legal treatises the most important are *Syntagma Juris Feudalis* (1653); *Syntagmata Jurisprudentiæ Civilis* (1655); and *Jurisprudentia Romano-Germanica Forensis* (1670). D. at Weimar, Sept. 15, 1692.—His son, BURKHARD GOTTHELF STRUVE (b. at Weimar, May 26, 1671; d. at Jena, May 24, 1738), was a jurist and historian. He studied law, traveled, was appointed librarian of the University of Jena 1697, then Professor of History 1704 and of Jurisprudence 1730. He was historiographer to the house of Saxony. The most important of his many works are *Syntagma Historiæ Germanicæ* (1716); *Corpus Juris Gentium*; *Publici* (1717); and *Bibliotheca Historica* (11 vols., 1705). F. STURGES ALLEN.

**Struve**, OTTO WILHELM, von: astronomer: b. at Dorpat, Russia, May 7, 1819; son of Friedrich Georg Wilhelm von Struve, under whom he studied astronomy; succeeded him as director of the observatory of Pulkowa, and became known in the history of astronomy by many valuable researches. His *Determination of the Constant of Procession* is a classic, as is also his *Measurements of Double Stars*, a continuation of his father's work. He visited the U. S. in 1879 to order the object-glass of the proposed great telescope of his observatory from A. Clark & Sons, and again in 1883 to receive the glass. He resigned the directorship at Pulkova in 1890. SIMON NEWCOMB.

**Strychnine**, or **Strychnia**: See NUX VOMICA.

**Strych'nos** [Mod. Lat., from Gr. στρύχνος, a kind of nightshade]: a genus of trees and climbing woody vines of the family *Loganiaceæ*, found in the tropical parts of Asia and America. Most species are poisonous. *S. nux vomica* of India (see NUX VOMICA), a tree of moderate size, yields the alkaloids strychnine, brucine, and igasurine, all active poisons in overdoses. Equally poisonous are the *S. ignatia* of the Philippines and *S. tieute*, a climbing vine of Java. The East Indian *S. ligustrina* and *S. colubrina* are reputed to cure snake-bites. *S. pseudo-quina* of Brazil yields copalche-bark, a valued febrifuge; *S. potatorum* of India is the clearing-nut tree; and *S. toxifera* of South America probably affords the dreaded curare (or woorari) poison. Revised by L. H. BAILEY.

**Stryker**, MELANCTHON WOOLSEY, D. D., LL. D.: clergyman and educator; b. at Vernon, N. Y., Jan. 7, 1851; educated at Hamilton College and Auburn Theological Seminary; pastor of Calvary church, Auburn, N. Y., 1876–78; First Presbyterian church, Ithaca, N. Y., 1878–83; Congregational church, Holyoke, Mass., 1883–85; Fourth Presbyterian church, Chicago, 1885–92; since 1892 president of Hamilton College. He has published *The Alleluia* (1880); *Church Praise Book* (New York and Chicago, 1881); *Christian Chorals* (1885); *Church Song* (1890); *Choral Song* (1891); *Miriam and other Verse* (1888); *Essay on Dies Iræ* (1892); and *Inaugural Address, Hamilton College* (1893). C. K. HOYT.

**Strype**, JOHN, D. D.: ecclesiastical historian; b. at Stepney, England, Nov. 1, 1643; educated at St. Paul's School and at Cambridge; from about 1670 to about 1732 held the living of Low Leyton in Essex; later was settled at Tarring, Sussex. His important works are *Annals of the Reformation in England* (4 vols., 1709–31); lives of *Thomas Cranmer* (1694), *Sir Thomas Smith* (1698), *John Aylmer* (1701), *Sir John Cheke* (1705), *Edmund Grindall* (1710), *Matthew Parker* (1711), and *John Whitgift* (1718); and *Ecclesiastical Memorials* (3 vols., 1721). Editions of the *Historical and Biographical Works of John Strype* were issued from the Oxford Press in 27 vols. (1827–40). D. at Hackney, Dec. 11, 1737.

**Stuart**: town; Guthrie and Adair cos., Ia.; on the Chi., Rock. Is. and Pac. Railway: 41 miles W. of Des Moines, 105 miles E. of Omaha (for location, see map of Iowa, ref. 5–F). It is on a high rolling prairie, and contains 6 churches, 4 public-school buildings, electric lights, large locomotive and machine shops, a national bank with capital of $75,000, a State bank with capital of $50,000, and 2 weekly newspapers. Pop. (1880) 1,994; (1890) 2,052; (1900) 2,079. EDITOR OF "LOCOMOTIVE."

**Stuart**, or **Stewart**: a royal family which has given several sovereigns to Scotland and England. They trace their descent to a Norman baron, Alan, who accompanied William the Conqueror, and received large gifts of land in England. His second son went to Scotland, entered the service of King David I. (about 1130), by whom he was made steward of the kingdom, the dignity remaining hereditary in the family, who assumed the title as their family name. The sixth of these Stewards or Stewarts married in 1315 a daughter of Robert Bruce, and their son Robert in 1371 succeeded David Bruce on the throne of Scotland, under the title of Robert II. The following are the sovereigns of the Stuart line, with the dates of their accession: ROBERT II. (1371); ROBERT III. (1390); JAMES I. (1424); JAMES II. (1437); JAMES III. (1460); JAMES IV. (1488); JAMES V. (1513); MARY STUART, Queen of Scots (1542); JAMES VI., crowned King of Scotland in 1568, King of England under the title of JAMES I. (1603), and transmitted both thrones to his successors; CHARLES I. (1625); CHARLES II. (1649); and JAMES II. (1685). For an account of the reigns of these monarchs, see the respective titles. James II.'s son, JAMES EDWARD FRANCIS STUART (*q. v.*), assumed the title of James III. upon the death of his father, and is known in history as the Old Pretender. His eldest son, CHARLES EDWARD (*q. v.*), is known as the Young Pretender. Henry, the second son of the Old Pretender (see STUART, HENRY BENEDICT MARIA CLEMENT), died in 1807, and with him ceased the line of the Stuarts. The present royal family of England are descended only indirectly, and in the female line, from the Stuarts, through a granddaughter of James I. of England, upon whom the succession was bestowed by Parliament. F. M. COLBY.

**Stuart**, ARABELLA: member of the royal house of England and Scotland; b. at Chatsworth about 1575. Her father was Charles Stuart, Earl of Lennox, brother of Lord Darnley. She was in the direct line of descent to the English crown, standing in the same degree of relationship to Elizabeth as did her cousin James, and she became a subject of frequent intrigues. Upon the death of Elizabeth in 1603, an unsuccessful plot, in which it is said Sir Walter Raleigh was implicated, was formed to place her instead of James upon the throne; and from this moment she became an object of jealousy to her cousin; this was still more inflamed when in 1610 she was secretly married to William Seymour, grandson of the Earl of Hertford, who was also in the line of descent. Seymour was thrown into the Tower, and his wife was placed in the custody of the Bishop of Durham. She managed to escape, and made her way to the coast, where a French vessel was waiting for her and her husband, who had escaped from the Tower. He did not succeed in reaching the vessel, which sailed without him, but found another one, by which he reached France. The vessel in which was the Lady Arabella was captured by an English ship, and she was imprisoned in the Tower, where she became insane, and died Sept. 27, 1615. F. M. COLBY.

**Stuart**, GILBERT CHARLES: painter; b. at Narragansett, R. I., Dec. 3, 1755. His first instructor, Alexander, a Scotch artist, took him to Edinburgh in 1772, and soon died, but the youth worked his way back to Newport. Thence he removed to Boston. The stir of the Revolution drove him to New York, and thence in 1788 to London. There, after months of poverty, friendlessness, and ill success, he became acquainted with Benjamin West, who gave him encouragement and showed him every kindness. A full-length portrait of West, now in the National Gallery, gained for him reputation and opportunity. He soon rose to eminence in London, and painted people of rank—George III., the Prince of Wales, John Kemble, Joshua Reynolds (of whom he was held to be the peer). The Duke of Rutland invited him to Dublin, and there he lived in splendor as the artist of the nobility. In Paris he met with similar fortune, having as a sitter the king, Louis XVI. A desire to revisit his native country and to paint the portrait of Washington, whom he profoundly revered, led him to return to the U. S. in 1793. The first picture of the President was destroyed as unsatisfactory; the second, the original sketch whereof is in the Boston Athenæum, is the accepted portrait. Besides Washington, Stuart painted John Adams, Jefferson, Madison, Monroe, John Jay, and many other distinguished men and women of the day. The last painting was that of John Quincy Adams, which was finished by Sully. From 1806 till his death Stuart resided in Boston, and painted industriously. D. in Boston, Mass., July, 1828. No complete catalogue of his portraits exists. They are more than 750 in number, and are greatly prized. In the painting of heads he rivaled Copley, but the details are sketchy. Stuart was a brilliant man, eccentric, sensitive, proud, a wonderful talker, a penetrating observer, a genius in his art. In his early years he was an accomplished musician. His pictures are widely scattered, and are mostly in private hands.

**Stuart**, HENRY BENEDICT MARIA CLEMENT: last male descendant of the royal house of Stuart in the direct line; b. in Rome, Mar. 5, 1725; the son of the Pretender, James Francis Edward Stuart, by whom he was created Duke of York. He was preparing to join his brother in the rising of 1745 with a force of French troops when that prince was overthrown at Culloden; subsequently took orders in the Roman Catholic Church, and in 1747 was raised to the cardinalship by Pope Benedict XIV. as Cardinal York, taken from his ducal title. In 1788, on the death of his brother, the Young Pretender, he assumed the style of Henry IX., King of England—*gratia Dei, non voluntate hominum*, as expressed on a medal struck upon the occasion. When the French troops in 1798 took possession of the papal states he retired to Venice, but returned in 1801. During the later years of his life he was maintained by a pension from the British Government. D. at Frascati, July 13, 1807.

**Stuart**, JAMES: archæologist and architect; b. in London in 1713; until nearly thirty years of age was a decorator of fans and similar articles; made his way to Rome, where he studied Greek and Latin art and archæology; in 1752 accompanied the antiquarian Nicholas Revett to Athens, where he remained three years, making drawings from the remains of Greek architecture; in 1755 returned to London; became eminent as an architect; was appointed surveyor of Greenwich Hospital, and in conjunction with Revett began the great work, *The Antiquities of Athens, Measured and Delineated* (3 vols., 1762–94; supplementary volume, edited by Joseph Woods, 1816). This work may be said to have first made clear to Europe that there existed a Grecian architecture very different from the Græco-Roman of Italian and French ruins. A second supplementary volume was published in 1830 by Messrs. Cockerell, Kinnard, Donaldson, Jenkins, and Railton. He also published *Critical Observations on the Buildings and Improvements of London* (1771), and furnished the illustrations for a *Picturesque Tour through part of Europe, Asia, and Africa* (1793). D. Feb. 2, 1788. Revised by RUSSELL STURGIS.

**Stuart**, JAMES EWELL BROWN: soldier; b. in Patrick co., Va., Feb. 6, 1833; graduated at the U. S. Military Academy July 1, 1854, when appointed a brevet second lieutenant in the regiment of mounted rifles, receiving his full commission in October. In Mar., 1855, he was transferred to the newly organized First Cavalry, in which regiment he attained a first lieutenancy in the following December, and a captaincy Apr. 22, 1861. During the Kansas political troubles of 1855–58 he served with his regiment, and in 1859 was a volunteer aide to Col. Robert E. Lee during the John Brown insurrection at Harper's Ferry. On May 10, 1861, he was appointed lieutenant-colonel and July 16 colonel of a Virginia cavalry regiment, and was in chief command of the Confederate cavalry at the first battle of Bull Run. Promoted to be brigadier-general in the Confederate army in Sept., 1861, and major-general in July, 1862, he served thenceforth with the Army of Northern Virginia. Gen. Lee, assuming command of this army (June, 1862), and having reorganized it, determined upon a bold reconnoissance prior to resuming the offensive. Accordingly, on the morning of June 12, Stuart, with some 1,500 cavalry and four guns, left Richmond, and on the morning of the 13th reached Hanover Court-house, where he met and drove back two squadrons of the Fifth U. S. Cavalry; proceeding down the Pamunkey as far as Old Church, thence toward New Kent Court-house, striking the railway at Tunstall's Station and crossing the Chickahominy at Jones's Bridge the next morning, was safely back in Richmond that night, having made the circuit of McClellan's army with the loss of but one man. This cavalry raid, the first one of the war, caused much commotion in the Union army, and was the source of valuable information in the subsequent movements of Jackson, where Stuart led the advance. During Pope's campaign in Northern Virginia, Stuart surprised the headquarters' train of the former near Catlett's Station on the night of Aug. 22, 1862, capturing the personal baggage and official correspondence of Pope, and on the night of the 26th and morning of the 27th, in connection with two regiments of infantry, made a descent on Manassas Junction, capturing eight guns, several hundred prisoners, ten locomotives, and immense quantities of quartermaster and commissary stores. During the invasion of Maryland by Gen.

Lee in September, Stuart covered the Confederate rear, resisting the Union cavalry advance at South Mountain and holding the Confederate left at Antietam. During the subsequent period of inaction he crossed the Potomac above Williamsport with 1,500 cavalry Oct. 9, 1862, and passing through Maryland, he entered Pennsylvania and occupied Chambersburg on the 10th, and recrossed the Potomac below Harper's Ferry Oct. 12. In the battle of Fredericksburg his command formed the extreme right of the Confederate line. At Chancellorsville, after the fall of Stonewall Jackson and the disablement of Ambrose P. Hill, Stuart succeeded to the temporary command of Jackson's corps, which he led with ability in the severe fighting of Sunday, May 3. In anticipation of the proposed invasion of Pennsylvania, a large cavalry force had been accumulated at Culpeper under command of Stuart, against which Gen. Hooker dispatched two divisions of cavalry and two brigades of infantry, which, crossing at Beverley and Kelly's Fords (June 9), soon encountered Stuart advancing to cover the flank of the main movement. A fiercely fought but indecisive battle between the cavalry on both sides ensued, resulting in a loss to each of 500 or 600. During the subsequent campaign of Gettysburg he passed up through Eastern Maryland and Pennsylvania, and rejoined Lee at Gettysburg. In the campaign of 1864, Stuart by a wide detour succeeded in interposing himself between the Confederate capital and Sheridan's advancing column. Concentrating all his forces at Yellow Tavern, near Richmond, he was here attacked by his able rival. During the obstinate but ineffectual struggle Gen. Stuart was mortally wounded. D. May 12, 1864, soon after reaching Richmond. See *The Campaigns of Stuart's Cavalry*, by H. B. McClellan (Boston, 1885). Revised by JAMES MERCUR.

**Stuart**, JAMES FRANCIS EDWARD: See JAMES FRANCIS EDWARD STUART.

**Stuart**, JOHN, Earl of Bute: See BUTE.

**Stuart**, MOSES: biblical scholar and educator; b. at Wilton, Conn., Mar. 26, 1780; graduated at Yale College 1799; studied law, and was admitted to the bar in 1802, and for two years was tutor in Yale College; afterward studied theology with President Dwight, and in 1806 was ordained pastor of the First church (Congregational) in New Haven. In 1809 he became Professor of Sacred Literature in the Theological Seminary at Andover, Mass., and occupied the chair until 1848. By his stimulating influence as a teacher and author, he made an epoch in the study of biblical literature in the U. S. He was the teacher of more than 1,500 ministers. He held his professorship for thirty-eight years. He published several Hebrew and Greek grammars, commentaries on various books of the Bible, of which those on the epistles to the Romans and the Hebrews are among the most prominent, and *Elements of Interpretation* from the Latin of Ernesti (1822); *The Sabellian and Athanasian Modes of Representing the Doctrine of the Trinity*, from the German of Schleiermacher (1835); *Philological View of Modern Doctrines of Geology* (1836); *Hints on the Prophecies* (1842); *Critical History and Defense of the Old Testament Canon* (1845); *Conscience and the Constitution* (Boston, 1850); and other works. D. at Andover, Mass., Jan. 4, 1852.

**Stuart-Wortley**, CHARLES B.: See the Appendix.

**Stub**, stoob, AMBROSIUS: poet; b. on the island of Fünen, Denmark, May, 1705. The greater part of his life was spent in poverty, his genius failing to win recognition till long after his death. After serving as private tutor at various estates he finally established a private school in Ribe, where he spent the latter part of his life. He was the only great lyric poet of his time, and may be regarded as a worthy predecessor of Ewald and Wessel. All but one of his poems were published posthumously (1771). He is the original of the hero of C. K. F. Molbech's romantic drama *Ambrosius*. D. at Ribe, July 15, 1758. His collected poems were edited by Fr. Barfod (Copenhagen, 5th ed. 1879). D. K. DODGE.

**Stubbs**, WILLIAM, D. D., Bishop of Oxford: historian; b. at Knaresborough, England, June 21, 1825; was educated at the grammar school at Ripon and at Christ Church, Oxford, where he took a first class in the classics and a third class in mathematics, and was elected to a fellowship in Trinity College; took holy orders in 1848; became vicar of Navestock in 1852; librarian to the Archbishop of Canterbury at Lambeth in 1862, and was school inspector in the diocese of Rochester 1860–66, when he received the appointment of Regius Professor of Modern History at Oxford. In 1869 he became curator of the Bodleian Library; was chosen as a member of the hebdomadal council in 1872, and in 1875 received the presentation of the rectory of Cholderton, Wiltshire. He was appointed canon residentiary of St. Paul's in 1879, consecrated Bishop of Chester in 1884, and became Bishop of Oxford in 1889. He published *Hymnale secundum Usum Sarum* (1850); *Registrum Sacrum Anglicanum* (1858); *The Foundation of Waltham Abbey* (1861); *Chronicles and Memorials of Richard I.* (1864); the *Chronicle of Roger de Hoveden* (1868); *Select Charters, etc., of English Constitutional History* (1870); *Memorial of Walter of Coventry* (1872); *Memorials of St. Dunstan* (1874); *The Constitutional History of England* (3 vols., 1874, 1875, and 1878); and (with Haddam) *Councils and Ecclesiastical Documents relating to Great Britain and Ireland* (1869–78). His *Constitutional History of England* is one of the ablest and most authoritative works on the period of which it treats. D. Apr. 22, 1901.

**Stucco** [= Ital.: Fr. *stuc*, from O. H. Germ. *stucchi*, piece > Mod. Germ. *stück*]: plastic, adhesive composition applied to walls both internally and externally in order to give them a smooth and even surface, either decorative or plain in color or form. The cementing medium of the composition for inside work is common lime or calcined gypsum, or a combination of the two, generally mixed with a certain proportion of sand, depending on the special object to be secured. The word *stucco* technically applies to a mixture of lime-putty and white sand or powdered marble, and to a coating produced with this compound. The rudest example of the plasterer's art is the application of a single coat of mortar composed of lime-paste and common sand laid on the surface of a wall with the trowel, while the highest consists in imitating fine marbles and other beautiful building-stones by using pure calcined gypsum, mixed with gum, isinglass, and suitable coloring-matter, laid on in a variety of decorative forms in order to produce panels, pilasters, mouldings, cornices, etc. The implements used by the plasterer are of the simplest kind and few in number. They comprise a lathing-hammer, the hawk, the plastering or laying-on trowel, the float, a brush, and straight-edges and moulds of various kinds, together with a screen, shovel, rake, and hod for his attending laborer. The hawk is used by the plasterer for holding the mortar in his left hand while he applies it with the trowel held in his right hand. It is simply a piece of board about 10 to 11 inches square, held by a stout handle fixed on the under side in the center of the board and at right angles to it. The laying-on trowel is a thin plate of hardened steel or iron about 3 inches wide and 9 to 10 inches long, rounded slightly at the front end, square at the other end, and a little convex on the face. It is provided with a handle on the back parallel to the blade. The hand-float is of wood, shaped something like the laying-on trowel. It is used to rub down finished work and give it a hard, smooth, and even face. A cork float is sometimes used upon surfaces which are to receive a high degree of polish. A derby is a long, two-handed float, used principally in forming the floated coat of lime and hair. Jointing-trowels are of steel, the plate being triangular, with an acute angle at the front end, the handle being attached to the heel or base of the tool. They are used about cornices and mouldings in forming the miters where fine workmanship is desired. A corner-trowel is like a small laying-on trowel with its face bent lengthwise to a right angle; it is used at the intersections of walls and ceiling, etc. Moulds are pieces of hard wood cut to the form of the cornices or mouldings that are to be formed, to assist the workman in securing accuracy and uniformity in his work. They are sometimes made of copper plates inserted in a wooden stock. The plasterer's brush is broad and thin, and is used for keeping the material wet and plastic until it is finished to the required form. The plasterer's materials are lath-nails, laths, lime, calcined gypsum or plaster, hydraulic cement, and sand, together with various pigments for giving the requisite colors.

The mortars used for inside plastering are "coarse stuff," "fine stuff," "gauge stuff," called also "hard finish," and "bastard stucco." Coarse stuff is simply common lime-mortar, of the quality suitable for brick masonry, mixed with well-switched bullock's hair free from all animal and vegetable matter. Fine stuff is prepared by slaking pure lump-lime with a small quantity of water, and afterward adding water until the paste is diluted to the consistency of cream. It is then allowed to stiffen by evaporation to the proper condition for use. It is then sometimes called putty. It is used for the finishing coat, but always with some fine sand or calcined plaster, except for what is known as a slipped coat, and even for slipped work fine sand may be added in small quantities. Gauge stuff is composed of putty or fine stuff and calcined gypsum, in the proportion of 3 or 4 of the former to 1 of the latter. The mixture called stucco is prepared with lime-putty and white sand, and is used only for a finishing coat.

One coat of plastering on laths is said to be *laid*, and the coat is called a *laying* coat; and work in two coats is said to be *laid* and *set*, and the coats are styled a *laying* coat and a *set* coat. In three-coat work on laths the first is called the *pricked-up* or the *scratch* coat, the second is the *floated* coat, and the third the *set* coat. On masonry, plastering in one coat is styled *rendering*; two-coat work is said to be *rendered* and *set*; and three-coat work *rendered, floated*, and *set*. In good two-coat work upon laths, and also upon uneven masonry, the first coat should be a *screed* coat—that is, laid in *screeds* and "filling out." The screeds are strips or ledges of coarse stuff, 6 or 8 inches in width, applied at the angles of the room, and also in parallel strips 3 to 4 feet apart all over the walls and ceiling. They are carefully worked on, so that all those on the same wall or ceiling shall be accurately in the same plan, as determined by the frequent application of the straight-edge in all possible directions. When the screeds have become somewhat firm, the spaces between are filled in flush with the surfaces already established, so as to produce a continuous straight and even surface. In three-coat work the second is the screed coat. One-coat work on either laths or masonry—that is, either *laid* or *rendered*—although an inferior quality of work for walls and ceilings, is in common use for attics, kitchens, cellars, vaults, and places of like character. After the first coat of two-coat work has become partially dry, so that it will not break up under the trowel in the work which follows, it is in readiness for the *set* or finishing coat, which may be in *slipped work, stucco, bastard stucco*, or *hard finish*.

Hard finish is applied with a trowel to the depth of an eighth of an inch, and may be polished with the water-brush and trowel, but not hand-floated. Hard finish requires the least labor, and is extensively practiced in the U. S. In three-coat work on laths, the first coat—the *pricked-up*, the *scratch*, or *brown coat*—is applied in the same way as *laying*, with the exception that inasmuch as it is designed to form merely a good foundation for the *screed* coat, its thickness does not usually exceed one-quarter to three-eighths of an inch. After it has become partially dry, but while still soft, the mortar is *scratched* over nearly to its entire depth with a stick cut on the end into pointed teeth. The scratching is done in two sets of parallel scorings at right angles to each other, each running diagonally across the surface. The lines are about 2 inches apart, and are designed to assist the adhesion of the screed coat which follows. The second and finishing coats are applied as already described for a screed coat and set.

For *exterior plastering* a mortar composed of common lime and sand is not the most suitable, although frequently used upon the walls of common buildings well protected by projecting eaves. A cheap and useful surfacing of this kind is made by first cleaning off and roughing up the surface and raking out the joints to the depth of half an inch, and then rendering it with a not very thick coat of lime-paste and hair. When this has set, another coat of the same mixture is laid on evenly with the trowel without floating; and as soon as a few square yards are executed, a semi-fluid and thoroughly incorporated mixture of strong lime and fine clean gravel is firmly applied. This is at once, while soft, tinted to any desired color with an ocherous mixture put on with a brush. The whole dries and hardens into a compact mass.

Common lime forms the basis of some very good outside stuccoes, which, when properly applied, are very durable. Water holding coarse brown sugar or molasses in solution may be used for mixing the mortar, with beneficial effects on its subsequent induration. One lb. of sugar to 8 gal. of water will answer for all except the surface coat, which should contain four times this proportion of sugar. Powdered slaked lime, mixed with the scales from a smith's forge and tempered with bullock's blood, produces a moderately hydraulic and durable mortar, frequently used for exterior stucco. The wall should be previously coated over with boiled oil. In the U. S. hydraulic cement and clean, sharp sand, mixed up with fresh water to the consistency of plasterer's mortar, is most commonly used for the exterior coating of walls, more especially of brick walls. The mortar is usually applied in two coats in one operation; that is, the second coat is put on while the first is yet soft and plastic, so that the two become one. The workman never covers more than 2 or 3 superficial feet at one time, finishing it off with the second coat as he goes along. The aggregate thickness of both coats should be about half an inch. It should be protected from the direct rays of the sun for some days, and kept moist by sprinkling with a hose or brush. Sometimes the first coat is replaced by a wash of thick cream of pure cement, put on with a brush just in advance of the mortar. Faithful workmanship is most essential in this kind of plastering. The mortar must be put on under a firm pressure with the trowel, in order to secure intimate contact with the wall, and the surface must not be too dry. Deficient adhesion will result from neglect of these precautions. When a cement is too dark to give an agreeable shade of color, a judicious use of white sand, common lime, and ochers, singly or in combination, may generally be depended upon to greatly lessen if not entirely remove the objection.

Certain precautions are indispensable to the durability of stucco upon the exterior faces of walls. In the first place, the sand used must be perfectly clean, and should therefore be washed, repeatedly if necessary, until it will no longer discolor clean water. The most destructive agent to be guarded against is frost, when accompanied by the penetration of moisture between the stucco and the wall, which will inevitably result in throwing off the mortar. In well-troweled and hand-floated work all the vertical surfaces will shed the water with sufficient promptness to prevent that degree of saturation which would be likely to receive injury from frost. The points to be specially looked to are at the eaves and gables, the projecting portions of a wall, and the jambs of windows and doors. A projecting roof will afford sufficient protection to the upper edge of the stuccoed surface. Where the stucco abuts against a projection, like a sill or a lintel, the joint should be cleaned out to the depth of at least three-fourths of an inch, and the mortar firmly calked into it. At the jambs of openings extra care should be taken to secure close adhesion throughout, followed by a careful inspection by sounding and the renewal of all spots where the stucco has failed to unite with the wall. Revised by RUSSELL STURGIS.

**Studitæ**: See ACŒMETÆ.

**Stuhlweissenburg**, stool-vīs'en-boorch: town; in the county of Fehér, Hungary; on a marshy plain 16 miles N. E. of Lake Balatony (see map of Austria-Hungary, ref. 6–G). It has several fine buildings, a gymnasium, a military academy, a Magyar theater, manufactures of potash, leather, linen, and woolen fabrics, and an extensive trade in oil, wine, grain, cattle, and wool. In its magnificent cathedral the Kings of Hungary were crowned and buried from 1027 to 1527. Pop. (1890) 28,942.

**Stumpf**, CARL, Ph. D.: psychologist; b. in Wiesentheid, Bavaria, Apr. 21, 1848; educated at Würzburg and Göttingen Universities; became Professor of Philosophy at Würzburg in 1873, at Prague in 1879, at Munich in 1889, and at Berlin 1894; member of the Prussian Academy of Sciences 1895. His principal works are *Ueber den psychologischen Ursprung der Raumvorstellung* (1873) and *Tonpsychologie* (2 vols., 1885–90). J. M. B.

**Stupor** [= Lat., deriv. of *stupe're*, be struck senseless, whence (by deriv.) *stu'pidus*, senseless, dazed, stupid]: that condition in which, when fully developed, the functions of the brain, so far as the mind is concerned, are almost entirely suspended, the individual lying in an unconscious state, though he may still be aroused by vigorous shouting or shaking. When there is complete loss of consciousness the condition is properly spoken of as COMA (*q. v.*). It may be induced by pressure upon the brain, as from a depressed piece of bone of the skull or the entrance of some foreign body, as a bullet; by a blow or fall, causing concussion of the brain or compression from extravasated blood; by the rupture of a blood-vessel, causing cerebral hæmorrhage; by the circulation of poisoned blood through the cerebral vessels, as occurs, for instance, when an over-dose of opium or alcohol has been taken. Stupor and coma are to be distinguished from sleep by the fact that it is easy to awake a person from sleep, while it is difficult to arouse him from stupor and impossible in coma. In sleep the mind may be active; in stupor it is, as it were, dead. Stupor is a symptom of serious importance in various injuries and diseases to which the brain is liable. It may exist in all degrees of severity. There is a form of stupor, met with in certain diseases of the brain, in which the individual, though unconscious, is nevertheless not altogether deprived of the power to think and to move the limbs. There is, in fact, a marked degree of restlessness, though the movements are, as it were, automatic, and the speech is incoherent. This condition is known as "coma vigil." It generally only occurs in cases of great gravity, and it indicates a fatal termination.

Revised by W. PEPPER.

**Sturgeon** [from Fr. *esturgeon* : Ital. *storione* : Span. *esturión* from Teuton. *sturjo*, appearing in O. H. Germ. *sturio, sturo* > Germ. *stör* : O. Eng. *styrja*]: any ganoid fishes of the family *Acipenseridæ*. All the species have the body elongated and subcylindrical, or slightly compressed and tapering backward into a rather slender caudal peduncle; the skin is generally armed with minute bony plates, as well as five rows of larger keeled bucklers, one dorsal, one pair lateral, and one pair on the sides of the abdomen; there is no well-defined lateral line; the head is produced into a projecting snout, which is provided below with four barbels in a transverse row; the operculum proper well developed; the mouth is small, inferior, transverse, protractile, with fleshy lips; teeth entirely wanting in the adult; the dorsal fin far behind, and short; the anal still nearer the tail than the dorsal; the caudal with the upper lobe prolonged; ventral behind the center of gravity. The skeleton is cartilaginous. The stomach is not cæcal; the pyloric appendages are numerous; the rectum has a spiral valve; the air-bladder is large and simple, and communicates with the œsophagus; two accessory gills occur. Species are found in all the temperate portions of the northern hemisphere. All breed in the fresh water, but some are residents of the sea part of the year, while others are permanent denizens of the lakes and rivers. They nearly agree, in fact, in distribution with the salmonids, save that they are less generally found in streams, on account of their larger size. There are two primary types —(1) *Acipenser*, which embraces several subordinate subgenera or genera; and (2) *Scaphirhynchus*, of which only two species are known, one (*S. platyrhynchus*) confined to the Mississippi river and its tributaries, and another from Central Asia. The number of species of *Acipenser* is about twenty. The most common American species are *A. brevirostris*, or short-nosed sturgeon, and *A. oxyrhynchus*, or sharp-nosed sturgeon, which ascend the rivers of the Atlantic slope, and the fresh-water *A. rubicundus* of the Great Lakes and their tributary rivers. Their flesh is reddish, and is by some highly esteemed. Their eggs are often made into caviare; their air-bladders can yield a kind of isinglass. They are the largest of fresh-water fishes, the huso (*A. huso*) of the Caspian and Black Seas and Sea of Azov sometimes exceeding the length of 15 feet and the weight of 2,000 lb. See also FISHERIES and STERLET. For illustration, see FISHES.

Revised by J. S. KINGSLEY.

**Sturgeon Bay**: city; capital of Door co., Wis.; on Sturgeon Bay, about midway between Green Bay and Lake Michigan, and on the ship-canal connecting those bodies of water (for location, see map of Wisconsin, ref. 4–F). The bay is 8 miles long by 2 miles wide, and affords an excellent harbor for the largest vessels. The city is in an agricultural and lumbering region, has large shipping interests, and contains a State bank with capital of $25,000, a private bank, and a monthly and two weekly periodicals. Pop. (1880) 1,199; (1890) 2,195; (1900) 3,372.

**Sturges**, OCTAVIUS: physician; b. in London, England, 1833; educated at Addiscombe as a cadet in the service of the East India Company; served in India as a lieutenant in the Bombay Artillery; returned to England and entered Emmanuel College, Cambridge, taking the degrees A. B. and A. M. in 1862; entered St. George's Hospital, London; in 1862 became a member and in 1870 a fellow of the Royal College of Physicians; M. D., Cambridge, 1867; lecturer on forensic medicine 1868–71, on materia medica 1871–74, on medicine 1874–93 in Westminster Hospital. He was the author of *An Introduction to the Study of Clinical Medicine* (London, 1873); *The Natural History and Relations of Pneumonia* (London, 1876); *On Chorea and other Allied Movements* (London, 1881). D. Nov. 3, 1894. S. T. A.

**Sturgis**: village; St. Joseph co., Mich.; on the Gr. Rapids and Ind. and the Lake Sh. and Mich. S. railroads; 31 miles E. by N. of Elkhart, and 36 miles S. by E. of Kalamazoo (for location, see map of Michigan, ref. 8–H). It is in an agricultural region, and contains 9 churches, public, central, and ward schools, water-works, electric lights, fair-grounds, a mile race-track, several large manufactories, a national bank (capital $65,000), a State bank (capital $50,000), and a monthly and 3 weekly papers. Pop. (1900) 2,465.

**Sturgis**, JULIAN: See the Appendix.

**Sturgis**, RUSSELL: architect and writer on art; b. in Baltimore, Md., Oct. 16, 1836; studied architecture in a New York architect's office and in Europe, and practiced from 1865 to 1878. He then retired on account of feeble health and has since occupied himself with archæology and fine art, and the work of societies devoted to fine art in New York and elsewhere. Among the buildings designed by him are Battell Chapel, Farnam Hall, Durfee Hall, and Lawrance Hall of Yale College, the Homœopathic Medical College and Flower Hospital in New York, the Mechanics' and Farmers' Bank at Albany, and churches, business buildings, and residences in New York, Albany, Aurora, Tarrytown, Watertown, N. Y., New Haven, Farmington, and Litchfield, Conn., Minneapolis, and Louisville. Author of *European Architecture, an Historical Study* (New York, 1895), and editor of decorative art and mediæval archæology in *The Century Dictionary*, of fine art in general in *Webster's International Dictionary*, and of archæology and art in *Johnson's Universal Cyclopædia*. He has also published numerous magazine articles.

**Sturlason**, SNORRE: See SNORRI STURLUSON.

**Sturm**, stoorm, JOHANNES, von: educator; b. at Schleiden, Germany, Oct. 1, 1507; founded (1537) the gymnasium in Strassburg, which attained, under him, worldwide celebrity. He was generally regarded as the greatest educator connected with the Reformed Church, and received the title *Præceptor Germaniæ*. His work gave a great impulse to the establishment of classical schools. To read, write, and speak Ciceronian Latin was the great object of his instruction, and to this end a course of twenty-one years—six at home, ten at school, five at college or university—was thought about sufficient. D. at Strassburg, Mar. 3, 1589. See Joseph Payne, *Lectures on the History of Education*. C. H. T.

**Sturt**, Sir CHARLES: explorer; b. in England early in the nineteenth century; entered the army at an early age. In 1828 he was the leader of an expedition organized to explore the interior of Australia, during which he discovered the Macquarie, Castlereagh, and Darling rivers, and soon after led another expedition which explored the course of the Murrumbidgee river, and in June, 1830, discovered the great Murray river, which he followed to its mouth in Lake Alexandrina, returning early in 1831. In 1844 he penetrated to the great stony desert nearly in the center of the continent. He was made registrar-general and subsequently colonial secretary of South Australia. In consequence of his exposure in these expeditions he became totally blind, and returned to England, where he was knighted a short time before his death. He published *Two Expeditions into the Interior of Southern Australia in 1828–31* (1833) and *Narrative of an Expedition into Central Australia in 1844–46* (1849). D. at Cheltenham, England, June 16, 1869.

Revised by M. W. HARRINGTON.

**Sturzenbecker**, stoorts'en-bek-ker, OSKAR PATRICK (*Orvar Odd*): writer; b. in Stockholm, Sweden, 1811. He was from the first one of the warmest advocates of the union of Scandinavian countries, on behalf of which he began to write in 1830. His greatest success was achieved in the light feuilleton style imitated from the French, in which he has never been equaled in Sweden. His best sketches are collected in *Grupper och Personagen från igår* (Groups and Persons from Yesterday). He was also the author of lyrics that display patriotic warmth and a deep sympathy for human progress. D. near Helsingborg, Feb., 1869. Selected works were published at Stockholm in 1878. D. K. DODGE.

**Stuttering**: See STAMMERING.

**Stuttgart**, stoot'gaart: capital of the kingdom of Würtemberg, Germany; on the Nesenbach, an affluent of the Neckar; 38 miles E. S. E. of Carlsruhe (see map of German Empire, ref. 7–D). It lies in a charming valley among hills covered with forests and gardens, and is regularly and beautifully built. The Altstadt, occupying nearly the center, and grouped around the market-place, contains several small and narrow streets, but the new parts of the city, mostly erected during the nineteenth century, have broad and beautiful streets and symmetrical squares. The most prominent point is the palace square, ornamented with gardens and fountains, containing the jubilee column, over 50 feet high, and surrounded by magnificent buildings. Among these the new palace is the most remarkable—a very handsome structure, with two projecting wings, the central building containing 365 rooms rich in works of art by Dannecker, Gegenbaur, Thorwaldsen, and others. To the right of this edifice stands the old palace, built 1553–70, a gloomy castle with towers and pinnacles, but containing a beautifully painted chapel and large halls, the curious Reitschnecke, a spiral horse-path giving access to the third floor, and in the court the equestrian statue of Eberhard, the first Duke of Würtemberg. In the left wing of the new palace is the royal theater, finished in 1846, and opposite the palace is the Königsbau, a beautiful structure with an Ionian colonnade, built 1855–59, and containing numerous shops, elegant *cafés*, a concert-hall, and other assembly-rooms. In the rear of the old palace is the Schiller Square, containing the statue of the poet, the immense building of the palace of the princes, and the parish church, erected 1436–90, and restored in 1841. One of the most beautiful and most important streets is the Neckarstrasse, running from the palace square in a northeastern direction, and containing the museum of natural science with a rich collection of mammals; the national library, comprising 400,000 volumes, 3,600 manuscripts, 2,300 incunabula, and a collection of 8,700 Bibles in eighty-nine different languages; the museum of art, containing an art school and collections of paintings and statues, etc. Nearly parallel with the Neckarstrasse runs the Königsstrasse, traversing the palace square and dividing the city into two parts, a southeastern and northwestern; on this are the royal stables and the royal central hall for commerce and industry, with a good library and important collections. Other remarkable buildings are the museum for Wurtembergian antiquities, the polytechnic school, the new market-hall; and among the churches, the Leonhard's church, Johannis church, a Roman Catholic church, an English church, and the magnificent synagogue. The finest promenade is the palace garden, a park with lakes, fountains, statues, etc., stretching from the palace for the distance of about 2 miles. In the vicinity are the royal summer palaces, Solitude, Villa Rosenstein, Wilhelma, and the Villa, and the charming town of Cannstatt-on-the-Neckar, with 22,000 inhabitants, much frequented as a bathing-place, connected with the city by a railway. The industry in woolen manufactures is important; a wholesale cloth-fair is annually held in August. The manufactures of pianos, carriages, chocolate, sugar, and machinery are also considerable. The commerce of the city is extensive: the book and art trade is especially important. Pop. (1900) 176,318. The name *Stuttgart* first occurs in history in 1229, though the exact date of its foundation is not known. It became the residence of the Count of Würtemberg in 1320, and the capital of the country in 1482. The city was held by Austria from 1519 to 1534, and occupied by Alba in 1546 in the Smalkaldic war. In the period from 1634 to 1638 one-half (8,810) of the inhabitants died from the plague. In the wars of Louis XIV. it was taken by the enemy three times; also several times during the wars of Napoleon.

Revised by M. W. Harrington.

**Stuyvesant**, stī've-sănt, Peter: director-general of New Netherlands; b. in Holland in 1602: served in the West Indies; was director of the colony of Curaçoa; lost a leg in an attack upon the Spanish island of St. Martin; returned to Holland in 1644, and in 1647 was sent to the New Netherlands as director-general. Upon his arrival at New Amsterdam (now the city of New York) in May, 1647, he made peace with the Indians, and a few years later arranged the boundary-line between the Dutch and the English possessions in North America. In 1651 the Dutch built a fort on the site of the present Newcastle, Delaware river, which the Swedish governor Rising captured in 1654. In 1655 Stuyvesant sailed for the Delaware with seven vessels conveying 600 or 700 men, recaptured the fort, and took possession of the entire colony of New Sweden. In the meanwhile discontent had sprung up against the arbitrary administration of the Dutch West India Company, and in 1653 a convention of two delegates from each settlement in the colony assembled and demanded that obscure and obsolete laws should not be revived, and that no officer should be appointed except with the approbation of the people. Stuyvesant replied that the magistrates derived their authority from God and the Dutch West India Company, and not from a few ignorant subjects, and ordered the convention to disperse under pain of condign punishment. The discontent, however, still continued. The English colonies in New England, in spite of the repeated remonstrances of the governor, began to encroach upon the boundaries of New Netherlands. In 1664 Charles II. of England issued a charter to his brother, the Duke of York, afterward James II., bestowing upon him all the country between the Hudson and the Delaware, including New Netherlands, as well as some territory which had previously been granted to the New England provinces. In August of that year, although England and Holland were at peace, Col. Nicolls, with an English fleet, appeared in the bay and demanded the surrender of New Amsterdam. Stuyvesant at first refused, but the municipal officers, seeing little hope of successful resistance, and having no very warm attachment to their Dutch masters, insisted that he should yield, and the town was surrendered Sept. 3, 1664, and its name changed to New York—a designation soon extended to the whole province of New Netherlands. Stuyvesant went to Holland the next year, but returned soon after, and passed the remaining eighteen years of his life at his farm, called the *Bowerij*, which has given its name to the street called the Bowery. D. in Aug., 1682. Revised by F. M. Colby.

**Sty**, or **Horde'olum** [*sty* < O. Eng. *stigand*, swelling, adjec. sc. *ēage*, eye]: a small boil which occurs on the edge of the eyelid. It should be treated with a warm-water dressing or light wet poultice; after the discharge of a little pus and a slough, it usually gets well at once. If there be a long succession of sties, as sometimes happens, iron and quinia, with occasional mild laxatives, will be useful.

**Style**, or **Stylus**: See Pen.

**Style, Old and New**: See Calendar.

**Stylites**: See Pillar Saints.

**Stylites, St. Simeon**: See Simeon Stylites.

**Stylopidæ**: See Strepsiptera.

**Styptics**: See Bleeding.

**Styraca'ceæ** [named from the typical genus *Styrax*, from Lat. *styrax* = Gr. στύραξ, storax, or the tree yielding it]: a family of exogenous, gamopetalous trees and shrubs, with the stamens commonly monadelphous or polyadelphous, and adnate to the base of the corolla; the calyx more or less adnate, and the seeds few and large with a bony coat; the leaves alternate entire, serrate membranous, or coriaceous feather-veined. There are about 235 species distributed among seven genera, the most important of which are *Halesia* and *Styrax*. The former is the Snowdrop-tree (*q. v.*). *Styrax* contains over sixty species, restricted to the warmer parts of Asia, Europe, and America. Many of the species yield valuable gums, such as Benzoin (*q. v.*) and storax. The latter is a solid resin, resembling vanilla in odor, obtained from *S. officinalis*, a small tree of Asia Minor and Syria. Liquid storax is a balsam obtained from the inner bark of *Liquidambar orientalis*. It is used in making incense and perfumery. Its chief market is in the East.

**Styr'ia** (in Germ. *Steiermark*): province of Austria; bounded N. by Upper and Lower Austria, E. by Hungary, S. by Carniola and Croatia, and W. by Carinthia and Salzburg. Area, 8,670 sq. miles. In the southern part, on some of the plains, and in the valleys are raised wheat, maize, tobacco, flax, hemp, wine, and fruit; elsewhere the province is mountainous, and cattle-rearing, dairy-farming, mining, and manufactures of metallic wares are the principal branches of industry. The Noric Alps cover the surface between the Ens and the Mur; the Styrian Alps, between the Mur and the Drave; and the Carnic Alps, between the Drave and the Save. These mountains rise to a height of between 7,000 and 8,000 feet, and are rich in iron, copper, salt, alum, marble, and coal. Pop. (1890) 1,282,708, of whom over 710,000 are of German and the rest of Slovenian descent. Capital, Gratz. Revised by M. W. Harrington.

**Styrian Literature**: See Slovenian Literature.

**Styx** [Gr. Στύξ, the hateful]: in Greek mythology, a river of Hades which flowed from the tenth source of Oceanus. At the entrance to Hades was the abode of the nymph or goddess Styx, by whom the most solemn oaths of the gods were sworn, thus dedicating themselves to death in case of perjury.—Styx was also the name of the highest waterfall (not, as Herodotus says, a fountain) in Greece, near Nonacris in Arcadia. The ancients, like the modern residents of the vicinity, considered its waters fearfully poisonous, and it was believed that no vessel could hold any of it unless made of the hoof of an ass or horse. The ancients associated this waterfall with the mysterious Styx of the lower world. Revised by J. R. S. Sterrett.

**Suabia**: See SWABIA.

**Suakim**, swaa-keem′, or **Sawakin**: fortified town of Nubia and best port on the Red Sea; on an island a few hundred feet from shore; lat. 19° 7′ N. (see map of Africa, ref. 3–G). It has been in the possession of the British since 1882. Formerly the head of the caravan routes into the interior, it lost much of its importance as a result of the Mahdist rebellion, and this is not yet recovered, because of the insecurity of the interior. The influence of the British hardly extends beyond the reach of their cannon. Opposite Suakim on the mainland is the suburb of El-Kef, also fortified, connected with the city by a low bridge and short railway. The latter is all that was made of a railway projected to Berbera on the Nile in 1884, but prevented at that time by the Mahdists. Suakim is considered of great strategical and commercial importance, and is the most suitable terminus for a railway into Egyptian Sudan. The chief exports are gum arabic, silver, ivory, senna, and skins. Pop. (1897) 15,713. MARK W. HARRINGTON.

**Subcarbonif′erous Series**: in American geology, the lowest group of Carboniferous strata. It occupies the interval between the Devonian system and the coal-measures. Earlier designations of the same division are mountain limestone, Carboniferous limestone, and Lower Carboniferous, and a later proposed title, Mississippian series, has much to commend it. In the Mississippi valley it consists principally of limestones and shales, and includes, in an ascending order, the Kinderhook, Burlington, Keokuk, Warsaw, St. Louis, and Chester formations or groups. In Pennsylvania the equivalent series consists principally of sandstone and shale, having a maximum thickness of 5,000 feet. The series has also been recognized in Nova Scotia and New Brunswick, and has a great development in the Rocky Mountain region. The fossils are principally marine invertebrates, some of which, especially the brachiopods, are of worldwide distribution. Remains of fishes and of reptiles also occur. Rocks corresponding to the Mississippian series in time have a wide distribution in other countries, and especially in Europe. See CARBONIFEROUS PERIOD and DEVONIAN PERIOD. ISRAEL C. RUSSELL.

**Subconscious States**: states of mind which belong to us and which we can pay attention to, but which we may not be actually thinking of; such as our sense of the furniture in the room about us. Such states or elements are very common in our mental history, and are called subconscious as long as there is evidence that they have not sunk entirely out of the whole of our present state of mind. On the other hand, things which we may merely remember on occasion, and are in no sense conscious of at a particular moment, are then "unconscious." See UNCONSCIOUS STATE. J. M. B.

**Suber′ic Acid** [*suberic* is from Lat. *su′ber*, cork-tree, cork]: a homologue of oxalic and succinic acids. Its general characters are those of that family of dibasic acids, and its empirical formula is $C_8H_{14}O_4$. The name was originally due to the fact that this acid was first obtained by the action of nitric acid on cork. Fats generally, however, yield it by the same treatment, and it is by no means a characteristic product of cork. To obtain suberic acid free from the other acids produced by the action of nitric acid on fats, the mixed product is treated with cold ether, in which this acid is almost insoluble. It is necessary, however, to purify it further by recrystallization. It may be obtained in large needles, which sublime like oxalic acid. It is sparingly soluble in cold, but easily in boiling water, and soluble in alcohol.

Revised by IRA REMSEN.

**Suberine**: See CORK.

**Subiaco**, sōō-bēē-aa′kō (anc. *Sublaqueum*): town; in the province of Rome, Italy; on the right bank of the Teverone; 42 miles E. N. E. of the city of Rome (see map of Italy, ref. 6–E). It derived its name from its situation below a villa belonging to Nero, in the grounds of which were three lakes. In the monastery of Santa Scolastica, founded in the fifth and restored in the tenth century, the printing-press was first used in Italy, a Lactantius (1465) being the first issue. The monastery of St. Benedict, the first founded by the saint himself, was rebuilt in 817. Pop. 6,503.

**Subinfeudation**: See LANDLORD AND TENANT.

**Sublima′tion** [from Lat. *sublima′re*, raise, deriv. of *subli′mis*, lifted up, on high]: a chemical process of separation and purification, applicable only occasionally in cases in which a volatile substance condenses or crystallizes from the condition of vapor directly to the solid condition, and not to the usual liquid form. In such cases this method of obtaining bodies in pure and crystallized form is highly convenient and valuable. Among the more important substances to which this method is applicable are sulphur, iodine, vermilion, corrosive sublimate, calomel, salts of ammonia, arsenious oxide, oxalic, benzoic, succinic, and pyrogallic acids, camphor, caffeine, etc. As those substances which volatilize at low temperatures will readily pass through porous diaphragms like paper when in a vaporous state, it is often convenient to cover the lower vessel, containing the substance to be volatilized, with paper, which will prevent the crystals that condense in the head or upper inverted vessel from falling back and causing waste of time. In cases of bodies requiring high temperatures wire-gauze screens may be employed in the same way. Revised by IRA REMSEN.

**Sublime** [from Lat. *subli′mis*, lifted up, lofty, sublime]: Contradistinguished from the beautiful, which charms and attracts us, the sublime awes us, moves us with a feeling of pleasure mixed with fear. The sublime in nature is usually found in the boundless expanse of the ocean, in the resistless might of its waves when moved by a storm, or more frequently in the thunder-storm with its threatening look, its vivid and destructive lightnings, and its deafening crashes of thunder. Still more adequate is the manifestation of the sublime in instances of moral heroism—in deeds of daring and self-denial; the sublime in art has most frequently made use of this phase. Kant, in his *Critique of the Judgment* (§ 23–53), has given the first thorough and systematic treatment of the sublime. According to him, "while the beautiful in nature appertains to the form of an object—hence to its circumscribed limits—the sublime, on the contrary, is to be found also in formless objects: a want of limitation attaches to it. It is, however, represented as a whole, and not as something merely fragmentary. The beautiful may therefore be regarded as the portrayal of an idea of the understanding (not a mere concept), but the sublime is rather the portrayal of an idea of the reason, which, from its nature, can not be adequately represented by material things." "The pleasure of the beautiful appertains to the quality of an object, while the sublime is manifested chiefly in the quantitative aspect of it." "To the charm of the beautiful there is frequently joined a sportiveness, but the sublime is always earnest." "The sublime, in its proper form, is not presented in a sensuous manner, but concerns only ideas of the reason, whose very incommensurability with sensuous forms, being exhibited, stirs the heart." "The beautiful pleases us immediately, but in its presence we feel disinterested; the sublime pleases us, but through its hostility to our sensuous interests." Cousin (*On the True, Beautiful, and Good*, lecture vii.) says: "A beautiful object is something completed, circumscribed, limited, which all our faculties easily embrace, because the different parts are on a somewhat narrow scale. A sublime object is that which, by forms not in themselves disproportional, but less definite and more difficult to seize, awakens in us the sentiment of the infinite." Hegel (*Æsthetics*, 2d part, div. i., chap. ii.) makes the sublime a province of symbolic art, whose chief function is to portray the purification of spirit and its separation from the world of sense and all visible existence. "The highest principle is regarded as existing apart by itself, and as incapable from its very nature of finding adequate expression in the finite appearances of the real world." "The sublime arises in an attempt to express the infinite without finding in the domain of visible phenomena an object capable of representing it. The infinite elevates itself above particular existences, considered either in themselves or in their totality; they are as nothing before it; and the positive relation which sensuous objects have to the beautiful, in the sublime changes to a negative relation which is more in conformity to the divine nature. God is thus represented as purified of all contact and participation of visible appearance." "In the Orient, in India, the One, or Substance, is conceived as immanent in contingent existences created by it; they are portrayed as mere instruments of the divine power, or as mere ornaments for the display of the glory of the Absolute." In the *Bhagavat Gita* (ch. xi.) the vision of the Universal Form of Vishnu furnishes us the highest example of this phase of the sublime. The speech of the *Erdgeist* in Goethe's *Faust* is an example quite similar in form and content. In Hebrew poetry Hegel finds the highest realization of the sublime; "Jehovah is not 'immanent' in nature, but 'transcendent'

—lord over the universe—and in his presence the entire creation is devoid of power and sinks into nothingness. The grandeur of the Lord is revealed by the fact that the real world, with all its splendor, pomp, and magnificence, is a mere accident, an instrument, an ephemeral appearance in comparison with the eternal and immutable Being. In the 104th Psalm God is represented as covering himself with light as with a garment, and as stretching out the heavens like a tent. 'He layeth the beams of his chambers in the waters; he maketh the clouds his chariot; he walketh upon the wings of the wind; he looketh on the earth, and it trembleth; he toucheth the hills, and they smoke. He laid the foundations of the earth, that it should not be removed forever.' In the psalm of Moses (Ps. xc.) the finitude of man furnishes the contrast which makes the portrayal of the omnipotence of God sublime." For other but less adequate treatises on this subject, the reader is referred to the writings of Burke, Dugald Stewart, and Addison. The famous treatise of Longinus (Περὶ Ὕψους) should not be omitted. WILLIAM T. HARRIS.

**Sublime Porte**: See PORTE.

**Subluxation**: See SPRAIN.

**Submarine Navigation** [*submarine* is from Lat. *sub*, under + *marine*, from Lat. *mari'nus*, deriv. of *ma're*, sea]: the art of navigating a submerged vessel. In submarine navigation it is requisite that an operator should be able to move freely in any direction and at any depth, and with no communication with the surface except at long intervals. The accounts of early attempts to accomplish these results are exceedingly meager. William Bourne, of London, is mentioned as proposing a plan in 1578, and Cornelius Debbrel, in 1624, is said to have constructed a submarine boat to carry twelve rowers, besides passengers, and also to have discovered a liquid which had the property of restoring air when it became impure by breathing: but he died before his plans were perfected, and his secret died with him. Papin and Borelli are mentioned in 1672, and Stapleton in 1693; but little was apparently accomplished till 1771, when David Bushnell first suggested the idea of attacking a vessel underneath the water, and constructed a submarine boat capable of accomplishing the desired object. There is no drawing extant of this remarkable invention, but the accompanying figure corresponds with the descriptions, which are quite accurate, and will serve to illustrate an invention which, for the purpose for which it was designed, was the most perfect thing of its kind that has ever been invented. The boat was shaped like a turtle, and floated in the water with the tail down. It contained air enough to support life for half an hour, and air could be renewed at the end of that time through small ventilators by rising to the surface. The operator was seated in the middle, the seat forming a brace between the two sides, and in this position he had his eyes opposite one of the numerous glass plates in the cover or top of the boat. In front of him was the handle of a screw, by which the boat was propelled; another, by which it was raised or lowered; a compass marked with phosphorus; a water-gauge, to show the depth, marked with oil and phosphorus; and near him the handles or treadles of various small pumps and levers, by which water and foul air were expelled, the rudder moved, ballast let go, etc. The torpedo—or submarine magazine, as Bushnell called it—consisted of a block of oak containing a charge of about 150 lb. of powder. This block was on the upper after

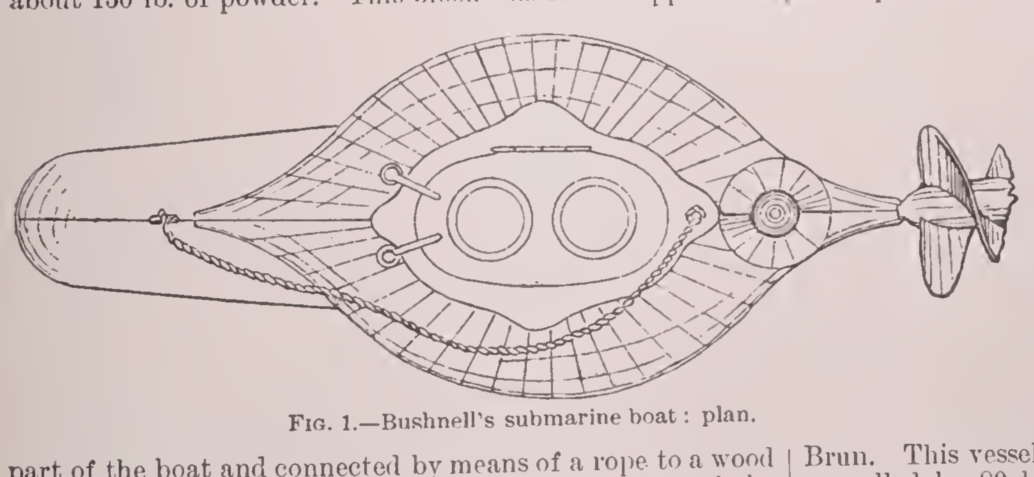


FIG. 1.—Bushnell's submarine boat: plan.

part of the boat and connected by means of a rope to a wood screw, the handle of which was directly in front of the operator. The mode of operation was to move slowly along the surface, with the top just awash, till within a short distance of a vessel at anchor, then to sink, and, coming up underneath the bottom, fasten the torpedo by means of the screw. The torpedo and screw were then detached from the

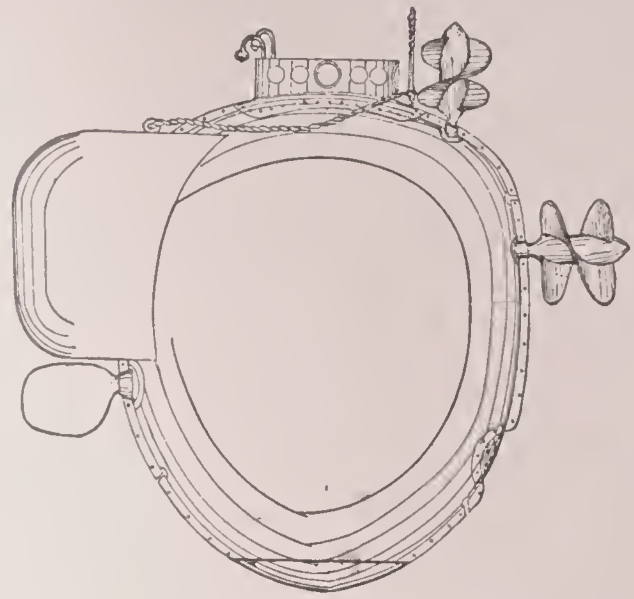


FIG. 2.—Bushnell's submarine boat: elevation.

operator's boat, a clock-work mechanism inside the torpedo being set going at the same time. This clock-work could be set for six, eight, or twelve hours' run, thus allowing the operator ample time to make his escape. See TORPEDOES.

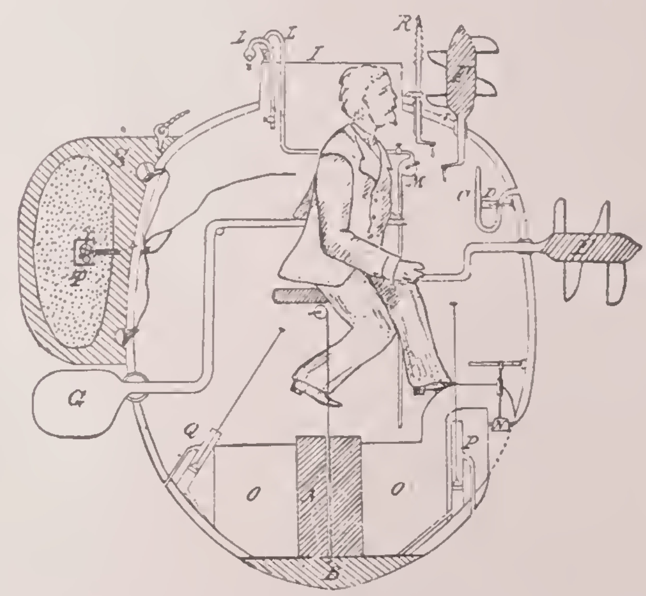


FIG. 3.—Bushnell's submarine boat; vertical longitudinal section.

| | |
|---|---|
| A, permanent ballast. | M, ventilator. |
| B, movable ballast. | $x$ $x$, valves in L L. |
| C, water-gauge. | N, valve to admit water. |
| D, compass. | O O, water-tank. |
| E, screw. | P, pump for discharging O. |
| F, screw. | Q, bilge-pump. |
| G, rudder. | R, wood screw. |
| I, entrance. | S, magazine. |
| L L, air-pipes. | T, percussion clock-work. |

In 1845 a shoemaker of Michigan City, Ind., named Phillips, devised a submarine boat in which he made frequent descents, sometimes taking his family. In 1864 occurred the only successful use of a submarine boat in warfare, when the U. S. S. Housatonic was sunk by a spar-torpedo carried by a Confederate "David," a cigar-shaped boat built of boiler-iron and having a crew of nine men, eight of whom worked the propeller. This boat is, however, supposed to have been only partially submerged when the attack was made. She was sunk with her entire crew by the explosion of her own torpedo. About the same time the French Government tried a boat called the Plongeur, designed by Admiral Bourgeois and M. Brun. This vessel was of about 200 tons displacement and propelled by 80 horse-power compressed-air engines. Her depth of immersion was to be regulated by the admission or expulsion of water, but horizontal rudders of large area were found a better means of attaining this end, and a vertical screw worked by hand was afterward added to assist in the depth regulation. Although since Bushnell's time many inventors, including Fulton, have turned their attention to submarine navigation, little real progress was made for over a century. The principal naval powers, however, have conducted experiments looking to the adoption of submarine boats for war purposes, and it has been shown that submarine navigation is feasible, though opinions differ greatly as to its value for actual service.

In Great Britain the Nordenfelt boats have attracted widespread attention. Their principal features are steam-propulsion on the surface, the use of the reserve heat stored in the water and superheated steam for propulsion under water, and submergence by vertical screws. The first boat, built in 1883 and sold to Greece, had a surface speed of 9 knots. The second and third boats were of 160 tons displacement, with 12 knots surface speed, and were built for the Turkish Government. The fourth boat embodies numerous improvements over her forerunners. Her displacement is 250 tons submerged and 160 tons when running on the surface. Engines of 1,000 horse-power give a speed of 15 knots on the surface, and the heat stored in her boilers, which contain 27 tons of hot water, furnishes power for a submerged run of about 20 knots at 5-knot speed. Submergence is effected by vertical screws, working in wells, one at each end of the boat, and actuated by separate engines, the boat being first brought awash by filling certain compartments with water. The reserve buoyancy is never less than half a ton, and can be increased by expelling the water by powerful pumps. In the conning-tower are placed the necessary connections for controlling the machinery for driving and steering the vessel, sinking or rising, and for discharging the Whitehead torpedoes with which she is equipped.

In France, where perhaps the greatest advance in the art of submarine navigation has been made, the Goubet boats, a number of which are said to have been bought by Russia, succeeded the Plongeur. These are very small boats and originally were driven by hand-power, though in the later ones an electric motor working from accumulators is used. The submerged displacement is 2 tons and the speed 5 knots. Trim is preserved by water-tanks at each end connected by a pump which transfers water from one to the other on being started by the automatic action of a pendulum. The crew of two men are provided with sufficient air, from a reservoir at 50 atmospheres pressure, for ten hours. The screw is fitted with a universal joint so that the propelling power can be applied to changing the course in any direction. The armament consists of a torpedo carried outside the boat and intended to be released at the proper moment so as to rise under the enemy's bottom and there be exploded by a wire leading to the boat after she has withdrawn to a safe distance. The utter impracticability of this method of attack is evident. A later French production is the Gymnote, of 30 tons displacement, spindle-shaped, and 56 feet long by 6 feet maximum diameter. This boat was so successful that a larger boat of the same general design, and named after the inventor, Gustave Zédé, was also ordered. The Gymnote is propelled by a 55 horse-power electric motor worked by accumulators, submergence being effected by filling water-compartments until she has only a slight buoyancy and then causing her to dive by means of horizontal rudders. She has a speed of 10 knots and is worked by a crew of three men. An electric gyroscope indicates angular movements in the horizontal plane, and enables her to maintain a fixed course beneath the surface.

In the U. S. two improved types of submarine boat, invented respectively by George C. Baker, of Detroit, and J. P. Holland, of New York, have been tried. The essential feature of the Baker boat is the use of two screws on a transverse shaft through the center of gravity of the boat, these screws being susceptible of movement so that the thrust developed by their rotation can be directed at will in a plane at right angles to the shaft. The motive power is electricity from storage-batteries, and submergence is effected and maintained by giving the screws a sufficient angle to overcome the buoyancy by the vertical thrust and at the same time propel her by the horizontal component. This plan renders it less important to preserve horizontality of the boat's axis than in a boat whose motive power is at the stern, but it has the disadvantages of being wasteful of power and of placing the screws in a greatly exposed position. The Holland boat, which has been, perhaps, as successful as any yet built, is shown in the drawing. She was 31 feet long by 6 feet in diameter, circular in cross-section, and weighed 18 tons when submerged. The motive power was obtained from a petroleum-engine which gave a surface speed of 8 knots and a submerged speed of about 6 knots. Reservoirs containing 240 cubic feet of air at 300 lb. per square inch supplied the air necessary for breathing purposes, for the engine, for the propelling charge of a gun fixed in the bow, and for expelling water from the water-ballast tanks if it became necessary to ascend quickly to the surface. The engine-compressor, drawing its air directly from the living space, gave sufficient ventilation. The essential feature of this boat was the use of diving-rudders on a horizontal shaft at the stern, to produce and maintain submergence, the boat being steered in a vertical direction just as an ordinary boat is in the horizontal plane. The practicability of this method was proved by numerous dives in water of various depths, and it was found possible to maintain a nearly constant depth either by hand-steering or by an automatic device similar to the depth-regulator of a Whitehead torpedo. A camera-lucida projecting above the water gave a clear view while the boat was running several feet below the surface.

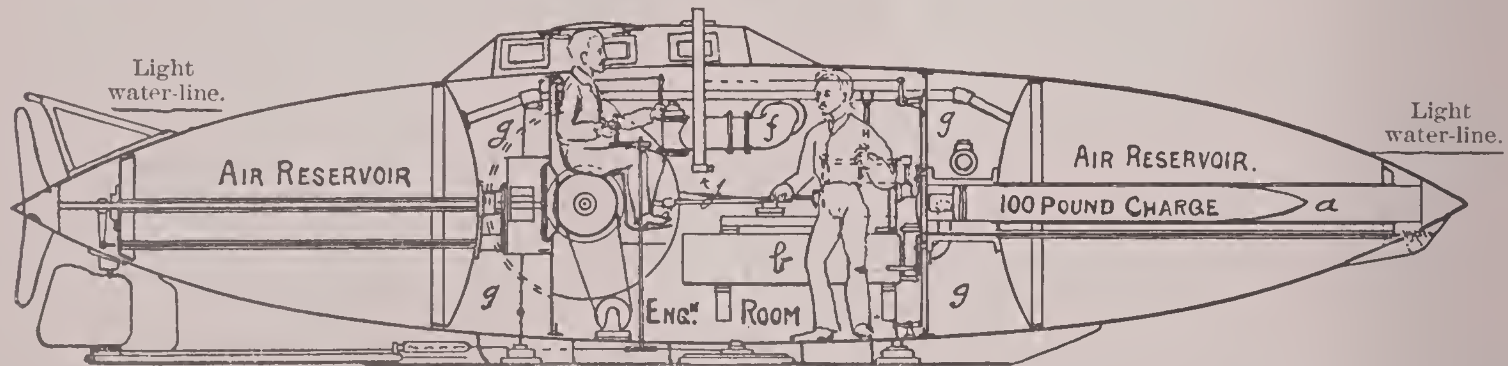



Fig. 4.—Vertical longitudinal section of Holland's submarine boat: *a*, submarine gun and projectile; *b*, firing-charge chamber; *f*, automatic air-pressure regulator; *g g*, water-ballast tanks; *j*, camera-lucida.

In 1892 an appropriation of $200,000 was made to enable the Navy Department to build and test a submarine boat, and Mr. Holland's plans for a boat of about 150 tons displacement were adopted. This boat differs from that above described in having a 70 horse-power electric motor, worked from storage-batteries, for under-water propulsion. Her surface speed was designed to be 15 knots, with 1,000 horse-power steam-engines actuating twin screws, and her submerged speed 8 knots for six hours. An automatic device controlling the vertical rudders enables a straight course to be held under water. The armament adopted consists of Whitehead torpedoes expelled from a pair of bow tubes. In addition to the diving-rudders this boat has a vertical screw at each end actuated by an 8 horse-power electric motor to maintain submergence when not moving. An important feature is an automatic safety device by means of which, when a dangerous depth is reached, air is admitted into a bow compartment, expelling a large quantity of water, and, by raising the bow, changing the course upward.

General requirements for submarine boats for war purposes—and this is their only practical use—stated in the order of their importance, are safety, facility of manœuver, speed, endurance, and offensive power. For safety the boat must have strength to resist the crushing force of the greatest depth to which she will descend, and must possess a reserve buoyancy, overcome during submergence by mechanical means but never destroyed. She must have stability enough to prevent capsizing or considerable change of trim under service conditions, and must carry an ample supply of air for the crew. Modern steel construction enables the necessary strength for a submergence of 150 feet, which is ample, to be obtained with a weight of hull of about one-half the displacement. Reserve buoyancy is a feature of all modern submarine boats, and additional safety is given by various devices whereby the pressure due to any stated depth will automatically impel the boat upward, either by expelling water from the tanks or by moving the horizontal rudders. Stability on the surface is obtained as in ordinary vessels, and below the surface by simply placing the center of gravity below the center of buoyancy. Compressed air in tanks gives a ready means of ventilation, but in a boat of ordinary size there is enough air to last the crew several hours, especially as the storage-batteries generally in use for propulsion under water give off a certain quantity of oxygen. Complicated means for purifying the air are found to be practically not necessary. Facility of manœuver in the vertical plane can probably be best obtained by diving-rudders, for with these a boat can most quickly come to the surface and again disappear. Any simple form of pressure-gauge will indicate the depth of submergence, and the variations of the water-pressure are easily made to control the diving-rudders automatically, the replacement of fuel, torpedoes, or other stores expended by an equal weight of water keeping the buoyancy and trim unchanged. Motion in the horizontal plane is controlled by ordinary rudders and twin screws add to the turning power. Surface speed is of great importance, since approach to an enemy must be on the surface, and escape may depend upon it. Steam propulsion is still the best for surface use, means being provided for rapidly housing the smoke-stack and sealing the furnace-doors preparatory to diving. Endurance depends only on the weight which can be allotted to fuel or other sources of power. Fuel for a run of 1,000 miles on the surface and electric power for a run of 50 miles under water can easily be carried in a boat of 150 tons. For purposes of offense the automobile torpedo is probably most effective, though the submarine gun, using either powder or compressed air as a propelling charge, promises well. Speed under water is best obtained by the use of the electric motor and storage-batteries, the feature of unchanging weights having manifest advantages. With a vessel of good form there should be no difficulty in attaining as great or greater speed than on the surface, but there is no probability that high speeds will ever be used in submarine navigation, the impossibility of seeing anything and the uncertainty of position and direction rendering it necessary to move slowly.

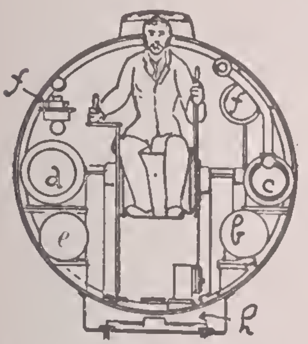


FIG. 5.—Vertical cross-section of Holland's submarine boat: *b*, firing-charge chamber; *c*, air-compressor; *d*, petroleum engine, 20 effective horse-power; *e*, engine air compressor; *ff*, automatic air-pressure regulators; *h*, manhole for diver.

PHILIP R. ALGER.

**Subpœ'na** [Lat. *sub*, under + *pœ'na*, penalty]: in law, a writ or process by which either parties or witnesses are compelled to appear in court or before a judicial officer and answer or testify, as the case may be, under a penalty for their disobedience. There are several different kinds of this writ. In the courts of chancery it was for a long time the ordinary process, issued upon filing a bill of complaint, for the purpose of procuring the defendants to appear and answer. This use, however, was abolished in England some time before the consolidation of the law and equity courts and procedure (see COURTS), and the defendant in a chancery suit was simply served with a copy of the bill, and with a notice or summons indorsed thereon or accompanying the same. The common species of subpœna now used in all the courts, civil and criminal, is the subpœna *ad testificandum*, for the purpose of ordering witnesses to attend upon a trial or other judicial examination, and to give their evidence thereat. It generally purports to be issued by the court, to be signed by its clerk, and sealed with its seal; but in the loose practice prevailing in many States of the U. S. it is issued by the attorney. It commands the person to whom it is addressed to lay aside all excuses and pretenses, and to appear before the court or officer at the time and place mentioned, and testify on behalf of the party issuing it, under a penalty in case of a neglect to comply with the order. A variety of this species is termed the *subpœna duces tecum*, and contains an additional clause directing the witness to bring with him into court certain books, papers, etc., in his possession which may be useful as evidence, and which must be designated with sufficient particularity to apprise the witness of the exact papers to be produced. Both these forms are compulsory; the witness must obey the mandate, and it is for the court alone to decide whether his evidence or the documents he is ordered to produce are material and proper. If the witness violates the command, an action for damages may be maintained against him by the party who is materially injured by his default. The subpœna is served by exhibiting the original to the witness and delivering to him a copy thereof, and paying him his lawful fees for travel and for attendance. Both the subpœna *ad testificandum* and the subpœna *duces tecum* may be used by committees of legislatures and other *quasi* judicial bodies lawfully constituted for the purpose of carrying on investigations, as well as by courts and magistrates. Revised by F. STURGES ALLEN.

**Subroga'tion** [from Lat. *subroga're*, put in another's place, substitute; *sub*, under + *roga're*, ask]: an equitable doctrine by which a person paying in proper circumstances a debt which as between himself and another should have been paid by the latter is given the rights and remedies of the original creditor. It may be stated as a general principle that whenever a person *secondarily* liable for a debt pays the same, the demand is not regarded in equity as discharged, but he at once and by operation of the equitable doctrine succeeds or becomes subrogated to all the rights, remedies, and securities which the creditor held against the debtor primarily liable, and may enforce the same as a creditor against such debtor in order to reimburse himself for the outlay which he has made on behalf of that party. The following are some of the most common and important instances which result from an application of this general principle to different facts and circumstances: (1) When a junior mortgagee pays the debt due to a prior mortgagee of the same land he becomes entitled to the prior mortgage, is regarded as its equitable assignee, and can compel its actual assignment to himself. The rule applies to all cases where a junior creditor pays the demand of a prior creditor; he succeeds to the latter's claim and is entitled to all the securities held for its enforcement. (2) When one of several joint debtors pays the entire demand he is entitled to a contribution from the others for their respective shares, and acquires the rights and securities of the creditor against them. (See CONTRIBUTION.) (3) The principle is most frequently applied in the case of the surety who pays the demand primarily owing by his principal debtor. He is entitled to recover their contributory shares from his cosureties, if any, and the entire amount which he has advanced from his principal. To aid him in enforcing these rights he is entitled to hold and use all the collateral securities given by the principal debtor to the creditor. For example, if as such surety he pays off a mortgage debt he is an equitable assignee of the mortgage itself. If the creditor has recovered a judgment against the principal and surety, or against the principal alone, and the surety pays the demand, he is not only entitled to hold this judgment, but he is permitted to enforce it by execution against the principal.

Revised by WILLIAM A. KEENER.

**Subsidies** [from Lat. *subsidium*, reserve-troops, support, relief; deriv. of *subsi'dere*, settle down, lie in wait]: (1) in English constitutional history, special taxes assessed upon persons and not directly upon property; (2) in the political history of Europe, payments to an ally, to aid in carrying on a war; (3) the usual application of the term since 1840, grants of money by the state in aid of individual enterprises. The most important subsidies of this kind have been granted in aid of transportation companies.

*Railway Subsidies.*—In Great Britain the Government granted no subsidies whatever except in Ireland. France defrayed about half the original cost of her railways, and left them to the companies to operate. This policy was followed in most of the other states of Southwestern Europe, as well as by Austria, Russia, and British India. (For the history of direct ownership of railways by the state, see TRANSPORTATION.) In the U. S. the subsidy system has been much more complicated. Railways have been assisted by State and municipal subscriptions to their stock and their bonds, even on an unwisely large scale. National aid to railways, with one important exception, has been in the form of grants of public land. From an early period there had been important grants of this kind in favor of roads and canals. In 1850 large grants of public land were made to the Illinois Central and the Mobile and Ohio railroads, through the medium of the States of Illinois, Alabama, and Mississippi, Congress for form's sake delivering the land to the States, to be in turn by them delivered to the railway companies. The example was rapidly followed in other parts of the U. S., the system being extended to Missouri in 1852, to Arkansas in 1853, and in 1856 to Michigan, Wisconsin, Iowa, Florida, and Louisiana, besides additional grants to Alabama and Mississippi. It was a game of sectional interests, each part of the republic being anxious to secure its share of the spoil. Some 27,000,000 acres were given to corporations in this way before the crisis of 1857 put a temporary stop to all schemes of the kind.

The civil war, though it stopped railway building, gave a new impulse to the policy of subsidies. California was at that time so far out of communication with the rest of the republic that its adherence to the Union was a matter of sentiment rather than of direct connection. To strengthen this sentiment on the one hand, and to secure the means of communication by land when it was no longer safe by sea, public attention was directed to the project of a Pacific railway, which seemed to be a political necessity, to be obtained at almost any price. The Pacific Railroad Bill, carried by Thaddeus Stevens in 1862, gave to the Union and the Central Pacific railroads a money subsidy amounting to over $25,000 a mile, and more than 30,000,000 acres of land in addition. The money subsidy took the form of a loan, but it was not expected that it would be repaid. It seemed for a time doubtful whether the road would be built at all; but the work proved unexpectedly easy, and the Crédit Mobilier, a construction company formed for the purpose of building the road, realized enormous profits, involving a public scandal, since many Congressmen were found to hold the stock of this construction company without having furnished any consideration therefor. The unexpected success of this enterprise made the company profitable, and it might have paid interest on the moneys advanced by the U. S., but, taking advantage of a technical defect in the remedies by which the lien of the U. S. could be enforced, the company evaded this obligation. The Thurman Act of 1878 attempted to settle the matter by providing for the payment to the U. S. of a portion of the earnings of the company, to form a sinking fund which should meet the amount of the debt at maturity; but these earnings proved much less than had been expected.

The Northern Pacific road did not succeed in getting a cash subsidy, like that of the Union Pacific, but its promoters secured a double grant of land per mile, amounting to about 47,000,000 acres in all. The two southern routes secured about 70,000,000 acres, so that there have been granted in aid of railways something like 160,000,000 acres of territorial land. In addition to this, Congress, in the years immediately following the war, renewed the policy of State land grants, renewing those which had been forfeited and adding new ones to the amount of some 30,000,000 acres. Besides these grants of U. S. land, certain swamp and timber lands, which under general laws had been made the property of the States themselves, were also devoted to the aid of railway construction. The nominal amount of land thus granted in aid of railways under various acts exceeds 200,000,000 acres, but only a little more than a fourth of this has been actually patented.

The method adopted in the granting of the lands was ingenious. The whole country being divided into quarter sections of 160 acres each, the U. S. reserved the alternate squares or quarter sections, like the black squares on a checker-board, and granted to the railways only the intermediate parts. On the lands thus reserved by the U. S. the price was at once doubled, so that the treasury was as well off as before, and even better off, since its land came into market more rapidly, owing to the construction of the roads. Meantime, it was ingeniously argued that a settler, so far from being burdened by the change, was better off than before, for he could better afford to pay $2.50 an acre for land that was near a railway than $1.25 an acre for land which was wholly out of reach. Thus it was thought that the help might be rendered to the railways without sacrifice of any other interests. Unfortunately, it proved that the system stimulated unsound railway schemes and caused railway building to be misdirected; that the provisions intended to protect the Government interests were disregarded; that the settler was induced to move too far West, where he was, for the time being, at the mercy of the railway; and that the real gainer by these schemes was usually either the land speculator or the financial operator of the worst sort. The best practical proof of these mistakes is seen in the reaction against land grants which made itself suddenly felt at the time of the granger movement. Since 1872 the policy has been abandoned, though it has been impossible always to enforce forfeitures, even in cases where such a procedure would be clearly just. The whole history of the land grant system, as well as that of municipal subscriptions to railway stock and bonds, gives force to the views of those who disbelieve in Government interference. It appears that business men, as a rule, can judge better than Congressmen of the necessities of the various sections of the U. S., and that the attempts to stimulate enterprise in particular directions, though well meant, have been apt to do harm rather than good. It is probable that the subsidy to the Union Pacific was justified by the result, and perhaps that to the Illinois Central also, but the number of mistakes is largely out of proportion to the number of successes.

A most important system of subsidies has been that of the Dominion Government to the Canadian Pacific Railway. The reasons in this case were a good deal like those for the Union Pacific route in the U. S., and the success of the enterprise seems to have justified the policy of its promoters.

*Steamship Subsidies.*—Ocean steam-navigation was proved possible as early as 1818, but it was not until many years afterward that the commercial success of any such enterprise was assured. The marine engines of that period were not economical in their construction, and sails furnished cheaper, though less sure, motive power. It was a political necessity, however, for Great Britain to have steamships sooner than any other nation, even if such steamships were for the time being unprofitable. Her colonial possessions were so scattered that every argument in favor of the Union Pacific Railway subsidy in the U. S. applied with vastly greater force to steamship subsidies for Great Britain. In 1838 proposals were asked for a line of Atlantic steamers, and in 1839 the contract was awarded to Samuel Cunard. In 1840 four ships were put on, with an annual subsidy of £81,000. The contract was gradually extended until 1858. It was not until about 1870 that it was gradually reduced. About the time of the establishment of the Cunard subsidy a contract was made with the Peninsular and Oriental Steamship Company for the carriage of the mails to Gibraltar, and this contract was afterward extended so as to secure the carriage of the mails by the same company to Alexandria, Calcutta, Bombay, and finally to Australia. In 1840 a contract was also made with the Royal Steam Packet Company for the carriage of mails to the West Indies, and afterward to South America. At the time when the subsidy system was most largely developed, the British Government was spending in round numbers £1,000,000 annually for the conveyance of the mails—a sum which has been reduced to about £700,000 annually.

To the Cunard Company and to the Royal Mail Company these contracts were unquestionably of great value. In the case of both these companies the price paid was sometimes much more than the service was commercially worth. If proof were needed, this is shown by the fact that the Inman line, established in 1850, has worked successfully without the aid of subsidies. Other unsubsidized companies of the same sort soon followed, and ultimately public sentiment forced the Government to reduce the payments to the Cunard line. The Peninsular and Oriental Company was not quite so liberally dealt with as the two other great subsidized lines. In many cases it would appear that the special requirements as to construction, sailing ports, and penalties for delay almost offset the advantage of a subsidy. Great Britain was paying not for mail contracts but for military strength, and she got what she paid for, and on the whole she got it cheaply. In one instance, at least, that of the Galway and the Anchor line, a subsidized line failed in the competition with an unsubsidized one.

The admiralty subsidies in Great Britain are at present £33,847 annually. Besides this, the payments for carrying the mails in the fiscal year 1893–94 were £710,585, which is about £450,000 in excess of the receipts for sea-postage.

The U. S. did not want Great Britain to get the start in ocean steam-navigation. In 1841, two years after the first Cunard contract, there was an agitation in favor of similar action on the part of the U. S. In 1845 the Postmaster-General was authorized to make contracts for the conveyance of foreign mails in steamships sailing under the U. S.

flag. A line to Bremen was established under this act in 1847. In the same year an act was passed requiring the Secretary of the Navy to arrange for U. S. steamships to carry the mail from New York to Liverpool, to the West Indies and Gulf ports, and from Panama up the Pacific coast. From these contracts arose the Collins line and the Pacific Mail Steamship Company, besides others less important. By act of 1851 provision was made for the Panama Railroad, and in 1852 the Collins line subsidy, originally $385,000, was increased to $858,000 annually. In 1852 the payments for U. S. foreign mail service amounted to about $2,000,000. The Collins line was the most important enterprise, and for the time being the most successful. It had the fastest and best steamships of their period, built of oak, and relying on paddle-wheels as their motive power. The subsidy was $33,000 a voyage, or $4.70 per mile run. The average speed attained was nearly half a day better than that of the Cunarders. In 1854 the Arctic was sunk in a collision, and the Pacific disappeared in 1856. Such was the effect of these accidents that, in spite of the subsidy, it was no longer possible to run the Collins line, and the field was left to the British steamers. At the outbreak of the civil war the U. S. lines to Europe were withdrawn. In 1864 arrangements were made for subsidizing a line to Cuba and Brazil. In 1865 the Pacific Mail Company was offered large inducements to extend its lines to China and Japan; $150,000 annually was spent for the Brazil line; $500,000 for the China and Japan line. In 1868 an attempt was made to establish a European line with a subsidy of from $400,000 to $600,000 a year, but it failed because the mail service provided under this act would have been inadequate. In 1872 an attempt was made to increase the subsidies to the Pacific Mail and Brazil companies. But the reaction was close at hand. An investigation into the history of the means by which these appropriations were secured brought such scandalous corruptions to light that no Congressman dared to vote for the continuance of a policy of this kind. Meantime the Pacific Mail Company had been unfortunate in every way. Prior to 1865 it had been a sound concern. When the subsidy was increased it fell into the hands of speculators. The stock fell from par to below 40. The money under the supplementary contract of 1872 was not earned by the company, owing to its failure to construct the vessels at the appointed time. In 1875 the Brazilian and Pacific mail subsidies expired, and hardly a voice was heard in favor of their renewal. In the year 1879 a strong effort was made to secure renewed subsidies for a Brazilian steamship line, but without success. It was not until 1891 that the efforts to secure profitable mail contracts for American lines met with anything like success. By an act of Mar. 3 of that year the Postmaster-General was directed to make arrangements with U. S. steamship companies, whose vessels were so constructed that they could serve as naval auxiliaries in time of war, to carry the U. S. mails at a rate not to exceed $4 a mile run with first-class vessels—i. e. vessels of not less than 8,000 tons register and 20 knots an hour ordinary sea speed. Vessels of lower classes in tonnage and speed were limited to $2, $1, and $0.66⅔ per mile for successive classes. Mail contracts for service between the U. S. and Great Britain were only to be made with vessels of the first class. A number of lines to South American ports took advantage of these contracts, and the Pacific Mail and Oceanic companies arranged for a considerable Pacific service on this basis; but it was not until the autumn of 1892 that the International Navigation Company made an arrangement for first-class European service (in connection with the admission of the Paris and New York to the U. S. register).

To U. S. steamships carrying mails without special contract an advantage is given by paying them $1.60 a pound for letters and post-cards and 8 cents a pound for other articles, instead of 44 cents and 4½ respectively, which are the rates paid foreign vessels. The total ocean mail payments of the U. S. in the year 1893–94 were as follows:

| SERVICE. | U. S. vessels. | Foreign vessels. |
|---|---|---|
| Transatlantic service | $188,722 | $422,160 |
| Transpacific service | 140,756 | 11,699 |
| Miscellaneous service | 381,966 | 28,098 |
| Totals | $711,444 | $461,957 |

The Dominion of Canada voted a subsidy of £15,000 to the Canadian Pacific Railway for its service to China and Japan, and a few years later (1893) it voted £150,000 for a transatlantic steamship line.

Germany has paid subsidies to mail-steamers amounting in 1893 to 4,990,000 marks, or $1,240,000—averaging about $1.25 per mile run—besides regular payments at low rates for mail carriage on ordinary routes.

France has adopted a much more comprehensive system of shipping bounties. It includes payments both for construction and navigation of steam-vessels, whether they carry mails or not. By the act of 1893 the construction bounties are as follows:

| | | |
|---|---|---|
| Iron and steel vessels | | 65 francs per gross ton. |
| Wooden vessels: | Over 150 tons | 40 " " " " |
| | Under 150 tons | 30 " " " " |
| Engines and boilers | | 15 francs per 100 kilos. |

In addition to this there are navigation bounties for vessels engaged in foreign trade. For those engaged in the "distant" trade (beyond Gibraltar or the Suez Canal) these bounties are as follows per 1,000 nautical miles run:

| VESSELS. | First year, francs per ton. | Decrease for each successive year. |
|---|---|---|
| Steel or iron, steam | 1·10 | 0·4 |
| Wooden, steam | 1·10 | 0·6 |
| Steel or iron, sail | 1·70 | 0·6 |
| Wooden, sail | 1·70 | 0·8 |

In order to earn this bounty these boats must be built in France and almost entirely manned by French sailors. The act of 1881 allowed one-half the regular rate of navigation bounty to foreign-built ships run under the French flag, but this was withdrawn by the act of 1893. Vessels in the short-distance foreign trade earn two-thirds of the amount above given. The average annual payments under the act of 1881 were: Construction bounties, $570,000; navigation bounties, $1,540,000. The act of 1881 was more successful in encouraging navigation than in encouraging construction.

Italy has a combined system of construction and navigation bounties. The construction bounties are nominally in the form of a tariff rebate on materials used; but as this rebate is purposely made larger than the tariff, it operates as a premium. The navigation bounties are at the rate of .65 lire (about 12½ cents) per net ton per 1,000 miles on all long distance voyages. The total amount paid averages about 4,000,000 lire a year. Most of the long mail routes are maintained under special contract rather than under the general act.

Austria has a combined system of mail contracts with navigation bounties. Norway and Sweden have no direct subsidies, and their postal contracts are trifling in amount.

A. T. HADLEY.

**Substance** [from Lat. *substan'tia* (*sub*, under + *stare*, stand), constructed first as translation of Gr. ὑπόστασις, support, real essence, substance; ὑπό, under + ἱστάναι, stand]: in philosophy, a term which appears first in Aristotle, who uses it in two senses, between which it has wavered ever since. Logically, it is the first of the categories as opposed to the other nine, which are its accidents (συμβεβηκότα). There are first and second essences, the first always designating singulars—e. g. *a man*, *a horse*; the second being general terms, as *man*, *horse* (*Categ. V.*). It is also used in the sense of εἶδος or constituting essence, in which acceptation it is sometimes rendered into Latin by *essentia* (*Metaph. IV.*, 8). The logical οὐσία is the first of induction (πρῶτον πρὸς ἡμᾶς); the metaphysical οὐσία, the first of deduction (πρῶτον φύσει). None of the post-Aristotelian philosophical schools had profundity enough to require the category of substance until the rise of the Neo-Platonists, who re-established it. Plotinus criticises Aristotle rather severely for not distinguishing between material and spiritual substance (*Enneads*, bk. vi.), as he himself did. Porphyry and Simplicius accepted the Aristotelian doctrine. In the Middle Ages the metaphysical view prevailed, and substance was identified variously with God, person, etc. The same is true of modern times, dating from Descartes. He regarded substance as that which can exist independently of anything else, and Spinoza (*Ethics*, i., def. iii.) as "that which is in itself and is conceived by itself"—a definition which, of course, identifies it with God. Leibnitz identified with substance the monads. Locke looked upon substance as a mere imagined substratum, holding attributes together, but did not altogether deny its validity, as did Hume (*Human Nature*, pt. i., § 6). Kant classed substance in his Transcendental Table of the Concepts of the Understanding along with Cause and Community under the head of Relation, and defined its scheme as the "permanence of the real in time" (*Critique of Pure Reason*, p. iii., Meiklejohn's translation). Hegel defines substance as the "absolute, as relation to itself" (*Logik*, pt. 2, p. 185, ed. 1834), and as "the unconditioned essence (*Wesen*) existing in and for itself as being immediate existence" (*Propädeutik*, p. 105). Mill and the English school mostly follow Locke. In the orthodox doctrine of the Trinity, substance is used of the essential unity of the Divine Being as distinct from the tripersonality.

THOMAS DAVIDSON.

**Substitutions, Theory of**: a recondite but most attractive branch of modern mathematics, which has placed the theory of algebraic equations on a new basis. A substitution is an operation which is conceived to interchange quantities or symbols among themselves, putting one in place of another, but taking none away, and adding no new ones. If we have an algebraic expression containing several symbols, say the roots of an algebraic equation, some substitutions may change the value of the expression and others may not. For example, in the expression $x + y - z$, an interchange of $x$ and $y$ makes no change of value, because $x + y = y + x$; but interchanging either of these quantities with $z$ changes the value. An excellent treatise on the subject is that of Netto, of which an English translation from the German original has been made by Prof. Cole, of the University of Michigan, and published at Ann Arbor. The most exhaustive treatise is that of Jordan, of Paris, published in 1870. S. NEWCOMB.

**Succession** [from Lat. *succes'sio*, deriv. of *succe'dere*, *succes'sum*, go under, follow after; *sub*, under + *ce'dere*, go]: in European law, a term which covers all cases where rights or obligations previously established are acquired or assumed by new parties. Where one acquires a right previously held by another, the jurist speaks of an active succession; where one takes the place of a debtor, they speak of the succession as passive. The ordinary transactions of life give rise only to special or "singular" successions. In case of death, however, the Roman law, and the majority of modern legislations provide that some person or persons shall step into the place of the deceased, acquiring, in principle, all his rights, and becoming answerable for all his obligations. These persons are the "heirs" (see HÆRES), and their succession is termed universal.

The heir or heirs may have been designated by the deceased. At Roman law this could be done only by testament. (See WILL.) Teutonic custom, however, permitted rights of inheritance to be created by contract also, and most of the modern German codes retain the Teutonic rule (so the Prussian and Saxon codes, the German draft code, and, with limitations, the Austrian code). In the French law, rights of inheritance can be created by antenuptial contracts, but by such contracts only.

In the absence of heirs designated by the deceased, the succession is determined by the law. Succession *ab intestato* may be based upon the family organization or upon consanguinity. The first principle would wholly exclude illegitimate children. The second would exclude succession between husband and wife, and between adoptive parents and children. The Roman law, in its latest development, represents a compromise between the two principles. The same is true of all modern European legislations. Illegitimate children have some rights of inheritance, not only from the mother and her relatives, but also (if "recognized") from the father. Husband and wife also have reciprocal rights of succession, but the exact position assigned to the surviving spouse differs in different legislations. The law of intestate succession is often modified in this point by the rules of matrimonial property. See MARRIED WOMEN.

In general, succession is determined by the degree of kinship, nearer relatives excluding the more remote. (For the different methods of reckoning degrees, see CONSANGUINITY.) It should be noted, however, that the degree of consanguinity is never wholly decisive. In every legal system direct descendants, though of remoter degree, are preferred to ascendants and collaterals; and even among collaterals the remoter relative may be preferred—e. g. a brother's grandchild will always take precedence of an uncle, although by either the Roman or the canonical computation the latter is one degree nearer. In other words, every legal system regards the *kind* of relationship as well as the degree, and divides the relatives into classes, so that any member of a prior class excludes all members of a posterior class. Such a classification becomes perfectly logical only when succession is avowedly based on the preference of the nearer *parentela*. This term designates the descendants of one ancestor. The *parentela* system divides all the relations of a deceased person into a series of such ancestral groups. The direct descendants of the deceased constitute the first *parentela*. His parents and their other descendants (i. e. his brothers, sisters, nephews, nieces, etc.) make up the second *parentela*. His grandparents and their descendants (not already included in the first or second group) are of the third *parentela*, and so on. As long as any member of a nearer *parentela* is in existence, all members of other *parentela* are shut out. This is claimed to be the Teutonic principle of succession. It lies at the basis of the English law of succession to real property. It is logically carried out in the Austrian code and in the codes of several Swiss cantons. It is adopted in the German draft code.

Whenever, under any system of succession, there are several heirs of the same class, those nearer in degree are preferred. This principle is modified, however, by the right of "representation," by which more remote relatives may be put into the place of their ancestor, and take the share to which he would be entitled if he had survived the intestate. In such a case succession within the class is said to be *per stirpes*, by lines. (See DESCENT.) In all modern legislation direct descendants take *per stirpes*; and the same system obtains, to some extent at least, among collaterals. Among remoter collaterals, however, the right of representation is frequently refused, because it tends to an undesirable subdivision of property.

Teutonic law never developed a "universal succession." It always recognized distinct succession to realty and to personalty. It often drew further distinctions. It exhibited, in particular, a tendency to consider the channel through which property had come to the deceased; to prefer the paternal relatives when the property had been inherited from the father, the maternal when it had come from the mother. Modern European codes generally reject this distinction.

*Special variations* in the law of succession, which have existed in past times and still exist sporadically, are the exclusion of females or of the descendants of females (older Roman law), or a preference of the male line (classical Roman law). Similar tendencies reveal themselves in the older Teutonic law of real property; and under the influence of feudalism the preference of males was associated with the preference of the eldest son. (See PRIMOGENITURE.) In the succession to German peasant estates, also, the system of primogeniture generally obtained through the Middle Ages, and still obtains in some territories. Sporadically, a preference of the youngest son has also existed.

At Roman law the estate of a deceased person did not devolve *ipso jure* upon the heir unless he was a child or slave of the deceased. All others had to "enter," and could refuse to enter. The Teutonic principle, on the contrary, is that death vests seizin (at least as regards real property)—i. e. the legal heir acquires *ipso jure*. This rule is recognized in the French code and in the German draft code (in the latter for testamentary as well as intestate heirs); but the heir may divest himself of the inheritance by an express renunciation.

Since the acquisition of an inheritance makes the heir personally liable for the debts of the deceased, the Roman law established the rule, first for the children and then for other heirs, that they might take with the "benefit of inventory," in which case their liability was limited to the amount of the assets. This rule obtains generally in modern Europe. Conversely, when the heir is insolvent, the creditors of the estate may demand a separation.

See Demolombe, *Des Successions* (Paris, 1880); Koeppen, *Erbrecht* (Würzburg, 1888), and *Motive zum deutschen bürgerlichen Gesetzbuch* (vol. v., Berlin, 1888).

MUNROE SMITH.

SUCCESSION, in the common-law system, is employed in a more limited sense than in the civil law. In England and the U. S. the term is used only to describe the transmission of property (*a*) from a person or group of persons composing a corporation to his or their successors; or (*b*) upon the death of a person to his heir, devisee, or next of kin. Technically, it is only in the former sense—as describing the persistence of the rights of a corporation through all changes in its membership—that the term has any footing in the common law. The power of perpetual *succession* is one of the peculiar properties of a corporation, and the term successor, applied to a person in his corporate capacity, is the legal equivalent of the term heir, applied to a person in his natural capacity.

In the other sense mentioned, however, the term succession is sometimes, by analogy with its signification in the civil law, employed to describe the acquisition of property rights upon and in consequence of the death of the former owner. Thus used it may comprehend the transmission of property by will or by descent, and it is under the description of those terms respectively that the devolution of property upon the death of the owner is treated by the common law. The subject of succession by testament is considered under the title WILL. "Descent," in its more general acceptation, includes the devolution, in case of intestacy, of personal as well as of real property. As only the latter is considered under that head, however (see DESCENT), the transmission of personal estate under those circumstances is considered here.

There was no such thing as a universal succession at the common law. This familiar principle of the civil law is not to be found in the early Teutonic customary law, nor did it ever find a place in the English system. The functions of the Roman *hæres* were from an early period divided up between the "heir," who took the real property, and the person or persons to whom the personal property descended; and it is not the English heir, but the personal representative—the executor or administrator—of a decedent, whose position bears the closest analogy to that of the Roman heir.

Although the right to dispose of personal property by will has always existed at common law, it was in the early history of English law much restricted by considerations of public policy, and of what were regarded as the rightful claims of the surviving members of the family. A rule of "reasonable partition," as it was called, prevailed, which provided that if a man left a wife and children surviving, one-third of his personal estate should go to the wife and one-third to the children, leaving only one-third of the whole to be disposed of by the will of the decedent. If the testator left a wife, but no children, or if he died a widower, but leaving children, he was entitled to dispose of one half of the estate, the other half to go to the surviving wife or children, as the case might be. Long before the time of Blackstone, however, this compulsory feature of the law of descent of personal property had disappeared, and the law was confined in its operation to cases where the owner of the estate died wholly or partially intestate.

There being no absolute right of succession to personal property recognized by the common law, except as above described, the title to all such property as a decedent might have disposed of by will, but which he failed so to dispose of, vested in the crown. By a series of early statutes this right of the crown was speedily reduced to a right of ADMINISTRATION (*q. v.*), the property being "distributed very justly to the wife and children and relations, to every one according to the degree that belongs to him." (Stat. Canute, cap. 71.) So a statute of William the Conqueror (cap. 34) provided that if a man died without a will, his children should divide the inheritance equally. In the course of time this right of administration became vested in the Church, and it continued to be exercised by the ecclesiastical tribunals in England from before the reign of Edward I. (A. D. 1272) down to the year 1857. It seems, from the authorities, to be clear that by an abuse of this right of administration the clergy claimed and for a considerable period exercised the right to appropriate the personal property which thus came into their hands in case of intestacy to "charitable and pious uses," but when they were constrained by statute (31 Edw. III., Stat. I., cap. 11) to grant administration to the next of kin of the intestate the just distribution to the nearest relations which the law contemplated was again made possible.

The distribution of intestate estates which now prevails dates back directly to a statute enacted in the year 1670 (22 and 23 Car. II., cap. 10) by which the respective rights of wife, children, and next of kin were fairly and, as the event has proved, permanently adjusted. By that statute one-third of the personal estate undisposed of by will, and remaining after the payment of debts and funeral expenses, was to go to the widow, and the residue to the children, to be equally divided among them. If there was no widow, the children took the whole of the surplus; if there was a widow but no children, the widow took one half and the next of kin (parents, brothers and sisters, grandparents, etc., "every one according to the degree that belongs to him") took the other half. If the intestate left no widow or children, the next of kin were entitled to the whole surplus. In case a person entitled was dead, his legal representatives would take his share. There was no discrimination (as there was in the rules regulating the descent of real property) against kin of the half-blood nor against female kin, but all of the same class or grade of kinship inherited equally. The rights of the husband in the personal estate of his wife were not altered by this statute, but remained as at common law. As a married woman could own no personal property during her life, she could of course leave none at her death, save only such claims against others (*choses in action*) as her husband had not previously reduced to possession. As to these, he was solely entitled to administration for the purpose of collecting them in and converting them to his own use. See MARRIED WOMEN (*Property Rights*).

The statutes of distribution now in force in Great Britain and the U. S. are substantially only re-enactments of the act of Charles II. above described. (See, for example, New York Revised Statutes, ii., 96, § 75, and Laws 1845, chap. 236.) In those States in which the common-law disabilities of the married woman have been removed and she has been rendered capable of holding property free from her husband's control, the rights of the latter with respect to the property left by the wife *ab intestato* have also generally been somewhat modified. Thus it is provided by statute in New York that the husband of a deceased married woman who leaves descendants her surviving, shall be entitled only to such distributive share in the personal estate of his wife as a widow is entitled to in the estate of her husband. (Laws 1867, chap. 782, § 11.) This statute does not, of course, affect the rights of her husband in case the wife dies leaving no descendants. He is not required to share the estate with her next of kin, but takes the whole surplus as at common law.

The meaning of the expression "next of kin" and the relative rank of such persons, and the order of their succession, are defined with precision in the several statutes of distribution to which reference has been made. The test usually applied is nearness in degree of blood, and the method employed to ascertain the degree is usually that of the civil law. (See CONSANGUINITY.) Persons born out of lawful wedlock have no part in the distribution of personal estate, whether they claim as children of the intestate or as next of kin. A bastard is *nullius filius* by the common law, and is wholly outside the pale of consanguinity. In some of the States, however, an illegitimate child has by statute been rendered capable of inheriting from his mother. Of course, if such a person marries, he or she thereby becomes capable of taking property by descent from the wife or husband, the capacity in that case being wholly independent of any relationship of blood.

See the articles on DESCENT and HEIR. Consult also Stephen's *Commentaries*; Kent's *Commentaries*; *The American and English Encyclopædia of Law*, title *Intestate Laws*; Williams on *Executors*; Woerner on *The American Law of Administration*; and the statutes of the several States.

GEORGE W. KIRCHWEY.

**Succession Wars**: in general, wars resulting from conflicting claims to the throne. The term is especially applied to the four wars of the eighteenth century that arose from the disputed succession to (1) the throne of Spain (1701–14); (2) that of Poland (1733–38); (3) that of Austria (1741–48); and (4) that of Bavaria (1778–79)—of which only the first and third are of sufficient importance to be treated within the limits of the present article.

*War of the Spanish Succession.*—The weak and imbecile King of Spain, Charles II. (1665–1700), had no children, and the succession accordingly devolved upon the collateral heirs. In the lifetime of Charles there were three principal claimants, first, Louis XIV., in right of his wife, Maria Theresa, daughter of Philip IV., who, however, had expressly renounced her right in the Treaty of the Pyrenees; second, Leopold I., Emperor of Germany, by virtue of his descent from Philip III. of Spain; and third, Joseph Ferdinand, the electoral Prince of Bavaria, grandson of Leopold and Margaret Theresa, the younger daughter of Philip IV. Neither Louis nor Leopold ventured to claim the throne for himself, but only for a member of his family, the former supporting the candidacy of his grandson, Philip, Duke of Anjou, the latter that of his second son, the Archduke Charles. Nevertheless, so great an accession of power to either the Bourbon or the Hapsburg dynasty was thought to endanger the independence of other nations, and it was finally agreed that the electoral prince should succeed to the Spanish throne

His death, however, in 1699, reopened the question, now further complicated by the fact that there was no third candidate on whom all could agree. In the intrigues which ensued Louis was successful, and Charles II., just before his death in Nov., 1700, made a will bequeathing all his possessions to Philip of Anjou. The latter was well received in Spain, and his title was generally recognized throughout Europe, but Louis took a course that was at once aggressive and impolitic. He alienated the other nations by declaring that Philip's succession to the Spanish throne had in nowise affected his right to the throne of France, and he angered England by pronouncing the Pretender the lawful heir to the English throne. In the winter of 1701–02 the Grand Alliance was concluded between England, the emperor, the Dutch, the King of Prussia, and the Grand Duke of Hesse, with the object of breaking the power of the Franco-Spanish monarchy. For ten years the war was actively carried on, the chief campaigns being in Spain, in Italy, in the Rhine countries, and in the Spanish Netherlands. In Spain the French were generally successful, and, first under Berwick and afterward under Vendôme, expelled the invaders and maintained Philip on the throne. In Northern Italy the Austrians, under Prince Eugene, conquered Milan and Mantua, and finally, after a victory at Turin, forced the French to withdraw altogether from Italy. In the meanwhile Marlborough and Prince Eugene had won the important victory of BLENHEIM (*q. v.*) in 1704. Marlborough's victory at Ramillies, two years later, drove the French out of the Netherlands, and their attempts to regain their lost footing were foiled by Marlborough and Prince Eugene at Oudenarde (1708) and Malplaquet (1709). Louis now sued for peace, but the terms imposed by the allies were so humiliating that he preferred to continue the war. Circumstances soon came to the rescue of France: the death of Leopold I. and of his son and successor, Joseph I., brought the Archduke Charles to the throne. To unite the thrones of Spain and the German empire seemed even more menacing to the balance of power than to maintain the Bourbon king in Spain. In England the Tories, who had supplanted the Whigs, desired peace, and in 1713 was signed the Treaty of Utrecht, stipulating that the two lines of the Bourbon house should renounce all claims of inheriting from each other, and the two crowns should never be held by the same person. In the following year the treaties of Rastadt and Baden settled the particular questions at issue between Austria and France.

*The War of the Austrian Succession.*—As the Emperor Charles VI. had no male heirs, he tried to obtain the accession of all the powers concerned to the Pragmatic Sanction, by which it was stipulated that after his death all the Austrian possessions should be transmitted undivided to his eldest daughter, Maria Theresa. The nearest claimant to the Austrian inheritance, the Elector of Bavaria, Charles Albert, never gave his consent to the Pragmatic Sanction, and when Charles VI. died (Oct. 20, 1740) a general desire was manifested among the other European powers to break up the Austrian state and divide its dominions. Claims were advanced by Spain, Augustus III. of Poland and Saxony, the King of Sardinia, and Frederick the Great of Prussia, to whom France was added by her traditional hatred of the Hapsburgs. Great Britain alone went to the aid of Austria. The Elector of Bavaria took possession of Bohemia in 1741, and in the following year was crowned emperor. Frederick the Great had in the meanwhile seized Silesia. Stripped of her provinces and threatened with an advance of the Bavarian and French troops upon her capital, Maria Theresa appealed to her Hungarian subjects for aid. It was granted, and a large army was soon in the field. A period of Austrian success followed, due in part to the purchase of Prussian neutrality by the surrender of Silesia to Frederick the Great; but the latter, alarmed by the continued success of the Austrians, again took the field in support of the emperor (1744). At the same time a reverse took place in the Austrian fortunes at other points of the contest. In Upper Italy a French army joined the Spanish, and fought with great success, and in the Netherlands Marshal Saxe began his brilliant campaign with the victory at Fontenoy May 11, 1745. Soon, however, events occurred which gradually prepared people's minds for peace. On Jan. 20, 1745, the emperor, Charles VII., died, and in September, Joseph, the husband of Maria Theresa, was elected Emperor of Germany under the name of Francis I. Frederick the Great had become thoroughly disgusted with his allies, the French, and in the death of Charles VII. he found an opportunity of retiring from the coalition; peace was concluded between Prussia and Austria on Dec. 25, 1745. The war with France continued. Marshal Saxe gained brilliant victories in the Netherlands (at Raucoux Oct. 11, 1746; at Laufeldt July 2, 1747) and penetrated into Holland, where he took Bergen-op-Zoom and Maestricht. The British, however, had nearly destroyed the French shipping and conquered many French colonies, and when Russia, in June, 1747, joined Austria and sent an auxiliary army to Germany, France was willing to make peace. Peace was concluded at Aix-la-Chapelle in Oct., 1748. Austria gave up Parma, Guastalla, and Piacenza to Don Philip, of the Spanish Bourbon line, several districts of Milan to Sardinia, and confirmed Frederick II. in the possession of Silesia.

F. M. COLBY.

**Succin'ic Acid** [*succinic* is from Lat. *suc'cinum*, *sucinum*, amber, deriv. of *suc'cus*, *su'cus*, juice]: one of the series of acids of which oxalic acid is the first member. Its composition is $C_4H_6O_4$. Succinic acid was known to the ancients as volatile salt of amber, from which it is obtainable by distillation. It is found ready formed in several plants, and even in animal bodies. It has been identified in the urine of dogs and rabbits. It is formed, with SUBERIC ACID (*q. v.*) and others of this homologous series, by the action of nitric acid on fatty substances. Pasteur found that it is an invariable product of the alcoholic fermentation of saccharine liquids. Many other organic transformations engender it. It is found in the watery part of the products of the distillation of amber, in solution, and crystallizes out by cooling. Warming with nitric acid will destroy the impurities, and enable pure succinic acid to be obtained by recrystallization. It is, however, obtainable much more cheaply from crude calcic malate, prepared from mountain-ash berries. This is fermented with yeast or rotten cheese, and the calcic succinate formed decomposed by sulphuric acid. Succinic acid crystallizes well, and is soluble in five parts of cold water. It melts at 356° F., and boils at 455° F., and is decomposed with formation of water and succinic anhydride, $C_4H_4O_3$. Revised by IRA REMSEN.

**Succory**: See CHICCORY.

**Suc'coth** (tents or booths): the Hebrew name of the second station in the Exodus itinerary (Ex. xii. 37, xiii. 20; Num. xxxiii. 5, 6). Excavations made by Naville in 1883, at Tell el-Maskhûta near the eastern end of the Wâdi Tûmîlât in the eastern Delta region of Egypt, and just westerly of the middle of the Isthmus of Suez, resulted in the discovery of a place which bore the civil or political name *Theku-t* (Succoth), the religious or sacred name *Pi-Tum* (PITHOM, *q. v.*), the Greek name HEROÖPOLIS (*q. v.*), and the Latin name Ero-Castra. The importance of the discovery was in the confirmation of the record of the building of Pithom as one of the "store cities" (Ex. i. 11) constructed for Ramses II., the Pharaoh of the oppression (thus approximately fixing the date of the Exodus), and in the determination of the starting-point and of the route followed by the Israelites when they left Egypt. See also MIGDOL. C. R. G.

**Suchet**, sü'shā', LOUIS GABRIEL, Duke of Albufera: soldier; b. in Lyons, France, Mar. 2, 1770. Entering the army in 1792, he served under Bonaparte, Brune, Masséna, Joubert, and Moreau in the campaigns in Italy and Switzerland, passing through the grades from *chef de bataillon* (major) to that of lieutenant-general before the age of thirty. Subsequently he distinguished himself at Ulm, Jena, and Austerlitz. Under orders of Lannes he served with the Fifth Corps at the siege of Saragossa, and was designated by him to Napoleon on his departure for the command in Aragon. A series of battles and sieges (of Lérida, Mequinenza, Tortosa, Tarragona) gained for him the marshal's baton (July 8, 1811), and after the battle of Albufera and the siege and capture of Valencia he was created Duc d'Albufera (Jan. 24, 1812). He immediately joined Napoleon on his return from Elba. Under the Restoration he lived for several years in retirement, but was again invited to the court in 1819. The *Mémoires du Maréchal Suchet sur ses Campagnes en Espagne* forms one of the classics of military literature. D. in Marseilles, Jan. 3, 1826.

**Suchow**, or **Soo-chow-foo**: a city of China, capital of a department of the same name, and of the province of Kiangsu; situated on the Grand Canal, 80 miles W. of Shanghai (see map of China, ref. 6–K). The city is rectangular in plan, with walls 30 feet high and 12 miles in circuit. Outside five of the six gates by which the walls are pierced are large suburbs. The original plan, engraved in stone, has been preserved since 1247 in the temple dedicated to Confucius. In 1861 the Taipings reduced the city almost to a heap of ruins, the only buildings which escaped destruction being the temples (300 in number) and pagodas, of which there are seven, one of them, the Great Pagoda, being the highest in China. Suchow is a great commercial and manufacturing city, thousands of looms turning out many varieties of silk and satin, and there are numerous workers in wood, iron, brass, tin, stone, silver, and gold. Its streets —7 or 8 feet wide—are too narrow for much traffic, but a great network of canals extends throughout the city and surrounding region, and along these all the heavy traffic passes. Though devoid of Western improvements, Suchow has, from an Eastern standpoint, many marks of culture and refinement, and the gaiety and elegance of life and manners entitle it to be called the Paris of China. With HANGCHOW (*q. v.*) it shares the distinction of being likened by the natives to an earthly paradise. Pop. 500,000. A history of Suchow in 150 vols. was written 1,000 years ago. See *The Chinese Recorder*, vol. xiv. On Sept. 26, 1896, Suchow was opened to foreign trade. THOMAS A. HEARN.

**Sucker**: any one of several fishes which have no resemblance to each other except that they "suck" in some way. 1. The CATOSTOMIDÆ (*q. v.*). 2. The ECHENEIDIDÆ (*q. v.*). 3. Representatives of the families *Cyclopteridæ*, *Liparididæ*, and *Gobiesocidæ*. These have ventral fins peculiarly modified and adapted for adhering to rocks and other bodies. The species are numerous, and each family is represented on the coast of the U. S. Revised by F. A. LUCAS.

**Suckling**, Sir JOHN: poet; b. at Whitton, Middlesex, England, in 1609; educated at Trinity College, Cambridge. In 1631–32 he served as a volunteer under Gustavus Adolphus, King of Sweden, who was waging war against the Emperor of Germany. Returning to England, he was attached to the court of Charles I., and in 1639 equipped a troop of horse for the royal service against the Scotch. In 1640 he was elected to the Long Parliament, but was obliged to flee to France in consequence of his complicity in a plot to rescue the Earl of Strafford from the Tower. His works, most of them first published after his death, include four plays, some letters, *An Account of Religion by Reason*, and a number of songs, of which *A Ballad upon a Wedding* and *Why so Pale and Wan, Fond Lover*, are still popular, and are admirable specimens of the gay and graceful poetry of the Cavaliers. A complete edition of his poems, plays, and remains was published in 1874. D. in Paris about 1642. Revised by H. A. BEERS.

**Sucre**, soo'krā, more commonly called **Chuquisaca**, choo-kee-saa'kaa, and formerly **La Plata**: the official capital of Bolivia and capital of the department of Chuquisaca; on a terrace of the Eastern Cordillera of the Andes, overlooking the valley of the upper Pilcomayo, and in the midst of magnificent mountain scenery, 8,840 feet above the sea (see map of South America, ref. 6–D). It was founded by order of Pizzaro in 1539, on the site of the Indian village of Chuquichaca (golden bridge), and during the colonial period was renowned for its riches, derived from the silver mines of the vicinity. Later, the Potosi mines attracted part of the population; but La Plata, as it was then called, remained the metropolis of the district. From 1559 it was the seat of the *audiencia* of Charcas, and hence the capital of Upper Peru, now Bolivia. After independence was won, in 1826, the name was changed to Sucre, in honor of the first president. It remained the official capital, but during the civil wars it became customary for congress to meet at La Paz, which is now virtually the capital of Bolivia. Remains of its former grandeur are seen in the fine cathedral and other public buildings. It has a university, the oldest in the republic, and is still the metropolis of the mining region and of a rich agricultural district. A railway to Oruro is projected. Pop. about 26,000. HERBERT H. SMITH.

**Sucre**, ANTONIO JOSÉ, de: general; b. at Cumaná, Venezuela, Feb. 3, 1793. He joined the revolutionary army in 1811, served with distinction under Miranda and Piar, was on the staff of Bolivar's army, and rose to be general of division. He commanded the advance in the movement on Guayaquil, and his victory at Pichincha, May 24, 1822, finally drove the Spaniards from Quito or Ecuador. In the Peruvian campaign he took a leading part. After the battle of Junin, Bolivar left him in command of the army, and the decisive and brilliant victory of Ayacucho, Dec. 9, 1824, practically ended the South American war for independence. In honor of this event he was created grand-marshal of Ayacucho. In 1825 he was elected first president of Bolivia, and he governed with wisdom and success; but in 1828 the faction opposed to Bolivar, having obtained power in Peru, demanded Sucre's removal. To prevent a civil war he resigned and went to Colombia, where Bolivar placed him in command of the army acting against Peru. He defeated the Peruvians at the battle of Giron, near Cuenca, Feb. 26, 1829, and forced them to sue for peace. The same year he was president of the congress of Colombia. While returning to his home at Quito he was assassinated near Pasto, June 4, 1830. HERBERT H. SMITH.

**Sucto'ria**: a group of *Protozoa*. See INFUSORIA.

**Sudan'**, **Soudan**, or **Soodan** (Arabic, *Belad es-Sudan*, or country of the blacks): geographic name for that part of Africa lying S. of and adjacent to the Sahara, and extending, roughly, from 5° N. lat. to 15° N. and from 10° W. lon. eastward to the Nile. This region is occupied by many peoples and many different states, and embraces the basins of the Niger, Lake Chad, and the Bahr-el-Ghazal branch of the Nile, representing, respectively, Western, Central, and Eastern or Egyptian Sudan. The upper part of the basin of the Senegal is sometimes distinguished as the French Sudan. This, with the Kong country on the upper Niger, is mountainous, with elevated plateaus. Central Sudan is less elevated and generally level, but contains some high mountains (as Alantika, 9,800 feet). French, Western, and Central Sudan are generally well wooded and watered, and of great agricultural capacity. The Egyptian Sudan is generally arid. The races occupying the Sudan are very varied, mostly Negroes (hence sometimes called Nigritia, or Negroland), but also including Fulas, Tuaregs, Arabs, and in the east Shoas. See SENEGAMBIA, NIGER, SOKOTO, CHAD, DARFUR, BAHR-EL-GHAZAL, NILE, SAHARA, etc. See also the *Travels* of Mungo Park, Vogel, Baikie, Barth, Rohlfs, Schweinfurth, Nachtigal, and Lenz. M. W. H.

**Sudbury**: town of Nipissing district, Ontario, Canada; junction of the Canadian Pacific Railway with its Sault Ste. Marie branch; 125 miles W. of Mattawa and 182 miles E. of the Sault (see map of Ontario, ref. 1–C). It is in the center of a rich copper and nickel mineral district. Branch lines of railway run out short distances to the more important mines. Pop. 800. M. W. H.

**Su'dermann**, HERMANN: dramatist and novelist; b. at Matziken, East Prussia, Sept. 30, 1857; was a private teacher and journalist until he suddenly became famous by his drama *Die Ehre* (1890), which, on account of the clever and sentimental treatment of the social question, achieved a remarkable success, and which has since been translated into several European languages. His subsequent plays, *Sodoms Ende* (1891), *Die Heimat* (1893), and *Die Schmetterlingsschlacht* (1894), were less successful, and established the fact that their author had been greatly overestimated. He also wrote a number of novels and short stories, of which *Der Katzensteg* (1890) is the best. JULIUS GOEBEL.

**Sudeten-Gebirge**, soo-dā'ten-gā-beer'ge: a range of mountains which separates Silesia from Moravia, and connects the Riesengebirge with the Carpathian Mountains. They are 2,000 or 3,000 feet high, covered with pine forests, rich in coal and metals, and form plateaus with single peaks, rather than continuous chains.

**Sue**, sü, MARIE JOSEPH EUGÈNE: novelist; b. in Paris, Dec. 10, 1804; studied medicine, and held a position as surgeon, first in the army, then in the navy, until 1829, when, having inherited a considerable fortune, he retired and devoted himself to literature. His first novels, *Kernock le Pirate*, *Plick et Plock*, *Atar-Gull*, *La Salamandre*, *La Coucaratcha*, *La Vigie de Koat-Ven*, which appeared between 1831 and 1835, were inspired by Cooper, and inaugurated in France the novel of naval adventure. In *Cécile*, *Arthur*, *Le Marquis de Létorière*, *Jean Cavalier* (4 vols.), *Thérèse Dunoyer*, *Latréaumont*, from 1835 to 1838, he worked the historic, melodramatic, and romantic vein. After 1840 he became frankly socialistic, and celebrated the proletariat in his most famous and exceedingly popular novels, *Mathilde* (6 vols., 1841); *Les Mystères de Paris* (12 vols., 1842–43); *Le Juif Errant* (10 vols., 1844–45); *Martin* (12 vols., 1847); *Les Sept Péchés capitaux* (16 vols., 1847–49); *Les Mystères du Peuple* (16 vols., 1849–57). Elected to the Legislative Assembly in 1850, he took his seat among the most extreme radicals. After the *coup d'état* he left France and settled at Annecy, in Savoy, where he died Aug. 3, 1857. He wrote about fifty volumes of novels not mentioned here. Revised by A. G. CANFIELD.

**Suetonius** (swē-tō'ni-ŭs) **Tranquil'lus**, Gaius: author; b. probably about the beginning of the reign of Vespasian, and employed for some time by the Emperor Hadrian as his *magister epistolarum*. The date of his death is unknown, perhaps about 160. His principal work, *Duodecim Cæsarum Vitæ*, has been preserved entire and in authentic form. It contains biographies of the first twelve Roman emperors, beginning with C. Julius Cæsar and ending with Domitian. The best editions are by Baumgarten-Crusius (Leipzig, 1816), C. B. Hase (Paris, 1828), and Roth (Leipzig, 1858). The other writings are best given by Reifferscheid (Leipzig, 1860). English translations of the *Vitæ*, by John Clark (London, 1732), and by Thomson and Forrester in Bohn's Classical Library (1855). Revised by M. Warren.

**Suevi**, swee'vī: originally a collective name, comprising several individual Germanic tribes which formed a kind of union. It is thus used by Cæsar and Tacitus. In the fourth century the name was applied to a single tribe, one branch of which settled in the regions along the Neckar, afterward called Suabia, while another branch broke into Gaul, and in 409 crossed the Pyrenees and penetrated into Spain, where they embraced Christianity, conquered Galicia, and formed a kingdom, which in 585 was united with the Visigothic empire.

**Suez**, soo-ez': town of Egypt; at the head of the Gulf of Suez, an inlet of the Red Sea, in lat. 29° 59′ N. and lon. 32° 31′ E., and 2 miles from the southern end of the Suez Canal (see map of Africa, ref. 2–G). The surrounding region is a desert, and provisions and water must be brought to the town from a distance. Since the opening of the railway from Cairo to Suez, and the opening of the Suez Canal, the city has grown rapidly. Pop. (1882) 10,913; estimated (1895) 12,500. Revised by M. W. Harrington.

**Suez Canal**: See Ship-canals.

**Suez, Gulf of**: the western and larger of the branches into which the Red Sea divides lying between Egypt and the peninsula of Sinai. Its extreme length is about 180 miles; its average breadth 20 miles. It was known to the ancients as the Gulf of Heroöpolis, and the generally received scene of the passage of the Red Sea by the Israelites is near the present head of the gulf.

**Suez, Isthmus of**: a neck of land connecting the continents of Asia and Africa, and separating the Mediterranean from the Red Sea. Its extreme breadth from the Gulf of Suez to that of Pelusium is about 72 miles in a straight line, but following the course of the canal the distance is 100 miles. The surface is low and sandy, having an average elevation of not more than 6 or 8 feet above the sea, but in places reaching to 50 or 60 feet. In general, the isthmus is almost a desert; where irrigation has been practiced, however, it is quite fertile. It is probable that the whole isthmus was once covered by the waters of the Mediterranean and Red Seas, which were then connected.

**Suffix**: See Stem and Root.

**Suffocation**: See Asphyxia.

**Suffolk**: county of England; bounded N. by the Ouse, S. by the Stour, and E. by the North Sea; area, 1,475 sq. miles. The surface is flat, and the soil for the most part productive and excellently cultivated. Wheat, barley, beans, oats, and hemp are raised, dairy-farming is extensively carried on, and butter is one of the principal products of the county. Five members are returned to the House of Commons. Pop. (1901) 306,688. Capital, Bury St. Edmunds.

**Suffolk**: town; capital of Nansemond co., Va.; on the Nansemond river, and the Atl. and Danv., the Norf. and Car., the Norf. and W., the Seaboard Air Line, and the Suf. and Car. railways; 18 miles S. W. of Norfolk (for location, see map of Virginia, ref. 7–I). It is in an agricultural region; is engaged in lumbering, oyster-packing, and the manufacture of iron, lime, and woolen goods; and contains a State bank with capital of $20,000, and a daily, a monthly, and 2 weekly newspapers. Pop. (1890) 3,354; (1900) 3,827.

**Suf'fragan** [from O. Fr. *suffragant* < Lat. *suf'fragans*, pres. partic. of *suffraga'ri*, vote for, assist; cf. also Late Lat. *suffraga'neus*, suffragan]: a bishop of a single diocese in an ecclesiastical province subject to the ecclesiastical authority of the metropolitan of that province. A coadjutor is sometimes said to be suffragan to his superior bishop. A bishop of a limited part of a diocese is a suffragan to the bishop of the diocese. For instance, the Bishop of Dover is a suffragan of the Archbishop of Canterbury, while all bishops of the province of Canterbury are suffragans of the same metropolitan in a different sense. In the Protestant Episcopal Church in the U. S. suffragan bishops are not allowed, the canons forbidding their creation. All attempts to remove this prohibition have failed.

Revised by W. S. Perry.

**Suffrage**: See Citizen and Privilege.

**Su'fis**, or **Soofees**: the mystics of Islam, deriving their name from a coarse woolen cloak, their principal garment. Rabia, a Mussulman woman who lived not long after the prophet Mohammed, taught as her central doctrine divine love, and is reckoned by them their founder. Abu Saïd, son of Abul Khaïr, in the ninth century, advanced further, and urged abandonment of the world and consecration to a contemplative life. The various doctrines developed by his adherents and followers embrace every possible phase of mysticism. Many are pantheists, and declare that God is all, but that all is not God. Some claim direct communication with the Deity, and a mysterious union or identification with him. They are numerous in Persia, and have furnished noted scholars and poets. See Dervishes. E. A. Grosvenor.

**Sugar** [M. Eng. *sugre*, from O. Fr. *sucre*, Ital. *zucchero*, from Arab. *sokkar*, from Sanskr. *çarkarā*, whence Gr. σάκχαρον, whence Lat. *sac'charon*, whence Eng. *saccharine*]: any compound of a carbohydrate nature which is soluble in water. In the common acceptation of the word, it is any such compound having a sweet taste, but the term usually includes only cane-sugar (sucrose, or saccharose), and possibly also sugars made from starch, known as glucose or grape-sugar, and consisting chiefly of dextrose, dextrin, and maltose. By some chemists beet-sugar is called betose.

The sugar of commerce is derived almost exclusively from sugar-beets and sugar-cane, the former supplying a little less than two-thirds and the latter a little more than one-third of the world's consumption; sugar from either of these sources is usually called cane-sugar, although the more correct term is sucrose. The other sources of sugar, such as maple, palm, sorghum, and starch, while of importance for special purposes and in limited localities, do not supply sufficient quantities to affect sensibly the commerce of the world.

*Occurrence.*—Sugar is a normal product of almost every kind of vegetable growth. It is the first and principal result of the biochemical activity of all green plants, and is an important component of many plants devoid of chlorophyll, such as the mushroom. Its formation is the result of the condensation in the living plant-cells of its elements pre-existing in the air. These elements are carbon dioxide and water. The sugar thus formed furnishes the principal food-supply for the growth of all the other tissues of the plant. From it are formed directly the wood-fiber, the digestible fiber, the pentosans and the starches, all of which have essentially the same centesimal chemical composition. Indirectly, it enters into the formation of the fats and oils and of the nitrogenous constituents of the plant organism.

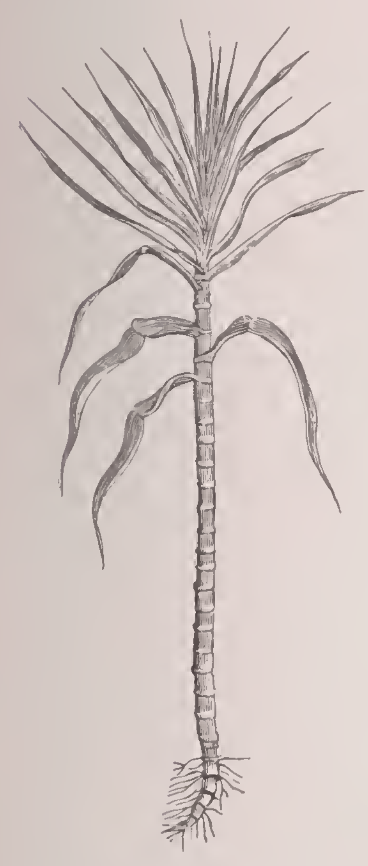
In many plants almost all the sugar produced is consumed in their further growth and development. In others the amount of sugar produced is far in excess of the demands of nutrition, and it is then stored as a waste or excess product in some part of the plant itself. In the sugar-cane, sorghum, and green Indian corn it is found in the stalks. In root-crops, such as beets and turnips, it is found in the fleshy roots. In trees, such as the maple and sugar-palm, it is dissolved by the first flowing sap of the spring. It exists in nearly all seeds, and of many, such as the coffee-bean, the peanut, and the cottonseed, it forms an important constituent. Sugar is also formed as a normal product of the functional activity of certain animal organs, such as the liver, and is an abnormal product of these in certain forms of disease, as diabetes mellitus. Many kinds of sugar have also been formed synthetically in the chemist's laboratory.

*History.*—(1) It is quite certain that the nations of remote antiquity were not acquainted with sugar as such, but honey was known to them all. The bees must be regarded as the first manufacturers of sugar. The sugar which is found in Honey (*q. v.*) is derived chiefly from the nectar of flowers, and this nectar consists of mixtures of cane-sugar and a sugar made by the inversion thereof, known as invert sugar or fruit-sugar. The sugar of the nectar of flowers in its fresh state consists largely of pure cane-sugar, but this, in passing through the organism of the bee, becomes inverted probably by some indirect biochemical action or under the influence of the formic acid which the bee secretes. The result is that the honey which is stored by bees, and which they obtain from the nectar of flowers, consists almost exclusively of invert sugar and water. The percentage of water varies largely, but the mean may be taken to be about 15 or 20.

The chief supply of sugar for consumption, for medicinal uses and as an article of luxury, was furnished by bees until probably the beginning of the fifteenth century.

(2) Sugar-cane, *Saccharum officinarum*, doubtless had its origin in India, and, from the best information which can be obtained, the original varieties contained only a very small quantity of sugar, probably not more than from 2 to 4 per cent. By constant cultivation and selection the content of sugar in the sugar-cane has been increased until it averages from 10 to 12 per cent. in Louisiana, 15 per cent. in Cuba, and 16 per cent. in the Hawaiian islands. It is believed that the original form no longer exists.

Cultivated sugar-cane will not return to the wild state, and it uniformly dies out when deprived of the care of man. Even the earlier travelers Cook (1773) and Forster (1777) found in the Hawaiian islands and other South Sea islands only the cultivated cane. The statements which have been made regarding the existence of the wild varieties in Africa have not been positively negatived, but it is more than likely that these were some of the varieties of sorghum which grow wild in all those localities and resemble in many respects true sugar-cane, as were those described by Humboldt on the Indus, the Euphrates, and the Persian Gulf. Hennepin, in 1690, declared that the banks of the mouths of the Mississippi were thickly covered with sugar-cane, which, under the heat of the sun, exuded sugar that dropped from the stalks like gum. This growth was doubtless the wild cane *Arundo donax or Arundinaria gigantea*, which, though also a grass, is very different from the sugar-cane.


Sugar-cane.

While the cultivated cane will not revert to a wild state, yet with proper care, in favorable climates, it will continue to grow from the same stubble for fifteen or twenty years. In some cases it has been known to grow for forty years.

The sugar-cane does not appear to have been known outside of Bengal at the time of the writing of the Rig-Veda (about the fourteenth century B. C.). In other Vedas the sugar-cane is mentioned, especially in the Atharva-Veda; but even at the time of Buddha the sugar-cane was not generally known in that part of India. At that period the stalk was either used directly or the expressed juice drunk without further preparation. The first use of fire for concentrating sugar-juices was doubtless also due to the inhabitants of India, about 600 or 700 years B. C. From there this art was spread among all nations of antiquity. Humboldt asserts that the Aztecs in Mexico were accustomed to make sugar from the stalks of maize before the Spanish invasion. At first only sirup or molasses was made, and after that the art of sugar-making was learned. Probably solid sugar was first made and used in India about the sixth century of the Christian era.

The existence of the sugar-cane was not known to the Grecian nations before the Christian era. Pliny (23–79 A. D.) says sugar came from Arabia, but the Indian product was preferable. It was a honey collected from canes, white like gum, breaking easily between the teeth, and was used only as a medicine. It was not until about 500 A. D. that the knowledge of the art of growing and refining sugar began to spread westward. In their wars of conquest toward the East the Mohammedans first learned of the manufacture of sugar. At the time of Harun-al-Raschid the tribute of some of the conquered provinces was paid partly in sugar. It was valued as a luxury and as a medicine.

In the eighth century the culture of the sugar-cane had spread over the greater part of the Nile delta. The sugar-cane grew so well in Egypt that it soon became an article of export from that country to the Mohammedan Asiatic provinces. Because it could not well be transported by water, it was always sent overland and many of these cargoes fell into the hands of the Christians during the crusades, and in this way the knowledge of sugar was diffused throughout Europe. When Sicily was conquered by the Arabs the culture of sugar was introduced into that island from Egypt, and thence also to Spain at the time of the Moorish conquest in the eighth century. Sugar-cane is still cultivated in the valleys along the southern Mediterranean shore of Spain. In the ninth and tenth centuries the culture of sugar-cane in Spain was carried on in all of the provinces of Andalusia. In the beginning of the fifteenth century the Spanish production amounted annually to over 2,000,000 cwt., and there were fifteen sugar-factories at the village of Motril, near Granada.

At the time of Marco Polo, about 1280, the sugar-cane industry had assumed considerable importance in China, whence it spread to Siam, Ceylon, and Japan. The first introduction into Western Europe was made by the returning crusaders, by whom it was used only as a medicine. The sugar brought from Syria soon came into use as a delicacy, and in parts of France as early as the twelfth century sugar became a regular article of commerce, being used for making cakes and preserving fruits. From France the use of sugar spread into Holland, Italy, and Germany. Venice, in the Middle Ages, became the headquarters of the industry, receiving the crude materials from the East, refining them, and delivering the products to the North and West.

Sugar is not mentioned in the oldest German literature, and it is first spoken of by the poets of the twelfth and thirteenth centuries. Later it became an article of commerce with the Venetian dealers and the German merchants at Constantinople. It was used in cakes and preserves and eaten only by the wealthy.

A considerable part of the sugar used in Europe in the fourteenth and fifteenth centuries came from Cyprus, where the culture of sugar-cane had been introduced by the Arabs in the seventh century. Perhaps the greatest quantity of sugar from any country among those mentioned was sent to Europe from Egypt.

The refining of sugar was probably first practiced at Venice; at least that is where the industry first assumed importance. In a directory of that city, published in 1473, refiners of sugar are mentioned. The art of refining, as at first practiced, consisted simply in melting the sugar in water and recrystallizing it by evaporation over an open fire. This was often repeated two or three times.

Columbus took sugar-cane from the Canary islands to San Domingo at the time of his second voyage, and his report to the Spanish king told of the wonderful growth of the cane in the New World. A new lot was sent in 1506. From San Domingo the culture of sugar-cane spread to Cuba and the neighboring islands and also to Mexico. As early as 1553 Mexico exported sugar to Spain. In 1532 sugar-cane was introduced into Brazil from Madeira. Within 100 years after the first introduction of sugar-cane into the New World the production of sugar therein was so great as to turn the dealers of Europe toward the West for their supply of this commodity.

In 1597 a sugar-refinery was erected in Dresden, and soon afterward Antwerp became a center for the sugar-trade. In the seventeenth and eighteenth centuries the production of sugar rapidly increased in the New World, especially in the British and French colonies in the tropics, San Domingo leading with a production of 80,000 tons annually. The revolution of 1791 in that island, however, almost destroyed the industry.

The processes of manufacture in all these countries were of the most primitive kind. The canes were crushed in crude mills driven by oxen, wind, or water; clay and lime were largely used in purifying the juices, the clay acting chiefly in a mechanical way in removing impurities. The boiling was accomplished in iron or copper kettles over the open fire. The raw brown sugar thus made was refined by melting and recrystallizing, the whitest product obtained in this way being known as "king's sugar." Europe continued to be the only market for American sugars, and in the competition thus produced the sugar industries of Sicily, Egypt, and Spain were ruined and practically ceased to exist. The desolation wrought by the Thirty Years' war in Germany put a stop to the consumption of sugar in that country, and the commercial downfall of Spain and Venice threw the trade of the world into the hands of Great Britain, France, and Holland. In Great Britain the consumption of sugar increased rapidly. In 1700 it was 10,000, in 1750 80,000, and in 1800 150,000 tons annually.

The first sugar made in Louisiana was in 1791 by Don Antonio Mendez, associated with a farmer named Solis. Étienne de Boré, about 1794, was the first to make sugar-culture a commercial success, and his first crop amounted to nearly 100,000 lb., for which he received about $12,000. His plantation is now a part of the city of New Orleans. In 1818 Joseph Coyron erected the first steam-engine ever used to grind sugar-cane in Louisiana. The variety of cane in cultivation at first was known as creole, and was a very tender plant, easily injured by frost. In 1820 the red-ribbon cane, a much hardier variety, was introduced from Georgia. The yield of sugar gradually increased in Louisiana until 1853, after which it slightly decreased until 1861, when the largest crop ever made in the State up to that time was secured, viz., 230,000 tons. The civil war almost paralyzed the sugar industry in Louisiana, and for three years no data of yields are recorded. In 1864 the crop amounted to only 5,000 tons. From this time on the production of sugar in Louisiana increased, but not with regularity on account of disasters from flood and frost, until the season of 1893–94, when it amounted to 320,000 tons.

Sugar-cane is also cultivated to a considerable extent in Texas and Florida, and in a smaller way in Georgia, Alabama, and Mississippi.

3. The sugar-beet, *Beta vulgaris*, originally came from the lowlands of Burgundy, and was carried by the Mennonite exiles into the Palatinate. From this locality it gradually spread to all parts of Germany, and was grown as cattle-food. In 1747 Marggraf (1709–82) discovered that sugar could be obtained from the common beet. Achard (1753–1821), in Kaullsdorf, near Berlin, was the first who undertook a systematic culture of the beet, and he largely increased its content of sugar. In France the sugar-beet appeared soon after its introduction into Germany and Holland, and was cultivated by Vilmorin in 1775, but its first systematic culture there was undertaken by Abbé Rozier in 1782. In 1786 it was introduced into England by Perkins and in 1830 into the U. S. by Vaughn and Ronaldson. In 1798 Achard, in Berlin, succeeded in preparing crystallized sugar from beets in considerable quantities, and as much as 16 cwt. was used in 1800 in the bakeries of Berlin.

The first real beet-sugar factory was erected by Achard, with royal aid, at Kunern, in Silesia, and put in operation in Mar., 1802. Many attempts were made to manufacture beet-sugar in Germany during the decade beginning in 1800, but in spite of the fact that the competition with cane-sugar was practically removed by the Napoleonic embargoes these attempts were generally unsuccessful. In France the Emperor Napoleon appointed a commission to investigate Achard's work, and as a result an imperial decree, in the early part of his reign, established the beet-sugar industry in France, and a considerable subvention from the imperial treasury was accorded it. Two factories were built at St.-Ouen and Chelles, but for lack of scientific supervision they failed of their purpose.

In 1808 Delessert undertook the culture of the sugar-beet at Passy, and by means of clarification with lime, sulphuric acid, and charcoal, succeeded in making a good merchantable sugar. In 1812 the Emperor Napoleon, as a result of a personal inspection at Passy, ordered that ten new factories be immediately constructed, and committed the work of construction to Delessert. In Great Britain, on account of her tropical colonies, the introduction of the beet-sugar industry was vigorously opposed, and its further development on the Continent discouraged.

In the U. S. attempts were made as early as 1830 by a Philadelphia company, of which John Vaughn and James Ronaldson were successively presidents, to introduce the culture of the sugar-beet. By reason of the absence of practical information little was accomplished. In 1839 a beet-sugar company was formed at Northampton, Mass., by David L. Child, and 1,300 lb. of sugar was made and the enterprise was then abandoned. The next company of which there is any account formed for the purpose of promoting the culture of the sugar-beet was in 1863, in Livingston co., Ill., but no practical results were obtained. In 1864 the Gennert Brothers established a beet-sugar factory at Chatsworth, Ill., but failed for lack of capital. The establishment was subsequently bought by a German company and removed to Freeport, Ill. All these attempts, however, ended in failure. The next beet-sugar factory in the U. S. was established in 1866 at Fond du Lac, Wis., and for two or three years a considerable quantity of sugar was made at that point. In 1870 the proprietors removed to California and organized the Alvarado Sugar Company, which, after various vicissitudes, finally succeeded in establishing itself on a firm basis, and is still in operation. Companies were also organized for the manufacture of sugar from the sugar-beet at Sacramento, San José, and Soquel, but none of them except the Alvarado company was finally successful. In 1878 a large factory built on modern principles was established at Portland, Me., and in the following year factories were also established at Wilmington, Del., and Franklin, Mass., and large sums of money were invested therein. After unsuccessful attempts at profitable manufacture all of these establishments were abandoned. For many years no further attempts were made to manufacture beet-sugar in the U. S., except at Alvarado, Cal. In 1888 a factory was built at Watsonville, Cal., and in rapid succession factories were established at Grand island and Norfolk, Neb., Chino, Cal., and Lehi, Utah. At present (1900) there are 31 fully established beet-sugar factories in the U.S. The total quantity of sugar manufactured at these localities during the season of 1899–1900 was valued at $7,323,857.

*Palm-tree Sugar.*—An old and, at one time, important sugar of commerce is the product of certain of the varieties of the palm-tree. It has been and is produced principally in India, where it is known as jaggery, a word which is of the same origin as the word sugar. The palms used for sugar-making are planted in rows in high and dry land, and can be used from five to thirty years. The trees are tapped in the same manner as the maple, but usually a small triangular hole is cut into the tree for the purpose of collecting the sap, which is removed by boring a hole into this receptacle from below and inserting therein a small bamboo cane, which conducts the sap into an earthenware receptacle. The sap flows principally during the night, and should be removed the following morning before the sun becomes very hot. After tapping, the tree will continue to afford a supply of sap for about three days, and must then be allowed a period of rest. The sugar season begins in November and lasts until the middle of February. The cooler and calmer the weather the better the harvest. The juice, with the addition of a little lime, is evaporated over the naked fire to a thick sirup. Part of it is sometimes further dried in the sun to a hard mass. This thick sirup is sometimes called date-tree honey, and was known as an article of commerce at the time of Herodotus and probably for many years before. The sugar of the palm as it comes from the tree is nearly pure sucrose, or cane-sugar, but much of it becomes inverted in the crude process of manufacture. Good palm-trees yield from 30 to 40 lb. of sugar in a season. The varieties cultivated are chiefly *Phœnix sylvestris*, *Cocos nucifera*, *Borassus flabelliformis*, *Caryota urens*, and *Arenga saccharifera*. A grove of from 600 to 800 palms is considered a valuable possession. The annual production in India is estimated at 1,000,000 metric centners (100,000 tons of 2,204·6 lb.).

*Maple-sugar.*—The maple-tree is the sugar-palm of temperate climates. Of the several varieties of this tree, only the *Acer barbatum* (also called *A. saccharinum*) is used to any extent for sugar-making. The principal centers of the maple-sugar industry are in Vermont, New York, and Ohio, but almost everywhere in the northeastern parts of the U. S., and also in parts of Canada, some sugar and molasses are made. Only the old trees are used for sugar-making, and, until within a few years, the natural forests. Within the past few decades there has been some planting of maple-trees for sugar-producing purposes, although a grove is not profitable for use until it is thirty or forty years old. The best groves for sugar-making are those in which the underbrush and small trees have been cut away, allowing the larger trees an opportunity to increase their leaf and twig growth. As a rule, the shorter trees with dense spreading overgrowth are better for sugar-production, both in the sweetness and quantity of sap. Woodpeckers are quick to discover the sweeter trees, which they fill with holes in the springtime for the purpose of drinking the sap. The excess of sap flowing over the bark darkens it, and the sweeter trees thus often have almost a black exterior.

The sugar season begins after the breaking up of the winter. In the more southern latitudes the sap will flow freely after the first thaw in winter, often in January. In

Southern Indiana and Ohio the manufacturing season usually begins in February and lasts until the end of March; in Vermont, in March, lasting until the end of April. A cold, steady winter is favorable to a good season, because it prevents the flow of sap until the sugar season fairly opens. The trees are tapped by boring with an auger, three-quarters of an inch in diameter, on the southern exposure of the tree. The holes are bored at a distance of from 2 to 4 feet from the ground. Spiles made of elder-bushes or of metal are fitted into the auger-holes, water-tight, so as to cause all the sap to flow out through the central orifice, where it is collected in appropriate vessels. Where little regard is had for the welfare of the tree a notch is cut in it as described for the date-palm. This is, however, very injurious, and trees thus treated during a series of years lose their vitality. From one boring the sap will continue to flow for a considerable time—usually for one season. Sometimes, however, a second boring is practiced to increase the flow. Usually two spiles are put into each tree; in small trees, sometimes only one; in very large ones, three or four. The flow of sap is most free during a warm, still day. It is checked by a frost at night and by high winds. In case of a thaw it will flow for twenty-four or even for forty-eight hours. It will then cease and begin again after another freeze. When the buds begin to swell later in the spring the flow ceases, and if started again by a subsequent freeze the sap is found to be less sweet and to have undergone a viscous fermentation which unfits it for sugar-making. The sap is nearly pure sugar and water, containing, however, certain organic aromatic compounds, which give the "maple flavor," and make both sugar and molasses so highly prized that they command double the price of similar sweets made from cane or other sources. The maple-sap also contains notable quantities of malic acid combined with lime. This is especially the case toward the end of the manufacturing season. In evaporating the sap the malate of lime is precipitated, and forms a scale or sandy deposit in the bottom of the pans which is known as sugar-sand. The sap of the maple contains varying quantities of sugar, depending on the year, the time of collection, and the position and peculiarities of the trees.

In the analyses of the sap from twelve trees from a maple-bush in Northwestern Indiana, taken on Mar. 21, the average content of sucrose was found to be 2·93 per cent. The highest content in any one tree was found to be 3·95 per cent.; the lowest, 1·95 per cent. At the same time the sap from a tree in Southern Indiana showed 4·30 per cent. The average content of sugar in the sap of fifteen trees near Lunenburg, Vt., examined daily from Apr. 7 to Apr. 28, was found to be 2·33, 2·72, 5·01, 3·66, 3·42, 3·15, 3·74, 2·98, 3·73, 3·53, 3·75, 3·55, 3·69, 4·36, and 3·18 per cent. respectively.

From a comparison of all the analyses made it is apparent that the average percentage of sugar in the sap is about 3·5. In one instance determined in Vermont in the mixed sap of 3,350 trees, taken at intervals from Apr. 9 to 22 inclusive, the average percentage of sucrose was found to be 3·25. The average yield of sugar from a tree is difficult to determine, inasmuch as the sap of the trees is mixed and no attempt made to keep the samples separate. In some few instances it is stated that trees have yielded as high as 40 lb., and yields of 20 lb. per tree are not uncommon. The average quantity of sap required to make a pound is 16 quarts. It is probable that the average yield of all the trees during one season and from one season to another is about 3 lb.

In the best orchards metallic spouts are used strong enough to hold a pail. Tin pails are preferred to wooden ones, the latter often imparting a bad taste to the sap. The sap is collected from the pails as often as possible, and when drawn to the small factory it should be strained before being placed in the storage-tanks. For boiling, the best sugar-makers use pans made of Russia iron, about 5 feet long, 2·5 feet wide, and 8 inches deep. They are set on arches of brick 20 inches in depth and provided with grate bars and other appliances to make the use of fuel economical. Open kettles are also often employed, but not by the best makers. In many factories the juice before entering the evaporator is passed through a heater, a copper box provided with tubes, through which the waste heat from the furnace passes. Many of the makers also use the continuous evaporating pans so largely employed in the manufacture of sorghum molasses. The fuel usually consists of the waste wood from the grove itself or adjoining forests. From 1 to 1·25 cords of wood are required for each 100 lb. of sugar produced. Sometimes the white of eggs is used for clarifying the sap, but as a rule this is not necessary. The scums which form during the boiling and which are usually of a very dark color, should be carefully removed. They contain large quantities of albuminous matters which if left in the sugars or sirups impair their keeping qualities. The sugar is either poured while hot into moulds, or, if a granular variety is desired, is vigorously stirred while cooling. This process is termed "sugaring off." The granular sugar thus made, especially while fresh, has a most delicious flavor and is highly prized. The refining of maple-sugar would deprive it of its characteristic flavor and thus reduce it in value to the level of ordinary sugar. It is therefore never practiced.

The quantity of maple-sugar made in the U. S. is not easily ascertained. Much of it goes into domestic use, while often large quantities which are placed on the market are adulterated. The total quantity varies probably between 15,000 and 20,000 tons per year. There is little evidence of either an increase or a decrease in the amount, but inasmuch as the maple-tree tends to grow naturally in rich soils, there is a disposition on the part of the farmers to clear the land and thus to diminish the output of sugar. The maple forests which are best preserved therefore are those which are found growing on places too hilly or rough for easy tillage.

Attempts were once made to introduce the growth of the maple-tree and the manufacture of sugar therefrom into Europe, but without any encouraging results. Maple-seeds were sent to Berlin from the U. S. in 1797 at the instance of a member of the Prussian cabinet, and encouragement was given to use also the sap of the silver maple, already growing in that country, for sugar-making purposes. Some little sugar was made in this way during the decade and a half beginning with the nineteenth century. The reopening of the West Indies to European commerce, however, which attended the downfall of Napoleon, caused all these efforts to cease, and the production of maple-sugar became confined to North America.

*Maize-stalks.*—The stalks of maize, *Zea Mays*, at the time of the formation of the starch in the grain are filled with a sap very rich both in sucrose and reducing sugars (sugars which reduce an alkaline copper solution with the formation of suboxide of copper). Humboldt reported in the account of his visit to Mexico that, before the arrival of the Europeans, the Mexicans as well as the Peruvians pressed out the sap of the maize-stalks, and by concentration thereof prepared sugar, and Cortés reported to Charles V. that the Mexicans had for sale honey, wax, sirup, and sugar from the maize-stalks, which were as sweet as sugar-canes. The maize used was doubtless sweet corn, the juice of which will sometimes yield as much as 16 per cent. of massecuite. From maize grown in Germany in 1766 Justi obtained a fairly good sugar, and in Italy, in 1784, Jacquin and Marabelli erected a mill for pressing the maize-stalks, and succeeded in making sugar therefrom.

Numerous analyses of the juice of maize-stalks were made in the U. S. Department of Agriculture from 1878 to 1882, and attempts were made on a small scale in the manufacture of sugar. Previous to this, in 1876, F. L. Stewart had announced in *The Public Ledger* of Philadelphia the result of some of his experiments in manufacturing sugar from maize-stalks. According to his analyses the juice of the maize-stalks contained 10·8 per cent. of sugar. In 1879, in the Department of Agriculture, samples of maize juices were analyzed showing 5·6 and 6·7 per cent. respectively of sucrose in the juices. In 1881 analyses of a large number of samples of maize juices showed a percentage of cane-sugar varying from 9 to 13, and in 1880 nearly 300 analyses were made showing a variation of cane-sugar in the juices from 9 to 15. The percentage of reducing sugars in the juices was also determined, showing a wide range in round numbers of from 1 to 4 per cent.

The attempts at making sugar, however, from these juices were attended with very little success, the sirups resulting from concentrating them crystallizing with great difficulty. Nevertheless a committee of the National Academy of Sciences reported that the experiments had shown that in successive years there was obtained from the stalks of common maize, after the ripened grain had been plucked, sugar at the rate of 900 lb. per acre.

Although the stalks of maize at the time the starch is in a milky state in the grains contain large quantities of sugar, there is no reason whatever to believe that maize can ever enter into competition with the sugar-cane and the sugar-beet as a source of commercial sugar. In a small way and for domestic consumption a fairly good sirup may be made therefrom, but all enthusiastic promoters of enterprises for making sugar from maize-stalks should be reminded that economically the task is a hopeless one so long as cheaper and better sources of raw material are available in practically inexhaustible supplies.

*Sorghum Sugar.*—The history and method of making sugar from sorghum are described in the article SORGHUM (*q. v.*).

*Culture of Sugar-cane.*—Since the sugar-cane and sugar-beet are practically the sources of all commercial sugar, a description of the methods of cultivation will be confined to these two plants. Sugar-cane is propagated by cuttings, and in rare instances from the seed. All parts of the cane having well-formed joints may be used for planting. In some localities it is customary to cut off the top, which is less rich in sugar, and use it for planting, while the rest is employed for sugar-making. The more common practice, however, is to use the whole cane, with the exception of that portion of the top devoid of well-formed joints. In the U. S. the time of planting extends from October to March. As a rule, autumnal planting is to be preferred. The soil is prepared by plowing and reducing with harrows and cultivators to a good tilth. Furrows are then opened by a double mould-board plow, at distances varying from 5 to 8 feet. The canes, cut into sections of about 2 feet in length, are laid in the bottom of the furrow and the soil thrown over them either by a hand-hoe or by a plow. Some planters prefer not to cut the canes unless they are crooked. When the seed is good, two canes alongside are enough to make a good stand. A third cutting is, however, often laid at the points of union of the canes, making, in the language of the planter, "two canes and a lap" in a row. The total quantity of seed required varies from 4 to 6 tons an acre. After planting it is best to either roll the top of the soil or to smooth the space over the furrows with a hand-hoe, removing all clods which might interfere with the exit of the young canes from the soil. The young canes grow from eyes held on the joints of the parent cane. When spring planting is practiced, the eyes of the cane are preserved from the injurious effects of frost by being preserved between the rows, the top of one cane being spread over the stalk of the one previously cut. This process is called windrowing. A light covering of earth, which can be thrown over the canes by running a plow on either side, is sufficient to protect the seed from all ordinary frosts and to prevent it from becoming too dry. If a better protection be desired the seed is preserved in mats, piles of cane carefully laid down and covered with cane-tops and earth. The preservation in windrows is usually preferred to that in mats, unless very cold weather be expected. Cane preserved for seed is subject to disasters due to drying up, frost, insects, and fungous diseases. For this reason the seed preserved for spring planting is often of poor quality, requiring a larger weight per acre.

Young canes are not seriously hurt by frost unless it comes very late in the spring. In the cane-growing districts of the U. S. frosts are not often experienced after Mar. 1. In fields which have long been under cultivation sugar-cane requires generous fertilizing. Superphosphates, potash salts, and cottonseed-meal are the fertilizing materials usually employed. The highest tonnage per acre has been obtained by using 350 lb. of cottonseed-meal, 430 lb. of acid phosphate, and 100 lb. of sulphate of potash.

The sugar lands of Louisiana consist almost wholly of alluvial deposits embracing two types, a light and a dark soil. The cultivation of the growing cane consists in keeping the ground well plowed and free from weeds. As the cultivation goes on it is the general custom to throw the soil toward the row, so that at the time of "laying by" the field is left in ridges, the canes growing on the summits. The cultivation usually lasts until the latter part of June. After the first crop of canes is harvested the stubbles will produce in the succeeding years a second crop and often a third or fourth. In the U. S. the replanting of the fields, however, usually takes place every second or third year, while in tropical countries the fields may run from ten to fifteen, and even a greater number of years, without replanting. The first crop from the fields is known as plant-cane, and subsequent crops as first and second year stubble, etc. The beginning of the cultivation of stubble-cane consists in barring off, that is, in throwing the soil from the stubble by means of a single mould-board plow. In addition to this the stubble is often shaved, that is, cut off smoothly just beneath the surface. At this time it is also customary to apply the fertilizers. After a few days the soil is thrown to the stubble and the middles broken out and reduced to good tilth, and the subsequent cultivation is the same as that for plant-cane already mentioned. The stubble crops from year to year become harder and contain more woody matter, but the juices are, as a rule, richer in sugar, so that the total amount of sugar per ton is about the same in both plant and stubble crops. In harvesting the canes are cut as near the surface of the soil or as little thereunder as may be with a broad steel knife furnished with a hook on the back, by means of which the laborer by a skillful stroke on either side of the cane relieves it of its leaves, after which the top is cut at the first immature joint and the canes thrown in a pile for subsequent removal to the factory by cart or portable railway. A good laborer will cut from 3 to 5 tons of cane per day.

*Culture of the Sugar-beet.*—Sugar-beets are grown to the best advantage for sugar-making purposes in northern temperate regions. In going southward, as a general rule, the beet becomes less sweet and more pithy and tends to grow to a larger size. A mean temperature of 70° F. is well suited to the growth of beets of high sugar content. The soil in which beets are planted should be plowed to the depth of about 10 inches and loosened by a subsoil plow to an additional depth of 6 inches. The plowing is often accomplished in the late autumn. In all cases before planting the surface should be reduced to perfect tilth. Any soil suited to the growth of good crops will produce beets, but they do not grow well in a stiff clay. The seeds are planted in rows about 18 inches apart, and covered to the depth of about 1 inch. Deep planting should be avoided, inasmuch as the tender shoots of the young plants are not able to emerge from a very deep covering of earth. From 12 to 20 lb. of seed are planted per acre. When the plants are grown until they show four well-developed leaves, the thinning process is commenced, leaving one vigorous shoot at about every 9 inches in the row. The number of plants per acre is determined in a large measure by the fertility of the soil and the degree of fertilization practiced; but in all cases they should be numerous enough to limit the average weight at harvest-time to a little more than 1 lb. The culture of the beet consists in keeping the soil well stirred and free of weeds. Deep culture is not admissible on account of the danger of disturbing the young plants in their position and of covering up the tops. At the time of laying by, which is about the middle of July, the surface of the soil should be left as smooth and level as possible. The planting in the chief beet-sugar countries extends from the last day of April till the end of May. In California, where are found exceptional climatic conditions, the planting begins as early as January and extends to June. As a rule, the earlier plantings produce the better crops. In Germany and France the harvest begins about Sept. 15, and is concluded by the middle or end of November. In California the harvest begins as early as August and continues until the end of the manufacturing season. The beets can be left without much danger until January, or until there is danger of second growth from the winter rains. In harvesting, the beets are loosened by a digger which passes under them, and are then removed from the soil by their tops and thrown into heaps. The tops with a portion of the neck of the beet are then removed by means of a large sharp knife, and the beets are then ready for preserving in silos or delivering to the factory. In siloing the beets they should be covered as lightly as possible, to preserve them from danger of freezing. If the temperature of the silo becomes too high the beets are apt to be injured.

The manufacturing season begins in California in August, and in other countries in September. The average duration of the manufacturing season is about three months, but in exceptional cases it lasts for four or five months. With the approach of spring, however, the beets rapidly deteriorate, and for this reason manufacturers try to close the season by the end of January.

The production of a beet rich in sugar has become a separate branch of the sugar industry. From an original content of from 4 to 6 per cent. of sugar, the development of the beet has continued until it now shows from 13 to 15 per cent., and in exceptional cases from 15 to 19 per cent.

At the time of harvest certain beets of typical shape and size and of apparently perfect nature are selected and preserved in silos over the winter without having their necks removed. In the following spring the silos are opened and each beet examined separately by taking out a core cut diagonally through it by an appropriate machine. The juice is expressed from this core and the content of sugar determined therein. The beets thus examined are classified according to their sugar content. The following table shows the number of beets of each variety placed in each class, as determined by analyses made at the experiment station of the Department of Agriculture in Schuyler, Neb., in 1893:

| VARIETIES. | No. 1 grade: sucrose 18 per cent. and upward. | No. 2 grade: sucrose 15 to 18 per cent. | No. 3 grade: sucrose 12 to 15 per cent. |
|---|---|---|---|
| Original Kleinwanzlebener.... | 36 | 465 | 448 |
| Dippe's Kleinwanzlebener..... | 6 | 483 | 1,176 |
| Vilmorin's improved.......... | 8 | 600 | 784 |
| Lemaire...................... | .. | ... | 476 |
| Desprez...................... | .. | ... | 168 |
| Élite Kleinwanzlebener........ | 7 | 210 | 224 |
| Totals.... .. ............ | 57 | 1,758 | 3,276 |

The beets are not materially injured by this boring, and after the examination is made they are carefully protected until all danger of frost is passed, when they are transplanted into a field devoted to this purpose and placed in rows at distances of about 3 feet. Each class is planted by itself, and thus three grades of seed are produced. The first grade is kept especially for the production of special beets of high content of sugar, while the second and third grades are used for the production of beets, which in their turn are planted in large quantities to furnish seed for commercial purposes. It is by the persistent application of this principle of scientific selection that the sugar-beet has been raised to its present high content of sugar, enabling it to compete successfully with sugar-cane, and even to exclude sugar made from the sugar-cane from the markets of Europe.

*Manufacture of Cane-sugar.*—The process of making sugar from sugar-cane is very simple. In its most primitive form it consists of crushing the canes between appropriate rollers, and evaporating the juice thus obtained to the crystallizing-point in open vessels. Commercially the process is as follows: The canes, harvested as previously described, are sent from the field to the factory, where they are crushed between powerful iron rollers. In many factories before entering the rolls the canes are passed through a shredder, which tears them into small pieces and thus puts them in a condition to be more evenly fed to the mill and to yield with a given pressure a higher percentage of juice. In the best factories the mills are erected in series of two or three. The first mill usually has three large rolls and the emerging canes, now called bagasse, are conducted by a carrier to a second mill, consisting usually of two rolls, but larger and heavier than those of the first mill. While in transit between the mills the bagasse is generally moistened with steam or hot water, whereby a better extraction of the saccharine matter is obtained, although the resulting juice is more dilute. Occasionally a third mill, similar in construction and operation to the second, is found. To avoid danger of breaking, the rolls are made adjustable to feeds of different magnitudes by means of rubber pads or springs or hydraulic regulators. With careful control, and with canes not too woody, from 75 to 86 per cent. of the saccharine matter contained in the canes may be obtained by milling. Taking into consideration all kinds of milling practiced in sugar-cane countries the world over, it may be said that only about two-thirds of the sugar produced in the canes is obtained by the crushing process.

The bagasse from good milling is conducted at once to a specially constructed furnace, and by its combustion renders the use of any other fuel in the factory unnecessary.

To a limited extent the diffusion process is used in the extraction of sugar-canes. This is described in the section on the manufacture of sugar from sugar-beets. The cutters used for canes to prepare them for the diffusion process are, however, different from those employed for beets. The canes are either cut into thin slices by being fed obliquely through hoppers against a revolving horizontal disk carrying radial knives, or else are torn into fine pieces by means of revolving, staggered, circular saws. From 90 to 95 per cent. of the saccharine matters in the cane are obtained by the diffusion process, but the juices are more dilute and the bagasse is left in a condition unsuited for fuel.

The juices obtained from the sugar-cane are treated with cream of lime to neutralize the free organic acids therein contained, heated to the boiling-point, and the blanket of scum thus produced removed. After standing for some time the sedimentary matters separate and the clarified juice is drawn off and sent to the evaporators. The scums and sediments are passed through a filter-press and the clear juice obtained thereby added to that secured as described above. The evaporation of the juice and its subsequent conversion into crystallized sugar are accomplished as in beet-sugar manufacture.

*Treatment of Sugar-beets.*—After the removal of the tops, together with a portion of the neck or collar, the beets are ready for the factory. The upper portion of the beet contains an excess of mineral matter, the introduction of which into the factory would prove injurious to the yield of sugar by preventing its crystallization. The beets are thrown into a trough and moved by a series of screw-paddles against a strong current of water. Adhering soil and sand, the presence of which would render the slicing of the beets difficult by reason of the dulling of the knives, are removed by this treatment. After washing, the beets are carried by an elevator to the slicing apparatus, situated above the center of the diffusion battery. In countries where a tax is laid upon the beets they are, after washing, carried into a weighing-machine, where their weight is noted by an agent of the inland revenue bureau. The best slicer consists of a revolving, horizontal disk carrying radial knives against which the beets are fed through a hopper. These knives are corrugated in such a way as to produce an irregular cutting, usually of a V-shape. The beet cuttings are known in France as *cosettes* and in Germany as *Schnitzel.* Their irregular form prevents the too close contact of their surfaces in the diffusion battery, and thus permits a freer circulation of the diffusion liquids throughout all parts of the system. The theory of the diffusion process rests upon the well-known principle of osmosis. If a crystallizable body in solution be separated from pure water by means of a pervious membrane there will be an interchange of such a nature that at the end of a certain time the crystallizable body will be found equally diffused within and without the membrane. The vegetable membranes which compose the cells of sugar-beets and sugar-cane easily permit this diffusion to go on. If, therefore, into a mass of finely sliced cane or beets warm water be introduced, it will soon become impregnated with sugar, and after a certain time, depending upon the temperature and the fineness of the cuttings, will contain the same percentage of sugar as the unbroken cells themselves. In practice the water thus impregnated with sugar is passed into another cell containing fresh cuttings, while fresh water is passed into the first cell, and this process is continued until all the cells of the battery, with two exceptions, are in operation. A diffusion battery usually consists of twelve cells. When in operation ten will thus be found under pressure, while one will be filling with the fresh cuttings and one will be emptying of the exhausted cuttings. The process once established goes on continuously.

*Treatment of Beet Juices.*—The saccharine juices extracted from beets require a more elaborate treatment than those expressed from sugar-canes. This arises from the fact that they contain foreign bodies more refractory to purifying treatment and more difficult to eliminate. The preliminary treatment of the beet juices preparatory to condensation is carried on as follows: The juices as they come from the diffusion battery are treated with lime in considerable excess of the quantity required to neutralize their natural acidity. From 2 to 3 lb. of lime are used for each 100 lb. of juice. Beet juices a few moments after expression or extraction become quite dark, and when in a large mass, as in the juice from a diffusion battery, the color is quite inky. The excess of lime precipitates this coloring-matter, as well as a part of the nitrogenous and other impurities present. To remove the excess of lime after the purification, carbonic acid is blown into the mixture, and the temperature is slowly raised until the boiling-point is reached, a little before the saturation is complete. The carbonic acid is obtained from a lime-kiln, which also furnishes the lime for the preliminary treatment. At the end of the saturation with carbonic acid the lime is found in the form of a carbonate of a fine granular texture, which is a great help in the following filtration, preventing the clogging of the filter-cloths. This treatment is technically called carbonatation or saturation. At the end of the operation the whole mass is passed through a filter-press, and the precipitated carbonate of lime and the other solid impurities are separated as press cakes. The emergent juice is of a bright amber color, transparent and apparently quite pure. In practice, however, it is found to be profitable to repeat the process just described. In the second saturation the quantity of lime used is much less than in the first, not exceeding from $\frac{1}{2}$ to 1 lb. to 100 lb. of juice. The second saturation is followed by a second filtration, and the bright juices thus obtained are ready for evaporation, although they still contain large quantities of soluble materials other than sugar, chief among which are salts of potassium.

The evaporation, concentration, and crystallization of the purified juices, both from beets and sugar-cane, are carried on in the same manner, and one description of the process is sufficient.

*Evaporation and Crystallization.*—The two chief points to be kept in view in securing the sugar from the saccharine juices, clarified as above described, are the removal of the water and the prevention of the inversion of the sugar during boiling. Evaporation in open kettles is largely practiced in making sugar in a small way. The heat is applied directly to kettles or pans by means of a fire of wood or bagasse, or indirectly by means of copper coils connected with a steam-boiler. As the concentration proceeds the condensed juices are carried to the finishing kettle or pan, fresh juices being added to the others. When the evaporation has proceeded to the crystallizing-point, which is determined by the temperature or the appearance of the boiling material, portions of the mass may also be removed, cooled, and tested. The sugar, still in a liquid state, is put into vessels, where it crystallizes. When the crystallization is complete, the molasses is removed by transferring the mass to hogsheads with perforated bottoms. Sugar-canes are often pushed into the crystalline mass to open up channels for the liquid portions. The sugar thus formed is of a more or less pronounced yellow color and quite moist. When made from cane it retains the natural aromatic flavoring matters of the original juices, and is highly prized, especially by bakers. The process, however, is not an economical one, both on account of the large amount of fuel required and by reason of the loss of sugar by inversion at the high temperature reached in the end process. Even in Louisiana, where this method was once the leading one, it has almost entirely given way to more modern processes.

All modern sugar-factories of a magnitude to be of any commercial importance conduct the evaporation of sugar juices in a partial vacuum. This not only secures great economy in the use of fuel, but also, by reason of the lower temperature which is maintained, avoids all loss by inversion. To avoid confusion, some of the technical terms in use in sugar-factories should be defined. The word juice or liquor is applied to all saccharine liquids of moderate density in the raw state after extraction from the cane or beets, or in the clarified state with its attendant concentration. The term sirup designates the saccharine liquid after its first evaporation but before it is finally boiled for sugar. The expression massecuite is used to designate the mass as it is finally boiled for sugar, and embraces not only the crystallized but also the liquid contents of the vacuum-pan at the end of the boiling. Molasses is a term applied to the separated portion of the massecuite, whether obtained by drainage or by centrifugal action. Multiple effect is the name given to the series of evaporators joined *en suite*, by means of which the juice is reduced to a sirup. When only two are *en suite* it is called double, and when three a triple or multiple effect. They are arranged in such a way as to require steam to be applied only to the first one. The vapors arising from the first pan become the source of heat for the second, those from the second of the third, and so on. This is accomplished by so arranging them as to have the lowest vacuum in the first of the series and the highest in the last. If three pans be used, the reading of the vacuum-scale on the first one will be, for example, 5 inches, on the middle one 15 inches, and on the last one 25 inches, 30 inches representing practically a perfect vacuum.

In point of fact, by this arrangement there is no economy of speed, four pans not evaporating any more than one would at the highest vacuum and with the same amount of steam. The amount of fuel required, however, for a given volume of evaporation is approximately only one-third that which would be required if only one pan were used plus the amount necessary to operate the vacuum-pump. Inasmuch, however, as the quantity of steam required for the pump is the same whether one or three pans be used, there is saved, approximately, two-thirds of the fuel. In practice it is found that no economy is secured by increasing the number of pans beyond three or four. The saccharine liquor is gradually transferred during the operation to the third pan, from which the finished sirup is removed from time to time or continuously by means of a pump which will create a higher vacuum than that existing in the pan. The process in a multiple-effect apparatus, when once started, is a continuous one, fresh juice entering the first pan and the finished sirup flowing from the last one.

The strike-pan is a boiling apparatus used with a high vacuum in which the sirup is concentrated to massecuite. Its size corresponds to the capacity of the factory, and for those houses which use from 200 to 400 tons of raw material a day the strike-pan will vary from 6 to 10 feet in diameter and from 10 to 20 feet in height, and with a capacity of from 20,000 to 70,000 lb. of massecuite at each strike. Heat is applied in the strike-pan by means of a series of copper coils, one above the other, beginning near the bottom and extending half way or more to the top. These coils of copper are of large diameter, in order to permit the free circulation of exhaust steam, at low pressure, from the engines and pumps of the factory. Live steam is not used in the pan except when the exhaust steam proves to be insufficient. For the manufacture of raw sugar the vacuum is maintained as high as possible. With a good pump and other apparatus, at sea-level, it can be kept at from 28 to 29 inches. In this vacuum the boiling will take place at a temperature of from 120° to 150° F., according to the density of the mass.

The operation is begun by taking into the pan a quantity of sirup large enough, when concentrated to the crystallizing-point, to cover the first coil. By means of the proof-stick the sugar-boiler determines when the sirup has a proper degree of consistence. At this point a considerable additional quantity of sirup is quickly drawn into the pan, whereby a crystallization is produced in the thickened sirup in the pan. The crystals formed at first are too small to be seen with the naked eye, but when some of the mass is put on a piece of glass it is seen to have a turbid appearance. The art of the sugar-boiler consists in feeding these crystals with fresh quantities of sirup, added in such a way as to avoid, on the one hand, the melting of the crystals already formed, and, on the other, the formation of a new crop of crystals known as false grain. When the operation is properly conducted, the pan is gradually filled with the growing mass of crystals, and coil after coil of the heating apparatus is brought into use until all are in operation. After this the boiling goes on with great activity until the pan is full. At the end the further supply of sirup is cut off, usually after the addition of a considerable quantity of sirup, for the purpose of washing the crystals, and the mass is thickened by further boiling until the minimum quantity of water consistent with the proper handling of the massecuite is secured, viz., from 6 to 10 per cent. The large valve at the bottom of the pan is then opened, after the vacuum has been broken, and the massecuite falls directly into a mixer or into wagons in which it is carried to a mixer. When the sirup is rich and pure the massecuite, as it drops from the pan, is already in appearance a solid body. In the mixer the massecuite is kept in motion by revolving paddles, and thus prevented from setting into solid masses, which would be difficult to break up and dry. From the mixer the massecuite passes directly into the centrifugal machines, where the sugar is separated from the molasses. So quickly is this accomplished that within a few minutes after leaving the strike-pan the dry sugar, still warm, may be found in packages ready for shipment to the consumer or the refiner.

The molasses secured by the above process is still rich in crystallizable sugar, and is reboiled for a second crop of crystals. When very rich it can be boiled to grain, as in the first instance, but if too poor for this it is boiled to string proof to the proper consistence, placed in cars in a warm room, and allowed to remain for a week or ten days. By this time the crystallization is completed, and the contents of the cars are thrown into the mixer, well broken up, and the sugar separated in the centrifugal in the manner already described.

The molasses obtained from this second crystallization is sometimes rich enough to be again reboiled, after which it is placed in wagons or large cisterns, and allowed to remain for several months, yielding a third crop of crystals, which when dried form a low-grade sugar. The residual molasses is finally either sold for culinary use or for mixing with glucose to make table sirups, or is sent to the distiller.

Beet-sugar molasses is unfit for table or culinary use on account of the large quantity of mineral salts which it contains. It is either sent to the distiller or the sugar it contains is recovered by combining it with strontium or lime, whereby an insoluble sucrate of the base used is obtained, which is separated from the soluble salts and other impurities by means of a filter-press. In this case it is the residue in the press cake which forms the valuable product. The sucrates therein contained are beaten to a cream with water, and the lime or strontium precipitated by means of carbonic acid. The carbonate of the base is separated by filtration, and the comparatively pure sugar juices obtained are concentrated and crystallized in the usual way.

*The Refining of Sugar.*—The sugar which is obtained by the above described processes is not white nor pure, and is prepared for table use by the refiner. In the historical sketch above given it was stated that the early processes of refining consisted at first in simply melting and reboiling the crude sugar. Each successive crystallization obtained in this way showed an improvement in color and purity, but the quantity of fairly white sugar finally obtained was a very small part of the raw material originally taken. The aid of clay, lime, and the white of eggs or blood was found to assist in the refining process, but without adding much to the total yield.

In India the term refined sugar includes sugars which have been purified by charcoal strainers and freed from all admixture of uncrystallized sirup, and also the raw native sugars prepared in the following way: The immediate product of the first boiling of the cane juice is known as gurh or rab, according as the sugar is boiled down to a hard mass, or allowed to remain in a semi-liquid condition. Both gurh and rab contain some uncrystallized sirup. Gurh, as a rule, is intended directly for home consumption, and is comparatively seldom used in the manufacture of refined sugar. Rab, on the other hand, is always intended for refining. In the process of refining the molasses known as shira is partially expressed from the rab by the primitive contrivance of a man standing on a pile of bags filled with rab, and working them backward and forward by the movement of his body. The rab partially refined in this way is called putri, and though it still contains a large percentage of shira it is far more compact, and shows more granulation than before pressing. The putri is thrown into a crate covered with a species of water-weed known as siwar (*Vallisneria spiralis*), and the remaining sirup slowly drains out at the bottom of the crate, and the putri gradually whitens into a mealy looking sugar called pachani, and it is then dried in the sun and broken up by being trampled on for some hours. When dried it is known as shakar.

These crude methods in sugar-refining have led to the modern processes, which are so perfect as to permit of the recovery in a state of purity of almost all the sugar in the crudest articles of commerce.

The process of refining is often carried on in connection with the manufacture of sugar from the raw materials. Various methods are employed. In one process the juices are subjected to the action of sulphur-fumes, whereby they become bleached. In the subsequent boiling the massecuite is left in a less dense state, so that the crystals are more readily separated from the molasses, and more easily washed. When the crystals are dried in the centrifugals they are washed with a little water, and also with a solution of chloride of tin, which give them a bright appearance. Sugar made in this way, especially from cane-juice, is quite pure, and has a white or delicate yellow tint, and is much prized by some consumers. The yield, however, as can be readily seen, is much less than that obtained by the dense boiling before described.

Instead of sulphur-fumes bone-black is also employed in making a white sugar directly in the factory. The bone-black is generally used on the sirups until they are practically decolorized. Sugar made with the use of bone-black is washed in the centrifugals with a little water, followed by a solution of ultramarine. The bluing thus practiced gives a whiter tint to the crystals.

These refining processes are profitable only where there is a good domestic demand for high-grade sugar, and in localities remote from refineries, where the freights attending the shipment of refined sugar materially increase the price.

From an economical point of view the refining of sugar is entirely distinct from its manufacture from the raw materials. It is carried on in the most economical way in large establishments kept in operation during the greater part of the year. In the U. S. there are in active operation less than a dozen refineries supplying nearly 2,000,000 tons a year.

Following is a brief description of the process of refining sugar on a large scale:

The raw sugar is dumped into vats, where it is stirred with warm water until melted. In this manner a sirup is obtained containing from 30 to 40 per cent. of sugar. The bags and other packages in which the sugar is shipped are washed, and the wash-water added to the saccharine mixture. The liquor thus formed is filtered through bags or filter-presses, to remove suspended matters. Sometimes the liquor is made thinner, and treated with lime and clarified in the manner described for cane juices. After filtration the limpid liquors are bleached with sulphur-fumes, or by passing over bone-black, which is the more usual way. Bone-black is prepared by subjecting bones to distillation in a retort practically excluded from the air. A large part of the organic matter in the bones is by this process converted into carbon, and left in a finely divided state distributed throughout the molecules of lime phosphate of which the mineral matter of bones is chiefly composed. This combination of animal char and lime phosphate has the property of rapidly oxidizing the coloring-matter of sugar solutions, and thus of bleaching them. The freshly burned char is contained in cylindrical vessels of steel or iron arranged in convenient series. The most highly colored solutions are passed first through those filters which have been in use some time, and thus have lost to a certain extent their decolorizing power. The process is continued in such a way that the less colored solutions are finally brought into contact with some fresh char, whereby they are rendered almost if not quite water-white. The more complete the decoloration the larger the percentage of white sugar which will be obtained. The bone-black, when it has once lost its decolorizing power by use, can have it restored by washing in a dilute acid, followed by water, and then burning in specially constructed retorts. These retorts are continuous in their operation, the spent black being fed in at the top and the revivified char being removed at the bottom. After repeated using, however, the char loses its virtue, and is then sold for fertilizing purposes.

The nearly white liquor finally obtained is ready without further preparation for treatment in the strike-pan. The general method of boiling is the same as that already described. The crystals are made large or small to meet the demands of the trade and at the will of the sugar-boiler. If a hard crystal be desired the boiling takes place at a lower vacuum, say 24 to 26 inches, while if a soft crystal be demanded the vacuum is made as high as possible, from 28 to 29 inches. After leaving the strike-pan the crystals are dried in the centrifugals in the manner already noted. The still slightly moist crystals, as they come from the centrifugal, may be moulded into cubes and dried (loaf-sugar), or dried in larger masses and cut or broken into approximately cubical pieces (cut or broken loaf), or dried and ground to a fine powder (powdered sugar). The hard crystals are also dried in revolving drums heated by steam, and form thus the granulated sugar of commerce, a form in which by far the larger part of refined sugar now reaches the consumer.

The molasses from the first granulation is reboiled and lower grades of nearly white sugar made therefrom. These sugars are sold under many names, such as coffee A, coffee C, brown sugar, etc. A third and even fourth crop of crystals is sometimes obtained, and finally nearly all the sugar originally present in the crude material is secured in a refined state. The art of the sugar-boiler is constantly brought into use to make grades of sugar which the trade demands, and also to use the material placed in his hands to the very best advantage. When his work has been properly conducted there is finally little waste material left to be sold to the mixers or distillers as "black strap."

In some countries, especially in Great Britain, sugar in the form of large yellow crystals is much in demand. These crystals were first made in Demerara, and hence the name which they bear. They are made by building a very large crystal in the strike-pan and then producing thereon a superficial coating of caramel to give a yellow color. This was formerly accomplished by introducing a quantity of sulphuric acid into the pan just before the strike was dropped. At present tin chloride is chiefly used for coloring the crystals. In making these large crystals, after the sirup in the pan has been reduced to a certain consistence, a large quantity of ordinary granulated sugar is put in the pan, and on these crystals the larger ones are built in the manner already described.

*Relative Sweetness of Beet and Cane Sugars.*—In chemical and physical character pure refined sugar made from beets is the same as that made from cane. In the raw sugars, however, and in the sugars made from molasses, there are marked differences. The beet contains a large quantity of alkaline salts, and these bodies are found to some extent in the raw beet-sugars and in beet-molasses. An unrefined beet-sugar has a higher percentage of ash than the same grade of cane-sugar. The aromatic organic ethers and essential oils that give an agreeable odor and flavor to cane-sugar are mostly absent from beet-sugar. A stranger entering a cane-sugar factory during the working season will at once notice the agreeable aromatic odor everywhere present. On the contrary, in a beet-sugar factory, especially if much molasses be in process of manufacture, the opposite will be noticed. Raw or unrefined cane-sugar may be used on the table or in the kitchen, and the old-fashioned open-kettle molasses is a luxury. Unrefined beet-sugar can not be used with comfort on the table, and beet-molasses as a culinary article is unknown. Beet-molasses contains a certain quantity of the sugar known as raffinose, which modifies both the physical and chemical characters of the sugars made therefrom. Even in the refined sugars a difference may be noticed between cane and beet sugars if the samples are kept well stoppered for some time. An air-tight package of granulated cane-sugar will have an agreeable aromatic odor when opened, while beet-sugar in the same condition gives an unpleasant sensation to the nostrils. In respect of the sweetening properties of pure cane and beet sugars there is no difference whatever between the two varieties.

*Chemistry.*—Until within recent years there has been much confusion in the classification of sugars and sugar-like bodies as made by different chemists. By many authors only those bodies were classed as carbohydrates which contain six atoms of carbon or some multiple thereof, together with oxygen and hydrogen in the proportion to form water. In 1882 von Lippmann published a work in which he took the view first proposed by Fittig, that the carbohydrates were all derived from a hypothetical, heptatomic alcohol having the composition $C_6H_7(OH_7)$. From this form by dehydration are produced the anhydrids, such as $C_6H_{12}O_6$ or $C_{12}H_{22}O_{11}$, representing glucose and saccharose respectively.

In 1888 a marked advance in the knowledge of carbohydrates was secured by the publication of Tollens's *Handbook*. Tollens defines carbohydrates as always or nearly always neutral bodies which form only loose compounds, especially with the bases, and consequently all bodies, such as methylhydroxyglutaric acid ($C_6H_{10}O_5$) and its lactone acid ($C_6H_8O_4$), as well as the saccharines which possess the general formula of carbohydrates but pass over easily into the form of acids, must be excluded from the list.

According to Tollens the carbohydrates have many common properties, and they possess these properties either in themselves, as, for instance, the glucoses, fruit sugars, and dextrose, or they are easily converted into bodies which do possess them, as, for instance, cane-sugar, cellulose, and starch. In some of the undoubted carbohydrates one of the general properties may be wanting, but there are other properties which are indispensable, and those bodies which do not possess them must be left out of the class even should they be indifferent chemically and have the general carbohydrate formula. According to this view the properties peculiar to the true carbohydrates are the following:

(*a*) The power of reducing alkaline metallic salt solutions and of forming a yellow color with alkalies.

(*b*) When in solution they must possess the ability to rotate the plane of polarized light.

(*c*) They must have the power of fermenting when treated with yeast, with the production of alcohol and carbon dioxide.

(*d*) When heated with hydrochloric or sulphuric acid they should produce levulinic and formic acids and humus substances.

(*e*) They should have the property of giving a yellow crystalline precipitate when treated with phenylhydrazin acetate.

(*f*) They should give characteristic color reactions when treated with acids and aromatic alcohols.

(*g*) They should be soluble in water either directly or after hydrolysis with an acid.

(*h*) When subjected to strong heat all carbohydrates are decomposed, turning brown at first and afterward black, with a production of many different substances.

Tollens, in accordance with his views, classifies the carbohydrates and nearly related bodies according to the number of carbon atoms which they contain, as monosaccharids having 6 atoms of carbon, disaccharids with 12 atoms, and polysaccharids with 18, 24, or 36 atoms, etc. By this classification the number of true carbohydrates is diminished until it is comparatively small, while the number of carbohydratoid bodies is large. The common sugars and carbohydrates, according to the above classification, are grouped as follows:

I. Monosaccharids or glucoses, type $C_6H_{12}O_6$.
 1. Dextrose.
 2. Levulose, invert sugar, mannitose.
 3. Galactose.
 4. Sorbin or sorbose.
 5. Different little-known glucoses.

II. Disaccharids or saccharoses, type $C_{12}H_{22}O_{11}$.
 1. Cane-sugar.
 2. Milk-sugar.
 3. Maltose.
 4. Trehalose.
 5. Melezitose.

III. Polysaccharids.
 (*a*) Crystallizable polysaccharids.
 1. Raffinose, $C_{36}H_{64}O_{32} + 10H_2O$.
 2. Lactosin, $C_{36}H_{62}O_{31}$.
 (*b*) Difficultly or non-crystallizable polysaccharids.
 1. Starch.
 2. Inulin.
 3. Saccharocolloids, gums, and slimes.
 4. Cellulose.
 5. Pectin and pectose bodies.

IV. Substances which resemble the glucoses, but do not have either the exact composition thereof or for other reasons are not to be classed therewith.

(*a*) Substances which contain oxygen and hydrogen in the proportion to form water.
 1. Arabinose, $C_5H_{10}O_5$.
 2. Cerasinose.
 3. Formose, $C_6H_{10}O_5$.
 4. Phenose, $C_6H_{12}O_6$.
 5. Inosit, $C_6H_{12}O_6$.
 6. Dambose, $C_6H_{12}O_6$.
 7. Scyllit, $C_6H_{12}O_6$.
 8. Quercin, $C_6H_{12}O_6$.
 9. Bergenin, $C_6H_8O_4$.

(*b*) Substances which contain more hydrogen than would be necessary to form water with the oxygen present.
 1. Isodulcit, $C_6H_{12}O_5$.
 2. Quercit, $C_6H_{12}O_5$.
 3. Pinit, $C_6H_{12}O_5$.
 4. Sennit, $C_6H_{12}O_5$.

(*c*) Mannit and its isomers.
 1. Mannit, $C_6H_{14}O_6$.
 2. Dulcit, $C_6H_{14}O_6$.
 3. Perseit, $C_6H_{14}O_6$.
 4. Sorbit, $C_6H_{14}O_6 + \frac{1}{2}(H_2O)$.

(*d*) Arabit, $C_5H_{12}O_5$.

Of the carbohydrates conforming to the above definition dextrose, levulose, galactose, and mannit are types. They respond to the reactions given, and have been found to possess the composition of ketones or aldehydes of the hexavalent alcohol $C_6H_{14}O_6$. On the other hand, there are carbohydrate bodies, such as arabinose, having the formula $C_5H_{10}O_5$, which are sugars having all the properties of a carbohydrate, and evidently should be classed with those bodies. There is another sugar, erythrose, having the formula $C_4H_8O_4$, which is an aldehyde of the tetratomic alcohol erythrite, and another sugar glycerose having the formula $C_3H_6O_3$, which also has valid claims to be classed with the other sugars. From the researches of Fischer on synthetic sugars it appears that the old classification is hardly a proper one, and a new one based on his work is preferable. It appears from these researches that there is a homologous series of aldehyde or ketone alcohols having the general formula $C_nH_{2n}O_n$ which have these common properties: 1, Sweet to the taste; 2, optically active; 3, reducing alkaline metallic solutions; 4, yielding with phenylhydrazin characteristic crystalline compounds. All these bodies therefore possess the essential characteristics of true carbohydrates and are as a consequence eligible to classification as such. According to Fischer, the classification of the substances which constitute this homologous series, so far as they have been made known, is as follows:

1. Trioses, type $C_3H_6O_3$, typical member glycerose.
2. Tetroses, type $C_4H_8O_4$, typical member erythrose.
3. Pentoses, type $C_5H_{10}O_5$, typical members arabinose, xylose.
4. Hexoses, type $C_6H_{12}O_6$, typical members dextrose, levulose, galactose, mannose.
5. Heptoses, type $C_7H_{14}O_7$, typical member heptose.
6. Octoses, type $C_8H_{16}O_8$, typical member octose.
7. Nonoses, type $C_9H_{18}O_9$, typical member nonose.

According to Fischer, every asymmetric carbon atom in a carbohydrate molecule makes two forms possible. There can therefore be at least eight hexoses, and each of these is optically paired, making sixteen in all. Of the sixteen possible forms, ten have already been discovered. Of the thirty-two possible heptoses only six have been discovered, and of the 128 possible nonoses only two are known. There is every reason to believe that the series will be extended by the discovery of new types, increasing very largely the number of possible sugars. In the sugars classified as above all those which contain three atoms of carbon or multiples of three are susceptible of fermentation, while the intervening members can not be fermented. Thus only the trioses, hexoses, and nonoses are fermentable.

Natural sugars all have the power of rotating a plane of polarized light, and this quality serves as a basis for optical SACCHARIMETRY (*q. v.*). Synthetic sugars, on the other hand, are devoid of rotatory power, and this is due to the fact that they are composed of twinned molecules having opposite rotatory powers of equal value. See STEREO-CHEMISTRY.

All sugars, natural or synthetical, containing three atoms of carbon or some multiple thereof in each molecule, are susceptible to fermentation when treated with yeast. The products of fermentation are chiefly alcohol and carbon dioxide, but a large number of secondary products are formed, such as glycerol and organic acids.

Cane-sugar, sucrose, or saccharose forms a molecule represented by the formula $C_{12}H_{22}O_{11}$. Cane-sugar belongs to the disaccharids, according to Tollens's classification, or to the hexoses according to that of Fischer. Under the influence of acids and certain ferments it undergoes hydrolysis, assimilating a molecule of water and forming equal quantities of two hexoses known as dextrose or glucose and levulose or fructose. The reaction which takes place is represented by the formula $C_{12}H_{22}O_{11} + H_2O = C_6H_{12}O_6 + C_6H_{12}O_6$. From the above it is seen that the two sugars formed are chemically identical, but optically and physically they have very different qualities, one being a right-handed sugar and easily crystallizable and the other a left-handed sugar and crystallizable with difficulty.

Cane-sugar forms compact, monoclinic crystals having a specific gravity of 1·58. Sugar is very soluble in water. At a temperature of 32° F. a saturated solution of sugar in water contains in each 100 parts sixty-five parts of sugar, and at 120° F. eighty-three parts. In pure aqueous solutions of sugar the density of the solution is directly proportional to the quantity of sugar present. Upon this fact is based a method of determining the percentage of sugar in a solution from its specific gravity. The instrument most commonly used is the Brix spindle. (See HYDROMETER.) For instance, a sugar solution which marks 5° Brix contains 5 per cent. of sugar and has a specific gravity of 1·0197, and one which marks 50° Brix contains 50 per cent. of sugar and has a specific gravity of 1·2328. Elaborate tables are found in works on sugar analysis, giving the percentages of sugar for varying degrees of density, and the specific gravities for each degree and half degree of the standard hydrometers in common use. It is only when sugar solutions are free of impurities that these tables can be used.

Cane-sugar does not possess the power of reducing an alkaline solution of copper, but the dextrose and levulose produced by the treatment of cane-sugar with an acid or inverting ferment possess this power. The process of converting cane-sugar into dextrose and levulose is known as inversion or hydrolysis. Upon the property of reducing alkaline copper solutions to suboxide is based the process of chemical saccharimetry.

When cane-sugar is subjected to a strong heat it suffers a partial decomposition, becomes brown, and forms caramel or burnt sugar.

Many oxidizing bodies act upon cane-sugar with great vigor. For instance, if a mixture of cane-sugar and potassium chlorate be touched with a drop of sulphuric acid the oxidation will be so rapid as to produce a brilliant deflagration. Hot nitric acid also oxidizes cane-sugar with the production of organic acids. A saturated solution of cane-sugar stirred with strongest sulphuric acid will lose its water of composition, and will give a porous mass of carbon and humus bodies. Cane-sugar unites with the bases, especially those of the alkaline earths, forming distinct chemical compounds known as sucrates. The sucrates of calcium and strontium play an important part in the separation of sugar from beet molasses.

*Statistics.*—The total production of cane and beet sugar in the world in 1893–94 was over 7,550,000 tons, and in 1899–1900 more than 8,500,000. The following table includes all the most important countries producing sugar-cane except China. Most of the sugar consumed in Japan (125,000 tons per annum) is imported.

THE WORLD'S PRODUCTION OF SUGAR FROM SUGAR-CANE FOR THREE YEARS, IN TONS OF 2,240 LB.

Willett & Gray's estimates of cane-sugar crops, May 2, 1895.

| COUNTRY. | 1894-95. | 1893-94. | 1892-93. |
|---|---|---|---|
| United States | 285,000 | 275,000 | 238,000 |
| Spanish West Indies: | | | |
| Cuba, *crop* | 975,000 | 1,087,000 | 841,000 |
| Porto Rico | 52,500 | 60,000 | 50,000 |
| British West Indies: | | | |
| Trinidad, *exports* | 50,000 | 49,662 | 46,820 |
| Barbados, *exports* | 40,000 | 58,092 | 59,722 |
| Jamaica | 30.000 | 30,000 | 25,000 |
| Antigua and St. Kitts | 20,000 | 25,000 | 24,000 |
| French West Indies: | | | |
| Martinique, *exports* | 25,000 | 35,854 | 32,220 |
| Guadeloupe | 43.000 | 44,000 | 42,000 |
| Danish West Indies—St. Croix | 7,000 | 8,000 | 9,000 |
| Haiti and San Domingo | 38,000 | 40,000 | 30,000 |
| Lesser Antilles, not named above | 8,000 | 8,000 | 8,000 |
| Mexico | 2,000 | 2,000 | 2,000 |
| Central America: | | | |
| San Salvador, *crop* | 500 | 500 | 500 |
| Nicaragua, *crop* | 500 | 500 | 500 |
| British Honduras (Belize), *crop* | 200 | 200 | 200 |
| South America: | | | |
| British Guiana (Demerara), *exports* | 100,000 | 102,897 | 103,464 |
| Dutch Guiana (Surinam), *crop* | 6,000 | 6,000 | 4.000 |
| Peru, *crop* | 68,000 | 65,000 | 67,000 |
| Argentine Republic, *crop* (*no exports*) | 75,000 | 50,000 | 40,000 |
| Brazil, *exports* | 275,000 | 275,000 | 200,000 |
| Total in America | 2,100.700 | 2,222,705 | 1,823,426 |
| Asia: | | | |
| British India, *exports* | 50,000 | 50,000 | 50,000 |
| Siam, *crop* | 7,000 | 7,000 | 7,000 |
| Java, *exports* | 475,000 | 430,767 | 434,596 |
| Philippine islands | 225,000 | 200,000 | 260,758 |
| Cochin-China | 30,000 | 30,000 | 30,000 |
| Total in Asia | 787.000 | 717,767 | 782,354 |
| Australia and Polynesia: | | | |
| Queensland | 100,000 | 80,000 | 61,314 |
| New South Wales | 35,000 | 35,000 | 32,000 |
| Hawaiian islands | 150.000 | 140.000 | 135,000 |
| Fiji islands | 10,000 | 10,000 | 10,000 |
| Total in Australia and Polynesia | 295.000 | 265,000 | 238,314 |
| Africa: | | | |
| Egypt, *crop* | 97,000 | 85,111 | 60,000 |
| Mauritius and other British possessions | 100,000 | 139,751 | 70,020 |
| Reunion and other French possessions | 37,000 | 37,000 | 35,000 |
| Total in Africa | 234,000 | 261,862 | 165,020 |
| Europe—Spain | 20,000 | 20,000 | 20,000 |
| Total cane-sugar production | 3,436,700 | 3,487,334 | 3,029,114 |

PRODUCTION OF BEET-SUGAR IN EUROPE AND THE UNITED STATES FOR THREE YEARS, IN TONS OF 2,204 LB.

(From Licht's *Monthly Circular.*)

| | 1899-1900. | 1898-99. | 1897-98. |
|---|---|---|---|
| Germany | 1,798,631 | 1,721,718 | 1,852,857 |
| Austria | 1,108,007 | 1,051,290 | 831,667 |
| France | 977,850 | 830,132 | 821,235 |
| Russia | 910,000 | 776.066 | 738,715 |
| Belgium | 304,000 | 244,017 | 265,397 |
| Holland | 171,029 | 149,763 | 125,658 |
| Other countries | 253,929 | 209,115 | 196,245 |
| Total for Europe | 5,523,446 | 4,982,101 | 4,831,774 |
| The U. S. | 71,427 | 32,471 | 40,399 |

PRODUCTION OF SUGAR AND MOLASSES IN THE U. S. FOR THE CENSUS YEARS 1849-50, 1859-60, 1869-70, 1879-80, AND 1889-90, FROM THE REPORTS OF THE SEVENTH TO THE ELEVENTH CENSUSES, INCLUSIVE.

| YEAR. | SUGAR-CANE. | | SORGHUM. | MAPLE. | |
|---|---|---|---|---|---|
| | Sugar, pounds. | Molasses, gallons. | Molasses, gallons. | Sugar, pounds. | Molasses, gallons. |
| 1850......... | 297,092,400 | ......... | ......... | 34,253,436 | ........ |
| 1860......... | 277,178,400 | 14,963,996 | 6,749,123 | 40,120,205 | 1,597,589 |
| 1870......... | 104,451,600 | 6,593,323 | 16,050,089 | 28,443,645 | 921,057 |
| 1880......... | 214,646,400 | 16,573,273 | 28,444,202 | 36,576,061 | 1,796,048 |
| 1890......... | 301,284,395 | 25,409,228 | 24,235,219 | 32,952,927 | 2,258,376 |

CONSUMPTION OF SUGAR IN THE U. S. FROM 1887 TO 1899, IN TONS OF 2,240 LB., AND CONSUMPTION PER CAPITA IN POUNDS.

| YEAR. | Tons. | Pounds per capita. |
|---|---|---|
| 1887 | 1,392,909 | 53·11 |
| 1888 | 1,457,264 | 54·23 |
| 1889 | 1,439,701 | 52·64 |
| 1890 | 1,522,731 | 54·56 |
| 1891 | 1,872,400 | 67·46 |
| 1892 | 1,853,370 | 63·76 |
| 1893 | 1,905,862 | 63·83 |
| 1894 | 2,024,648 | 67·07 |
| 1895 | 1,949,744 | 62·6 |
| 1896 | 1,960,086 | 61·6 |
| 1897 | 2,070,978 | 63·7 |
| 1898 | 2,002,902 | 60·3 |
| 1899 | 2,094,610 | 61·7 |

The total consumption of foreign sugar in 1899 was 1,844,642 tons. The total consumption of domestic cane-sugar in 1899 was 160,400 tons (in 1898, 252,812 tons). The total consumption of domestic beet-sugar was 79,368 tons (in 1898, 34,453 tons). The total consumption of domestic maple-sugar was 5,000 tons (in 1890, 25,000 tons).

CONSUMPTION OF SUGAR IN EUROPE FOR THE YEAR 1894, IN TONS OF 2,240 LB., AND CONSUMPTION PER CAPITA IN POUNDS.

| COUNTRY. | Tons. | Pounds per capita. |
|---|---|---|
| Great Britain | 1,484,000 | 70 |
| Germany | 623,000 | 19 |
| France | 488,000 | 24·5 |
| Austria | 325,000 | 14 |
| Holland | 55,000 | 26 |
| Belgium | 75,000 | 26 |
| Russia | 450,000 | 10 |
| Italy | 55,000 | 4 |
| Spain | 40,000 | 6 |
| Sweden and Norway | 30,000 | 10 |

At present Canada consumes about 140,000 tons of sugar annually, amounting to approximately 56 lb. per capita, and Australia and New Zealand 175,000 tons annually, amounting approximately to 90 lb. per capita. From the above data it is seen that the English-speaking people of the world are the great consumers if not the great producers of sugar.

*Prices of Sugar.*—It is difficult to compare modern with ancient prices, not only on account of the change in the weights and names of coins, but especially because gold, which is the ultimate standard of value, has itself varied so much in its purchasing power in the last thousand years.

From the best authorities the prices of sugar in England at the dates mentioned below, calculated to the present value of gold, are as follows:

From 1259 to 1350, $156 per 100 lb.; from 1351 to 1400, $237 per 100 lb.; from 1401 to 1540, $150 per 100 lb.; from 1541 to 1582, $181 per 100 lb.; and from 1583 to 1702, $106 per 100 lb. From 1700 to 1800 the price varied through wide limits, but still remained pretty high, being in 1800 about $38 per 100 lb. From that time the price was much less, being $16 per 100 lb. in 1810 and $4 per 100 lb. in 1885.

In the U. S. from 1845 to 1895 the average price, duty free, for fair refining sugar, polarizing about 96 per cent., was $4.38 per 100 lb. The lowest price recorded for fair refining sugar was, Feb. 21, 1895, $1.94 per 100 lb. net cash, duty free. The selling price of refined granulated sugar, including the duty, was on Feb. 21, 1895, 4 cents a pound.

LITERATURE.—*Historical*: *History of Sugar*, by Dr. Edward O. von Lippmann.

*Cane-sugar*: *Sugar Growing and Refining*, by Lock and Newlands Brothers; Bulletins of the Louisiana Sugar Experiment Station; Bulletins 5, 11, 15, 17, 18, 21, 22, 23, Division of Chemistry, U. S. Department of Agriculture.

*Beet-sugar*: Books by Horsin-Déon, F. Stohmann, Karl Stammer, Frühling & Schulz, and Lewis Ware; Bulletins of the U. S. Department of Agriculture, Special Bulletin No. 28, by Wm. McMurtrie, Bulletins of the Division of Chemistry Nos. 27, 30, 33, 36, 39, and Farmers' Bulletin No. 3; *The Sugar-beet*, by Lewis Ware.

*Sorghum-sugar*: *Sorghum*, by Peter Collier; Annual Reports of the U. S. Department of Agriculture for 1878, 1879, 1880, 1881, and 1882; Bulletins of the Division of Chemistry, Nos. 2, 3, 5, 14, 17, 18, 20, 26, 29, 34, 40; Report of the National Academy of Sciences on Sorghum.

*Technological*: The works of Horsin-Déon, Stohmann, and Stammer, referred to above; Spencer's *Sugar-grower's Manual*; Bulletin No. 8, Division of Chemistry, U. S. Department of Agriculture.

*Chemical*: *Handbook of the Carbohydrates*, by B. Tollens; Prof. Emil Fischer's papers in the *Berichte* of the German Chemical Society.

*Analytical*: Tucker's *Sugar Analysis*; Wiechmann's *Sugar Analysis*; Bulletin 43, Division of Chemistry, Department of Agriculture.

*Statistical*: Willett & Gray's *Weekly Statistical Sugar-trade Journal*; *Commerce and Navigation of the United States*, Bureau of Statistics of the Treasury; Eleventh Census of the U. S.

*Bibliographical*: *A Guide to the Literature of Sugar*, by H. Ling Roth.

*Periodical*: *Louisiana Planter and Sugar Manufacturer*, New Orleans; *The Sugar Planters' Journal*, New Orleans; *The Sugar Beet*, Philadelphia; *Sugar Cane*, Manchester, England; *Sugar*, London, England; *Sugar Planters' Monthly*, Honolulu; Mackay's *Sugar Journal*, Australia; *Journal des Fabricants de Sucre*, Paris; *Sucrerie Indigène*, Paris; *Bulletin de l'Association de Chimistes de Sucrerie*, Paris; *Bulletin de l'Association Belge de Chimistes*, Brussels; *Zeitschrift für Rübenzucker-Industrie*, Berlin; *Neue Zeitschrift für Rübenzucker-Industrie*, Berlin; *Die Deutsche Zuckerindustrie*, Berlin; *Die Œsterreichische-Rübenzucker-industrie*, Vienna. HARVEY W. WILEY.

**Sugarberry**: See HACKBERRY.

**Sugar-cane**: See SUGAR.

**Sugar, Mountain-ash**: See SORBITE.

**Sugar of Lead**: See LEAD (*Compounds of Lead*).

**Sugar of Milk**: See MILK.

**Sugar-palm**: See CARYOTA and SUGAR.

**Sugden**, EDWARD BURTENSHAW, Lord St. Leonards, LL. D., D. C. L.: jurist; b. in London, England, Feb. 12, 1781, his father being a wig-maker. He was largely self-educated, and was called to the bar at Lincoln's Inn in 1807. He almost immediately rose to the front rank of his profession by the publication of his *Practical Treatise of Powers*, previous to which he had published (Feb., 1805) his *Concise and Practical Treatise on the Law of Vendors and Purchasers*; was made king's counsel in 1822, and a bencher of Lincoln's Inn; was elected M. P. for Weymouth and Malcombe Regis as a Tory; and in 1829 appointed Solicitor-General and knighted; elected M. P. again in 1830, and sat in the Short Parliament which passed the first reform bill, of which he was one of the most persistent and shrewd opponents; was sworn member of the privy council 1834, Lord Chancellor of Ireland 1835, and again 1841–46; Lord High Chancellor of Great Britain from Mar. to Dec., 1852, being raised to the peerage. He was a deputy lieutenant for Sussex, a trustee of the British Museum, and lord high steward of the borough of Kingston-on-Thames. Although a Conservative he effected reforms in the law of contempt of courts, and in the laws relating to the conveyance of the property of infants, lunatics, mortgages, etc. He was recognized as the highest authority on the law of real property, and as the first practitioner of his time in the court of chancery. D. at Boyle Farm, near Thames Ditton, Jan. 29, 1875. Besides his treatise on *Powers*, and great work on the law of *Vendors and Purchasers* (which has gone through many editions), he published many technical works of lesser importance, including *A Handy Book on Real Property Law* (1858). See *Irish Law Times* and *Law Times* for Feb., 1875. F. STURGES ALLEN.

**Suggestio Falsi**: See FRAUD.

**Suggestion**: a great class of phenomena typified by the abrupt entrance from without into consciousness of an idea or image which becomes a part of the stream of thought and tends to produce the muscular and volitional effects which ordinarily follow upon its presence. I suggest a course of action to my friend—he may adopt it. Besides this fact of ideal suggestion there is what may be called physiological suggestion, covering the same class of phenomena in cases where the suggestion does not attain the standing of a conscious image, but remains subconscious. It is called physiological because the nervous process, as in all cases of very faint degrees of consciousness, is largely self-acting or reflex. By physiological suggestion, therefore, is meant the bringing about of a reaction subconsciously by means of an extra-organic stimulus.

The clearest examples of such suggestions occur in sleep. Words spoken to the sleeper are intelligently answered. Positions given to his limbs lead to others ordinarily associated with them; the sleeper defends himself, withdraws from dangers, etc. The early development of the child's consciousness proceeds largely by such suggestions. Before mental images are definitely formed and subject to association, we find many motor reactions stimulated by such physiological suggestions from the environment.

From physiological the child passes to sensori-motor suggestion, the type of reaction which illustrates most clearly the law of dynamogenesis. In this case it is a sensation, a clear state of consciousness, which liberates motor energy and produces movement. Besides the inherited sensori-motor couples, which are numerous and well marked, other reactions grow up early in life and become habitual. Of the latter the following may be mentioned in particular:

*Sleep-suggestions.*—The early surroundings and methods of inducing sleep become powerful re-enforcements of the child's drowsiness, or even substitutes for it.

*Food-suggestions and Clothing-suggestions.*—These represent the spheres of most frequent and highly spiced joys and sorrows, and their reactions soon take on the involuntary and yet highly purposive character which marks our adult attitudes toward dress and the table.

*Suggestions of Personality.*—The child shows preferences for individuals at a remarkably early age. He seems to learn and respond to a personal presence as a whole. Probably the voice is the first indication of his nurse's or mother's personality to which he responds, then touch, then the sight of the face.

*Imitative Suggestion.*—The simple imitation of movements and sounds, clearly manifested about the seventh month of life. See IMITATION.

In *ideo-motor* or *ideal* suggestion we pass to the motor aspects of images, reproductions; and here the motor accompaniments are largely associations and follow the laws of association. As soon, further, as reproductions come up, with their suggested trains, we find the rise of will; that is, they become stimuli to the voluntary consciousness. Yet there is a state of conflict and hindrance among presentations which is mechanical in its issue, the attention being drawn in a reflex way. So states of vexation, divided counsel, conflicting impulse, and hasty decision against one's desire for deliberate choice. We often find ourselves drawn violently apart, precipitated through a whirl of suggested courses into a course we feel unwilling to own as our own. This is the case in the disease called *aboulia*, or loss of will. The man is prey to conflicting impulses. This state, called by the writer deliberative suggestion, characterizes many actions of the young child before will is clearly exercised.

*Organic Stimuli to Movement.*—In general, any condition of the organism, be it active or passive, which is sufficient to reach consciousness, tends to muscular expression, either natural or acquired. Any derangement of the digestion, respiration, or circulation quickens or deadens muscular tone, and comes out, if not in the face, yet in the conduct of the man. The muscular feelings themselves, so large a portion of the general sensibility, reflect direct changes in the tendency and direction of motor reactions. Diseases of the nervous system find their diagnosis in their effects upon the muscular apparatus: paralysis means rigidity; epilepsy, convulsions; sleep, flabbiness of the muscles. The effect of organic stimulation upon the motor consciousness is best seen in conditions of pleasure and pain. Among direct or native reactions an important class are called expressive; they are differentiated muscular movements which reflect uniformly various affective states of consciousness.

*Pleasure-suggestion and Pain-suggestion.*—Perhaps the most direct and invariable stimulus to involuntary movement is pain; and its motor force is independent, as it seems, of the intrinsic experience of which it is the tone. The motor force of a sensation of light, for example, may be in direct antagonism to the motor force of the pain which the light causes to a diseased eye. Despair begets inaction, but the painfulness of it begets restlessness. This is only to say that the tone is an element of sensibility apart from the sensation it accompanies, and that both the one and the other have motor force.

Yet the fact that there are no experiences absolutely indifferent as respects pleasure or pain gives the motor aspect of them an universality and importance which must be acknowledged and provided for in any mental theory. It is a question answered often in the negative whether any course of conduct is ever pursued without primary reference to the pleasure it will bring or the pain it will avoid. However this question may be answered, it may be said at this point that no line of muscular reaction is possible in which an element of motor discharge due to pleasure or pain has not entered. This must be true if the fundamental position is true that every ingoing process alters the equilibrium of the central system and modifies the direction of its outward tendency. Pleasure and pain arising from bodily states may therefore be called the most general internal stimuli to the reactive consciousness.

*Motor Spontaneity.*—The observation of infants clearly tends to show that movement is no less original a fact than feeling. It is impossible to say whether all antenatal movements are in response to feeling conditions, as claimed by some, just as it is impossible to prove that the beginning of feeling is possible only after sufficient physical organization to make motor reaction possible, as claimed by others. It is altogether probable that the two kinds of phenomena are equally original, and depend upon each other. This is certainly the case, at any rate, at the dawn of independent life. Internal conditions of the organism itself are sufficient stimuli to an endless variety of movements. Such reactions, which are simply the discharges, the outbursts, of the organism, independent of definite external stimulation, are called spontaneous. So the incessant random movements of infants and the extraordinary rubber-like activity of the year-old child.

The movements of infants seem to indicate greater suggestibility than is found in adults. A child's extreme restlessness is due to a high feeling of potential or readiness of discharge; and fatigue is accompanied by a correspondingly complete collapse of muscular movements. This follows from the mobility of the infant's cerebral elements before they are pressed into definite connections and systems which give them greater inertia, on the one hand, and greater general capacities for continued expenditure on the other. Upon this superfluity of motor energy is built up the so-called play instinct, which is not definite enough in its channels to be classed properly as an instinct.

REFERENCES.—Bernheim, *Suggestive Therapeutics* (New York, 1890); Baldwin, *Mental Developments: Methods and Processes*, chap. vi. (New York and London, 1895). See also the articles ASSOCIATION OF IDEAS and HYPNOTISM.

J. MARK BALDWIN.

**Suhm**, soom, PETER FREDERIK: historian; b. in Copenhagen, Denmark, Oct. 18, 1728; studied law and philology at the university of his native city; settled in 1751 in Trondhjem in Norway, where he lived till 1765, devoting himself to the study of Danish and Norwegian history and antiquities in preparation for his great works. D. in Copenhagen, Sept. 7, 1798. Among his many writings relating to the history of Denmark may be mentioned *Forsög til Forbedringer i den gamle danske og norske Historie* (1757); *Om de nordiske Folks ældste Oprindelse* (1770); *Kritisk Historie af Danmark i den hedenske Tid* (4 vols., 1774–81); *Danmarks Historie* (14 vols., 1782–1828). In spite of its many faults of style and arrangement this last still remains the greatest work of its kind in the Danish language, the chief authority from which later historians have borrowed. By his *Letter to the King* (1772), indorsing the conspiracy against Struensee and calling upon Christian VII. to restore the ancient liberties of Denmark, he became for the moment the most popular man in the North. Both as patron and author he devoted himself to the advancement of freedom and culture. His magnificent library, containing 100,000 volumes, he bequeathed to the Royal Library. Of *Scriptores Rerum Danicarum Medii Ævi* he edited vols. iv.–vii. (1776–92). Revised by D. K. DODGE.

**Suicide** [Lat. *sui*, of one's self + *cædere*, slay, kill]: intentional death by one's own hand. Among the ancients suicide was considered neither a crime nor dishonorable, Demosthenes, Themistocles, Mark Antony, Cleopatra, Hannibal, and many others having chosen this way of ending their days. The Scriptures and the Apocrypha furnish examples, as Samson, Eleazar, and Judas Iscariot. In modern times history furnishes numerous striking suicides. The famous suicides among the ancients followed various motives, the vindication of honor being a common object. Mithridates and Hannibal died in this way rather than be taken prisoners. Others have committed suicide through false pride or timidity: a striking case in point was the death of Cato; determined not to live under the despotism of Cæsar, he stabbed himself, but, having fainted, his wound was dressed. When he recovered he tore off the bandages, let out his entrails, and expired.

Many writers have defended this crime, the most able of whom were Madame de Staël, Gibbon, Hume, Schopenhauer, and von Hartmann. Suicide is rarely committed, however, except when the functions of the brain have been impaired and the action of the mind perverted and directed in improper channels.

Suicide has sometimes been epidemic in character. A remarkable epidemic prevailed in Versailles in 1793; the number of suicides in that year reached 1,300, which was greatly disproportionate to the population. Instances have been cited where children have followed the example of one of their number and have taken their own lives. An epidemic of suicide took place in the army of the First Napoleon, and it was only after a strong appeal made by the emperor to the pride and courage of the men in the ranks that it was finally stopped. One of these outbreaks followed the suicide of a convict, who hanged himself to the crossbar of his cell. Five others hanged themselves on the same bar within two weeks. The public prints probably have much to do with the increase of suicide. A morbid person who reads the account of such a case will very often have a train of thought started that will end in the commission of the act. Favorable opportunities for the accomplishment of self-murder will also produce a sudden irresistible impulse. People who have gone up into towers and monuments, or above precipices, have often refrained with difficulty from casting themselves down.

The consideration of suicide from the medical point of view has cleared up many mooted points, such as the degree of responsibility the person is under, the degree of prevention possible, etc. In certain forms of insanity the impulse to suicide is now a recognized symptom, notably in all the disorders which involve melancholia. Alcoholic mania is liable also to issue in this impulse. The peculiar liability of persons whose mental balance is at all weakened to the influence of suggestions of all kinds makes it a necessary part of competent medical treatment that any accounts of suicide, murder, or suggestions of death be kept from them. On the other hand, solitary confinement is found to increase the number of suicides; probably because by diminishing the number of the patient's interests his thought is brought home more forcibly to his own condition, grievances, etc.

*Statistics.*—Thorough and adequate statistics of suicide are not to be had. Those now given are current ones, and should be quoted only with reservation. In Roman Catholic countries the number of suicides is considerably less than in Protestant countries (about half), the figures in the aggregate for Protestant countries being about 175 to 200 for each million of the population. As to the difference between men and women, suicides are oftener men by about three to one.

From Table I. (from Morselli) and other sources we get the average annual number of suicides per million of inhabitants: Denmark, 258; Germany, 175; Norway and Sweden, 100; France, 150; to which may be added England and the U. S., each 70. Among uncivilized and barbarous tribes and peoples, suicide is practically unknown. It is therefore peculiarly a disease of civilization. In all countries it is more frequent among the mercantile than among the professional classes; and more frequent among the responsible heads of institutions, business houses, etc., than among the dependent classes represented by clerks. Indeed the fact of responsibility seems to be a prevailing cause of suicide. Those, on the contrary, who live a most precarious life, such as the day-laborers, who may be thrown out of employment at any moment, seem to take their chances with less brooding and personal violence. There is here a discrepancy between the tendency to murder and that to commit suicide; for the murderers are more common among the laboring class, or

TABLE I.—SHOWING THE AVERAGE ANNUAL NUMBER OF SUICIDES PER MILLION INHABITANTS IN VARIOUS COUNTRIES AT SUCCESSIVE PERIODS.

| STATES. | 1816–20. | 1821–25. | 1826–30. | 1831–35. | 1836–40. | 1841–45. | 1846–50. | 1851–55. | 1856–60. | 1861–65. | 1866–70. | 1871–75. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sweden | 48 | 58 | | 69 | 66 | 66 | 67 | 71 | 57 | 76 | 85 | 81 |
| Norway | .. | 80 | | 97 | 109 | 107 | 110 | 107 | 94 | 85 | 76 | (73) |
| Denmark | .. | .. | .. | .. | 213 | 232 | 258 | 272 | 276 | 288 | 277 | 258 |
| England | .. | .. | .. | 628 | | | (64 ?) | | 65 | 66 | 67 | 66 |
| Ireland | .. | .. | .. | .. | 10 | ... | ... | ... | ... | (14) | 15 | 18 |
| Prussia | 74 | 83 | 89 | 96 | 103 | 110 | 99 | 130 | 123 | 122 | 142 | 134 |
| Hanover | .. | .. | | 83 | | 106 | 109 | 118 | 131 | (133) | ... | 140 |
| Mecklenburg | 63 | .. | .. | .. | .. | 135 | 142 | ... | 162 | ... | 161 | 167 |
| Nassau | .. | .. | .. | .. | 85 | | ... | ... | 95 | 102 | ... | 147 |
| Kingdom of Saxony | .. | .. | .. | .. | 158 | 198 | 199 | 248 | 245 | 264 | 297 | 299 |
| Bavaria | .. | .. | .. | .. | ... | 55 | 73 | | 80 | | 90 | 91 |
| Würtemberg | .. | .. | .. | .. | ... | 107 | 108 | | 85 | 123 | | 160 |
| Baden | .. | .. | .. | .. | ... | 68 | ... | ... | 108 | 109 | 139 | 156 |
| Belgium | .. | .. | .. | 39 | 46 | 62 | 60 | (37) | 55 | | 66 | 68 |
| France | .. | .. | 54 | 64 | 76 | 85 | 97 | 100 | 110 | 124 | 135 | 150 |
| Italy | .. | .. | .. | .. | ... | ... | ... | ... | ... | (28) | 30 | 35 |

TABLE II.—SHOWING THE NUMBER OF DEATHS BY SUICIDE IN THE CITY OF NEW YORK, ACCORDING TO THE MEANS USED, NATIVITY AND SEX, FROM 1878 TO 1891.

| NATIVITY. | Cut and stab. | | Drowning. | | Gunshot. | | Hanging. | | Jumping from height. | | Poison. | | Other means. | | Totals. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. |
| Austria-Hungary | 4 | .. | 1 | 1 | 21 | 3 | 5 | 2 | 3 | 2 | 14 | 6 | .. | .. | 48 | 14 |
| Bohemia | 3 | 1 | .. | .. | 11 | 1 | 9 | .. | 2 | 1 | 9 | 3 | .. | .. | 34 | 6 |
| Belgium | 2 | .. | .. | .. | 3 | .. | 2 | .. | .. | .. | .. | .. | .. | .. | 7 | .. |
| British America | 3 | .. | 3 | .. | 6 | .. | 2 | 1 | 1 | .. | 3 | 5 | .. | .. | 18 | 6 |
| England | 17 | 3 | 2 | .. | 31 | .. | 5 | .. | 5 | 5 | 31 | 10 | .. | .. | 91 | 18 |
| France | 6 | 1 | .. | 1 | 27 | 2 | 9 | 1 | 3 | 3 | 14 | 5 | .. | .. | 59 | 13 |
| Germany | 92 | 10 | 46 | 16 | 366 | 14 | 232 | 31 | 35 | 10 | 218 | 76 | .. | 1 | 989 | 158 |
| Ireland | 32 | 10 | 9 | 13 | 37 | 2 | 24 | 14 | 19 | 10 | 59 | 59 | 2 | .. | 182 | 108 |
| Italy | 5 | .. | 3 | .. | 17 | 1 | 3 | .. | 1 | 3 | 3 | 5 | .. | .. | 32 | 9 |
| Poland | .. | .. | .. | .. | 11 | .. | 7 | .. | 2 | 1 | 5 | 2 | .. | .. | 25 | 3 |
| Russia | 2 | .. | .. | .. | 7 | .. | 10 | 2 | .. | 1 | 4 | 5 | .. | .. | 23 | 8 |
| Scotland | 4 | .. | 1 | 1 | 6 | .. | .. | .. | 1 | .. | 7 | .. | .. | .. | 19 | 1 |
| Switzerland | 3 | .. | 1 | .. | 17 | 1 | 4 | 1 | 1 | 1 | 3 | 4 | .. | .. | 29 | 7 |
| Sweden | 3 | 1 | 1 | .. | 6 | .. | 4 | .. | 1 | .. | 2 | 2 | .. | .. | 17 | 3 |
| United States | 52 | 9 | 21 | 5 | 251 | 23 | 66 | 11 | 34 | 24 | 131 | 113 | 1 | .. | 556 | 185 |
| Unknown | 6 | .. | 10 | 1 | 48 | 1 | 19 | 1 | 2 | 1 | 21 | 4 | 1 | .. | 107 | 8 |
| Other foreign countries | 5 | .. | 5 | 1 | 26 | .. | 10 | 2 | 5 | 2 | 19 | 3 | .. | .. | 70 | 8 |
| Totals | 239 | 35 | 103 | 39 | 891 | 48 | 411 | 66 | 115 | 64 | 543 | 302 | 4 | 1 | 2,306 | 555 |

still lower classes. Education also seems to increase the propensity to commit suicide. One of the defects of most statistics of suicide is that they do not take account of the unsuccessful attempts at self-destruction, in which the person is equally a suicide.

LITERATURE.—Morselli, *Suicide* (London and New York, 1882); Legoyt, *Le Suicide Ancien et Moderne* (Paris, 1881); statistics contained in successive *Census Reports* of the different governments; Lewis, *History, Literature, etc., of Suicide* (London, 1885); full list of titles in *Notes and Queries* (1890), p. 489; Tuke, article *Suicide* in *Dic. of Psych. Medicine* (London, 1892), where statistics are given down to 1888. J. MARK BALDWIN.

SUICIDE IN LAW.—The legal definition of suicide is intentional self-murder by a person of criminal responsibility, in point of age and mental condition. According to Bracton, the early English law treated suicide as a felony, punishable by the forfeiture of lands in case it was committed to escape conviction for a crime, by the forfeiture of goods in all other cases. (2 *De Legibus*, ch. 31.) Later English law imposed the forfeiture of goods and chattels real in all cases. The rule was evaded frequently by a finding of the coroner's jury that the suicide was insane, and was formally abolished in 1870. (33 and 34 Vict., ch. 23.) From an early day the practice prevailed of burying suicides at cross-roads with a stake through the body; but it is said to have been without warrant in the common law. (3 Stephen's *History of Criminal Law*, p. 105.) Its origin is doubtful, but has been ascribed to a Teutonic custom taken up into the canon law. (Guernsey, *Penal Laws against Suicide*.) The object of impaling the body appears to have been to keep the ghost from wandering about to the discomfort of the living. (Stranahan, *Suicide and Insanity*, London, 1893.) Parliament abolished the practice in 1823, and later statutes authorize the interment of suicides in churchyards or burial-grounds, with such funeral services as those in charge of the body may provide. (45 and 46 Vict., ch. 19.) The Roman law dealt very leniently with suicide, even to the extent of legalizing it in various circumstances. During the later empire and the Middle Ages the legal rules upon this subject underwent a radical change, produced not only by different ethical and religious views but by political considerations. It was argued that "there could be no patient endurance in the state unless there was patient endurance in the citizen. If the people resorted to suicide to escape trouble, so would the state, and all social order would be at an end."

In the U. S. suicide is not treated as a crime. It is deemed unlawful, however, and a person who unintentionally kills another while attempting to commit suicide is guilty of criminal homicide. (*Commonwealth* vs. *Mink*, 123 Mass. 422.) At common law a person who kills another at the latter's request, or who persuades another to kill himself, or who agrees to join another in committing suicide, is guilty of murder. Such is still the rule in England, although it is improbable that one who joined another in a common attempt at suicide, but who escaped, would be punished capitally. An unsuccessful attempt at suicide is a common-law misdemeanor. In some of the U. S. such an attempt is punishable as a statutory felony, as is the offense of aiding another to commit suicide, and that of abetting another to attempt suicide. (See New York Penal Code, §§ 172–178.) The Indian penal code provides a severer punishment for persons aiding minors or incompetents to destroy themselves than for those who abet the suicide of sane adults. (§§ 305 and 306.) Macaulay, in his report of the draft of this code, argues strongly against the common-law rule which places the abettor of suicide in the same category with the abettor of murder. (See Wharton, *On Homicide*, § 315, note.) The punishment of one who attempts suicide and fails has been criticised as putting a premium upon the successful completion of the suicidal act.

The law of Scotland does not treat suicide as a crime. It does provide for the escheat of the suicide's movables; but the proceeding leading to such escheat is civil and not criminal, and the next of kin to the deceased must be made parties. The proceeding is practically obsolete. (Erskine, *Principles of the Law of Scotland*, p. 559, § 20, Rankine's ed., Edinburgh, 1890.) There is no warrant in law or practice for the infliction of any punishment or indignity upon the body of a suicide in Scotland. 1 Hume, *Commentaries on the Criminal Law of Scotland*, p. 300; *Earl of Eglington* vs. *Campbell*; Maclaurin's *Criminal Cases*, 504–531.

The consequences of suicide in life-insurance cases are discussed in the article on LIFE-INSURANCE under the heading *Forfeiture*. See also Richards, *On Insurance*, § 184; *Smith* vs. *National Benefit Society*, 123 New York 85; and *Conn. Life-insurance Company* vs. *Akens*, 150 United States 468. FRANCIS M. BURDICK.

**Su'idæ** [Mod. Lat., named from *Sus*, the typical genus, from Lat. *sus*, hog]: a family of artiodactyl ungulate mammals, of the section *Omnivora* or *Non-ruminantia*, typified by the common hog. The form in all is essentially like that of the domesticated hog, but mostly less gross; the feet are unguligrade (i. e. with the hoofs only touching the ground), and the external toes and hooflets are reduced in size and do not assist in progression, the median (third and fourth of normal series) only being functional; the snout is disciform and provided with a cartilaginous ring, and in the disk the nostrils are open and forward; the mammæ are in considerable number (four to ten), ventral as well as inguinal; the back has no dorsal scent-gland; the tail is short or rudimentary; the tegumentary appendages are developed as stiff bristles; the orbits are directed outward and forward; the occipital bones have long deflected styliform paroccipital processes in front of the occipital condyles; the zygomatic processes overlie the malar bones; the articular surfaces for the lower jaw are transversely concave, antero-posteriorly convex, and limited by no post-glenoid processes; the pterygoid bones are twisted and reflected outward, the crest continued upward and backward into the temporal region; the malar bones are elongated, and have long inferior processes; the teeth are generally in full number, i. e. M $\frac{3}{3}$, P. M. $\frac{4}{4}$ $(\frac{3}{3})$, C. $\frac{1}{1}$, I. $\frac{3}{3}$ $(\frac{2}{3}) \times 2 = 44$; the molars have corrugated cusps, presenting, when worn, deeply sinuated insular areas; the canines of the upper jaw, in the males, are more or less twisted outward and upward, and parallel with the lower. In their anatomy the feet offer characters shared with the wart-hogs and peccaries, and differentiating from the hippopotamids. The living representatives of the family are aboriginally peculiar to the Old World, although in the Tertiary epoch species appeared to have existed in America. Exclusive of the domesticated forms, fifteen species have been recognized. Twelve of these belong to the genus *Sus*, and are all peculiar to Asia, except *S. scrofa* (the wild boar of Europe) and *S. sennaarensis* of Northern Africa; the genus *Potamochœrus* is confined to West Africa, the single species of *Babirussa* to Celebes and a few of the adjoining islands, and a single species in India and the Archipelago exemplifies the very strongly marked genus *Babirussa*. The domesticated swine are subject to great variation, and Gray even differentiated them into two peculiar genera—*Scrofa* for most of the breeds, and *Centuriosus* for a peculiar race of Japan and China, distinguished by the strongly defined concentric wrinkles of the face. See BABYROUSSA, BOSCHVARK, and SWINE. Revised by F. A. LUCAS.

**Su'idas** [= Lat. = Gr. Σουΐδας]: lexicographer. Of his life nothing is known; even the age in which he lived is uncertain, though it may be fixed not later than the twelfth century. His book contains explanations and notices of Greek words and names, illustrated by extracts from older Greek writers. It has evidently gone through many hands before reaching its present form, and it is generally of very little critical value; but as many of the works from which it quotes passages are lost, it has great historical interest. Editions by Gaisford (Oxford, 1834); Bernhardy (Halle, 1834); and Bekker (Berlin, 1854.)

**Suine**, or **Butterine**: See BUTTER, ARTIFICIAL.

**Sukhāvatī** [Sanskr., paradise of pleasures]: the heaven over which, according to the Mahā-yāna, or "Great Development" of Buddhist doctrine, a Dhyāni-Buddha (see DHYĀNI-BUDDHAS) called Amitābha presides, and where the saints, exempt from suffering, death, and sexual distinction (but not from rebirth), may live for countless ages in absolute bliss. Summer and winter are there unknown; the sun never scorches and cold winds never blow; sweet flowers shed their perfume around, and birds of the most beautiful plumage sing day and night of the five chief virtues, the five sources of moral power, and the seven steps in knowledge, and the listener is so affected by their music that he can think of nothing but of Buddha, His law, and his Order. Among the Chinese this paradise is called *Tsing-tu*, the Pure Land (in Japanese, *Jōdō*), because its inhabitants are free from the five impurities of this world. Rebirth in Sukhāvatī can be secured only by unswerving faith in Amitābha, by fervent prayer addressed to him, and by the practice of every virtue. Amitābha is not only the Buddha of "boundless light," but also of great mercy and sympathy. His worship is peculiar to the northern school of Buddhists, among whom it takes the place of NIRVĀNA (*q. v.*), which is too difficult of attainment. Sukhāvatī is situated in some universe in the far West, and hence is known as the "Paradise of the West."

**Sula Islands** (Dutch. *Soela*): a group of three islands and many islets in the Dutch Moluccas, E. of Celebes and N. W. of Buru, between lat. 1° 40′ S. and 2° 30′ S., and 124° and 127° E. lon. Area, 2,590 sq. miles. The largest and westernmost is Taliabu (70 miles long and 15 broad); immediately E. is Mangola, the second in size, and S. of the latter is Besi, the smallest but most thickly populated, and containing Senana, the capital. Pop. about 7,000, formerly six times as large, but depopulated by pirates and slave-merchants. The islands are prosperous under Dutch management. M. W. H.

**Suleïman′**: Ottoman prince. After the battle of Angora (1402) he, as the eldest surviving son of Bayezid I., ascended the throne at Adrianople, but was overthrown by his brother Musa (1410). The Ottoman historians do not consider him a sultan, inasmuch as he reigned only over a part of the empire. E. A. G.

**Suleïman**: the name of two Ottoman Sultans. SULEÏMAN I., EL KANOUNI, the Legislator, often called the Great, the Magnificent, the Sublime (1520–66); b. in 1495, son of Selim I. His reign is a series of generally successful wars, during which he conducted thirteen campaigns in person. In 1521 he crushed a rebellion in Syria, concluded a treaty with Venice, wherein she promised an annual tribute of 10,000 ducats, and captured Belgrade. In 1522 he subdued Rhodes, expelling the Knights of St. John of Jerusalem, whose stronghold it had been 214 years, who found an asylum at Malta. In 1526 he concluded a partial alliance with Francis I. of France against Charles V.; broke the Hungarian power at the battle of Mohacz, where King Louis and 25,000 Hungarians were slain, and brought to Constantinople 100,000 Christian captives, the royal jewels of Hungary, and the precious library of Mathias Corvinus. Besieging Vienna with 120,000 men and 400 cannon, he was repulsed (1529); concluded an offensive and defensive alliance with Francis I. (1535); and took Bagdad from Persia (1534). Meanwhile his admiral, Khaïreddin Pasha, terrorized the Mediterranean and subjected Northern Africa. Moldavia and the Khan of the Crimea made submission (1538). Venice, after a disastrous war, purchased peace by promising annual tribute of 300,000 ducats (1539), and Austria, by like tribute of 50,000 ducats (1547). He conquered Persian Kurdistan, captured Van and Tebriz, and partially subdued Georgia (1548). Austria fared better in the next war, defeating the Ottomans with fearful loss in their five months' siege of Erlau (1552). Though Suleïman formed an offensive and defensive alliance with Henry II. of France, dissensions prevented real benefit to either. Fruitless wars followed with Persia (1554–55) and with the Hungarians (1558). Instigated by his favorite, Roxelana, who sought the succession for her son, he put to death his oldest son, Mustapha (1553). Enraged with his son Bayezid, who fled to Persia, he paid the Shah Tahmasp 400,000 gold pieces to insure the murder of the fugitive and of his four sons (1561). To break the naval power of Spain and control the Mediterranean he attacked Malta, but was defeated with the loss of 20,000 men (1565). Carrying on a last war with Austria, he died at the siege of Szigeth (1566), which, after an heroic resistance, fell three weeks later. Meanwhile the death of Suleïman was kept secret, that his successor, Selim II., might have time to reach Constantinople from Kutahia. During his reign the Ottoman empire reached its acme and began its decline. The discipline of the janissaries was relaxed: the harem, in the person of Roxelana, first began to exert undue and hence pernicious influence, and expenditure was carried to its utmost extravagance. More fatal still, during the latter part of his life, Suleïman partially withdrew into Oriental seclusion, leaving affairs to his ministers. Yet this was the golden age of Ottoman jurisprudence, literature, and art. Suleïman remodeled and almost recreated the code, determined ecclesiastical procedure, introduced a less vicious system of taxation, and erected the mosques of Suleïman—the masterpiece of Ottoman architecture—of Selim, the Shahzadeh, Djeanghir, and the Hasseki. He had statesmen and generals of unusual ability in Ibrahim Pasha, Rustem Pasha, and Sokolli Pasha. His admirals, Khaïreddin Pasha, Dragut Pasha, and Piali Pasha, were the most skillful naval commanders Turkey has possessed. But Suleïman was the spoiled favorite of Ottoman fortune, and his successes were mainly won during the early years of his reign. Though he extended the boundaries of his empire, he left it at his death weakened and exhausted. —SULEÏMAN II. (1687–91), b. in 1642, the son of Sultan Ibrahim. Timid and incapable, he committed the administration of affairs to his vizier, Kuprnli Zadek Mustapha Pasha, the Virtuous, who was slain, with 28,000 Ottomans, at the terrible defeat of Selankemen (Aug. 19, 1691), two months after the death of his master. E. A. GROSVENOR.

**Suleïman Pasha**: Ottoman prince; son of Orkhan and grandson of Osman I. He captured Tzympe and Gallipoli (1357), the first territorial acquisition made in Europe by the Ottomans. He was killed by a fall from his horse in 1359, and his father died of grief in 1360. E. A. G.

**Su′lidæ** [Mod. Lat., named from *Sula*, the typical genus, from Icel. *sūla*, gannet]: a family of swimming birds of the order *Steganopodes*, limited to the gannets. The neck is moderately long, although shorter and stouter than in either the pelicans or cormorants; the bill about as long as the head, straight, but with the tip decurved, with the lateral grooves well defined, composite as in the other members of the group, and with the edges serrate; narial openings lacking; no gular pouch developed; wings moderately long and pointed; tail long and cuneate, and with twelve to fourteen feathers; tarsi moderately short; toes (four, as in all *Steganopodes*) well developed and connected by a full membrane. The skull is of the desmognathous type, and exhibits modifications co-ordinate with the external characteristics. The species are almost exclusively marine, and one or more may be found on the seacoast of every country. See GANNET. Revised by F. A. LUCAS.

**Suliman′ Mountains**: a chain of mountains forming the boundary between India and Afghanistan. They range from N. to S., and reach their greatest height, 11,300 feet, in Takht-i-Suliman, in lat. 31° 25′ N. They connect S. with the Kurlekhi Mountains of Kelat, and N. with the Sefid Koh, which is 15,622 feet high and ranges from E. to W. The descent toward India is steep, but gentle toward the Afghan plateaus; the valleys drain eastward to the Indus. The most convenient ascent to Kandahar is effected along the Gomal from Dera Ismael Khan on the Indus.
Revised by M. W. HARRINGTON.

**Suli′na**: the name of the central delta-branch of the Danube. The Danube, at 45 miles from the coast, divides into the Kilia and Toulcha branches, the former conveying more than half the entire discharge. The latter again divides into the Sulina and St. George branches. The Kilia and St. George mouths are 33 miles apart, and the Sulina mouth nearly half way between. The European Commission of the Danube, representing eight European states, was created by the treaty of Paris (1856), for the purpose of removing obstructions to navigation and deepening the channel, and its powers were prolonged until Apr., 1904, by the treaty of London (1883). This commission has so far succeeded that the Sulina branch is navigable by the largest vessels. (See HARBORS.) The town of Sulina, at the corner of the right bank and the Black Sea, originally a miserable fishing-village, has remarkable public works. Pop. (1889) 4,315. E. A. GROSVENOR.

**Su′liotes** [deriv. of *Suli*, in the Cassopeian Mountains, formerly their chief village]: a band of 1,500 Albanian Christian warriors who forced the Ottomans to acknowledge their independence about 1730. In 1788 and again in 1792 they successfully resisted Ali Pasha of Tepeleni, who undertook their subjection. From 1799 to 1803 they were blockaded and practically besieged in their mountain fastnesses by Ali Pasha; their strongholds were gradually captured, despite desperate resistance, and they finally surrendered on favorable terms. The conquerors violated their oath, and men, women, and children were indiscriminately massacred. Only a few escaped. The story of the twenty-two Suliote women, who, rather than fall into the hands of the Ottomans, hurled their children from a precipice and then leaped after them, is everywhere known. Marco Botzaris was a Suliote. They were avaricious and haughty, but loved their freedom above all. E. A. GROSVENOR.

**Sulla**, or **Sylla**, LUCIUS CORNELIUS, surnamed FELIX: dictator; b. 138 B. C.; was noted in youth for his vices, but distinguished himself under Marius as a cavalry leader in the Jugurthine war, and it was through his skill as a negotiator that Jugurtha was surrendered to the Roman general.

From this moment Marius feared and hated him as a rival. In the war against the Cimbri and Teutones (104–101), Sulla commanded with distinction, and in 92 he was sent as proprætor to Cilicia, where he defeated Gordius, the general of Mithridates, reinstated Ariobarzanes as King of Cappadocia, and received an embassy from Arsaces, King of Parthia. In the Social war both Sulla and Marius commanded with success, but it was Sulla who defeated Papius Mutilus, the chief of the Samnites, and took Bovianum, their capital. For the year 88 he was elected consul almost unanimously, and, to the deep mortification of Marius, appointed commander in the Mithridatic war, a war which Marius had in many ways instigated, in the hope of being chosen general. By means exceedingly violent, though in form legal, Marius succeeded in subverting the appointment of Sulla and getting himself appointed, but during the riot which took place in Rome Sulla escaped to Nola in Campania, where his army was stationed. Followed by the rank and file of his army, he now marched on Rome. Marius fled to Africa, and Sulla was perfect master of the situation; but realizing his dependence upon the army, which was eager for the spoils of an Eastern war, he soon left the city and proceeded with the army to Greece. He stayed away four years (87–83). Shortly after his departure he was declared a public enemy: his property was confiscated; his friends were persecuted or slain. Marius returned, and the Marian or popular party domineered in Rome and Italy. But of all this Sulla took no notice; he simply prosecuted the war. Sulla took Athens by storm in 86 and gave it up to plunder. Shortly after he routed one of the hostile armies at Chæronea; next year he totally destroyed another at Orchomenus, and having expelled Mithridates's troops from Greece and pacified the country, he crossed the Hellespont in 84. Pressed at the same time by another Roman army sent out by the Marian party under Flaccus and Fimbria, ill supported by his Greek subjects in Asia, who found him as unamiable as the Romans, and nearly exhausted by his enormous losses in Greece, Mithridates now sued for peace, and after a personal interview between him and Sulla a treaty was concluded, according to which he returned all his conquests in Asia, surrendered a fleet of seventy large vessels, and paid 2,000 talents. Sulla now turned against Fimbria, whose soldiers deserted him, and who committed suicide; he then regulated the affairs of the province of Asia, from whose cities he made enormous conscriptions, and finally set sail for Italy, where he landed at Brundisium in the spring of 83. His soldiers were now rich, and they knew that the final success of their general was a condition of the enjoyment of their riches; they clung firmly to him, and he acted cautiously. Marius was dead, but his son was consul and his party in power, strengthened by an alliance with the discontented Italian nations. The final battle was at the gates of Rome, where Sulla's veterans defeated a large body of the Samnites. Sulla was made dictator for life. It was not his purpose, however, to establish a monarchical constitution in Rome. The legislation which he enacted as dictator, the so-called *Leges Corneliæ*, aimed simply at the restoration of the old aristocratic constitution, the extension of the authority of the senate, the restriction of the power of the tribunes, etc. In order to establish this constitution firmly and safely, he first determined to extirpate its adversaries, the Marian party. Thousands of men fell under his *proscriptio*; that is, they were outlawed and slain, and their property was confiscated and given to somebody else. He then attempted to form a steady support for it by settling his veterans in military colonies on such Italian soil as had been confiscated in the Social war or afterward, and by organizing a bodyguard stationed at Rome. When he considered his work finished, he assembled the people, abdicated the dictatorship, retired to his villa at Puteoli, and returned to the lazy, voluptuous habits of his youth. His death, which occurred in 78 B. C., was hastened by his debaucheries.

Revised by F. M. COLBY.

**Sullivan**: city; capital of Moultrie co., Ill.; on the Chi. and E. Ill., the Peo., Dec. and Evansv., and the Wabash railways; 14 miles N. W. of Mattoon, 25 miles S. E. of Decatur (for location, see map of Illinois, ref. 7–F). It is in an agricultural and stock-raising region, and contains 2 State banks with combined capital of $55,000, and 3 weekly newspapers. Pop. (1880) 1,305; (1890) 1,468; (1900) 2,399.

**Sullivan**: town (laid out in 1843); capital of Sullivan co., Ind.; on the Evansv. and Terre Haute and the Ind. and Ill. S. railways; 26 miles S. of Terre Haute (for location, see map of Indiana, ref. 9–B). It is in a coal-mining region; manufactures lumber, flour, and tile; and contains 6 churches, graded public schools, electric lights, 2 State banks with combined capital of $24,000, and a semi-weekly and 2 weekly periodicals. Pop. (1880) 2,161; (1890) 2,222; (1900) 3,118.

EDITOR OF "DEMOCRAT."

**Sullivan**, ALEXANDER MARTIN: journalist and politician; b. at Castletown, Ireland, in 1830; was connected in 1855 with the Dublin *Nation*, of which he was editor and proprietor until 1876. In 1868 he was indicted for sedition in consequence of articles referring to the Manchester executions, and sentenced to four months' imprisonment. He was returned to Parliament in 1874 in the Home-rule interest, a movement with which he was especially identified. Mr. Sullivan represented the county of Louth till the general election of 1880, when he was elected for Meath. In 1882 he withdrew from Parliament in consequence of ill health. He published several works, among which are *A Visit to the Valley of Wyoming*, a pamphlet descriptive of a tour in America made in 1857, and *New Ireland* (1877). D. at Dalkey, Ireland, Oct. 17, 1884.

F. M. COLBY.

**Sullivan**, Sir ARTHUR SEYMOUR: composer; b. in London, May 13, 1842; the son of a teacher of music. He was early trained in the art, singing in the chapel royal when a mere child; at the age of fourteen gained the Mendelssohn scholarship, which enabled him to pursue his studies under the best masters at home and on the Continent. For *The Tempest* of Shakspeare he composed incidental music which was performed for the first time at the Crystal Palace in 1862. He was knighted May 15, 1883. His compositions include overtures, symphonies, songs, and piano music; the operettas *Box and Cox*, *Thespis*, and *Contrabandista*; the cantatas *The Bride of Neath Valley*, *Kenilworth*, and *On Sea and Land*; the oratorios *The Prodigal Son*, brought out at the Worcester musical festival in 1868, and *The Light of the World*, produced at the Birmingham festival in 1873; and an opera, the libretto by Chorley, entitled *The Sapphire Necklace*. Sullivan's greatest successes have been made with his comic operas, in which he had the invaluable collaboration of William S. Gilbert, the distinguished playwright. Beginning with *H. M. S. Pinafore* (1878), and followed by *The Pirates of Penzance* (1879), *Patience* (1881), *Iolanthe* (1882), *The Mikado* (1885), also *The Yeomen of the Guard*, *The Gondoliers*, etc., his popularity has been greater, perhaps, than that of any other English composer. He also wrote a grand opera called *Ivanhoe*, which did not prove a success. D. Nov. 21, 1900.

**Sullivan**, BARRY: actor; b. in Birmingham, England, in 1824; made a successful *début* on the stage at Cork in 1840, acting thereafter in the principal towns of Ireland, Scotland, and England, and making his first appearance at the Haymarket theater, London, in 1852, as Hamlet. He visited the U. S. in 1857; returned to Great Britain in 1860, and in 1861 made a profitable professional visit to Australia, returning to England in 1866. He subsequently became lessee of the Holborn theater, London, and in 1875 made a second and not very successful visit to the U. S. D. at Brighton, England, May 3, 1891.

Revised by B. B. VALLENTINE.

**Sullivan**, FRANCIS STOUGHTON, LL. D.: lawyer; b. probably in Ireland near the middle of the eighteenth century; became Professor of Common Law in the University of Dublin, and was the author of two legal works of great value, *Historical Treatise on the Feudal Law, and on the Constitution and Laws of England* (1772) and *Lectures on the Constitution and Laws of England* (1776).

F. S. A.

**Sullivan**, JAMES, LL. D.: jurist and statesman; b. at Berwick, Me., Apr. 22, 1744; studied law; practiced at Biddeford, and in 1770 was appointed king's attorney for York County. As the Revolution approached, he espoused the patriot cause; was a member of the provincial congress of Massachusetts, of which Maine was then a part, and was one of a commission of three who were in 1775 sent on a secret mission to Ticonderoga. In 1776 he was appointed a judge of the superior court, in 1779–80 a member of the State constitutional convention, and a delegate to Congress in 1784–85. He removed to Boston, for which he was repeatedly chosen representative in the Legislature; was a member of the executive council and judge of probate in 1787; attorney-general of the State 1790–1807; elected Governor in 1807, and again in 1808. He was the projector of the Middlesex Canal, a member of the American Academy of Arts and Sciences, and for many years president of the Massachusetts

Historical Society. Among his works are *Observations on the Government of the United States* (Boston, 1791); *History of Maine* (1795); *Review of the Causes of the French Revolution* (1798); and *History of Land Titles in Massachusetts* (1801). D. in Boston, Dec., 1808. See *Life*, with selections from his writings, by his grandson, Thomas C. Amory (2 vols., Boston, 1859).

**Sullivan**, JOHN, LL. D.: soldier; brother of James Sullivan, jurist; b. at Berwick, Me., Feb. 17, 1740; studied law and practiced successfully; was a member of the first general congress, and in Dec., 1774, led a company which captured a fort near Portsmouth, N. H. In June, 1775, Congress appointed him a brigadier-general, and during the siege of Boston he commanded the left wing under Gen. Lee. In 1776 he commanded the Northern army in Canada, attacked Three Rivers unsuccessfully, and retreating, joined at New York the army under Gen. Washington. On Aug. 10, 1776, he was made a major-general, and in the battle of Long Island commanded temporarily the division of Gen. Greene; was taken prisoner, but soon afterward exchanged; commanded at Trenton and Princeton the division of Gen. Lee, who had been captured; at the battle of Brandywine commanded the right wing of the army, and defeated the British left at Germantown. Transferred in the winter to command in Rhode Island, he laid siege to Newport in Aug., 1778, but the French fleet under d'Estaing failed to cooperate, and he was compelled to withdraw his forces from the island, after defeating the enemy at Butt's Hill, Aug. 29. In the summer of 1779 he marched against the Indians of the Six Nations, defeated them and their Tory allies, and laid waste the country to prevent their return. Shortly after, he resigned from the army, and in 1780 was again a member of Congress. Resuming the profession of law in New Hampshire, he was attorney-general 1782–86, and president of the State 1786–89; in 1788 his exertions secured the adoption of the Constitution. In Oct., 1789, he was appointed U. S. district judge of New Hampshire. D. at Durham, N. H., Jan. 23, 1795.

**Sullivan's Island**: a long, narrow island in Charleston co., S. C.; 6 miles from Charleston, and on the north side of the entrance to Charleston harbor. It is the site of FORT MOULTRIE (*q. v.*), and is a fashionable resort for sea-bathing. There are many summer residences. The island is connected with Charleston by steam-ferryboats, which convey some 200,000 passengers annually. The island is 6 miles long, and is separated from the mainland by a tidal channel.

**Sullivant**, WILLIAM STARLING, LL. D.: botanist; b. near Columbus, O., Jan 15, 1803; graduated at Yale College in 1823; took charge of the extensive landed estates left by his father, and devoted himself with great zeal to botany, making the mosses a special subject of study. He published *Catalogue of Plants Native or Naturalized in the Vicinity of Columbus, Ohio* (1840); *Musci Alleghanienses*, to produce which he made a journey from Maryland to Georgia (1845); *Musci and Hepaticæ of the United States East of the Mississippi River* (1856); *Mosses brought Home by Wilkes's Exploring Expedition* (1859); *Mosses and Hepaticæ, collected mostly in Japan* (1860); *Musci Cubenses* (1861); *Icones Muscorum* (vol. i., 1864; vol. ii. (posthumous), 1874); and in conjunction with L. Lesquereux, two series of *Musci Boreales Americani*. D. in Columbus, Apr. 30, 1873.

Revised by CHARLES E. BESSEY.

**Sul'ly**, JAMES, M. A., LL. D.: psychologist; b. in Bridgwater, Somersetshire, England, Mar. 3, 1842; educated at Taunton, London, and Göttingen; was lecturer in College of Preceptors, London, until 1892, when he became Professor of Philosophy in University College, London. His principal works are *Sensation and Intuition* (London, 1874); *Pessimism* (London, 1877); *Illusions* (London, 1881); *Outlines of Psychology* (London, 1884); *The Teacher's Handbook of Psychology* (London, 1886); *The Human Mind* (London, 1891).

J. MARK BALDWIN.

**Sully**, sü'lee', MAXIMILIEN DE BÉTHUNE, Baron of Rosny, Duke of: chief minister of Henry IV. of France; b. at Rosny, department of Seine-et-Oise, Dec. 13, 1560, of a Protestant family; was from his eleventh year educated with Henry of Navarre; accompanied him through his shifting fortunes at the court and in the camp, and became his Minister of Finance and chief adviser in all public and private affairs when he ascended the throne under the name of Henry IV. A skillful administrator rather than a statesman, he made no radical changes, but contented himself with improving the efficiency of the existing system. His chief work was the reform of the finances, which were in a disorganized condition, and managed in such a manner as to invite fraud and corruption. By enforcing a proper system of auditing accounts and by insisting that the levy of all sums should be authorized by the Government, he did away with illegal taxation, saved France more than 120,000,000 francs annually, and amassed a reserve of 30,000,000 livres. His economical views were characteristic of his time; he considered agriculture as the only productive source of the wealth of a nation, but his policy had the advantage of making France independent of foreign nations for the prime necessities of life, at a time when she was on the point of entering upon a long period of war. After the assassination of Henry IV., he resigned his offices and retired into private life. D. at Vielebon, Dec. 22, 1641. Of his *Mémoires*, two volumes were published by himself in 1634, and two more in 1662 by Jean le Laboureur; translated into English by Mrs. Lennox (1761).

F. M. COLBY.

**Sul'ly**, THOMAS: painter; b. at Horncastle, Lincolnshire, England, June 8, 1783; was taken to the U. S. by his parents, who were actors, in 1792; lived in Charleston, Richmond, New York, and finally in Philadelphia; painted Jefferson, La Fayette, *Washington crossing the Delaware*, Fanny Kemble, Charles Kemble, Mrs. Wood, Cooke the tragedian, and other actors of celebrity. In England he painted a portrait of Queen Victoria for the St. George's Society of Philadelphia. The *Jefferson* is at West Point, the *Washington* in Boston. Sully did not, like Stuart, confine himself to portraiture. D. in Philadelphia, Nov. 5, 1872.

**Sulphates**: See SULPHURIC ACID AND SULPHATES.

**Sulphides**, or **Sul'phurets** [derivs. of *sulphur*]: compounds of sulphur with metals and other elements more basylic or less electro-negative than itself. This class of compounds is probably quite as large in number as the oxides. Indeed, sulphur combines with one element, fluorine, which is not known to combine with oxygen at all. There seems a general strict analogy between sulphur and oxygen in combination, running through very extended ranges of compounds. The sulphides of the metals possessing practical importance will generally be found described under the head of the metal.

**Sulphites**: See SULPHUROUS ACID.

**Sulphocyan'ic Acid**, also called **Hydrosulphocyanic Acid** and **Sulphocyanhy'dric Acid** [(the names being various combinations of) *sulphur* + *cyanic* + *hydrogen*]: a compound of cyanogen, CNHS, analogous in composition to cyanic acid, CNHO, in which the atom of oxygen is replaced by one of sulphur. It occurs in saliva, and in some sulphuretted essential oils of plants, such as mustard and radish. It may be prepared from sulphocyanate of mercury, which is first made by precipitating a mercurous salt with sulphocyanate (sulphocyanide) of potassium, the material of the so-called "Pharaoh's serpents." *Potassium sulphocyanate* (CNKS) is a salt of much interest from being an important and delicate laboratory reagent for ferric compounds, with which all soluble sulphocyanates strike a deep and characteristic blood-red color. The potassium salt is prepared by fusing cyanide of potassium and sulphur and subsequently purifying.

Revised by IRA REMSEN.

**Sulphur**, or **Brimstone** [*sulphur* is from O. Fr. *soulfre* < Lat. *sulfur*, *sul'phur*; cf. Sanskr. *çulvāri*, sulphur; *brimstone* is M. Eng. *brimston*, *bremston*, *brenston*, *bernston*; *brennen*, *bernen*, burn + *ston*, stone]: one of the most important of the elements of matter, very abundantly and almost universally distributed throughout the earth and the sea. It occurs native as a mineral in many countries. It is also found in mineral form as GYPSUM (*q. v.*) and in a great variety of metallic SULPHIDES (*q. v.*); also dissolved in the ocean as sulphates. It is an important essential element of the blood, muscles, skin, hair, and other parts of animals, and exists also in some essential components of plants, though not in the woody substance thereof. It is evolved also from volcanoes, both as vapor of sulphur and as sulphuretted hydrogen and sulphurous dioxide, these gases being doubtless products of the action of oceanic water, that has penetrated to the volcanic focus, upon metallic sulphides it finds there. Indeed, it is more than probable that such action is itself one *vera causa* of vulcanicity.

Most commercial sulphur is merely the native mineral purified by fusion or further by distillation and sublimation. In Sicily, where the crude sulphur, mixed more or less with other minerals, is very abundant and fuel scarce, the method is often adopted of making a portion of the sulphur of the ore furnish the heat (not very great in amount) necessary to fuse out and separate the rest of the sulphur. The ore is piled in heaps, sometimes in kilns, so constructed that a portion of it can be set on fire and heat the whole mass throughout to the fusing-point of the sulphur. The latter then collects slowly in liquid form in cavities formed for the purpose, and may be ladled out and sold or refined. The Sicilian sulphur, being free from arsenic, which is the most objectionable impurity liable to occur, is highly prized for making SULPHURIC ACID (*q. v.*). Deposits of sulphur are reported in various parts of the U. S., but the chief source is from iron pyrite. In 1899 the product was 4,380 short tons (value $107,500) from Louisiana, Nevada, Texas, and Utah. The refined sulphur (brimstone) of commerce and the pulverulent material known as flowers of sulphur are products of distillation and sublimation—operations which are often conducted simultaneously, there being duplicate condensing-chambers, the first of which being hot condenses liquid sulphur, which is drawn off and cast into sticks or cylinders; while in the second, which is kept cool, the vapor precipitates in the form of "flowers," which are, when freshly prepared, composed of a special allotropic modification of sulphur.

Sulphur is one of those elements most liable to assume allotropic states when isolated. These are characterized by differences of crystalline form or by amorphous character, different relations to solvents, and different densities, but not so much by different colors as is the case of phosphorus-allotropes. Native sulphur often occurs in very beautiful and brilliant transparent yellow crystals, which are orthorhombic in form, with two imperfect cleavages. When molten sulphur cools it takes the crystalline form, the crystals belonging to the monoclinic system. Very beautiful crystals of this form are easily obtained by breaking the crust upon a cooling mass of melted sulphur and pouring out the liquid interior. On breaking the mass after cooling, the cavity will be found filled with slender brilliant prisms. Sulphur on heating passes through a succession of changes, melting at about 120° C. to a thin yellow liquid. If again cooled, it becomes a permanently transparent solid. Above 120° the sulphur becomes thick and viscid, losing its fluidity altogether and assuming a brown color at about 250° C. At 300° the mass again becomes liquefied. At 440° C. (822° F.) sulphur boils, forming an orange-yellow vapor. Some of the sulphur-allotropes, including the two crystalline forms above described, are soluble in several liquids, such as bisulphide of carbon, oil of turpentine, and others. The bisulphide-of-carbon solution on evaporation yields beautiful transparent crystals similar to those of native sulphur. Flowers of sulphur are composed of an amorphous soluble modification. Sulphur inflames in air at a remarkably low temperature, about 482° F., burning with blue flame and evolution of suffocating sulphurous oxide, $SO_2$.

MEDICINAL USES OF SULPHUR.—Taken internally, sulphur produces little effect beyond that of a mild and somewhat slow laxative. Externally, applied in the form of ointment, it is a powerful parasiticide, principally employed to kill the little insect that produces the itch disease. *Potassium sulphide* is a sharp irritant, and in large dose internally a corrosive poison. It may be used instead of the simple sulphur ointment as a local remedy in itch and in other skin diseases, and dissolved in water as a bath is used in skin disease and in lead-poisoning. In common with other sulphides it is sometimes used as a depilatory.

Revised by IRA REMSEN.

**Sulphurets**: See SULPHIDES.

**Sul'phuretted Hydrogen**, called also **Hydrosulphu'ric** [*hydrogen + sulphur*] **Acid**, etc.: a gas, $H_2S$, analogous to water, $H_2O$. It was first discovered by Rouelle the younger, but Scheele first ascertained its nature and properties. Sulphuretted hydrogen is emitted naturally by mineral springs and from volcanoes, and in combination with ammonia is evolved in the putrefaction of animal and vegetable matters. The smell of rotten eggs and that of a privy, generally attributed to sulphuretted hydrogen itself, are due chiefly to the compound it forms with ammonia or sulphide of ammonium. Artificially this gas is prepared by the action of a dilute mineral acid on certain metallic sulphides, of which ferrous sulphide of commerce is the one generally employed, though the native sulphide of antimony may also be used. If hydrogen gas be passed through melted sulphur this compound is formed, and a convenient way to evolve sulphuretted hydrogen for laboratory use is to melt together in a flask sulphur and paraffin. When pure, sulphuretted hydrogen is a colorless gas of an intense odor, somewhat recalling that of bitter almonds, which produces immediate vertigo in the case of some persons and acts as a deadly poison upon some animals even in very small proportion. Many persons will, however, inhale it in diluted form without much apparent effect for a considerable time, so that it can not be regarded as necessarily a dangerous poison in the case of mankind, though its unnecessary inhalation in quantity ought to be avoided. The density of the gas is 1·175, air being unity. Faraday reduced it by compression to a liquid whose density he gives as about ·9. The solubility of the gas in water is given by Bunsen as 4·37 per cent. of its volume at freezing, and about 3·2 per cent. at normal temperature. Alcohol takes up about three to four times as much as water. It is combustible, with a blue flame, burning to water and sulphurous dioxide. This gas is a very important reagent in the laboratory for precipitating metals from their solutions in processes of analysis and in many processes of preparation of organic compounds in pure state, particularly in cases of organic acids, which are first converted into lead salts, to be decomposed afterward by sulphuretted hydrogen.

Revised by IRA REMSEN.

**Sulphu'ric Acid and Sulphates**: a compound of sulphur, $H_2SO_4$, and its forms of combination with metals. Sulphuric acid is called also *oil of vitriol*, from its having been originally obtained by distillation from *vitriol*, or sulphate of iron. This acid was probably known to the Arabian protochemists. Basil Valentine, however, is the first known author who, writing in the fifteenth century, mentions the making of sulphuric acid by distilling iron sulphate. The manufacture by burning sulphur, as now practiced, was introduced in England by Dr. Roebuck about 1720. The general method is to burn sulphur, either as brimstone or in the form of metallic sulphides, as pyrites, in a draught of air, which is passed into very large chambers built of metallic lead, where the sulphurous oxide gas formed by the combustion is mixed with steam and a quantity of nitrous fumes evolved from a mixture of saltpeter or sodium nitrate with sulphuric acid. The oxides of nitrogen in the presence of water oxidize the sulphurous acid to sulphuric acid and are themselves reduced to lower forms which, in the presence of air, are converted into higher oxides, among which is nitrogen peroxide $NO_2$, and these again react with sulphurous acid, so that the operation of a limited amount of nitrous fumes is continuous, acting as a carrier of oxygen to the sulphurous dioxide without consumption of its own substance. The product precipitates with condensing steam upon the walls and floors of the leaden chambers as diluted sulphuric acid, which is then concentrated to oil of vitriol—first, in pans of lead, and when it has become strong enough to attack these, the boiling down is completed in large stills made of glass or platinum.

Sulphuric acid when fully concentrated has a density at 0° C. of 1·846. It is an oily, colorless, inodorous liquid, which boils at 620° F. and freezes at −31°. It absorbs water rapidly from the air, being one of the most useful agents in the laboratory for drying air and for absorbing moisture from other substances, which are for this purpose simply placed in a confined space with a quantity of oil of vitriol, which, through the medium of the air, will gradually abstract all the moisture from such substances. When mixed with water, great heat is developed.

*Nordhausen*, or *Fuming Sulphuric Acid*.—This is the acid obtained by distilling ferric sulphate. It has the composition $H_2S_2O_7$, and is considered by some chemists as containing sulphuric trioxide $SO_3$ or as $H_2SO_4.SO_3$, but this seems hardly in accordance with the fact that it crystallizes as a whole in transparent crystals at zero. When gently heated, however, it breaks up into sulphuric oxide, which distills over and condenses as a solid body, and ordinary oil of vitriol, which remains behind in the retort. Its name of *fuming* acid comes from the fact of its forming white fumes in the air, due apparently to the evolution of vapor of $SO_3$ even at ordinary temperatures. Fuming oil of vitriol is used in the laboratory for dissolving indigo and as a reagent in gas analysis, to absorb the illuminant hydrocarbons from ordinary coal-gas.

*Diluted Sulphuric Acid*.—It is very useful in chemical and technical operations to be able to determine the strength of a dilute acid from its density as taken with the hydrometer. The following figures are condensed from tabulated determinations of densities of dilute sulphuric acid by J. Kolb:

| DEGREES BAUMÉ. | Densities. | $SO_3$ in 100 parts. |
|---|---|---|
| 1 | 1·007 | 0·7 |
| 5 | 1·037 | 4·7 |
| 10 | 1·075 | 8·8 |
| 15 | 1·116 | 13·2 |
| 20 | 1·162 | 18·0 |
| 25 | 1·210 | 23·2 |
| 30 | 1·263 | 28·3 |
| 35 | 1·320 | 33·9 |
| 40 | 1·383 | 39·5 |
| 45 | 1·453 | 45·2 |
| 50 | 1·530 | 51·0 |
| 55 | 1·615 | 57·1 |
| 60 | 1·711 | 63·8 |
| 65 | 1·819 | 73·2 |
| 66 | 1·842 | 81·6 |

*Uses of Sulphuric Acid.*—Among those materials and products of science and art that constitute the main pillars of modern civilization sulphuric acid occupies incontestably a first rank. Probably none other except iron could be justly ranged with it in this regard. This will appear on a mere enumeration of some of the principal products necessary to human life, health, comfort, luxury, or necessity which are dependent, directly or indirectly, upon sulphuric acid as an essential agent in their production: *soda* from common salt, and through this, *glass, soap, sodium, aluminium, magnesium*; *nitric* and *hydrochloric acids*, upon which depend the arts of *refining gold and silver* for money and jewelry, with the *electroplater's* and *photographer's* arts; artificial *mineral waters*; all the *vegetable acids* and *alkaloids*; *alum*; *ammonia*; *ultramarine*; the *aniline colors*; *bleaching-powder*; *chrome compounds*; *chloroform* and *ether*; *phosphorus* and *matches*; *artificial fertilizers*; *kerosene*; and so on.

*Sulphates.*—Among the compounds of sulphuric acid with metals are many of commercial value and importance which are described under the heads of the different metals. The following is a more complete enumeration:

*Aluminium Sulphates.*—Of these there are several, some of which occur as native minerals. The normal sulphate is $Al_2(SO_4)_3.18H_2O$, constituting the mineral *alunogen.* The alums (see ALUM) are double salts of normal aluminium-sulphate with the sulphates of potash, ammonia, or soda, containing 24 equivalents of crystal-water.

*Ammonium Sulphate*, $(NH_4)_2SO_4$.—A commercial salt of great importance, anhydrous, not deliquescent, made largely from the ammoniacal liquor of gasworks, and used as a fertilizing agent.

*Barium Sulphate*, the mineral *barite*, *barytes*, or *heavy spar* ($BaSO_4$).—Insoluble in water, very heavy: densities, 4·123 and 4·554. The source of most commercial barium compounds. It is ground, purified, and sold largely as a pigment or inferior substitute for white lead.

*Calcium Sulphates*; the *anhydrite* mineral is $CaSO_4$.—It is orthorhombic. Minimum and maximum densities, 2·911 and 3·104. See GYPSUM and SELENITE.

*Cobalt Sulphate* ($CoSO_4.7H_2O$).—The mineral *bieberite.*

*Copper Sulphate* ($CuSO_4.5H_2O$).—*Blue vitriol*, an important commercial salt. Crystals triclinic.

*Iron Sulphates* ($FeSO_4.7H_2O$).—*Copperas* or *green vitriol.* A large article of commerce. Crystals monoclinic. This is *ferrous sulphate. Ferric sulphate* (normal) is $O_{12}S_3Fe_2.9H_2O$, as the mineral *coquimbite.* There are many basic ferric sulphates.

*Lead Sulphate* ($PbSO_4$).—The mineral *anglesite.* Splendid orthorhombic crystals. Minimum and maximum densities, 6·2 and 6·42.

*Magnesium Sulphate, Epsom Salt* ($MgSO_4.7H_2O$). See MAGNESIUM.

*Manganese Sulphate* ($MnSO_4.7H_2O$).—Monoclinic, like green vitriol.

*Mercury Sulphates.*—Mercurous sulphate is $Hg_2SO_4$, and mercuric sulphate is $HgSO_4$. The former is insoluble, like calomel or mercurous chloride; the latter soluble, like corrosive sublimate or mercuric chloride. The mercuric salt is obtained by boiling mercury with oil of vitriol.

*Nickel Sulphate* ($NiSO_4.7H_2O$).—Very beautiful green crystals, right rhombic and isomorphous with Epsom salt. This salt, of much commercial importance by reason of its large use in nickel-plating, is liable to contain iron and copper as impurities, both wholly destructive to its usefulness.

*Potassium Sulphate* ($K_2SO_4$).—A hard anhydrous salt, crystals trimetric; minimum and maximum densities, 2·423 and 2·888. Much less soluble than other potash-salts generally. Water at 0° C. dissolves but 8·36 per cent. It is a considerable article of commerce for fertilizing purposes, for which it has great power.

*Silver Sulphate* ($Ag_2SO_4$).—Trimetric crystals, turned green by light. Requires as much as 200 parts of cold water for solution.

*Soda Sulphate* or GLAUBER'S SALT (*q. v.*).

*Strontium Sulphate* ($SrSO_4$) forms the beautiful mineral *cœlestine*; trimetric. Densities, minimum and maximum, 3·589 and 3·992.

*Uranium Sulphate* ($U_2SO_6.3H_2O$).—Small lemon-yellow prisms.

*Zinc Sulphate* ($ZnSO_4.7H_2O$), *White Vitriol*, also the mineral species *goslarite.*—Orthorhombic and isomorphous with nickel-sulphate and Epsom salt.

Sulphur forms with oxygen two compounds: sulphur dioxide ($SO_2$), that combines with water to form SULPHUROUS ACID (*q. v.*), and sulphur trioxide ($SO_3$), that combines with water to form SULPHURIC ACID (*q. v.*). Salts of sulphurous acid are called sulphites, and salts of sulphuric acid are called sulphates. Also there is known in combination sulphur sesquioxide ($S_2O_3$), which is contained in hyposulphurous acid ($H_2S_2O_4$), whose salts are called hyposulphites, and sulphur heptoxide ($S_2O_7$), which is contained in persulphuric acid ($H_2S_2O_8$), whose salts are called persulphates. Thiosulphuric acid was formerly called hyposulphurous or hyposulphuric acid, and its salts hyposulphites or hyposulphates.

Revised by IRA REMSEN.

**Sulphuric Ether**: See ETHER.

**Sul'phurous Acid**: an acid formed when sulphurous dioxide gas is passed into water. A crystalline hydrate, $H_2SO_3.6H_2O$, was obtained by Schönfeld. Sulphurous acid is a strong reducing agent. It deoxidizes iodic, arsenic, chromic, and permanganic acids and gold chloride, precipitating metallic gold from the latter.

*Sulphites.*—Of these the sulphites of calcium and of sodium only are of much practical interest, they being prepared commercially to some extent for bleaching and for the prevention of fermentation of wines, sirups, and other organic liquids. There are two soda-salts—one neutral, $Na_2SO_3$, and one acid, $HNaSO_3$. The latter is obtained as a crystalline precipitate on cooling a warm solution of sodium carbonate which has been supersaturated with sulphurous oxide gas. This salt is used as a reagent. Sulphites that contain an additional atom of sulphur are called hyposulphites, as sodium hyposulphite ($Na_2S_2O_3$), which is used in medicine for febrile diseases and in dyspepsia. Revised by IRA REMSEN.

**Sulphurous Oxide, Sulphur Dioxide**, or **Sulphurous Anhydride**: the gaseous substance ($SO_2$), formed by the combustion of sulphur in the air. Even in pure oxygen the same compound is formed. It is emitted by volcanoes. It may be obtained artificially, in a pure state, by heating oil of vitriol with some metals, copper and mercury being among these. Sulphate of the metal and water are at the same time formed: $Hg + 2(H_2SO_4) = HgSO_4 + 2H_2O + SO_2$. It is also obtainable pure by heating together sulphur and sulphuric trioxide, $SO_3$, in one limb of a sealed U-tube. It then appears as a liquid, condensed by the pressure, in the other limb. Sulphurous oxide is colorless, with the well-known suffocating odor. Bunsen gives its density as 2·21122 (air being 1), and its solubility in water as about 69 per cent. of the volume of the latter at zero, and 41 per cent. at normal temperature. Alcohol at zero takes up nearly five times as much as water. A pressure of about three atmospheres, or the cold of snow and salt, condenses it to a liquid, which produces so much cold in its evaporation as to freeze water when poured upon it. Sulphurous oxide has strong bleaching power over most vegetable colors, and is therefore used for bleaching. See REFRIGERATING PROCESSES.

Revised by IRA REMSEN.

**Sulphur Springs**: city; capital of Hopkins co., Tex.; on the St. L. S. W. and the Sherman, Shreveport, and S. railways; 80 miles E. by N. of Dallas (for location, see map of Texas, ref. 2–J). It is in an agricultural region, and contains Central College (Methodist Episcopal South, opened in 1876), 2 national banks with combined capital of $200,000, and 4 weekly papers. Pop. (1890) 3,038; (1900) 3,635.

**Sulpic'ia**: (1) a Roman poetess, probably the daughter of Servius Sulpicius Rufus, and niece of Messalla, to whom are attributed a group of six charming elegies, describing

the love of Sulpicia and Cerinthus, which have been preserved among the poems of Tibullus (book iv., 7–12). (2) A poetess contemporary with Martial, and highly praised by him. Her poems were amatory, and in various measures. The extant poem known as *Sulpiciæ satira*, in seventy hexameters, supposed to refer to the banishment of the philosophers by Domitian, must belong to a much later period, and is by some scholars regarded as a modern forgery. See E. Baehrens, *De Sulpiciæ quæ vocatur satira* (Jena, 1873), who also gives the text, and J. G. Boot (same title, Amsterdam, 1868).
M. WARREN.

**Sulpic'ians**: a Roman Catholic congregation of priests founded in Paris in 1642 by Abbé J. J. Olier. They were confirmed in 1645. They have (1895) several houses in France, one in Rome, one in Canada, and three in the U. S. Their chief work is the training of young men for the priesthood. They are properly called the Society of St. Sulpice, from the parish where they were first organized.
Revised by J. J. KEANE.

**Sulpic'ius** (or **Sulpitius**) **Severus**: ecclesiastic and author; b. in Aquitania about 365 A. D., though the precise date is not known. He was descended from a noble family, and in his youth had a career of distinction at the bar and in public life open before him. The loss of his wife, to whom he was greatly attached, led him to abandon, about 392 A. D., the career on which he had entered, and to give himself up to solitude and religious meditation. He entered the Church; became a presbyter and a devoted admirer of St. Martin of Tours, whose life he wrote. The date of his death is not known, but it was probably about 425. His chief writings are *Chronica*, in two books, from the Creation to A. D. 400, *Vita S. Martini*, *Tres Epistolæ*, all relating to his patron St. Martin, and a sort of continuation of the *Life*; *Dialogi duo* (in some editions *tres*); to these are added *Epistolæ Septem*, though doubtfully ascribed to Sulpicius. The best editions of his collected works are that of de Prato (2 vols. 4to, Verona, 1741–54) and that of Halm (8vo, Vienna, 1866), in which the seven doubtful epistles are given as an appendix. His complete works were translated by Alexander Roberts in vol. xi., 2d series, *Nicene and Post-Nicene Fathers* (New York and Oxford, 1894).
Revised by M. WARREN.

**Sultan**: a title; first used by Mahmud of Ghazni (997–1030). It is assumed by many Mussulman sovereigns, as the rulers of Zanzibar, Borneo, etc., and is the common European appellation of the sovereign of the Ottoman empire, who is sultan of sultans, though commonly called by his Mussulman subjects *Padishah*. The feminine, sultana, is applied to the mother or daughter of a sultan. The masculine form precedes the name, as Sultan Mahmud; the feminine follows, as Nachshedil Sultana. E. A. GROSVENOR.

**Sulte**, BENJAMIN: See the Appendix.

**Sulu** or **Suluk Islands**: a group of 162 small, mountainous, fertile islands in the Indian Ocean, extending from Borneo to Mindanao; between lat. 4° 44′ and 6° 56′ N., and lon. 119° 30′ and 122° 30′ E. Area, 1,948 sq. miles. Pop. 75,000, mostly Malays, addicted to piracy and the taking of slaves till conquered by the Spaniards in 1876, and since then chiefly engaged in pearl-fishing and collecting edible birds' nests. The islands yield sandalwood, teak, sugar, rice, coffee, spices, metals, and fish. The largest island is Basilan (450 sq. miles), adjoining Mindanao on the N. Spain's claim to these islands was recognized by the powers in 1885, and they were ceded to the U. S. by the treaty of Dec. 10, 1898.

**Su'mach**, or **Sumac** [= Fr., from Arab. *summāq*]: any plant of the genus RHUS (*q. v.*), which includes about 120 species, mostly natives of warm or hot climates. In the U. S. there are about twelve species of sumachs, all of which are shrubs or small trees; of these the most common is the well-known smooth sumach (*Rhus glabra*), which is often found covering large tracts of barren ground, where it grows to a height of from 2 to 12 feet, with compound leaves a foot long. The yellowish-green flowers appear in June, and have a fragrant odor. The fruit is in dense crimson clusters with a velvety appearance and a pleasant acid flavor; the leaves are among the earliest to take on their autumn colors of yellow and scarlet. The stag's-horn sumach (*R. typhina*) sometimes reaches the height of 30 feet, and is readily distinguished by the soft down at the extremity of the branches. The dwarf sumach or mountain sumach (*R. copallina*) is rarely more than 6 or 8 feet high, with dark shining leaves, which in autumn become a rich purple. A still more diminutive species (*R. pumila*) is found in the pine-barrens from North Carolina southward. The fragrant sumach (*R. aromatica*) ranges from Vermont to Florida, and as far westward as the Rocky Mountains; its leaves are among those which are smoked by the Indians in lieu of tobacco under the name of killikinick. The *Toxicodendron* group of the sumach family includes two species, with white or dun berries and a very poisonous foliage, the poison-oak and the poison-ivy. (See RHUS.) The sumach of commerce formerly consisted of the leaves of the *R. coriaria*, closely resembling the North American stag's-horn sumach, which is largely cultivated in Sicily, and used in tanning, dyeing, and calico-printing; but it has been proved that the sumachs of the U. S. are quite as valuable, and the collection and preparation of the leaves has become an important industry in parts of the South. The Japan wax is yielded by the *R. succedanea*, being prepared from the white coating of the seeds within the capsules. The Japanese lacquer is prepared from the juice of *R. vernicifera*, a shrub closely resembling the poison-sumach of the U. S. The Chinese galls are the result of the deposition of the eggs of an insect on the leaf-stalks and young shoots of *R. semialata*, and are largely imported into England for dyeing and tanning. See SUMACH FAMILY and LEATHER.
Revised by CHARLES E. BESSEY.

**Sumach Family**: the *Anacardiaceæ*; a small group (430 species) of mostly tropical, dicotyledonous trees and shrubs, with a gummy or milky-resinous juice. The small flowers have three to seven sepals, three to seven petals, with as many or more stamens, and a superior, monocarpellary, one-ovuled ovary. The native species of the U. S. are all sumachs. Important tropical representatives are the cashew-nut of the West Indies, the pistachio-nut (*Pistacia vera*) of Syria, the mastic-tree (*P. lentiscus*) of Southern Europe, the mango-tree (*Mangifera indica*) of the East Indies, and a Peruvian tree (*Schinus molle*) very freely grown in California and other mild climates under the name of pepper-tree. See SUMACH and RHUS. CHARLES E. BESSEY.

**Sumaro'kov**, ALEKSANDR PETROVICH: author; b. in Moscow, Russia, Nov. 14, 1718; first attracted attention by his tragedy of *Khorev* (1747), followed by *Sinav i Truvor* and *Semira*, which increased his fame. From 1756 to 1761 he was director of the newly founded court theater in St. Petersburg, after which he devoted himself exclusively to literature, being the first Russian writer to have no other profession. D. Oct. 1, 1777. Sumarokov's place in the literary history of his country is far greater than his talent as an author would alone justify. Though his satires and his tragedies were little more than spiritless imitations of the French, his comedies of even less merit, his eighty or so odes, his sonnets, madrigals, epigrams, fables, etc. (produced in acknowledged rivalry with Voltaire's many-sidedness), of almost no value at all, he was still the father of the Russian drama. His style is clear, and on the whole unaffected; he was a pioneer who led the way for greater men than himself, and his influence as a critic was of value in forming the public taste. Second edition of complete works 1787; French translation of his tragedies by M. L. Pappadopoulo 1801.
A. C. COOLIDGE.

**Suma'tra**: island; extending from N. W. to S. E., between lat. 5° 45′ N. and 5° 55′ S., and between lon. 90° 40′ and 105° 5′ W., divided by the equator into two equal parts; extreme length, 1,115 miles; extreme breadth, 275 miles. Its area has been computed at 162,608 to (with coastal islands) 170,780 sq. miles (see map of East Indies).

*Physical Features and Climate.*—Through its whole length Sumatra is traversed by a mountain range, Bukit Barissan, which reaches its greatest height, 9,655 feet, in Ophir, in lat. 0° 4½′ N., lon. 100° 1′ E. The range runs as a narrow ridge nearer to the western than to the eastern coast; a true mountain region is formed only in the center of the island, where some ranges run transversely. The principal rocks are granite, syenite, gneiss, mica-slate, and red sandstone, none of which are found in Java, whose geological and chorographical formation is entirely different from that of Sumatra. Six volcanoes are known, situated near the equator. The southeastern part is rich in streams, navigable even for large vessels far into the interior. These streams carry large masses of mud and earth to the sea, the result of which is a considerable extension of the coast-line; at the same time the surface of the island, like that of Java and Borneo, appears to be rising slowly, but steadily. The several river systems are connected with each other by arms and canals, and on the banks, in the midst of a luxuriant vegetation, stand the towns and villages. The climate varies in the different parts of the island, but is generally healthful, with the exception of the low coast regions to the W. The heat varies on the coast between 82° and 86° F., at an elevation of from 2,500 to 3,000 feet between 64° and 73°; these highlands are known for their healthful climate. The monsoons are not so steady and regular as elsewhere. The dry season lasts N. of the equator from October to May, and S., from the end of April to the end of October.

*Natural Products.*—The natural productions are more varied and more abundant than in any of the other islands. Of metals, gold, iron, copper, and tin abound; brown coal occurs, but not anthracite. Petroleum abounds and is exported. Rice forms the principal food, then sago, beans, and roots (jolichos, batatas, and dioscoreas). The most palatable among the fruits are the mangosteen, durian, rambutan, rambei, pisang, pineapples, etc., many of which thrive only here, and can not be introduced into other countries. Of trees, the species of *Sideroxylon* (justly called *kayu* (wood) *besi* (iron), that is, iron-wood) yield the best wood for shipbuilding, it being so hard that it blunts the sharpest arrow; teak is not found. The most important plants entering into commerce are cotton, black pepper, caoutchouc, benzoin, gutta-percha, dyestuffs, and camphor, for which the island was celebrated among the ancients. The Dutch have introduced coffee, tobacco, and cacao. The fauna, Indian in its general character, corresponds nearer to that of Borneo than to that of Java. Of mammals there are eighty species, among which are the elephant, rhinoceros, tapir, tiger, panther, and bear; among the ruminants, the *Cervus equinus* is noticeable; among the many species of apes are the orang utan and two gibbons, the siamang (*Hylobates syndactylus*) and the wau-wau (*Hylobates variegatus*); the buffalo occurs both wild and domesticated; the horse is small, but vigorous, adapted to a mountainous country.

*Population.*—The population, which was 2,972,383 in 1892, is chiefly Malayan. There are about 25,000 Europeans, mostly Dutch, some Chinese, and other Asiatic races. Sumatra was the cradle of the Malays as a nation; in the interior they founded the empire of Manang-Kaban, once very powerful. Next to them the Battas are the most important division; they formerly inhabited the country N. of lat. 1° N., but the population of Achin has separated from them, and they themselves have decreased in number, and are crowded together in a small space. The Orang Koabos live in the forests; in physical respects they do not differ from the other inhabitants of the islands, but they are uncivilized, though harmless; they are agriculturists. The Malays are all Moslems. The Battas are fetich-worshipers and addicted to cannibalism—a custom which the Dutch have tried in vain to abolish.

*History.*—Ptolemy calls the island *Aurea Chersonesus*, the Arabs *Fantsaur*; the name *Sumatra* occurs in 1330, used of the city of Samatrah. The Arabs visited Sumatra about 860 A. D.; Islamism was introduced into Achin in 1205; the Venetian merchant Marco Polo landed here in 1290; the Portuguese under Alvaro Talesso in 1506, the Dutch in 1597; an English squadron appeared before Achin in 1602. The Dutch East Indian Company established settlements on the eastern coast in 1618. Great Britain tried to compete, but was compelled in 1783 to return all its possessions in Sumatra to Holland. In 1811 it once more occupied the island, but by the treaty of Mar. 17, 1824, it exchanged all its possessions in the archipelago for the Malayan peninsula, and thus Holland became the only European power holding dominion in Sumatra. Since then the Dutch have been occupied in gradually extending their conquests over the entire island. The last to hold out were some tribes of the Battas in the interior, and about 150,000 of them were yet practically independent in 1895.

Revised by M. W. HARRINGTON.

**Sumba'wa**: an island of the Sunda islands, Dutch East Indies, E. of Java, between Lombok and Flores. Area, 5,400 sq. miles. It is high, mountainous, and volcanic. The still active volcano Tambora, on the north coast, 8,940 feet high, caused a terrible destruction by its eruption in 1815; the ashes fell in Sumatra, 840 miles distant, and in a large part of the island itself all vegetation was completely destroyed. The sea also rose and swept away men and houses. More than 12,000 people are said to have lost their lives. Another eruption, less destructive, occurred in 1836. The principal products are gold, sulphur, saltpeter, rice, various kinds of wood, and a fine breed of horses. The inhabitants, 150,000 in number and closely allied in habits and manners to those of Celebes, live in four states which are under Dutch authority. Revised by M. W. HARRINGTON.

**Sum'bul** [from Pers. and Hind. *sumbul*, spikenard]: an umbelliferous plant, the *Ferula sumbul*, indigenous to certain parts of Central Asia. It was originally thought to possess the properties of musk, and to be a nervous stimulant, or, more properly, a drug to "steady" the nervous system. In reality it is of very little value, but is popular with some physicians, who give it to nervous women in association with more powerful remedies. H. A. HARE.

**Sume'rians**: the people who are believed by most Assyrian scholars to have occupied Babylonia before the Semites appeared in that region; to have invented the cuneiform script; and to have been the teachers of the Semites, by whom they were finally displaced or absorbed. It would seem that there were two branches of this people —the Sumerians and the Akkadians. To designate the whole people, sometimes one name, sometimes the other, and sometimes the compound name, is employed. In the Sumero-Akkadian language are written some of the oldest inscriptions from Babylonia, like those discovered by de Sarzec at Telloh. There are also many bilingual productions of a later date, notably from the library of Asshurbanipal. These are mainly grammatical, lexical, magical, ritual, or religious in content. The language seems to have become a sacred tongue, like the Latin of the Middle Ages. While this account represents the prevailing view, it must be added that several eminent scholars, in particular Joseph Halévy in France and Friedrich Delitzsch in Germany, deny *in toto* the existence of a Sumero-Akkadian people or language. (Cf. J. Halévy, *La prétendue langue d'Accad*, etc. (Paris, 1875); J. Halévy, *Recherche critique sur l'origine de la civilisation babylonienne* (Paris, 1876); F. Delitzsch, *Assyrische Grammatik* (Berlin, 1889), § 25. On the other hand, cf. E. Schrader, in *Zeitschrift der deutschen Morgenländischen Gesellschaft*, xxix., 1–52 (1875); P. Haupt, *Akkadische und Sumerische Keilschrifttexte* (Leipzig, 1881–82); P. Haupt, *Die Akkadische Sprache* (Berlin, 1883).) These scholars maintain that in the so-called Sumerian or Akkadian we have not a language different from Assyrian, but genuine Assyrian in archaic form, or written in a hieratic script. The question is not one of linguistics merely, but it involves the origin of the Babylonian culture. It can not be considered definitely settled so long as the lack of agreement among specialists prevails. The vast majority of Assyrian scholars, however, feel no doubt as to the reality of the Sumero-Akkadian language and people, as A. H. Sayce, in *Hibbert Lectures for 1887*, pp. 415–436, while others hold themselves neutral, as Tiele does in his *Babylonisch-Assyrische Geschichte*, pp. 58–71. D. G. LYON.

**Sumeru**: See MERU.

**Summary Proceedings**: in a general sense, any legal proceedings, or proceedings before a judicial tribunal, which are of a summary and peremptory nature, that is, those which are short and simple, and ordinarily dispense with the aid of a jury. Such proceedings, except perhaps in cases of contempt, can be instituted only under express authority of statutory laws, which, being in derogation of the common law, must be strictly construed.

The ordinary purposes for which summary proceedings are resorted to are: (*a*) Ejectment of a tenant for non-payment of rent, or for holding over his term. Authority to bring these proceedings was first granted in England by the Statute of Laborers, followed by others down to the Summary Act of 1879, which greatly extended the power, and in the U. S. it has been granted to a greater or less extent by the statutes of the various States. (*b*) For the recovery of debts due the state of the U. S. from a collector of taxes or revenue. (*c*) For the punishment of the contempt of court. (*d*) For the punishment of many minor offenses, violations of municipal ordinances, etc., which may be proceeded against without a jury; while in respect to others, the constitutional requirements as to due process of law are satisfied if a trial by jury in an appellate court is accorded the accused.

In the U. S. statutes authorizing summary proceedings are unconstitutional and invalid when they conflict with the constitutional provisions requiring that a trial by jury shall remain inviolate. Such provisions as to the right of trial by jury did not extend the right, but prevented its being abridged. The offense to be punishable by summary proceedings must be petty or trivial, and not of a serious character affecting the public at large; nor can the right of appeal be done away with. They are usually such offenses as are punished by fines, though in some cases by short terms of imprisonment. Violations of municipal ordinances are not strictly criminal in nature, but they are generally made summarily punishable.

The procedure is statutory, and the statutes must be strictly complied with.

See McAdam on *Landlord and Tenant*; Dillon's *Law of Municipal Corporations*; Stephen's *History of the Criminal Law of England*; Cooley's *Constitutional Limitations*.
F. STURGES ALLEN.

**Summer-duck**: See WOOD-DUCK.

**Summers**, THOMAS OSMOND, D. D., LL. D.: clergyman and author; b. near Corfe Castle, Isle of Purbeck, Dorsetshire, England, Oct. 11, 1812; removed to the U. S. 1830, and prepared for the ministry; was "admitted on trial" into the Baltimore Conference of the Methodist Episcopal Church in 1835; aided in organizing the Texas Conference Dec., 1840; was transferred to the Alabama Conference; became assistant editor of *The Southern Christian Advocate*, Charleston, S. C., 1846; was secretary of the Louisville convention in 1845, at which the Methodist Episcopal Church South was organized; compiled hymn-books for the connection; was the general book-editor of the Church from its organization; founded and edited for four years *The Sunday-school Visitor*; removed to Nashville in 1855, the publishing-house being there located; edited *The Quarterly Review of the Methodist Episcopal Church South*; revised and edited hundreds of books for the Church. Dr. Summers was the author of *Commentaries on the Gospels, the Acts, and the Ritual of the Methodist Episcopal Church South* (6 vols.); a *Treatise on Baptism*, one on *Holiness, The Sunday-school Teacher, or the Catechetical Office of the Church*: *Seasons, Months, and Days*; *Talks Pleasant and Profitable*; *Refutation of the Theological Works of Paine* (not answered in Bishop Watson's *Apology*); *The Golden Censer, an Essay on Prayer*, with a collection of forms for all occasions; and of minor works. He returned Feb., 1862, to Alabama; in 1866 was re-elected general editor, and editor of *The Sunday-school Visitor*; became also editor of *The Christian Advocate*; was Professor of Systematic Theology in Vanderbilt University and dean of the theological faculty, and *ex-officio* pastor of that institution. D. at Nashville, Tenn., May 6, 1882. See his *Life*, by O. P. Fitzgerald (Nashville, Tenn., 1884).
Revised by A. OSBORN.

**Summerside**: port of entry in Prince County, Prince Edward island (see map of Quebec, etc., ref. 1–B). It is the second town in size in the province, and has a good harbor, rather difficult of access, a large export trade, considerable ship-building, a public hall, and several manufactories. Pop. (1891) 2,882.

**Summers's** or **Somers's Islands**: See BERMUDA ISLANDS.

**Summerville**: town; Dorchester co., S. C.; on the S. C. and Ga. Railroad; 22 miles N. W. of Charleston (for location, see map of South Carolina, ref. 7–F). It is a noted winter resort for invalids, on a pine-clad ridge extending from the Cooper to the Ashley rivers, and contains several hotels and boarding-houses, brick-works, sawmills, and a weekly newspaper. Pop. (1890) 2,219; (1900) 2,420.

**Sumner**, CHARLES: scholar and Senator; b. in Boston, Mass., Jan. 6, 1811, educated at the Boston Public Latin School and at Harvard College, where he graduated in 1830. He was a recluse and studious boy, seldom joining in any amusement or athletic games; and this mood lasted through his college years. Though a diligent student, he gave more attention to general literature than to the special studies of the university. After his graduation he gave a year to science, belles-lettres, history, and art. In 1831 he joined the Harvard Law School, then under the charge of Judge Story, and entered on his studies with enthusiasm, renouncing all other subjects, and giving himself, without any relaxation, to a profound study of law. This devotion gained him the warm friendship of Story, who treated him as a son. Admitted to the bar in 1834, he visited Washington with such earnest letters of introduction from Story as secured him the friendship of Kent, Horace Binney, Judge Marshall, and others, who frankly expressed their wishes that before long he should find his place on the bench. Appointed by Story reporter to his circuit court, he published three volumes of Story's *Decisions*, and often supplied his place as lecturer at the law school, where he was himself lecturer from 1835 to 1837 and in 1843. In 1836 he edited Dunlap's *Admiralty Treatise*. In 1837 he went to Europe with numerous letters of introduction; was received with most flattering attention, and became personally acquainted with almost every leading man and woman in Europe. While his days were passed in society and galleries, his nights were spent in study, for he early showed that almost incredible power of working which distinguished him through life. Returning in 1840 from Europe, he again opened a law office, and, with J. C. Perkins, edited twenty volumes of Vesey's *Reports*. It was during this labor that his health broke down, and an illness followed which nearly proved fatal. He could have had, after Story's death (1845), his professorship at the law school, but declined it. In 1845 he was chosen by the city of Boston to pronounce the Fourth of July oration, and took for his subject the *True Grandeur of Nations*. This was a plea for peace, and was bitterly criticised at home, though welcomed abroad, and pronounced by Cobden "the most noble contribution made by any modern writer to the cause of peace." His protest against war he repeated frequently in later years.

Favorite as he had been, and great as was his promise at the bar, his decided anti-slavery position created a resolution to crush him socially and professionally. This hostility pervaded Boston society, her merchants, and the Suffolk bar till the civil war broke out. Sumner valued his social position very highly. He had not inherited it, but had himself achieved it. It is unspeakably to his credit that, when he saw this long-coveted and hardly earned distinction and all his professional prospects crumbling around him, though too fond perhaps of praise and keenly sensitive to blame, he never retreated an inch or remodeled a phrase to regain his place or conciliate opposition. From this moment, however, he was recognized as the leader of the young men of the Commonwealth, and hidden in their hearts. No matter that in after years the Legislature censured, the press abused, and politicians criticised him. He always had, to the day of his death, the hearty, entire, steadfast, and loving confidence of the young men of Massachusetts. This explains his strength and influence in years when, judging of public opinion by the ordinary signs, he seemed to have lost his hold and to be near defeat.

In 1849 he maintained before the Supreme Court of Massachusetts the unconstitutionality of separate schools for whites and blacks. The decision was against him. In 1851, by a coalition between Free-Soilers and Democrats, he was elected Senator of the U. S., the first civil office, and the only one, he ever held. There were twenty-six ballotings, and the struggle lasted three months. He took his seat Dec. 1, 1851. Once in the Senate, the force of his will, the almost entire devotion of his time to one cause, the aggressive attitude he took, and the vigor and ability of his incessant assaults, made him indisputably the leader of the political anti-slavery movement.

In Aug., 1852, he began his congressional assault on slavery by an argument for the repeal of the Fugitive Slave law, entitled *Freedom National—Slavery Sectional*. This phrase became the watchword of his party, and gives the key to most of his later arguments. In May, 1856, he made one of his ablest speeches, *The Crime against Kansas*, advocating the admission of that State to protect it from slavery. His comments on the conduct of several Senators who had taken a part in the debate, especially Butler of South Carolina, Douglas of Illinois, and Mason of Virginia, and his indignant reply to their personal attacks on himself, led to a scene which Sir George C. Lewis characterized as "the beginning of the civil war." On May 22, 1856, Preston S. Brooks, a nephew of Senator Butler, and one of the Representatives from South Carolina, approached Sumner while writing at his desk in the Senate chamber and struck him, without warning, repeatedly over the head with a heavy cane. Sumner, blinded by the blows, strove to rise and free himself from the restraint of the desk. He succeeded in wrenching it from the floor, to which it was screwed, but fell unconscious from the repeated blows. The indignation at the North was wide and hot, but while Massachusetts and the North generally thrilled with indignation, leading citizens of Boston refused to take part in meetings called to protest, and when Sumner returned to Boston, Nov. 3, 1856, though received by crowds in the streets and by the State authorities, the windows of every house in Beacon Street, through which he passed, except those of Prescott and Samuel Appleton, had their blinds closed to show indifference or contempt.

His injuries proved more serious than was at first supposed. Illness detained him nearly four years from Congress, with the exception of one brief attempt in the winter of 1857–58 to attend the Senate sessions, to which he found himself unequal. Two visits to Europe, rest, and the best medical skill of both hemispheres enabled him at last to resume his seat on Dec. 5, 1859. On Jan. 13, 1857, during his illness, he had been elected unanimously by the Senate, and almost unanimously by the House of Representatives of Massachusetts, to the senatorship. Again in Jan., 1863, and subsequently in 1869, he was re-elected, passing the last twenty-three years of his life in the Senate.

His attention was by no means given exclusively to slavery. His speeches cover all topics of national importance, and are always able. He took a leading part in all great debates. His speech in Jan., 1862, advocating the surrender of Mason and Slidell, taken from the British mail-steamer Trent, is a masterly exhibition of maritime law, and did much to reconcile the republic to that distasteful course. His speech on the Alabama claims in 1869, bitterly offensive to all his English friends and severely criticised by John Bright, was undoubtedly a fair representation of opinion in the U. S., and was the basis of final settlement. His addresses on the constitutional law respecting seceding States, on reconstruction, the war powers of the Government, international relations, internal improvements, etc., exhaust the subjects of which they treat. His sketches of Story, Allston, Granville Sharpe, Lincoln, and Lafayette show rare powers of portraiture. His articles on *White Slavery in the Barbary States*, *Prophetic Voices concerning America*, and other literary efforts, show good taste, ingenious research, and exact scholarship.

Worn down by the labor and excitement of the session, and by a return of the illness which Brooks's assault produced, he again sailed for Europe on Sept. 5, 1872, returning in November. In May, 1872, he had moved in the Senate that the names of victories in the civil war should not be inscribed on the regimental flags. On Dec. 2, 1872, the first day of the session, he again introduced a similar resolve to the Senate. For this he was censured by the Legislature of Massachusetts Dec. 18, 1872. This was rather a political trick than any real expression of Massachusetts feeling. The censure was rescinded the last month of his life. During this session of 1872–73, and the following one, he gave most of his time to his Civil Rights Bill, which puts the Negro on the exact level of the white in respect to inns, juries, schools, churches, public conveyances, and all civil privileges. His health was much broken, however, and an attack of his old malady, agony of the chest, in the Senate Mar. 10, 1874, proved fatal in his own house at Washington on Mar. 11, 1874. Almost his last words were addressed to Judge Hoar: "Take care of my Civil Rights Bill."

His natural powers were not of the highest order. "Industry was his talisman." He knew how to work, and had, as he said of Story, "the genius for labor." In mind he was more like Story, trained to exhaustive research and clear statement, than like Kent and Marshall, born lawyers. In preparing to write or speak he ransacked libraries, laying under contribution all ages and tongues. He had read everything and listened to everybody. His memory never lost a phrase or a fact he had once heard, and could always recall it at the right moment. His wealth of illustration was no effort, but the natural action of a full and ready mind. When first in the Senate his speeches were carefully prepared and written out. It took him five to seven years to acquire the power of extemporaneous debate; but to the last he usually wrote out his speeches. It has been generally supposed he was a mere scholar, fit only for investigation or debate. In truth, no man in Congress was more methodical, exact, painstaking, prompt, and efficient in attending to the details of business pertaining to his office. His eloquence belongs to the school of Burke, whom he liked to be thought to resemble, as indeed he did in features. His speeches had more learning than Burke cared to show, but in wealth of illustration, gorgeous rhetoric, lofty tone, and a "gigantic morality which treads all sophistry under foot," the resemblance was close. His real power lay in the sincerity and fiery enthusiasm of the speaker, whose whole soul freighted his words, and in the fact that there was "always a man behind the speech." He did not know what fear was. Alone in Baltimore on Apr. 18, 1861, he yielded nothing to that mob which the day after shot down the Massachusetts troops. For ten years he walked Washington streets, his life constantly threatened, and well knowing that if a fanatic's or drunkard's hand took his life the assassin would not only be sheltered by the power of ten States, but petted and applauded as a champion. When he entered the Senate, free speech could not be said to exist there. To him, as much as to any man, was due the breaking of that chain. Sumner was exact in all etiquette, careful in dress, fond of society, easy of access, and had always time for every comer, his hours of study running to midnight and long after. His manner was always courteous, but in his last years had a marked tenderness. To the very last day of his life he was a loving student of the classics of all languages; a "bite of the classics" being his preparation for bed somewhere about two or three o'clock in the morning. He cultivated art, and was a diligent collector of autographs, pictures, rare books, bronzes, and other objects of *virtu*, most of which he bequeathed to the Art Museum of Boston and to Harvard College. To the college library he also gave half of his estate. He was married Oct. 17, 1866, to Alice (Mason) Hooper, widow of W. S. Hooper, of Boston. They separated very soon, and he was divorced May 10, 1873. His complete works were published in 15 volumes (Boston, 1870–83). Eleven of the volumes, with copious notes, were published under his own supervision. For full details of his life, see Pierce's *Life of Charles Sumner* (4 vols., Boston, 1877).

Revised by C. K. Adams.

**Sumner**, Charles Richard, D. D.: bishop and author; b. at Kenilworth, Warwickshire, England, Nov. 22, 1790; educated at Eton and Cambridge (B. A. 1814): took holy orders; became curate of Highclere 1816; librarian and historiographer to George IV. and chaplain to his majesty's household at Carlton House, London, and rector of Abingdon—all in 1821; was made prebendary of Worcester in 1822 and of Canterbury in 1825; dean of St. Paul's and Bishop of Llandaff 1826; in 1827 was transferred to the more important see of Winchester, which he resigned in 1869 on account of the infirmities of age. He published *Prælectiones Academicæ Oxon. habitæ* (London) and the *Ministerial Character of Christ Practically Considered* (1824), besides several *Charges*, and edited in the original and translated the long-lost Latin manuscript of Milton, *De Doctrina Christiana* (1825), which gave occasion to Macaulay's brilliant essay on Milton. He was a brother of John Bird Sumner, Archbishop of Canterbury. D. at Farnham Castle, Surrey, Aug. 15, 1874. His *Life*, by G. H. Sumner, appeared in 1876 (London). Revised by S. M. Jackson.

**Sumner**, Increase, LL. D.: jurist; b. at Roxbury, Mass., Nov. 27, 1746; was admitted to the bar in 1770, and began practice in his native town; was representative in the Legislature 1776–80, State Senator 1780–82, associate judge of the Supreme Court 1782–97, Governor of Massachusetts 1797–99, and in 1789 member of the convention for the adoption of the U. S. Constitution. D. at Roxbury, June 7, 1799.

**Sumner**, William Graham, LL. D.: economist; b. at Paterson, N. J., Oct. 30, 1840; prepared for college at Hartford (Conn.) grammar school; graduated at Yale College 1863; traveled in Europe, residing at Geneva during winter of 1863–64; studied philosophy at the University of Göttingen 1864–66, and at Oxford, England; was tutor in Yale College 1866–69; took orders in the Protestant Episcopal Church Dec. 29, 1867; was for a time assistant minister of Calvary church, New York; appointed Professor of Political and Social Science at Yale College 1872. Among his works are a *History of American Currency* (1874); *Collected Essays in Political and Social Science* (1885); *Protectionism, the System which teaches that Waste makes Wealth* (1885); *The Financier and Finances of the American Revolution* (1891); and *Robert Morris* (1892).

**Sumptuary Laws** [from Lat. *sumptua'rius*, deriv. of *sumptus*, expense, extravagance]: laws which seek to restrict and regulate private expenditures, and generally are aimed at extravagant outlays for food, for clothing, or for funerals. Such laws were enforced, in past centuries, by every nation of the Old World, and have been indulged in, to some extent, even by the modern States of North America. For example, Massachusetts thought it necessary at one time to regulate by legislation the cost of funerals. These laws have flourished most abundantly in the periods of transition from semi-barbarism to civilization. Witness the legislation of Lycurgus and of Solon, in Greece, that of the Roman republic especially from the Twelve Tables to the second century before Christ, and that of modern European states during the thirteenth, fourteenth, and fifteenth centuries.

The reason for this is twofold: First, public opinion among the governing class does not keep pace with the rapidly increasing conveniences and refinements of life, but insists upon tabooing them as conducive to effeminacy. Second, the state has unlimited confidence in its strength and wisdom and undertakes to guard its subjects with paternal care. Some of the most interesting specimens of sumptuary legislation in modern Europe are found among the laws of Frederick II. in Italy, of Edward III. in England, and of Philip IV. in France. One of these statutes (10 Ed. III., st. 3), ordaining that no man should be served at dinner or supper with more than two courses, except upon certain great holidays, when he might be served with three, was not repealed until the nineteenth century.

This kind of legislation is condemned generally by modern political science. Adam Smith declares, "It is the highest impertinence and presumption in kings and ministers to pretend to watch over the economy of private people and to restrain their expense, either by sumptuary laws or by prohibiting the importation of foreign luxuries." Roscher, however, contends that while such laws are at present useless or harmful, they have proved salutary at times, citing in support of his views the laws of Florence in the fifteenth century against extravagant outlays upon personal pleasures, which, he believes, tended to promote indulgence in the nobler luxury of building churches and palaces, of collecting libraries, and of encouraging artists; and the laws of the Roman empire which drove the most odious forms of vice under cover.

During the sixteenth and seventeenth centuries the motive of sumptuary legislation underwent a change. It was enacted not so much from a benevolent regard for the spendthrift as from commercial and police considerations. English legislators, for example, prohibited the wearing of silk on garments, not with a view to limit personal expenditures, but to promote domestic manufactures of wool. In various countries laws wearing a sumptuary appearance were passed for the purpose of maintaining class distinctions. The latest piece of true sumptuary legislation in Great Britain is the Scotch luxury law of 1621. In our day the term sumptuary is often applied to laws curtailing or prohibiting the liquor traffic. They are dealt with by the courts, however, as police regulations. Under the Federal and State constitutions of the U. S., with their special guaranties of individual liberty, it is held that the habits, occupation, food and drink—the life of the individual—are severally matters for his own determination. They can be abridged by the majority of the people, speaking through the Legislature, only when the public safety, the public health, or the public protection requires it. The constitutional guaranty of life, liberty, and the pursuit of happiness can be limited only by the absolute necessities of the public. *Intoxicating Liquor Cases*, 25 Kan. 751, 765; *Mugler* vs. *Kansas*, 123 U. S. 623.

FRANCIS M. BURDICK.

**Sumter**: city; capital of Sumter co., S. C.; on the Atlantic Coast, the Cent. of S. C., and the Charleston, Sumter and N. railways; 43 miles E. by S. of Columbia; 93 miles N. by W. of Charleston (for location, see map of South Carolina, ref. 5–F). It is in an agricultural and a tobacco and truck raising region; ships annually 25,000 bales of cotton; and contains 6 churches for white people and 6 for colored, 5 public-school buildings, 2 academies for young ladies, 2 planing-mills, cotton, telephone, and sash and blind factories, improved system of water-works, electric lights, a national bank with capital of $75,000, a State bank with capital of $75,000, and 6 newspapers. Pop. (1880) 2,011; (1890) 3,865; (1900) 5,673.

EDITOR OF "HERALD."

**Sumter, THOMAS**: soldier; b. in Virginia in 1734; removed in early life to South Carolina; participated in the Cherokee war, and was a prominent actor in the events which preceded the Revolution: was appointed lieutenant-colonel of the Second Regiment of riflemen in Mar., 1776, of which he became colonel; served in the interior of the State until the fall of Charleston; went to North Carolina and raised a large force, with which he defeated (July 12, 1780) a force of British and Tories; made an unsuccessful attack on the post at Rocky Mount Aug. 1, but Aug. 6 defeated and routed the Prince of Wales regiment at Hanging Rock, and dispersed a large body of Tories; was defeated and routed by Tarleton on the 18th at Fishing Creek; gained a victory at Broad river Nov. 12, and on the 20th defeated Tarleton at Blackstocks, and was severely wounded; had previously been appointed brigadier-general of South Carolina militia in Jan., 1781; received a vote of thanks from Congress for his eminent services; having raised three regiments of rangers, co-operated with Marion, Pickens, and other partisan leaders; was member of the convention which adopted the Federal Constitution; was member of Congress 1789–93 and 1797–1801, U. S. Senator 1801–09, and U. S. minister to Brazil 1809–11. D. at South Mount, near Camden, S. C., June 1, 1832.

**Sumter, Fort**: See FORT SUMTER.

**Sun** [O. Eng. *sunne*: O. H. Germ. *sunna* (< Mod. Germ. *sonne*): Icel. *sunna*: Goth. *sunna*; cf. (with different suffix) O. Eng. *sōl*: Goth. *sauil*: Sanskr. *svar*: Gr. ἥλιος: Lat. *sōl*]: for us, the most important body in the universe. next to the earth on which we dwell. It is the great center around which all the planets of our system revolve, and without its vivifying influence the whole earth would speedily be enveloped in a mantle of ice. on which no living being could exist. Yet to the question what the sun is, science can not as yet return an entirely satisfactory answer. The ancients knew that it was a shining sphere, and it is now known to be a very hot body; what is known more than this consists rather of fragments than of a well-rounded body of knowledge. Numerous though the fragments are, it is true that modern science has raised more questions about the sun than it has conclusively answered.

Beginning with certain particulars on which there is exact knowledge, it may be stated that the mass and volume of the sun are enormous compared with those of the earth, and that nature there conducts her operations on a scale of which we can form no conception. In volume it is more than a million times that of our earth; in mass more than 300,000 times. Its density is about one-fourth that of the average of the materials which make up the earth, and therefore only about half as much again as that of water. Its mean distance from us is 93,000,000 miles; its diameter 866,000 miles. The force of gravity on its surface is twenty-seven times what it is on the earth. Under such circumstances a man attempting to stand up would be instantly crushed to death by his own weight. High mountains could scarcely exist, because they would be flattened out by the pressure, and vegetation of the sort familiar to us would not be possible.

Like the earth and planets, the sun rotates from W. toward E. on an axis nearly perpendicular to the ecliptic. It has therefore two poles, where the axis intersects its surface, and an equator of its own. The period of rotation is about 26 days. A curious circumstance is that the equatorial regions rotate in less time than those nearer to the poles, the range being perhaps from 25 to 26¼ days.

*Temperature and Physical Constitution.*—The flood of heat which the sun sends us at its enormous distance indicates that the matter composing it is intensely hot; but estimates of the actual temperature have differed widely. It appears higher than any that we have yet produced, even in the electric arc; probably more than 10,000° F. This statement applies to the photosphere, or visible surface of the sun; the great invisible interior must be at a much higher temperature. There must be a constant interchange of matter between the interior and the surface, else the latter would speedily cool off under the influence of its rapid rotation. Consequently the interior must be, at least in the great mass, either liquid or gaseous. The best sustained view at the present time is that at such a temperature as that within the sun no permanent chemical combination is possible. There can be only an indiscriminate mixture of elements; for example, a mixture of oxygen and hydrogen, instead of water. Moreover, the distinction between a liquid and a gas becomes obliterated under the combined effect of the temperature and the pressure. We must therefore regard the sun as a mass of gas, condensed nearly to the density of a liquid by the pressure of its own mass. The visible photosphere is, indeed, sometimes supposed to be wholly or partially solid. This is a point not yet settled. It may be that, under the influence of rapid cooling, the substances which rise to the surface are constantly condensing to solids, and then falling down again are once more melted by the heat of the interior; but it has also been pointed out that a purely gaseous envelope around the sun would increase so rapidly in density toward the interior, owing to the immense pressure of gravity, that it would present the same appearance that the sun actually does.

*Appearance of the Photosphere.*—Through a good telescope, under favorable conditions, the photosphere is seen to have a mottled or curdled appearance, looking much like a plate of rice soup. This appearance probably arises from a constant rising of currents of heated matter from the interior. Although attempts have been made to assign definite shapes to these seeming rice-grains, the writer believes that they are quite irregular, both in size and shape, and have no well-marked outline or distinctive features.

When the apparent center of the sun is compared with the edge of the disk, it is seen to be markedly brighter; this difference can be seen without a telescope, if the sun is examined through a very dark-green or blue glass, so as no longer to dazzle the eye. It is attributed to absorption of the rays by the solar atmosphere, a view which is confirmed by the fact that different rays of the spectrum are absorbed in very different degrees. The absorption is greatest of all in the case of the photographic rays, so that a photograph of the sun will ordinarily show very dark at the extreme limb unless over-exposed at the center. The absorption is less in the visual rays and still less in the heat rays, which shows that as we descend in the spectrum the transparency of the sun's atmosphere to the rays increases.

*Solar Spots.*—The most striking and peculiar feature of the photosphere is formed by the spots, which may nearly always be seen when the sun is examined with a telescope. They were seen by the earliest telescopes, and have formed a subject of constant study by astronomers ever since. When examined with a high power, and under favorable conditions, a sun-spot is found to possess marked peculiarities of structure. A general idea of the appearance may be formed from Fig. 1. We have in the center a dark portion called the nucleus, or *umbra*, which is commonly of irregular form. The word dark must, however, be interpreted in a relative sense; though apparently dark in contrast with the effulgence of the photosphere, the spot would be intensely bright if isolated. Around this dark center is a gray fringe intermediate in brightness between the nucleus and the photosphere, which is called the *penumbra*. To ordinary examination the penumbra appears to be nearly uniformly gray, but when best seen in a good telescope it is found to have a striated or fibrous appearance, being composed of an immense number of root-like filaments directed from the outside toward the center. Groups of minute specks, brighter than the general surface of the sun, are often seen in the neighborhood of spots or elsewhere and are called *faculæ*.

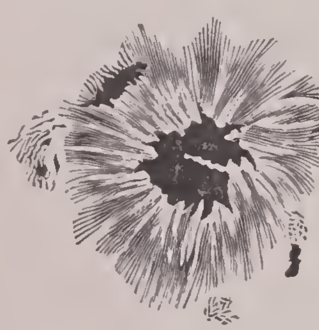


FIG. 1.

The spots vary in size from the smallest visible points to objects large enough to be seen with the naked eye, and therefore nearly 100,000 miles in diameter. A curious circumstance is that the spots are not seen all over the solar disk, but only near to what, in our globe, would correspond to the tropics. They are most numerous about twenty degrees on each side of the solar equator; they are rarely seen exactly at the equator, and scarcely ever in more than thirty-five or forty degrees of latitude. They frequently appear in groups comprising two or three, and sometimes many more. In consequence of the sun's rotation, each spot is seen to move slowly across its disk, occupying about thirteen days from the time it appears on one side until it disappears on the other, always supposing that it endures as long as this. The duration of a spot is very variable, ranging from a few days to several months.

A view very generally entertained is that the spots are cavities in the photosphere. This was believed because, as the spot approaches the edge of the sun, the umbra is supposed to appear wider on the side toward the sun's limb, which would be the case if it were a hollow cone at which we were looking obliquely. But the figure and size of the penumbra are so irregular that it is not easy to establish such a fact as this, and Schörer, of Potsdam, one of the industrious students of solar spots, denies that there is any such difference. According to his view, the penumbra is on the same level with the photosphere. Yet another view is that the spots are cooled portions of matter floating, as it were, upon the hotter photosphere. They have also been attributed to down-rushes of matter, carrying the cooler portions near the surface with them. Between these various views it is impossible at present to decide.

*Periodicity of the Spots.*—It has been well established by careful observation since about 1850, as well as by previous records, that the frequency of the sun-spots goes through a fairly regular period of about eleven years. In recent years the maxima have occurred about the years 1848, 1860, 1870, 1881, and 1892. The next maximum may therefore be expected about the year 1903 or 1904. During the years of maximum the sun is rarely seen without spots, and generally with a considerable number. During the intermediate years of minima the sun is seen without spots about half the time. The variation does not, however, go on with entire uniformity, the general rule being that the rise from minimum to maximum is more rapid than the fall from the maximum to the minimum. For instance, a maximum occurred about the year 1860, a minimum about 1867, and another maximum about 1870. Thus the number of spots took seven years to fall to a minimum, and only three to rise to a maximum. We also have here an illustration of the irregularity of the period. The interval is not always exactly eleven years, but sometimes a little more and sometimes a little less, varying in an irregular manner. Sufficient data have not yet been accumulated to determine accurately the law of change. It was formerly supposed that the maxima and minima might be associated with the revolutions of the planets, a view which was first suggested by the close approximation of the period of the sun-spots to that of Jupiter, the latter being somewhat less than twelve years; but careful investigation shows that the sun-spot period can not be as great as the period of Jupiter, so that the close approach to coincidence can be regarded only as an accident. The fact seems to be that the variation occurs in consequence of a cycle of changes going on within the body of the sun itself, but of the nature of those changes nothing is known.

*The Sun's Surroundings.*—The glare of the sun's rays in our atmosphere, even in the finest climates, is such that objects in its immediate neighborhood are ordinarily invisible. But from time to time there are a few rare minutes in which this glare is removed, in consequence of the moon passing over the sun's disk in a total eclipse. The opportunities thus offered for scrutinizing the immediate neighborhood of the sun have resulted in bringing to light a number of singular phenomena, many of which can be seen only during total eclipses. (See CORONA.) It is known that the photosphere is surrounded by a comparatively thin layer of vaporized or gaseous matter, known as the *chromosphere*. Continuous with this layer, and yet possibly having a different origin, are the protuberances, which appear to consist of vast masses of glowing gas ejected from the sun with inconceivable force, the velocity sometimes amounting to 200 miles a second. These protuberances exhibit a great variety of the most fantastic forms, sometimes appearing like immense flames, sometimes like clouds floating above the sun and remaining for hours, or even days, in the same region. It has been noticed that they are more frequently seen in the neighborhood of sun-spots than elsewhere, yet not necessarily over the spots. Some of the forms are shown in Fig. 2, on a scale on which the earth would be represented by a globe of perhaps one-eighth of an inch in diameter.

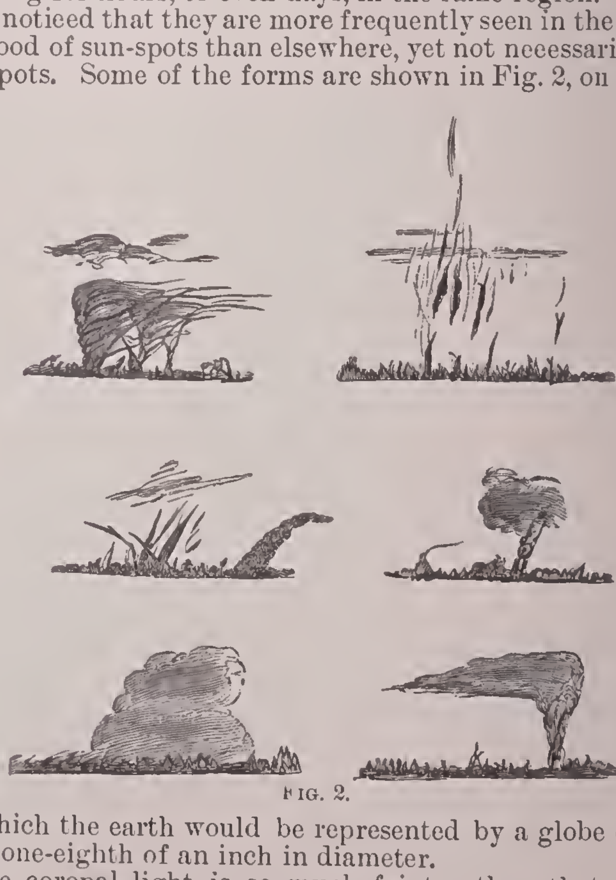


FIG. 2.

The coronal light is so much fainter than that of the protuberances that it can not be detected, even by the spectroscope, except during total eclipses. (See Eclipse.) It can be plainly seen extending to a distance from the sun nearly equal to its semi-diameter, but it also shows rays or streamers extending to much greater distances, sometimes a degree more, and therefore millions of miles in extent. The most remarkable feature of its spectrum is a bright line in the green, which was discovered independently by Young and Harkness during the total eclipse of 1869. This line has not certainly been identified as belonging to any substance known to exist on the earth, and the term *coronium* has been applied to the unknown element which causes it. Repeated study of the corona seems to show that it generally has the greatest extent about the middle latitudes of the sun, and that its structure is of a peculiar filamentous character like that of combed wool. A resemblance of these filaments to the lines of magnetic force has been brought out by Prof. F. H. Bigelow, who has constructed a magnetic or polar theory of the corona, ascribing it to the sun's magnetism. It can not be said, however, that any entirely satisfactory theory of this object has yet been established. Magnetic force may very well account for the structure and appearance, but the great difficulty is how substances of any sort can remain at rest so near the sun, under the enormous gravitating force of the latter. The corona has sometimes been described as a solar atmosphere, but it can not be such in the sense in which we use the term atmosphere. The fact that comets have passed through its substance with a speed of several hundred miles a second, without suffering, so far as could be seen, the slightest retardation or disturbance, shows that there can be in the corona no substances but such as are of the utmost tenuity—particles so light that the thinnest air would be as lead in comparison. It has been suggested that these particles may be held up by electrical repulsion, or that they may be in a state of projection, continually thrown up from the sun and falling back again upon its surface. All these hypotheses are possible, and some may be more or less probable, but no one is yet proved to the exclusion of the others.

*Elements which compose the Sun.*—A comparison of the solar spectrum with the spectra of the various elements found on the earth shows that the sun is composed very largely of the same substances as the earth. The most thorough comparison of this kind is that of Rowland, which is still in progress. He finds that thirty-six terrestrial elements may be detected in the sun. Of these, calcium, iron, and sodium are among those most strongly marked. The elements not yet detected are mostly those which are found on the earth in comparatively small quantities, such as antimony, arsenic, gold, mercury, etc. The most curious case among the doubtful elements is that of oxygen. It is not yet certainly decided whether the spectrum of the sun does or does not show the existence of oxygen in that body. It is to be remarked that the absence of the lines of an element in the solar spectrum does not prove the absence of that element. The solar spectrum shows only the lines of those elements which are vaporized at its surface; hence if any elements do not come to the surface at all, or do not form a vapor there, they will not show themselves in the solar spectrum. The general result has been summed up by Rowland in the remark that were the earth heated up to the temperature of the sun, its spectrum would probably resemble that of the sun very closely. It is also to be remarked that there are lines in the spectrum of the sun, or of its surrounding atmosphere, which have not yet been identified as belonging to any terrestrial element. Of these the most noteworthy is a line, $D_3$, found in the spectrum of the chromosphere and attributed to a non-terrestrial substance which has received the name *helium.* It has been announced by Ramsay (1895), however, that a gas obtained from *cleveite*, a rare mineral from Norway, shows this line, and therefore may be presumed to be helium. For an illustration of the solar spectrum see the article Spectrum.

The question whether the sun affects the earth otherwise than by its light, heat, and gravitation is one with which science is busy, but on which no positive conclusions are yet reached. A relation between the period of the aurora and that of the sun-spots seems to be not improbable, but the question whether auroras are themselves excited by actions going on in the sun is an open one. This whole class of questions can be settled only by long-continued observation and careful study.

*The Sun's Heat.*—The question of the permanence of the sun's heat is presented in a new light by those generalizations of modern science which relate to the conservation of energy. To our ancestors there was no apparent reason why the sun should not continue to light and warm the earth and planets forever; but modern science shows that the radiation of heat from the sun to the earth involves a continuous expenditure of an agent called energy, of which the supply is necessarily limited.

The quantity of heat which is received from the sun has been determined by several experimenters. The recent observations of Langley probably give the most accurate result, which may be expressed in the following way: Let us consider a cubic centimeter of water, that is, a cube about four-tenths of an inch on each side. We may realize this cube in the form of a thin metallic vessel, filled with water. Let this vessel be covered with lampblack, and one side of it be exposed perpendicularly to the rays of the sun. Langley's result is that if these rays reached the earth without being absorbed by our atmosphere, they would, when absorbed by the cube, heat it at a rate of 3·6° C., or $6\frac{1}{2}$° F. per minute. Taking as the unit of heat the quantity which would raise the temperature of 1 cubic cm. of water 1° C., we may say that the sun radiates upon each square centimeter of surface 3·6 heat units per minute. Imagine a spherical surface surrounding the sun, at a distance equal to that of the earth's orbit. Every square centimeter of that surface would receive this quantity of heat from the sun. We may state this result in another way. If the amount of heat falling on a square centimeter were transformed into a lifting force, without any loss whatever, it would raise a cubic centimeter of water against the force of gravity at the rate of about 4,800 feet per minute. A similar computation shows that the heat which the sun, when near the zenith, radiates upon the deck of a steamship would suffice, could it be turned into work without loss, to drive her at a fair rate of speed.

Considering the sun simply as a hot body, it would be cooled by the heat which it radiates, and calculation shows that the amount of heat radiated would result in a cooling of 5°, more or less, per year, according to the specific heat of the substances which compose it. It follows that, in such a case, the sun would cool off entirely in a very few thousand years. As no actual cooling seems to take place, the question arises how the heat is kept up.

Two theories on this subject have been maintained in recent times. One, known as the meteoric theory, is that the countless meteors which are known to be moving in all directions through the solar system are continually falling into the sun and supplying it with the heat generated by the impact. As to this theory it can only be said that it seems impossible that meteoric matter in sufficient quantity could be falling into the sun. The other theory, which is now universally accepted, at least provisionally, by the ablest physicists, is that the heat is kept up by the contraction of the sun's volume as it cools. A very curious result of this contraction was reached some years ago by an American investigator, J. Homer Lane, who showed that as the sun contracted it would actually become hotter, because although heat was lost by radiation, yet, so far as temperature was concerned, this loss would be more than made up by the resulting contraction, so long as the sun remained gaseous. This, however, does not mean that the heat would last indefinitely. After contracting to a certain point the matter composing the sun would necessarily begin to assume a solid or liquid form, and then would rapidly cool off. The available supply of energy would then be exhausted forever, and our system would be overtaken by eternal cold and darkness. Thus the physical conclusion to which we are led by a study of the laws of nature is that the sun, like a living being, must have had a birth and will have an end. From the known amount of heat which it radiates we can even, in a rude way, calculate the probable length of its life. From fifteen to twenty millions of years seems to be the limit of its age in the past, and it may exist a few millions of years, perhaps five or ten, in the future.

These computations have brought the conclusions of physics and astronomy into collision with those of geology. About the middle of the nineteenth century geologists were led by a study of the rocks composing the earth's surface in successive periods of their deposit to conclude that geological processes must have been going on for hundreds of millions of years. It can not be said that a complete reconciliation has yet been reached; but the writer believes that the general tendency of late years has been to shake the confidence formerly felt in the great length of the geological ages.

Connected with and yet apart from this is the question of the invariability of the supply of heat. Can we be sure that this supply has been every year the same during many ages past, and that it will remain unchanged for ages in the future? May it not be that the glacial epoch was due to a diminution of the sun's radiation? May this radiation not increase or diminish in the future to such an extent as to affect seriously the activities and destiny of the human race? These are questions to which the science of to-day can return no positive answer. All that can be said is that during the two or three centuries of accurate observations of temperature and climate there is no evidence of any permanent change. Adding to this the fact that a comparison of the ancient records of the magnitude of the stars with their present magnitudes does not show any evidence of change, and that the sun is undoubtedly a star which is brighter than others because we are so much nearer to it, the conclusion is that there is no reason to apprehend any sudden or rapid changes in the supply of solar heat.

BIBLIOGRAPHY.—*The Sun*, by C. A. Young, in the International Scientific Series, is the latest complete work in English on the subject. Proctor's *The Sun, Ruler, etc., of the Planetary System*, will also be found extremely interesting. A yet more voluminous work is that of Secchi, *Le Soleil* (2 vols., Paris, 1870), which is beautifully illustrated.

SIMON NEWCOMB.

**Sun Animalcules**: See HELIOZOA.

**Sun-bird**: any bird of the family *Nectariniidæ*, inhabiting a great part of Africa, Southern Asia, and Australasia. Although only distantly related, the sun-birds have a superficial resemblance to the humming-birds, with which they are generally confounded by colonists, in their smallness, slender build, brilliant, often metallic colors, and habits of feeding from flowers, but belong to a different order, the passerines. The tongue is practically tubular and suctorial, although their food consists mainly of insects. Their nests, which are roofed over, are swung from a slender twig or the tip of a leaf; the eggs, generally three in number, are white, plentifully sprinkled with grayish green. There are over 100 species, which have been described in a *Monograph of the Sun-birds*, by Capt. Shelley (London, 1876–80).

F. A. LUCAS.

**Sun-bittern**: a wading bird (*Eurypyga helias*) of somewhat uncertain affinities, but usually placed in a separate family (*Eurypygidæ*) near the cranes and rails. It is about 16 inches long. The head is black, with a white stripe above and beneath each eye; the balance of the plumage is curiously and elaborately mottled with black, white, chestnut, and various shades of buff and brown. The sun-bittern is found along the banks of rivers in the northern and eastern parts of South America, and feeds on fishes and insects. Its nearest relative is the KAGU (*q. v.*). F. A. LUCAS.

**Sunbury**: borough; capital of Northumberland co., Pa.; at the junction of the northern and western branches of the Susquehanna river; on the N. Cent., the Penn., and the Phila. and Reading railways; 54 miles N. of Harrisburg, the State capital (for location, see map of Pennsylvania, ref. 4–G). It is in a lumbering region; is an important shipping-point for coal; and contains the repair-shops of the Phila. and Erie Division of the Penn. Railroad, rolling-mill, organ-factory, saw and planing mills, nail-works, and coffin, table, and sash and door factories, a national bank with capital of $200,000, a trust and safe-deposit company with capital of $125,000, and a daily, a monthly, and two weekly periodicals. The borough was founded in 1772; was the site of the Indian village of Shamokin and of Fort Augusta, erected by the provincial government in 1756 as a defense against the French and Indians, the magazine of which is preserved in the Fifth Ward of the borough; and is separated from East Sunbury borough (incorporated in 1891) by a small stream. The interests of the two boroughs are identical. Pop. (1880) 4,077; (1890) 5,930; (1900) 9,810.

EDITOR OF "SUNBURY DAILY."

**Sunda Islands**: the chain of large islands belonging to the Malay Archipelago, which, beginning with Sumatra and ending with Timor, separates the Java Sea from the Indian Ocean. The name is derived from the indigenous name of the western part of Java, adjoining the Sunda Straits. See JAVA. M. W. H.

**Sun'darbans**, or **Sunderbunds**: the part of the delta of the Ganges which extends from the Hugli to the Megna. It has an area estimated at 7,550 sq. miles, and consists of a great number of smaller and larger islands covered with dense forests and infested by tigers and crocodiles. As this tract of land is in the highest degree pestiferous, the Government has taken measures to improve it, or at least make it innoxious, and in many places the forests have been cleared and the ground transformed into fields of rice and sugar.

Revised by M. W. HARRINGTON.

**Sunday** [O. Eng. *sunnandæg* (*sunne*, sun + *dæg*, day), transl. of Lat. *di'es so'lis*; *dies*, day + *solis*, genit. of *sol*, sun. See SUN]: the secular name of the first day of the week, which is held among Christians as a Sabbath, or rest-day, and in remembrance of Christ's resurrection. As soon as the Christian religion was recognized by the state, laws were enacted for the observance of Sunday. Constantine (321) prohibited all business except agricultural labor and all legal proceedings except the manumission of slaves. Subsequent emperors made similar enactments. Theodosius II. (425) forbade games and theatrical exhibitions on Sunday (*Cod. Theod.*, xv., tit. 7). The most strict of these laws is that of Leo and Anthemius (469, *Cod. Justin.*, iii., tit. 12). The laws of Theodoric the Great, several kings of France, and especially Charlemagne (813), prohibited servile work and secular business.

In England Sunday laws were of very early origin. The common law distinguished Sunday from other days by allowing no judicial acts on that day, according to the maxim, *Dies dominicus non est juridicus.* The code of Ina, King of the West Saxons (about 693), punished servile work by fine. Alfred the Great (876) forbade work, traffic, and legal proceedings on Sunday. Similar laws were in force through all the Saxon period, and were often enacted in subsequent reigns. The statute 27 Hen. IV., c. 5, enacts that all fairs and markets on Sundays, except in harvest, shall cease on pain of forfeiture of goods. The statute 5 and 6 Edw. VI., c. 3, makes Sundays, with Christmas, Easter, etc., holy days, but permits work in harvest and in other cases of need. The statute 1 Eliz., c. 2, punishes by fine persons absenting themselves from church without excuse. In 1618 James I. issued his *Book of Sports*, in which he declares certain games, sports, etc., lawful on Sundays after divine service. Charles I. in 1638 reissued the *Book of Sports.* The most important of the English statutes is 29 Chas. II., c. 7, which prohibits all worldly labor or business (works of necessity and charity only excepted), the sale of goods, traveling for purposes of trade, and the serving or executing of any process or warrant, except in case of treason, felony, or breach of peace. The dressing of meat in families and its sale in inns and eating-shops and the crying of milk before nine and after four are allowed. This statute, somewhat modified by subsequent laws, is the present Sunday law of Great Britain, and lies at the basis of the Sunday laws of the U. S.

In France, during the Revolution, when the Christian calendar was abolished and the decade substituted for the week, each tenth day was made a rest-day, and its observance was enforced by a law (17 Thermidor, An VI.) which required the public offices, schools, workshops, stores, etc., to be closed, and prohibited sales except of eatables and medicines, and public labor except in the country during seed-time and harvest. On the restoration of the Gregorian calendar, Sunday was recognized in the *Code Napoléon* (Art. 25, 260). A law of Nov. 18, 1814, prohibited ordinary labor, traffic, etc., and, though declared by the courts in 1838 and 1845 to be still in force, it has been for many years a dead letter. The International Sunday-rest Congress, in connection with the Paris Exposition of 1889, and the Berlin Labor Conference, convened by the German emperor in 1890, gave increased prominence to the question of the legal protection of Sunday rest which had been previously agitated by labor and other associations. Laws restricting Sunday labor and trade to a greater or less extent exist in Germany, Switzerland, Austria, Hungary, Belgium, Holland, Denmark, Sweden, and Norway.

The early English colonists of North America brought with them the observance of Sunday, both as a religious and as a civil institution, and both the religious and secular observance of the day was enforced by laws similar to the English statutes, though modified by the popular feelings and modes of life. The early laws of Massachusetts, Connecticut, Georgia, South Carolina, and Virginia compelled attendance at church, the Massachusetts law (1782) providing that such attendance was not required where there was no place of worship which the person could conscientiously attend. (The oft-quoted BLUE LAWS (*q. v.*) of Connecticut are a pure fiction, first published in London in 1781 by Samuel Peters, in revenge for being driven from the colony on account of his obnoxious royalism.) After the establishment of the Federal Government, as the separation between Church and state came to be more fully understood and carried out, the earlier Sunday laws were modified in conformity with this principle, and the legislatures and courts have been careful to distinguish between Sunday observance as a religious and as a civil institution, and to enforce only the latter. The existing Sunday laws rest chiefly upon the following grounds: The right of all classes, so far as practicable, to rest one day in seven; the right to undisturbed worship on the day set apart for this purpose by the great majority of the people; the decent respect which should be paid to the religious institutions of the people; the value to the state itself of the Sunday observance as a means of that popular intelligence and morality on which free institutions are conditioned. The Federal Constitution provides that Sunday shall not be reckoned in the ten days within which the President may return any bill; the Federal courts and the offices of the departments are closed; the service of the post-offices is restricted; no session of Congress is held, and provision is made by act of Congress for the observance of Sunday in the army and navy. Beyond this, Sunday legislation does not come within the sphere of the Federal Government. The constitutions of all but a very few of the States, like the Federal Constitution, except Sunday in reckoning the time within which the executive may return a bill to the Legislature. Sunday laws exist in all the States, with a single exception. The statutes of the States differ somewhat in details and strictness. Sunday is everywhere held as a *dies non.* Public affairs are suspended; the legislatures do not sit; courts are not held, except that in some cities police courts are open for an hour or two; legal processes are not served. In most of the States common labor and traffic are prohibited; contracts made or for service on Sunday are invalid; public amusements are restricted or forbidden. In many States partial exception is made for those who observe the seventh day of the week. The constitutionality of Sunday laws has been decided frequently by the highest State courts.

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**Sunday Letter**: See DOMINICAL LETTER.

**Sunday-schools**: gatherings for religious instruction and worship, in which the learners are clustered in classes under separate teachers, all the classes being associated under a common head, and the form of instruction being interlocutory or catechetical. These characteristics include many schools which are held on Saturday, or which are known as First-day schools.

*Modern Sunday-schools.*—These had their origin in a movement begun by Robert Raikes, the proprietor of *The Gloucester Journal*, in Gloucester, England, in July, 1780. His purpose was to provide instruction in reading, and in the Church of England catechism, for the neglected children of a manufacturing district of that city. His first school was gathered on a Sunday in a private house under the charge of four women, who were employed at a shilling a day. Its forenoon session was from ten to twelve o'clock. In the afternoon, after a brief session, the children were conducted to the parish church for a part in worship, and were afterwards examined in the catechism. The Rev. Thomas Stock, a parish clergyman, assisted Mr. Raikes in this work, and gave an extra sixpence a day to the teachers.

Descriptions of this movement in *The Gloucester Journal* and other periodicals in 1783 called public attention to it, and it soon became widely popular. Volunteer teachers took the place of paid ones. The queen gave it her approval by sending for Mr. Raikes to tell her its story, and to congratulate him on what he was doing. Bishop Porteus was an early and earnest friend of the movement. John Wesley introduced its plan of work into his religious operations. A general Sunday-school society was organized with the aid of William Fox and Jonas Hanway, having its center in London. The success of the movement was quickly assured, although not without opposition from ecclesiastical authorities and timid religionists. A council of bishops was summoned by the Archbishop of Canterbury to consider the best means of checking the innovation; and the Presbyterians of Scotland and the Congregationalists of New England took stand against it as tending to the secularization of the Sabbath. Within four years from the public announcement of his work by Mr. Raikes, however, the membership of such schools in the United Kingdom numbered over a quarter of a million, and the increase of their numbers has been constant.

*Ancient Jewish Schools.*—Although this was the beginning of the modern Sunday-school movement, its idea was of ancient origin, and had found expression in various forms all along the ages. Religious instruction, apart from that which was given in the family, seems to have been practiced in the days of Abraham (Gen. xiv. 14). Home instruction was not deemed sufficient for the children under the Mosaic law (Deut. xxxi. 10–13). The Levites were traveling Bible-teachers in the days of the kings of Judah (2 Chron. xvii. 9). The synagogue seems to have included in its exercises from its beginning, during the Captivity, the study of the law by interlocutory methods. According to the Talmud and to Josephus, a system of religious schools in connection with the synagogues was organized in the century before Christ. This system included many of the features of the modern Sunday-school. The size of classes was limited to the capability of the teacher. Selected Bible lessons were arranged for a series of years. Attention was given to the fitness of instruction to the ability and needs of the pupils. Freeness in questions and answers was cultivated. Such schools were general in Palestine in the days of Jesus, and there is reason to suppose that he was a pupil in one of these in his Nazareth home.

*Early Christian Schools.*—The religious school was a prominent agency in the early Christian Church. "The apostolic Church," says Baron Bunsen, "made the school the connecting link between herself and the world." Catechising engaged the best efforts of the best Christian teachers. A compulsory system of Bible-schools for children in every city was in force in extensive fields as early as the fourth century, and charity schools in all country churches were ordered by a general council of the Church in A. D. 680. Such work was never wholly lost sight of even in the Dark Ages, although as the ecclesiastical spirit began to predominate over the evangelical less attention was given to it. In the Reformation of the sixteenth century the school idea gained new prominence. Said Luther: "For the Church's sake Christian schools must be established and maintained. . . . God maintains the Church through the schools." And he acted on this idea, as did also Calvin, Zwingli, Beza, Knox, Cranmer, Ridley, Usher, and others. Under Jesuit lead the Roman Catholic Church paid fresh attention to schools, and regained a measure of its lost ground through methods with children similar to those now in use in Sunday-schools generally. Two causes combined to check the progress of what might be called "the Sunday-school idea" after its revival in the sixteenth century. The unintelligent memorizing of set answers, in catechisms intended as a mere guide in teaching, gradually took the place of religious teaching; and the polemical spirit among Protestants lifted sermonizing into an undue prominence over Bible study. A marked religious decline was the result, and social and personal morals were at a very low point in the latter half of the eighteenth century, when the new movement in favor of Sunday-schools was begun by Robert Raikes.

*Modern Beginnings before Raikes.*—The plan of Raikes was only the new application of an old idea, but the circumstances of his beginning gave fresh importance to his work, and therefore its date marks a new era. Single schools much like his are claimed to have been started before that date, as follows: In Bath, England (by Rev. Joseph Alleine), in 1665–68; in Roxbury, Mass., in 1674; in Norwich, Conn., in 1676; in Plymouth, Mass., in 1680; in Newtown, Long Island (by Rev. Morgan Jones), in 1683; in England (by Bishop Frampton), in 1693; in Berks and Montgomery cos., Pa. (by the Schwenkfelders), in 1734; in Savannah, Ga. (by Rev. John Wesley), in 1737; in Ephratah, Pa. (by Ludwig Höcker), in 1740; in Bethlehem, Conn. (by Rev. Joseph Bellamy), in 1740; in Philadelphia, Pa. (by Mrs. Greening), in 1744; in Norham, Scotland (by Rev. Mr. Morrison), in 1757; in Brechin, Scotland (by Rev. David Blair), in 1760; in Catterick, England (by Rev. Theophilus Lindsey), in 1763; in Columbia, Conn. (by Rev. Eleazer Wheelock), in

1763; in Bedale, England (by Miss Harrison), in 1765; in High Wycombe, England (by Miss Hannah Ball), in 1769; in Doagh, County Antrim, Ireland (by William Galt), in 1770; in Bright, County Down, Ireland (by Rev. Dr. Kennedy), in 1774; in Little Lever, near Bolton, England (by James Heys), in 1775; in Mansfield, England (by Rev. David Simpson), in 1778; also about the same time in Asbury, England (by Rev. Thomas Stock), and in Dursley, England (by William King).

*Beginnings in the U. S.*—For the credit of introducing the modern Sunday-school into the U. S. there are many claimants. It would seem that in several places Sunday-schools which were started within a few years after Raikes's beginning in Gloucester were continued for a time and then given up without leaving immediate successors. Thus a Sunday-school was organized under the direction of Bishop Asbury at the house of Thomas Crenshaw, in Hanover co., Va., in 1786; yet little is known of it save its beginning. A minute in favor of organizing Sunday-schools was adopted by the Methodist Conference in Charleston, S. C., in Feb., 1790; yet no record is found of Sunday-schools organized. In Dec., 1790, a meeting was called in Philadelphia to consider the importance of this work, and early in Jan., 1791, the First-day or Sunday-school Society was formed for the purpose of securing religious instruction to poor children on Sunday. This society is still active, yet its schools, like those of Robert Raikes, had paid teachers during the earlier years of its operation. In 1791 there was started a Sunday-school in Boston; in 1793 one in New York by Katy Ferguson, a Negro; in 1794 one in Paterson, N. J.; in 1797 one in Pawtucket, R. I., by Samuel Slater; in 1800 one in Pittsburg, Pa. In 1803 a Sunday-school was gathered by Mr. and Mrs. Divie Bethune in New York, and subseqnently other schools were begun by them. Mrs. Bethune was a daughter of Mrs. Isabella Graham the philanthropist. Mr. Bethune had seen something of Raikes's work in England, and the New York school was in imitation of that. In the same year with this beginning in New York a Sunday-school was begun in Portsmouth, N. H., and the year following one in Baltimore, Md. In 1809 a systematic Sunday-school movement was organized in Pittsburg, Pa. The Rev. Robert May, from London, gave a new start to Sunday-schools in Philadelphia in 1811, which proved a beginning of permanent progress. A local union for Sunday-school work was organized in New York in 1816, another in Boston the same year, and another in Philadelphia in 1817. These societies became the nucleus of the American Sunday-school Union, a national society organized in 1824.

*Progress and Influence.*—The Sunday-school movement led to a new interest in popular education, and to new measures for the Christian evangelization of the home field and the foreign. J. R. Green, the historian, says: "The Sunday-schools established by Mr. Raikes . . . were the beginning of popular education." The system of penny postage, and the organization of the British and Foreign Bible Society, and of other benevolent societies, were an outgrowth of interest in this movement. Adam Smith said at the time: "No plan has promised to effect a change of manners, with equal ease and simplicity, since the days of the apostles." A century later John Bright, looking back on the record, said: "There is no field of labor, no field of Christian benevolence, which has yielded a greater harvest to our national interests and national character than the great institution of Sunday-schools."

In the U. S. the influence of the Sunday-school has been even more important than in Great Britain. When the Sunday-school was introduced as a practical power into the U. S., unbelief and error were already largely in the ascendant, and a flood of godless immigration was making the matter worse year by year. The new agency was by various changes adapted to the peculiar needs of the republic, and it became a means of instructing and influencing children and youth in the field of organized churches and of pioneer religious work in new communities.

*Present Status.*—The Sunday-school is a recognized department of the Church in the U. S. for the religious instruction of the young, and for systematic Bible study by young and old. It is also employed as a pioneer agency of evangelism in newer portions of both the older and the newer communities, as in the outlying districts of cities and villages, and on the borders of an advancing and extending population, beyond the limits of existing church organizations. Both as a denominational and as an undenominational agency it is of marked and growing prominence. Protestants and Roman Catholics alike recognize its importance, and it is in favor among the Jews as among Christians. Its management varies according to the ecclesiastical systems of which it has become a part, but its main features are alike throughout.

Buildings for the use of Sunday-schools are often arranged so that numerous rooms can be used separately, and yet all opened together into the sight of the superintendent's desk at a moment's notice. Sunday-school hymns and music are an important aid to social worship. An extensive literature, in the form of books and periodicals, has been created by and for the Sunday-school. Improved methods of teaching have been promoted by Sunday-school normal classes and teachers' institutes. Conventions and assemblies have extended the influence and uplifted the standard of Sunday-school instruction.

*International Lessons.*—In 1873 a plan of uniform Bible lessons was formally inaugurated, on the recommendation of a national convention of Sunday-school workers, and that plan was approved in Canada and England, and came to be known as the international system. Gradually this system overbore opposition, and was employed more and more generally in North America and throughout the world, until now from 6,000,000 to 8,000,000 are engaged each week in the study of the Bible according to its outline. This centering of interest on particular portions of the Bible has justified the issue of many special works as aids to intelligent study, and of the employment of the ablest scholarship and talent for critical and popular expositions. As a result, there is more of biblical study and of interest in biblical research than at any previous stage in the world's history. Criticisms of this international system and attempts at a better one have been incessant, but it has made progress steadily in public favor. A scheme of Bible lessons widely used in the U. S., and considered by many as an improvement upon the international lessons, is known as the Blakeslee or inductive system; and other schemes have their enthusiastic advocates.

The influence of the Sunday-school has been manifestly for good over the individual, the family, and the community; and schools, colleges, and churches have felt that influence, as widely and as steadily as the Sunday-school has made progress.

The following statistics of Sunday-schools in all nations were compiled for the third world's Sunday-school convention, in London, July 11–16, 1898:

| COUNTRY. | Sunday-schools. | Teachers. | Scholars. |
|---|---|---|---|
| EUROPE: | | | |
| England and Wales | 43,632 | 613,036 | 6,843,072 |
| Scotland | 6,338 | 63,939 | 713,360 |
| Ireland | 3,620 | 27,980 | 319,316 |
| Belgium | 83 | 403 | 4,616 |
| Austria | 208 | 533 | 7,340 |
| Denmark | 819 | 4,275 | 71,371 |
| Finland | 7,611 | 12,928 | 165,140 |
| France | 1,475 | 3,876 | 61,200 |
| Germany | 7,131 | 39,872 | 814,175 |
| Greece | 4 | 7 | 180 |
| Italy | 336 | 1,482 | 15,787 |
| Netherlands | 1,900 | 4,962 | 168,110 |
| Norway | 749 | 3,311 | 65,311 |
| Portugal | 18 | 70 | 1,419 |
| Russia | 83 | 785 | 15,679 |
| Spain | 48 | 220 | 4,275 |
| Sweden | 5,360 | 18,144 | 252,247 |
| Switzerland | 1,762 | 7,490 | 122,567 |
| European Turkey | 30 | 170 | 1,420 |
| ASIA: | | | |
| India, including Ceylon | 5,578 | 13,937 | 247,472 |
| Persia | 107 | 440 | 4,876 |
| Siam | 16 | 64 | 809 |
| China | 105 | 1,053 | 5,264 |
| Japan | 150 | 390 | 7,019 |
| Central Turkey | 516 | 2,450 | 25,833 |
| AFRICA | 4,246 | 8,455 | 161,394 |
| NORTH AMERICA: | | | |
| United States | 132,697 | 1,394,630 | 10,893,523 |
| Canada | 8,986 | 75,064 | 582,070 |
| Newfoundland and Labrador | 375 | 2,363 | 23,856 |
| West Indies | 2,306 | 10,769 | 111,335 |
| Central America and Mexico | 550 | 1,300 | 15,000 |
| SOUTH AMERICA | 350 | 3,000 | 150,000 |
| OCEANICA: | | | |
| Australasia | 7,458 | 54,670 | 595,031 |
| Fiji islands | 1,474 | 2,700 | 42,909 |
| Hawaiian islands | 230 | 1,413 | 15,840 |
| Other islands | 210 | 800 | 10,000 |
| The World | 246,658 | 2,378,921 | 22,540,392 |

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H. CLAY TRUMBULL.

**Sunderland**: town; in the county of Durham, England; at the mouth of the Wear; 12 miles S. E. of Newcastle-upon-Tyne and 13 miles N. E. of Durham (see map of England, ref. 4–H). The borough includes Sunderland proper and other townships on the south side of the Wear, and Monkwearmouth on the north side, the river being crossed by two iron bridges. Sunderland is a well-built modern town with broad streets. Among the principal buildings are the Renaissance town-hall, completed in 1890, and the museum, art gallery, etc. (1879). The harbor is formed by two piers, 1,850 and 650 feet long respectively. Two new piers 2,870 and 2,700 feet long, inclosing a harbor of 125 acres, are in process of construction (1895). Four docks, covering a total space of 49 acres, are capable of receiving the largest vessels. The shipments of coal and coke average upward of 4,000,000 tons; in 1892 1,332,546 tons were exported. Glass, earthenware, iron, lime, cement, and chemicals are also exported. The principal imports are iron ores, timber, chalk, and agricultural produce. The total tonnage entered and cleared in 1893, exclusive of that coastwise, was 1,979,733. Ship-building is largely carried on; in 1892 67 steamers, with a total tonnage of 174,940, were launched. Other industries are iron-works, bottle-works, chemical works, ropewalks, paper-mills, and breweries. In Monkwearmouth is one of the deepest collieries in the world (381 fathoms). Pop. of the municipal borough (1901) 146,823; of the parliamentary borough, returning two members (1891), 142,097.

**Sunderland**, JABEZ THOMAS, A. B., B. D., A. M.: clergyman and author; b. at Howarth, Yorkshire, England, Feb. 11, 1842; educated at Madison University, Hamilton, N.Y., University of Chicago, and Union Baptist Theological Seminary, Chicago; held pastorates in Milwaukee, Wis., Northfield, Mass., Chicago, Ill., and Ann Arbor, Mich.; published *A Rational Faith* (1878); *What is the Bible?* (1878); *The Liberal Christian Ministry* (1889); *Home Travel in Bible Lands* (1891); *The Bible, its Origin, Growth, and Character and Place among the Sacred Books of the World* (1893); and various minor works; established and became the editor of *The Unitarian*, a monthly, in 1886.

**Sunderland**, ROBERT SPENCER, Second Earl of: politician; b. in 1640; lived on the Continent during the time of the Commonwealth; returned to England at the restoration of Charles II.; was sent on embassies to Madrid, Paris, and Cologne, 1671–73, and became Secretary of State in 1679. He at first opposed and then supported the bill for the exclusion of the Duke of York, afterward James II., and was removed from office by Charles in 1681, but was reinstated in 1682, and exercised a controlling influence in the Government during the remainder of the reign. He was continued in office by James II., and is said to have become a Roman Catholic, but, being opposed to some of the radical measures of the court, was dismissed in 1688, and took refuge in Holland. He gained the favor of William, and in 1697 was made lord chamberlain, but retired from public life in 1697 with the reputation of having been the basest public man of his age. D. at his seat, Althorpe, Sept. 28, 1702.—CHARLES SPENCER, his son, the third earl, b. in 1674, professed liberal principles, and was returned to Parliament for Tiverton in 1695. His first wife, a daughter of the Duke of Newcastle, having died, he married in 1699 a daughter of the Duke of Marlborough, thereby strengthening his alliance with the dominant Whig party. He succeeded to the earldom in 1702; distinguished himself on a mission to Vienna, and from 1706 to 1710 was Secretary of State; was dismissed in 1710, declining a large pension offered him by the queen. Upon the accession of George I. in 1714, he was made Lord-Lieutenant of Ireland, in 1715 Lord Privy Seal, and in 1718 Prime Minister. He was apparently deeply involved in the South Sea Bubble, and though in an investigation by the House of Commons he was acquitted of personal corruption by a vote of 233 to 172, he was driven from office in 1721. D. Apr. 19, 1722.
F. M. COLBY.

**Sundew**: See DROSERA and INSECTIVOROUS PLANTS.

**Sun-dial**: See DIAL.

**Sun-dog**: See HALO.

**Sunfish**: a name given to different aquatic animals on account of their brilliant colors, shape, or habit of basking in the sun. (1) In the U. S. and Canada it is most frequently applied to species of fresh-water fishes belonging to the family *Centrarchidæ*, and chiefly to the genus *Lepomis*. These are readily recognized by the extension of the opercula backward into more or less enlarged or elongated membranous, highly colored, ear-like lobes, and the radial formula—viz., dorsal fin with ten spines and ten or eleven rays, and anal fin with three spines and nine or ten rays; the colors are always quite brilliant. The species are quite numerous. The best known in the Northern States are the (1) *Lepomis gibbosus vulgaris*; (2) *L. auritus*; and (3) *Lepomis pallidus*. The *L. gibbosus* is the common sunfish of New England and the Middle States, and is at once recognizable by the ear-flaps being black, tipped with scarlet, and by the orange spots of the sides. The *L. auritus* is equally readily distinguishable by the very long black but bluish-edged ear-flaps. The *L. pallidus* has squarish black ear-flaps. The first is the smallest, and the last two the largest, of the species mentioned. Wherever found, they are generally among the most common fishes. They are quite carnivorous and bold, and take a hook baited with the common earth-worm with avidity. Many of the species build curious nests. (2) On the seacoast, to some extent, but more especially in Great Britain, the name is given to species of *Orthagorisca* or *Mola*, fishes of an almost circular outline, with high anal and dorsal fins and an aborted tail. (3) In some parts of England the name is also applied to the basking shark (*Cetorhinus* or *Selache maximus*). (4) It is also frequently applied by sailors to the species of floating acalephs or jellyfishes.
Revised by F. A. LUCAS.

**Sunflower**: the *Helianthus annuus*; a coarse and tall annual plant of the family *Compositæ*. It is often seen in gardens, and is well known for its large and showy compound flowers. It is a native of the Great Plains of North America, where it grows in great abundance. In Europe the plant is raised for its seeds, which afford a good drying oil, nearly equal to that of linseed. The leaves are fed to cattle, the seeds to poultry, and the flowers yield good honey. The planting of sunflowers is reputed to be a preventive of miasmatic fevers. The pith is sometimes used instead of the true moxa. In tropical America the sunflower often attains a height of 20 feet and produces a flower of from 1 to 2 feet in diameter. In Southern Europe it is cultivated as a field-crop on account of its seed. See COMPOSITES for illustration.
Revised by CHARLES E. BESSEY.

**Sunflower Family**: another name for the COMPOSITES (*q. v.*).

**Sunga'ria**, or **Zunga'ria** (sometimes *Jungaria*): the country of the Sungars or Kalmucks; a geographical expression of no scientific value, loosely used to indicate the region that was once the center of the kingdom established early in the eighteenth century by the Sungars or Mongols of the left wing. It is a plateau of moderate elevation, bounded on the S. by an eastern extension of the T'ien-Shan or Celestial Mountains, has the Russian provinces of Semirechinsk and Semipalatinsk on the W. and N. W., and is separated on the N. E. from Kobdo in Mongolia by the Great Altai Mountains. It is intersected by minor chains which divide the region into several basins with a number of considerable lakes. It includes the valley of the Ili, and with Chinese Turkestan to the S. it forms what is called *Sin-kiang* (or -chiang), the "New Frontier" province of the Chinese empire. The population of Sungaria has been estimated at 2,000,000. Capital, Kulja.
R. L.

**Sunn Hemp**: the fiber of the *Crotalaria juncea*, a leguminous herb of Bengal, extensively cultivated in India both for its fiber and as a forage-plant for cows. The sunn hemp is exported extensively. It is inferior to true hemp, but better than jute, and is used for cables and canvas.

**Sun'nites**: all orthodox Mussulmans. They are so called as adherents of the *Sunna* or tradition, a collection of prophetic laws, which embrace (1) the remarks and counsels uttered by the Prophet; (2) his deeds and practices; and (3) his silence, it being considered that what the Prophet abstained from doing or saying fully indicates his opinion and hence the duty of his followers. The Sunnites are divided into four classes, the Hanefites, Malekites, Schafiyites, and Hannbelites. See MOHAMMEDANISM. E. A. G.

**Sunstroke, Insolation**, or **Coup de Soleil**: See THERMIC FEVER.

**Sun-worship**: commonly regarded as one of the characteristic features of the religion of ancient Persia. The Peruvians of old, who worshiped every aspect of nature, paid the chief honors to the sun. The Egyptians, the Greeks, the Italians of antiquity, and the Celtic and Teutonic races, the East Indians, and some African pagans, were, as some heathen races still are, sun-worshipers. In fact, sun-worship is one of the most widely diffused forms of nature-worship, the genial and fructifying warmth and brightness, the mysterious nature, and the constant course of the great luminary appealing powerfully to the religious feelings of the ruder peoples. See the article WORSHIP.

Revised by A. V. WILLIAMS JACKSON.

**Supereroga'tion, Works of** [*supererogation* is from Late Lat. *supereroga'tio*, deriv. of *supereroga're*, pay out in addition; Lat. *su'per*, over, above + *eroga're*, pay out, expend; *e*, out + *roga're*, ask]: in the Roman Catholic Church, good works performed by a Christian over and above his simple duty. These works, it is alleged, constitute a fund of merit which is applied to the relief of souls in purgatory. The definition is based on a distinction between what is commanded and what is only counseled—a distinction which is known only to Roman Catholic dogmatics.

**Superior**: city; port of entry; capital of Douglas co., Wis.; at the head of Lake Superior, on St. Louis, Superior, and Allouez Bays, and the Gt. North., N. Pac., Chi., St. P., Minn. and Om., St. P. and Duluth, Dul. and Winnipeg, and the Dul., S. Shore and Atl. railways; opposite Duluth, Minn. (for location, see map of Wisconsin, ref. 2–B). It has three perfect landlocked harbors, all connected, with total length of 13 miles and width of from 1 to 3 miles. The city is platted at right angles to the water front, with streets 80 feet wide, avenues 100 feet, and alleys 20 feet. The climate is crisp, dry, and healthful, with average temperature for twenty years 40°; average velocity of wind, 7 miles per hour; average number of fair days per annum, 260. The water-supply is from Lake Superior, and the sewerage system, planned when the city was laid out, is sufficient for a city of 1,500,000 people. There are 31 miles of paved streets, 89 miles of graded streets, 47 miles of sewers, 87 miles of sidewalks, 43 miles of water-mains, 15 miles of gas-mains, and 15 miles of double-track electric railway.

*Churches and Schools.*—Superior has 60 church organizations and 52 church edifices. There are 12 public schools, with 120 teachers and 7,017 pupils, 4 parochial schools, public library, and State normal school, and a business college. The public-school buildings cost $456,000.

*Finances and Banking.*—The assessed valuation in 1900 was $11,887,319; bonded debt, general, $363,598; special improvements, $745,737; school district bonds, $235,000. In 1900 there were 2 national banks with combined capital of $300,000, 3 State banks with capital of $250,000, 2 building and loan associations, local and serial, with 247 shareholders and 4,100 shares in force.

*Business Interests.*—The manufactures are chiefly flour, lumber, lath, shingles, iron, chairs, barrels, bags, coke, and woolen goods. There are 8 flour-mills, with a combined capacity of 23,000 barrels per day; 15 elevators with a storage capacity of 19,000,000 bush.; 8 coal-docks with a capacity of 6,000,000 tons, one of which is the largest in the world, with capacity of 4,000,000 tons, and one of solid steel in which all coal-handling is done in large steel tunnels beneath the ground; a bank of coking-ovens; an iron-ore dock; shipyards for the construction of steel steamers; 3 sawmills; the largest dry dock on the Great Lakes. The city has large repair-shops of the Great Northern Railway; 4 iron-working plants; windmill-factory; 2 cut-stone works; adamant-plaster factory; 2 breweries; extensive dredging plant; 3 wholesale-grocery houses; grass-twine plant, and many other industrial plants. The receipts by water are coal, oil, salt, cement, sugar, iron, and general merchandise; shipments, wheat, flour, lumber, copper ore, and wool. The port collector's official report for 1900 showed, arrivals and clearances, 3,419; tonnage, 5,139,240; coal receipts, 1,839,010 tons; grain shipped, 25,340,632 bush.; flour shipped, 3,286,888 barrels; lumber shipped, 60,288,000 feet; copper, iron ore, etc., shipped, 1,588,000 tons; and wheat in store on Jan. 1, 1901, 9,230,000 bush.

*Shipping Facilities.*—Besides those furnished by the railways, the city has exceptional facilities for receiving and shipping freight by water. The water front is divided into harbor districts, so that the city may make improvements in any one of them when needed and charge the cost to the property in the district. There are 10 miles of substantial wharfage, and the water front may be slipped so as to furnish 138 miles of wharfage. The U. S. Government has expended $1,850,000 and private parties about $600,000 in harbor improvements; and the city $3,200,000 and private corporations and parties $2,225,000 on docks.

*History.*—Superior was a station of the Hudson Bay Company, over 200 years ago; trading-post for Daniel Greysohlon du Lhut (Duluth) in 1680; and headquarters for Radisson and Grosseilliers in 1661. In 1853, when it was supposed the U. S. Congress would charter and subsidize the Northern Pac. Railroad from Lake Superior to the Pacific Ocean, and after the great land grant had been made by Congress to the State of Michigan to aid in constructing the first canal and locks around St. Mary's Falls, distinguished men preempted the land where Superior now stands for a town-site. The canal was completed and a land office and lighthouse established at Superior in 1855, and the town boomed. The Northern Pacific charter failed and the panic of 1857 paralyzed the city. In 1881 the Northern Pacific Railroad, for a gift of about half the town-site, built a branch to the water front and erected a dock. In 1883 Gen. John H. Hammond organized a company which acquired land W. of the original town-site, on St. Louis and Superior Bays, and in 1885 platted a new city. In laying out the town a right of way was provided for terminal tracks to reach every railway coming to the head of the lake, and connecting them with every dock and slip on the entire 90 miles of water front. More than 1,000 acres of land near the bay and on one side of the town, separated from all residence and business streets, was reserved exclusively for railway, switching, and storage yards. Thus every dock, mill, and wholesale house has equal facilities for receiving and shipping freight over all the railways at the head of the lake. The city comprises the parts locally known as East Superior, West Superior, South Superior, and Old Superior. Pop. (1890) 11,983; (1900) 31,091. JOHN M. MCCABE.

**Superior, Lake**: the largest of the Laurentian chain of lakes. It is also the largest fresh-water lake in the world, and the largest inland water-body except the Caspian Sea. Its area, as determined from the charts of the U. S. lake survey, is 30,829 sq. miles; another computation from the same data gave 31,200 sq. miles. The only possible rival to Lake Superior in size is Lake Victoria Nyanza, which is estimated to have an area of 27,000 sq. miles. The mean elevation of the surface of Lake Superior is 602 feet above the sea, and 20 feet above Lake Huron, into which it discharges through St. Mary's river. Its greatest measured depth is 1,008 feet; the bottom of the basin is therefore over 400 feet below sea-level. Its hydrographic basin, including the lake surface, has an area of about 85,000 sq. miles. The mean discharge through St. Mary's river is estimated at 86,000 cubic feet per second. In the deeper portions of the lake the temperature varies but little from 39° F., the temperature of water at its maximum density. Analyses have shown that the water at all depths is fresh.

The boundary between Canada and the U.S. passes through the lake, about one-third of the area of the lake belonging to the Dominion. The north shore is formed of crystalline rocks, and in places is bold and picturesque. The southern shore is mostly low and covered to a great extent with blown sand, glacial deposits, and fine, evenly laminated, pinkish clays, which were deposited from the lake during a former high-water stage, when it extended for many miles S. of its present boundaries. The rocks beneath those superficial deposits belong mainly to the Algonkian period, which includes the copper and iron bearing series, and to the Cambrian period, which includes the red sandstone, largely used for building in Marquette and other cities. The Pictured Rocks, about 100 miles W. of the outlet of the lake, are cliffs of sandstone, formed by the edges of nearly horizontal strata, and together with other bold features about the lake are remnants of an old topography which was fashioned by stream erosion and weathering previous to the Glacial period.

The land bordering Lake Superior is not well adapted for

agriculture, but rich deposits of copper and iron, and abundant forests of pine, together with fisheries and the facilities for transportation which the lake affords, have led to rapid developments. See also St. Lawrence River and Gulf.
Israel C. Russell.

**Supernatural**: See Miracles.

**Suphis** [Egypt. *Khufu*, the *Cheops* of Herodotus and the *Chemmis* of Diodorus]: name given by Manetho to the second king of the fourth Egyptian dynasty. Besides prosecuting the wars inaugurated by his predecessor, Snofru (see Soris), against the tribes of Sinai, he was engaged in gigantic building operations in Egypt. The largest pyramid at Gizeh (see Pyramids) was erected as his tomb, and three smaller pyramids near by were erected for relatives. The founding of the temple of Hathor at Dendereh is also ascribed to him. According to Manetho he reigned sixty-three years, but the Turin papyrus reduces the time to twenty-three or twenty-four years. Charles R. Gillett.

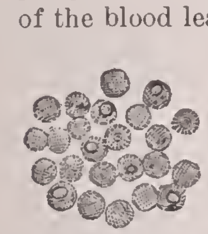
**Suppé**, soop'pā', Franz, von: opera-composer, whose baptismal name was Francesco Ezechiele Ermengildo Cavaliere Suppé Demelli; b. Apr. 18, 1820, on board ship near Spalato. He very early manifested musical talent, and at fifteen composed a mass which was sung at the Franciscan church at Zara. After study with the best masters he became conductor at the Josephstadt theater, Vienna, succeeded by other similar engagements. His first operatic work was *Sommernachtstraum*, founded on Shakspeare, in 1844. Then came a long list of operettas. In the U. S. he is best known by his *Fatinitza*, *Boccaccio*, and his overture *Poet and Peasant*. D. in Vienna, May 21, 1895.

**Supper, Lord's**: See Eucharist.

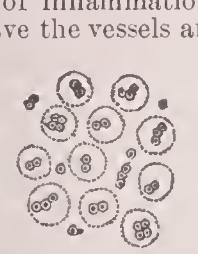
**Support of Land**: See the Appendix.

**Suppressio Veri**: See Fraud.

**Suppura'tion** [from Lat. *suppura'tio*, deriv. of *suppura're*, suppurate, form matter; *sub*, under, from under, (in compos.) up + *pus*, *pu'ris*, matter, pus]: a form of inflammation which goes on to the development of *pus* or matter. This is seen in abscesses, inflammations of the mucous membranes, and in granulating wounds. The product is a creamy yellow liquid composed of a fluid part, the *liquor puris*, and cellular elements, the *pus corpuscles*. The causes of suppuration have occasioned much study. Formerly a variety of traumatic, chemical, or other local injuries, together with certain general bodily conditions, were regarded as causes; but after the development of bacteriology attention was directed to micro-organisms as the active agents. Certain bacteria are now recognized as pus-producing or *pyogenetic*; but it is also admitted that suppuration may occur spontaneously or experimentally without the presence of bacteria. Injections of calomel, turpentine, and certain other substances, for example, are capable of exciting suppuration. In studying the process microscopically it is found that, as in other forms of inflammation, the white blood-corpuscles of the blood leave the vessels and accumulate in the tissues; at the same time a quantity of the fluid part of the blood exudes. Eventually the cellular exudate softens by degeneration, and yellowish pus results. At the same time the surrounding tissues produce a wall of young cells around the periphery of the suppurating focus, and thus an abscess with a retaining wall is formed. The older theory of the origin of pus-cells, viz., that they are altered tissue-cells, is thus seen to be abandoned. It is likely, of course, that some of the cells of a tissue are loosened and mingle with the pus, but the true pus-corpuscle itself is a white blood-corpuscle which has emerged from the blood-vessels and subsequently undergone more or less degeneration. When treated with acetic acid the protoplasm of the cells clears, and reveals a multiple nucleus, as shown in the accompanying illustration. The multinuclear character of the pus-cells is explained by the discovery that only these forms of white corpuscles have the property of readily escaping from the blood-vessels.



Pus corpuscles, as seen in healthy pus.



The same, after the addition of acetic acid.

Pus formed on the free surfaces, as in bronchitis, nasal catarrh, in granulating wounds, and the like, comes from the underlying blood-vessels, and filters through the superficial lining cells. Spreading suppuration is found in erysipelas, and certain other conditions in the submucous or subcutaneous tissues. The symptoms indicative of suppuration are those of inflammation—heat, redness, pain, and swelling; but the pain has often a peculiar throbbing character, and the swelling is found to be fluctuating or elastic. In addition, general fever of irregular type, sweats, or chills may be noted; and general infection of the blood (pyæmia and septicæmia) may occur.

The treatment of suppuration consists in abortive measures, and, these failing, in measures to promote "pointing," and in the evacuation of the abscess. Applications of cold are most useful for the first purpose; for the second heat, and especially poultices, is of value. After the development of fluctuation incision is called for. W. Pepper.

**Supremacy, Act of**: See Act.

**Sur**, or **Soor** (anc. *Tyros*): town; in the province of Syria, Asiatic Turkey; on an island in the Mediterranean, which Alexander the Great, when besieging Tyre, connected with the mainland by a broad dam. Sur has suffered very much from earthquakes, and its harbor has become so silted up as to be accessible for small vessels only. Pop. about 5,000.

**Surabaya**, soo-raa-bī'aa: town on the north coast of Java; capital of the Dutch province of Surabaya; opposite Madura, at the mouth of the Kediri (see map of East Indies, ref. 8–E). It has a good harbor, is strongly fortified, and contains barracks, magazines, hospitals, and other military establishments. It is a station on the railway from Surakarta to Probolingo, communicates regularly with Samarang, Batavia, and other places by steamboats, and carries on an important trade, exporting annually rice, coffee, cotton, sugar, tobacco, and cocoanuts. Its ship-building is also extensive. Pop. (1890) 107,878, of whom 6,523 (1894) are Europeans, the rest Javanese, Malays, and Chinese.
Revised by M. W. Harrington.

**Surakar'ta**: town of Java; capital of the Dutch residency of Surakarta; on the left bank of the Solo; connected with Samarang and Surabaya by railway (see map of East Indies, ref. 8–E). It contains a magnificent palace of the native emperor, who lives here as a pensioned rather than as a tributary prince; the Dutch fortress is opposite the emperor's palace. The trade is very large, especially in pepper, vanilla, and cacao. Pop. (1890) 91,368.

**Surat'**: town; in the presidency of Bombay, British India; on the Taptee, in lat. 21° 12′ N., lon. 72° 47′ E. (see map of S. India, ref. 2–C). It is 6 miles in circumference, and surrounded by walls surmounted by towers. It is said to have had 800,000 inhabitants at the end of the eighteenth century, but its manufactures died out, its trade is lost, and many of the Dutch, French, and Portuguese establishments are deserted. The place is most important from a military point of view. Pop. (1901) 118,364. M. W. H.

**Surette**, Thomas Whitney: See the Appendix.

**Surety**: See Guaranty and Suretyship.

**Suretyship** [viâ O. Fr. from Lat. *secu'ritas*, safety, security, (Late Lat.) security for a debt]: a term covering all cases of secondary liability of one person for the debt, default, or miscarriage of another, who is the primary obligor, whether the relationship results from express agreement or from implication. Guaranty (*q. v.*) and indorsement (see Bill of Exchange and Negotiable Instruments) are embraced by this definition. The word is used frequently in a specific sense to designate the relationship existing where the primary and secondary obligations are assumed in a single contract, as where one person signs a promissory note as maker and another adds his signature as surety. The distinction between suretyship in this sense and guaranty is stated clearly in a leading case as follows: "A contract of suretyship is a direct liability to the creditor for the act to be performed by the debtor, and a guaranty is a liability only for his ability to perform this act. From the nature of the former the undertaking is immediate and direct that the act shall be done, which if not done makes the surety responsible at once."

The creditor is under no legal obligation, as a rule, to disclose all the facts affecting the surety's risk. If, however, he makes any misrepresentation as to the subject-matter of the surety's undertaking, the latter will not be bound. The general principles governing the formation of this contract have been thus stated: "The surety is entitled to know the real nature of the transaction he guarantees and of the liability he is undertaking, and generally and naturally he looks to the creditor for information on this point, although he usually is acting at the debtor's request and as his friend, and so relies on him for collateral information as to general credit and the like. In that case the creditor's description of the transaction amounts to or is at least evidence of a representation that there is nothing further that might not naturally be expected to take place between the parties to a transaction such as described." Accordingly, it has been held that a bank can not enforce against the sureties a bond for the faithful and honest conduct of a teller who was known to the bank officers to have been dishonest unless such dishonesty was disclosed to the sureties before their execution of the bond. The failure to communicate such knowledge is declared to be fraudulent toward the sureties. Express contracts of suretyship are to be construed so as to give effect to the intention of the parties. The language is to be read in the light of the circumstances surrounding the execution of the instrument, and full effect is to be given to its meaning as thus ascertained. The surety's responsibility is not to be extended or enlarged by implication or construction, but is to be treated as *strictissimi juris*. It is also well established that any change in the contract made by the creditor and primary debtor without the surety's consent discharges the latter. Nor will the courts inquire whether the change operates to increase or diminish the surety's burden. He has a right to stand upon his own terms. An extension of the term of credit, however slight, pursuant to a binding agreement between the principals, must be assented to by the surety or he will be released.

Upon discharging his principal's obligation the surety is entitled to SUBROGATION (*q. v.*), to all the creditor's rights and securities. If there are two or more sureties either is entitled to CONTRIBUTION (*q. v.*) from the others.

FRANCIS M. BURDICK.

**Surface**: in mathematics, the locus of a point in space whose co-ordinates are connected by a single relation. It may also be generated by the movement of a straight or curved line. A surface forms the superficial configuration or boundary of a solid. It is said to be of the *n*th degree, when it is intersected by an arbitrary line in *n* points, real or imaginary. The surface of the first degree is a plane, and the surface of the second degree includes several varieties, treated under CONE, CYLINDER, HYPERBOLOID, PARABOLOID, SPHERE, and SPHEROID (*qq. v.*).

**Surf-bird**: a small wading bird (*Aphriza virgata*) of the American Pacific coasts, about 10 inches long, named from its habit of allowing the surf occasionally to dash over it as it seeks its prey on the rocky shores. Its flight is short and irregular. It is related to the oyster-catchers and the turnstones. F. A. L.

**Surf-duck**: a seacoast duck of America, the *Oidemia perspicillata*, known to gunners as the skunk-head coot. It belongs to the group called scoters in Great Britain and coots in the U. S. It is quite black, except a little patch of white on the head and another on the nape. F. A. L.

**Surgeon**, or **Surgeon-fish**: a fish of the family ACANTHURIDÆ (*q. v.*).

**Surgery** [M. Eng. *surgerie*, from O. Fr. *cirurgie* > Fr. *chirurgie* < Lat. *chirurgi'a* = Gr. χειρουργία, handicraft, skill, surgery, deriv. of χειρουργός, working by hand, handicraftsman, skilled workman, surgeon; χείρ, hand + ἔργον, work]: that branch of medical science which has for its object the treatment by manual operations of all lesions or malformations of the human body.

It is probable that in antiquity of origin surgery must take precedence of medicine, since attempts to assuage the pain or to remove the inconveniences of wounds or injuries resulting from external violence would be likely to be made before internal diseases were in any degree understood or supposed to be within the control of human means. Baron Percy has remarked that, while the internal diseases of mankind were still ascribed to the anger of the gods, and the smoke of expiatory sacrifices ascended from altars, surgeons had already become renowned by bold and salutary operations. He is inclined to attribute the origin of this art to the first occasion when some one, pierced by a foreign body, invoked the aid of a skillful comrade for its removal, remarking that in ancient times it was sufficient to extract adroitly darts or arrows, and to place on the wounded part some soothing balm, in order to be reckoned a benefactor of humanity entitled to divine honors (Homer, *Iliad*, lib. xi.). Students of Sanskrit literature, and those who have sought to decipher the inscriptions of Egyptian and Assyrian ruins, find some grounds for the belief that surgery was more advanced among those ancient peoples than is commonly supposed, pictures and *bassi-rilievi* having been found displaying surgical instruments and operations not unlike many in use in modern times. It is certain, at least, that the custom of embalming the dead, which implies some anatomical and surgical knowledge, was prevalent in very early times, and that among the Jews the operation of circumcision was practiced by divine command through many ages.

*Greek.*—The first definite traditions regarding surgery, and the first collected body of doctrine, came from the Greeks, who were, however, the pupils of the Asiatics and Egyptians, and Dujardin, in his erudite *History of Surgery*, has carefully traced the channels through which information was transmitted to a more gifted and brilliant nation. He would accept Plutarch's account, that Agenor, a Phœnician king, practiced surgery with distinction, dressing the wounded arm of a son of Priam, and devising the scarf or sling now so indispensable in many injuries of the upper extremities. Chiron, the Thessalian centaur, is more generally accredited the father of surgery in the fabulous ages of Grecian history. His reputation is eclipsed by that of Æsculapius, a son of Apollo, by some reckoned the pupil of Chiron, by others his contemporary and superior, believed to have been deified fifty years before the Trojan war, although skeptics have called his very existence in question. Jason, Theseus, and Hercules practiced surgery, and Epione, the wife of Æsculapius, as well as Medea, proved that women thus early not only shared with men the perils of war, but aided in repairing its ravages. A Thracian king, Orpheus, had such knowledge of the virtue of plants that he cured a woman bitten by a snake, whence arose the fable that he had rescued her from hell. The Greeks, prodigal in apotheosis, made many demigods partly because of their achievements in the healing art. Two sons of Æsculapius are named among the heroes of the *Iliad*. Menelaus, wounded by an arrow from Pandarus, and Philoctetes, struck by a poisoned javelin, are cured by the skillful Machaon; and Pausanias records that the Messenians, over whom he reigned, raised a temple to his honor. Podalirius, his brother, though much praised for his surgical skill in the Trojan war, has no important cures circumstantially ascribed to him, except that of the daughter of Damœtus, King of Caria, whom he bled from both arms when she was stunned by a fall, and, on her survival, married her, receiving the province of the Chersonese as a dowry. Hence the origin of phlebotomy is attributed to this surgeon. The surgical attainments of these sons of Æsculapius seem not to have extended further than the extraction of darts, the suppression of hæmorrhage by pressure or styptics, and the application of lenitive salves. Homer says that when the warriors at the Trojan siege sustained fractures of the bones, recourse was had, as when pestilence arose, to invocations to the gods.

For six centuries after the Trojan war there is little information of any advances in surgery. In common with other branches of knowledge, it was passing through that stage in which the intervention of supernatural powers is recognized rather than the scope of human possibilities. It was thus with the Asclepiadæ, or reputed descendants of Æsculapius, in the course of whose long monopoly, however, schools for the instruction in such surgical information as the professors possessed or were willing to impart were established about the temples, and those at Rhodes, Cnidos, and Cos became distinguished. Real achievements in surgery appear to have been known during this period, such as cutting for the stone and operating for cataract, although these advances were discredited by the priests, as suitable only for specialists of the baser sort.

*Hippocratic Surgery.*—It was not until Pythagoras brought the light of philosophy to bear upon the practice of the healing art that the way was paved toward raising its dignity in the direction of positive knowledge. The school that he founded at Crotona not only produced surgeons of distinction (among others, Damocedes, who, made captive by the Persians, treated Darius for a dislocated ankle and his Queen Atossa for a cancer of the breast), but also inspired the schools of Cnidos and Cos with the philosophic spirit, so that, a century later, there appeared in the latter that splendid genius Hippocrates. Born in the 80th Olympiad, about 460 years before the Christian era, this great man did much to free medicine from the absurdities with which superstition and ignorance had surrounded it, and through a long life gave a noble example of persevering industry, of philosophical research, and of lofty moral worth. His attention was more turned to medicine than to surgery, yet in the latter branch his practice was bold and decisive. He commended some operations that have only of late years been acknowledged to be legitimate surgical resources, such as tapping the chest for empyema, nephrotomy for calculus lodged in the kidney, and trephining the skull for persistent headache. He was familiar with cataplasms and venesection and cupping; with operations on ranula, nasal polypi, and ganglia; with the treatment of piles and fistulæ by ligature; with tapping in dropsies, advising even paracentesis in hydrocephalus; with all the surgical procedures known in his day except the operations for lithotomy and cataract, which seem to have been confined to specialists. He gave rules, for the most part rude and cruel, for the reduction and treatment of dislocations and fractures, and anticipated a multitude of the practices that have been vaunted by the moderns. For many generations after Hippocrates surgery made little progress. The religious prejudices that forbade the dissection of the human body precluded the acquirement of any definite knowledge of anatomy, and there was a barren interval of several centuries. Of the more immediate successors of Hippocrates, Diocles of Carystus was one of the most prominent in surgery. He devised sundry bandages, especially for wounds of the head, and improved the *beloulkon*, an instrument for extracting arrow-heads and darts, invented during the Peloponnesian war. Praxagoras of Cos is reported to have been a very bold surgeon, incising the fauces freely in cases of cynanche, and laying open the abdomen for the removal of intestinal obstructions.

*Alexandrian Period.*—The labors of Aristotle had some influence in promoting the healing art; but there was no advance of any practical importance until, on the dismemberment of the great empire of Macedonia, the chief center of learning was transferred to Alexandria, and the Egyptian school took its rise (B. C. 300). Herophilus of Chalcedon and Erasistratus were the most conspicuous leaders of the Egyptian school. The former was a pupil of Praxagoras. He was the first to direct attention to the radial pulse as an index of the varying conditions of health and disease. According to Falloppius, he held as an anatomist among the ancients the same place as Vesalius among the moderns. That he dissected human bodies is expressly asserted by Galen. Dr. Marx is satisfied that he discriminated nerves of motion from those of sensation; that he described the occipital depression now known as the torcular Herophili as the point at which the sinuses of the dura mater converge; distinguished the cerebrum from the cerebellum; and named the *calamus scriptorius* of the medulla oblongata, and the *duodenum*, and also carefully dissected the tunics of the eye and originated the term *retina*; and came near anticipating Aselli in the discovery of the lacteals, recognizing their relation with the mesenteric glands. Yet he fell into palpable mistakes, confounding the tendons and ligaments with nerves, and possibly the trachea with the aorta.

*Erasistratus*, a native of Chios, who had studied philosophy under Theophrastus, is also greatly distinguished as an anatomist, but his erroneous interpretation of the function of the arteries, overthrown by Galen, retarded the discovery of the circulation, reserved for the illustrious Harvey. Erasistratus is reported to have been a very bold surgeon, not hesitating to excise portions of the liver and of the spleen. The invention of a metallic catheter is ascribed to him. Xenophon of Cos, a pupil of Erasistratus, is said to have been among the first to restrain hæmorrhage from the limbs by tightly encircling the member with a ligature. Ammonius, surnamed *Lithotomus*, invented an instrument for crushing vesical concretions too large to be extracted through the ordinary incision—what would now be called a lithoclast—and hence is erroneously accredited with anticipating Civiale in the invention of the lithotrite, an instrument for crushing stone without a cutting operation.

*Celsus, Galen.*—From the time when the empire of the world was transferred to Rome until the reign of Augustus there appeared no surgical practitioner or writer of note until Aulus Cornelius Celsus, of whose numerous writings the eight books *De re Medica* are alone preserved. The last four books treat exclusively of surgery. He advises the amputation of limbs affected by gangrene. The method of lithotomy he describes is still regarded as of value in certain cases. He gives rules for the removal of cataract by depression, for forming an artificial pupil, and for the recognition and reduction of several varieties of hernia. The diagnosis and treatment of fractures and luxations he treats of judiciously and in detail. He is thought to have been the first to point out ruptures of the intracranial blood-vessels unattended by fracture. In the twenty-sixth chapter of his fifth book occurs the remarkable passage in which he advises that the bleeding from a wounded vessel, if it can not be otherwise restrained, shall be controlled by two ligatures, placed one above and the other below the bleeding point. He recommended the ligature also in varices and hæmorrhoids. It would be an endless labor, however, to particularize. Not only the value of his subject-matter, but the purity and elegance of his style, have made the work of Celsus classical and immortal. Aretæus of Cappadocia practiced in Rome in the latter part of the first century. His instructions on catheterism and on lithotomy are interesting; he opened hepatic abscesses and used the trephine for the cure of epilepsy. Heliodorus, the medical adviser of Trajan, was the author of some good observations on injuries of the head. Rufus of Ephesus is said to have been the first to tie successfully an artery for an aneurism at the bend of the elbow caused by venesection. He left a treatise on diseases of the bladder. No great surgical writer appeared from the time of Celsus to that of GALEN (*q. v.*), toward the close of the second century. He was a surgeon at Pergamus (A. D. 165), and afterward practiced his profession at Rome.

*Antyllus, Alexander of Tralles.*—After Galen, in the third century came Antyllus, who was a bold and successful surgeon. He recommended extraction for hard cataract, but cautiously, advising the operation only when the cataract was small. He also suggested arteriotomy in place of venesection in some cases, arguing that there was not risk of excessive bleeding, since the hæmorrhage might be controlled by cutting the vessel completely across. His name is associated with an operation for aneurism, revived by Syme of Edinburgh, and still occasionally employed, especially in cases of traumatic origin. Oribasius (326–403 A. D.) was the author of a valuable compilation of surgical knowledge, and alluded to the partial or bent fracture of the long bones of children (green-stick fracture)—an observation for which Malgaigne accredits Lanfranc, a surgeon of the thirteenth century. Aëtius (550 A. D.) was the first Greek medical man of prominence to embrace Christianity, and the bias of his religious ideas is clearly indicated in his writings. Alexander of Tralles (570 A. D.) appears to have been an independent thinker, and at the close of a long and useful career wrote from his own experience with such sound judgment that his work in twelve books is a valuable relic.

*Paulus Ægineta*, who was a professor at Alexandria about the time (640 A. D.) of its final subjugation by the Saracens, wrote a compendium of the healing art which is even more circumstantial than that of Celsus. The excellent translation by Adams, published by the Sydenham Society, has made the work familiar to English-speaking surgeons. In lithotomy he advised, after exploring by the rectum, an incision to the left of the raphe, or the modern lateral operation, instead of the median incision of Celsus. He discriminated aneurism by anastomosis, and performed ablation of the mamma, laryngotomy, and herniotomy in strangulation. He first treated of fractures of the patella. He was pre-eminent as an accoucheur, and is reputed to have devised the procedure of embryotomy. He was surnamed *Obstetricus*. He was the last of the Alexandrian school of any note.

*Arabian Surgery.*—In the seventh century, contemporaneously with the vast achievements and conquests of the followers of Mohammed, learning was gradually communicated to the Arabians, and for the next five centuries anything noteworthy in surgery must be looked for in this direction. Rhazes (852–932 A. D.) practiced and taught at Bagdad at the close of the ninth and beginning of the tenth century. He was the first to describe spina bifida. He cauterized the bites of rabid animals. He gave a better account of hernia than his predecessors. He seems to have had little confidence in ophthalmic surgery, for when he was old he had cataract, but could not be induced to submit to an operation. Haly Abbas lived at the end of the tenth century, and was a voluminous writer. In tapping for ascites he preferred to puncture in the linea alba, and he used caustics for the cure of hydrocele. Avicenna (980–1037 A. D.), educated in the schools of Bagdad, acquired an extraordinary distinction, but the most important to surgery among the Arabian celebrities is Albucasis (1110 A. D.). The edition of his *Chirurgia*, by Channing of Oxford, is still consulted, and contains the most complete view there is of the knowledge of surgery that then existed. He seems to have abused the actual cautery, and enthusiastically extols the surgical virtues of fire. He employed the cautery to suppress hæmorrhage, and styptics likewise, but also complete division of the vessel, and even the ligature. He was the first, apparently, to remark the occlusion of a divided artery by a coagulum. He practiced enterorrhaphy, and invented a probang for dislodging foreign bodies from the gullet, and an instrument for operating in lachrymal fistula. These and various other instruments he figures in his writings. After Albucasis arose two notabilities of the Saracenic school who were natives of Spain, yet wrote in the Arabic language. Avenzohar (1162 A. D.), a Jew, practiced at Seville in Andalusia, and his compendium entitled *Thaissyr*, though mainly a compilation, contains some original matter. He describes abscess of the mediastinum, and a case of suppuration of the kidney with discharge of 14 pints of pus. He treats judiciously of fracture involving the hip-joint, and of wounds of the blood-vessels. His pupil, Averroës (1198 A. D.), a native of Cordova, achieved a great reputation. A manuscript of 336 quarto pages, by an unknown author, was discovered in 1863 in the library of the University of Madrid, which gives an extended view of the Arabic treatment of wounds, including shot wounds by missiles of iron and stone. In a prize essay by Dr. Don Antonio, entitled *Memoria sobre el Origen y Vicisitudes de la Terapéutica que han usado los Cirujanos españoles en las Heridas de Arma de Fuego* (Madrid, 1863), it is claimed that the nature and treatment of shot wounds are judiciously discussed in this parchment, and that it dates from the closing part of the fourteenth century, or shortly after the introduction of gunpowder in warfare. Should the date and authenticity of this manuscript be established, it would be the earliest treatise on shot injuries extant. Neither Arnold of Villanova nor Guy of Chauliac mentions these injuries, and priority in adverting to them has commonly been ascribed to the German surgeon Heinrich von Pfolsprundt (1460 A. D.), whose manuscript, *Buch der Wundt-Artzney*, was printed in 1868 by Haeser and Middeldorpf.

*Mediæval.*—For several centuries there is among the successors of the Greeks and Romans no name in surgery to arrest attention by association with improvements either in theory or practice. The only attempts worthy of notice are in connection with the schools established at Salerno and Monte Casino, which maintained their prestige until the thirteenth century, when they were eclipsed by the rising reputation of the schools of Bologna and Paris. Most of the Italian surgeons of the thirteenth century whose names have left any trace in the history of the art appear to have derived their knowledge from one or the other of these schools. The first of these in date is Rogerius of Parma (about 1206). His *Chirurgia Magna* was long a text-book in Italy. He practiced enterorrhaphy, even in cases of complete division of the intestine, attempting to unite the divided surfaces by direct apposition over a cylinder of elder-wood. His disciple, Roland Capelluti, professed surgery at Bologna (1264), and composed a voluminous commentary on the work of his preceptor—whom he far surpasses in erudition—citing the Greek classics as well as the works of the Arabians. In a case of hernia of the lung he excised the protruding part, and the patient survived. Another disciple of Rogerius was Jamerius, who is described by Guy of Chauliac as a brutal and eccentric surgeon, but is placed by Peter of Argelata among celebrated operators of his time. Great obscurity envelops the history, and even the names, of the Four Masters, to whom are ascribed some important improvements in surgery, especially a method of suture of wounded intestines which still holds a place in the art. According to Devaux, they were four monks living at Paris in the time of Lanfranc (at the close of the thirteenth century), devoting themselves to good works. According to others, they were four teachers of surgery, who professed in four languages—Magister Salernus in Latin, M. Pontus in Greek, M. Abdallah in Arabic, and Rabbi Elimus in Hebrew. Weber and others believe that Rogerius, Jamerius, Theodoric, and William of Salicet are the four teachers referred to under the designation of the Four Masters. The little evidence extant gives most plausibility to the first of these conjectures. Manuscript copies of their voluminous work on surgery existed in the seventeenth century at Avignon and at Paris, and some fragments are said to be still preserved in the Bodleian Library at Oxford; but the work was never printed, and the opinions of these skillful masters are known only through citations in the works of their contemporaries. Hugo of Lucca (d. 1252) is regarded as the founder of the Bolognese school. He reduced a luxation at the hip of a year's standing in a man of twenty-five, and used alcoholic lotions largely as topical applications to wounds. After Hugo came Brunus of Longobucço, a professor at Padua (1262). He composed a *Chirurgia Magna*, and approved of dry dressings to wounds. Theodoric of Cervia, a pupil—and, according to Tiraboschi, a son—of Hugo of Lucca, expounded the views of his predecessors. He is accredited with having substituted soft and simple bandages and splints in fractures for the cruel appliances in vogue in his day. According to Guy of Chauliac, the Italian surgeons of this period may be classified in two schools. One, with Rogerius, Rolandus, Jamerius, and the Four Masters as its exponents, treated all wounds and ulcers by emollient fomentations and cataplasms; the other, in which Hugo, Brunus, and Theodoric were conspicuous, employed dry dressings or desiccating lotions. William of Salicet (b. at Piacenza in 1210) practiced in armies and at Cremona, Pavia, and Verona, and finally went to Bologna, and there (June 8, 1275) completed his work on surgery. He is the first Italian surgeon who treats at any length of the surgical affections of women. Gilbertus Anglicanus (1290) appears to be the first English writer on surgery. In 1271 Pitard founded the College of St. Côme at Paris, which was the origin of the Academy of Surgery that became so famous in later years. Pitard was a man of eminence in his day, and his observations on wounds of the head and on poisoned wounds are still remembered. Lanfranc, a Milanese and a pupil of William of Salicet, is generally regarded as the creator of surgery in France. He was the first to speak of the healing of wounds by "first intention." At this time flourished Master Jehan Ypermann (1295–1350), lately styled the father of Flemish surgery, whose manuscript treatise on the art was discovered and published as late as 1854 by the medical Society of Ghent. During the fourteenth century surgical science was dead in Italy. Rienzi states that Bartolomeo de Varignana dissected human bodies in 1290. Mondini de Lucci also publicly dissected at Bologna the cadavers of two women, braving the prejudices of his time, and published an anatomical work illustrated by wood engravings (1325).

*Fourteenth and Fifteenth Centuries.*—Early in the fourteenth century John of Gaddesden, after studying at Montpellier, practiced surgery with success at Oxford, and composed his *Rosa Anglica*. John of Ardern flourished in Newark about 1350, and subsequently removed to London. He compiled voluminously, but a treatise on *fistula in ano*, published in 1588 by John Reed, is the only one of his writings that was printed. Guy of Chauliac practiced in Avignon in the middle of the fourteenth century with renown. In his writings is found the first mention of the Cæsarean operation. Guy is esteemed a bolder surgeon than Lanfranc. Ackerman declares that his *Grande Chirurgie* embraces all of value written on surgery up to its epoch. Pre-eminence in surgical knowledge seems to have passed from Salernum to Bologna, and thence to Montpellier. The latter school, fostered by the neighboring papal court at Avignon, was enriched by manuscripts from both Spain and Italy. Guy described the use of weight-extension in fractures of the lower extremity (now commonly known as the "American method"), and treated indolent ulcers by binding on them a leaden plate. In the latter part of the fourteenth century the school of Montpellier rapidly declined. Both Italy and France were desolated by contending factions; the library of Guy was scattered. Balescon of Taranta, a Portuguese professor who succeeded to the chair of surgery, laments the loss of the works of Paulus, Rufus, and others. Balescon (or Valescus, as his name is sometimes Latinized) is said to have first advised the employment of mercurial ointment for the removal of lice and other parasitic vermin. Leonardo Bertapaglia (1429) is said to have practiced human dissections, and to have brought a certain luster upon the chair of surgery at Padua. He wrote on ulcers and wounds, and enumerates twenty-two kinds of punctured wounds by darts and arrows. He seems to have first described the tenaculum. Among other Italian surgeons who in some measure aided in the progress of surgery may be mentioned Guainerius, professor at Pavia, who wrote on diseases of the joints; his successor, Matthew of Gradi; and Bartolomeo Montagnana (1441), professor at Padua, who wrote on hernia, and first distinguished that variety of ventral hernia that protrudes through the linea alba. Arculanus also (1427) taught with credit at Verona and Ferrara, and devised several kinds of trusses and an instrument for extracting foreign bodies from the ear. He ligated the spermatic vein in varicocele, and wrote judiciously of ectropion. Marcellus Cumanus was a surgeon in the Venetian army in 1495 at the invasion of Charles VIII., and treated harquebuse wounds with boiling oil, regarding them as poisonous. Antonio Benivieni, a Florentine nobleman (1460), is probably the first writer treating systematically of morbid anatomy. He dissected two cases of coxalgia, an affection which J. L. Petit is sometimes supposed to have first described. Heinrich von Pfolsprundt, after participating in the great war in Poland in 1454, wrote his *Buch der Wundt-Artzney*, containing an early observation on shot wounds. He describes a rhinoplastic operation, anticipating Tagliacozzi by a century. In 1480 Colot, a French surgeon in favor with Louis XI. of France, performed lithotomy successfully on a condemned criminal; and this operation, previously abandoned to itinerant quacks, became a part of the legitimate practice of surgery. PARACELSUS (*q. v.*), noted in his time both as practitioner and author, was the introducer of many reforms.

*Sixteenth Century.*—With the revival of letters and of the natural sciences in the sixteenth century a new era dawned on surgery. Investigation of anatomy in the true spirit was undertaken by Vesalius (1513–64). Falloppius (1532–62) and Eustachius (1520–79) worthily succeeded this founder of modern anatomy. Fabricius of Acquapendente (1537–1619), a pupil of Falloppius, was the teacher of William Harvey (1578–1675), the immortal discoverer of the circulation of the blood. Gasparo Aselli (1581–1626) followed with the discovery of the lymphatic vessels. The way was thus paved for advances in surgery, which, illuminated by science, became a worthy pursuit for men of talent and education.

*Paré.*—Preceded by John di Vigo (1520), who still believed shot wounds poisonous, and by the Swiss surgeons Hans von Gersdorf (1520) and Felix Würtz (1576), who have left original observations of value, the latter being reputed the first surgeon who ventured to amputate in the thigh, appears Ambrose Paré, the founder of the modern French school, and reckoned the ablest of early army surgeons. If not the inventor, he was the restorer of the art of securing arteries by ligature after amputation—an advance which alone sufficed to secure for him immortality. Though originally a barber-surgeon, he became the counselor of four kings of France, and acquired such esteem that "his mere presence in a besieged town was enough to reanimate the garrison." His complete works were collected and published by his pupil, Guillemeau, in 1582, and have passed through many editions in many languages. Pigrai of Cremona succeeded Paré in his high dignities, and received great praise from his contemporaries. Morwitz accredits him with instituting ambulance-wagons, an advance in medico-military administration usually ascribed to Larrey in the nineteenth century. Guillemeau, besides editing Paré, distinguished himself in operative midwifery. In Italy at this period appeared several treatises on shot wounds. Maggius wrote *De Vulnerum Bombardorum et Sclopetorum Curatione* at Bologna in 1552. The work of Leonardo Botal on the cure of shot wounds (Lyons, 1560) is, after the writings of Paré, the most valued of the treatises on shot wounds of this period. Carcanus, of Milan (1573), and Berengarius, of Carpi (1550), published original but little-known treatises on injuries of the head. Marianus Sanctus, of Barletta, near Naples (1550), suggested improvements in lithotomy, and Tagliacozzi published in 1597 at Venice his treatise on plastic operations. The English surgeons of this period are not conspicuous. Thomas Gale, who served in 1544 with the army of Henry VIII. at Montreuil, published (1563) the *Institution of a Chirurgeon* and a treatise on gunshot wounds, which had the merit of denying the poisonous nature of such injuries. J. Hall (1561) also treated of shot wounds. John Woodall, who served in France in 1589, and was afterward surgeon-general of the East India Company's forces, published a *Military and Domestic Surgery.* William Clowes, a naval surgeon, wrote (1591) a *Proved Practice in Burnings by Gunpowder.* Peter Lowe, who served in France and Flanders, printed (1597) an *Army Surgery* that went through several editions. The work of Duchesne (*alias* Quercetanus) on shot wounds (1576) was translated into English. In Germany J. Schenckius, professor at Freiburg (1531–98), compiled a voluminous work of rare surgical cases, which remains a mine of interesting information.

*Seventeenth Century.*—In the seventeenth century the impulse given to the sciences by the diffusion of learning led to further improvements. Cæsar Magatus, professor at Ferrara, simplified the treatment of wounds. His work (*De Rara Medicatione Vulnerum*, Venice, 1616) is still consulted with advantage. Fabricius Hildanus, of Berne (1560–1634), by some styled the father of German surgery, was a man of great acquirements, but clung to old prejudices and amputated with red-hot knives. Richard Wiseman, surgeon to Charles II., has often been styled the true father of English surgery, but his *Severall Chirurgical Treatises* (1676) really contain no positive addition to the knowledge of the time. John Brown, another chirurgeon in ordinary to Charles II., a naval surgeon, published a *Discourse on Wounds, general and particular*, and a *Treatise of Gunshot Wounds*, in London in 1678—a work deduced from his practice in the navy in the Dutch war of 1665, in which he was severely wounded. Holland, restored to liberty in this century, furnished several good surgeons who promoted their art. Johann J. Rau, of Leyden, was probably the most successful lithotomist on record. Palfyn (1649–1730) was distinguished for devising a new plan for intestinal sutures. Roonhuysen (1663), by his operations for wry neck, may be regarded as the inventor of tenotomy. Peter Verduin, of Amsterdam, proposed (1693) an important modification in the flap method of amputating the leg. In France the tourniquet was first used in amputations by Morel at the siege of Besançon (1674). Frère Jacques improved the manual procedure of lithotomy, while Belloste (1696) deserves credit for denouncing the abuse of tents and complicated dressings then in vogue.

*Eighteenth Century.—France.*—In the eighteenth century we find great advances in surgery, and the French surgeons in the front rank. Jean Louis Petit (1674–1768) occupies a proud prominence among the early educated writers on the art. His treatise on diseases of the bones is classic; his work on general surgery is still consulted with profit. He devised the screw tourniquet, esteemed for a century an essential appliance in amputations. Le Dran (1685–1773), with less genius, was an original and excellent author. His copious writings abound in practical wisdom. Pierre J. Desault (1744–95) is one of the great names in surgery. He was the first who taught, systematically, surgical anatomy. His improvements in the treatment of fractures are illustrated in the everyday practice of the present time. He substituted straight amputating knives for the formidable sickle-shaped weapons previously employed. He improved the procedure for ligating arteries, and proposed the plan for the cure of aneurisms by distal ligature that bears the name of "Brasdor's method." Dominic Anel, of Toulouse (1678–1725), secured a permanent niche in the annals of surgery by first proposing the proximal ligature of the main trunk in aneurism. The institution of the Royal Academy of Surgery in Paris (1731) had great influence on the advancement of surgery not only in France, but throughout the world. Its *Mémoires*, composed of contributions from the most eminent men, constitute a rich mine of information which has been diligently worked by modern compilers, for the most part with scanty acknowledgment. Hévin may be regarded as the leading authority on wounds of the abdomen. Daviel, the oculist, Belloc, well known by his canula, Le Cat, the lithotomist, and Moreau, the founder of the practice of excision or resection of joints, are conspicuous among the specialists. Besides these academicians there were many French writers who hold an honorable place in surgical literature. Baron Percy, whose invaluable manual for the army surgeon was published in 1792, may be esteemed the foremost military surgeon between Paré and Larrey. The name of Xavier Bichat (1771–1802) closes this era in French surgery. This illustrious founder of general anatomy, the great genius who accomplished so much in his short space of life, commenced his career as a surgeon, and his earlier works are annotated editions of the teachings of his great preceptor, Desault.

*Great Britain.*—In Great Britain surgery attained great eminence in this century. William Cheselden (1668–1752), Samuel Sharpe (1700–65), Percival Pott (1713–88), W. Bromfeild (1712–92), Benjamin Bell (1749–1806), and the brilliant John Bell (1763–1820), all secured a permanent place in the literature of surgery, while the illustrious John Hunter (1728–93), a philosopher as well as an anatomist and surgeon, is justly ranked with the greatest minds that have graced the profession. Monro (1697–1767) is indissolubly associated with the birth and fame of the Edinburgh school. C. White, of Manchester (1770), rivaled the achievements of the Moreaus in France in excising the larger joints.

*Continent of Europe.*—In Italy, Scarpa (1747–1832), by his researches on hernia and aneurism, attained a high reputation. In Spain the name of Gimbernat is eminent.

Hendrik Callisen (1740–1824) was the most prominent surgeon of Denmark of his time. In Germany, Heister (1683–1758) wrote a system of surgery that was translated into many languages, and still enjoys a certain repute; and the encyclopædic Albert von Haller (1708–77) was Professor of Surgery at Göttingen.

*United States.*—Dr. William Shippen, of Philadelphia, in 1763 first delivered lectures on anatomy and surgery, and the first medical school in America (the University of Pennsylvania) was founded by Dr. Morgan in 1765. Dr. John Warren (1753–1815), Professor of Surgery in Harvard College, and James Tilton (1745–1822), a surgeon of the Revolutionary war and afterward surgeon-general of the army, were likewise eminent.

*Nineteenth Century.—Europe.*—At the beginning of the nineteenth century French surgeons were still in the foreground. Jean Dominique Larrey (1776–1842), the friend of Napoleon I., was an almost undisputed authority in military surgery in his time. Boyer (1757–1833) prepared a systematic treatise on surgery that was long a standard text-book. Delpech (1776–1832) taught surgery at Montpellier with nearly equal reputation. Dupuytren (1777–1835) may be regarded almost as the founder of a school. Many of the great French surgeons of the middle of the century were his pupils—Velpeau (1795–1867), Malgaigne (1806–65), Jobert (1799–1868), Vidal (1803–56), Nélaton (1807–73), and Goyrand of Aix; Roux (1780–1854) was Dupuytren's contemporary and rival. It would be endless to enumerate the eminent surgeons of the time. Lisfranc (1788–1847) acquired an unrivaled distinction in operative surgery. Cloquet (1790–1855) was renowned as a clinical teacher. Civiale (1794–1867) originated and Leroy (1798–1861) improved lithotrity. Bonnet of Lyons (1809–58) was among the first to treat in a scientific manner of diseases of the joints. Follin (1823–67), Guérin, and Sédillot, also were distinguished. In Germany the advance of surgery, if not as brilliant, was relatively as decided. Kern, of Vienna (1760–1829), Rust, of Berlin (1775–1840), von Walther, of Munich (1782–1842), Graefe, of Berlin (1787–1840), Konrad J. M. Langenbeck, of Göttingen (1776–1850), Dieffenbach, of Berlin (1795–1847), C. von Textor, of Würzburg (1782–1860), all aided the progress of surgery by their writings, and several of them made important improvements in the art. At the beginning of the century the Vienna school in ophthalmology was pre-eminent. G. J. Beer (1762–1821) was perhaps its most distinguished representative. The name of Albrecht von Graefe, of Berlin (1828–70), is indissolubly associated with the modern methods of treating glaucoma and cataract. The great illustrator of military surgery in Germany, the illustrious Louis Stromeyer (1804–76), the worthy successor of Paré and Larrey, was one of the founders of modern conservative surgery in cases of injury. Volkmann (1801–77) and Nussbaum (1829–90) stand high in the annals of German surgery. In Belgium, Seutin devised the method of treating fractures by starch bandages, which has led the way to the plaster treatment of the present time. In Italy, Assalini (1765–1840) and Porta acquired distinction. In Great Britain a succession of surgeons of the first merit rivaled their French contemporaries. The London school points with pride to Cline (1750–1827), to Abernethy (1764–1831), to Sir Astley Cooper (1768–1841), to Wardrop, Earle, Stanley, Travers, Hodgson, Lawrence, and Aston Key; to Sir Charles Bell; to the ophthalmic surgeons Tyrrell, Saunders, and Dalrymple; and to the illustrious Sir Benjamin C. Brodie (1783–1862). In Ireland, Colles, Carmichael, Jacob, Bellingham, and Tufnell are known by original researches, and Cusack, Crampton, R. W. Smith, and Maurice Collis earned high reputations. Scotland may boast of Liston, of Miller, of Syme, of Spence, and of Sir J. Y. Simpson, the obstetrician who recommended acupressure as a substitute for the ligature, and introduced chloroform as an anæsthetic. The annals of British surgery in the century are further advanced by two names that will always be remembered in the front rank of military surgeons—John Hennen (1770–1829) and G. J. Guthrie (1785–1856). Worthy contemporaries of Larrey, their works will ever be read with reverence by students of army surgery. The names of Fergusson, Callender, Savory, and many others, now deceased, add luster to the annals of British surgery, while Paget, Erichsen, Henry Thompson, Spencer Wells, Hutchinson, Holmes, Lister, and many more worthily sustain the reputation of their predecessors.

*United States.*—In the U. S. in the nineteenth century great advances have been made in practical surgery. A pupil of John Hunter, Philip Syng Physick (1768–1837), is often styled the father of American surgery. He left no work to record his vast experience, but his views were to some extent recorded by his nephew, John S. Dorsey (1783–1818), the author of the first systematic treatise on surgery published in America. John Collins Warren, of Boston (1778–1856), wrote a treatise on tumors, and was the first to perform (Oct. 16, 1846) an operation of importance on a patient anæsthetized by ether. Valentine Mott (1785–1865) acquired an immense fame by his daring operations on the arteries. According to Prof. Gross, "no surgeon, living or dead, ever tied so many vessels, or so successfully, for the cure of aneurism, the relief of injury, or the arrest of morbid growths." Benjamin Winslow Dudley (1785–1870), of Kentucky, had marvelous success as a lithotomist, and was noted for his dexterity in bandaging. Ephraim McDowell (1771–1830), of Kentucky, first performed ovariotomy (1809). William Gibson (1788–1868), of Philadelphia, was the first to tie the common iliac artery and to successfully perform the Cæsarean operation twice on the same subject. Nathan Smith (1762–1828), of New Haven, was a bold surgeon of indomitable industry and great versatility. Thomas D. Mütter (1811–59) was noted for his skill in the treatment of deformities. He bequeathed a valuable surgical museum to the Philadelphia College of Physicians, with a liberal endowment fund. George Hayward, of Boston (1791–1863), J. Rhea Barton (1796–1871) and George W. Norris (1808–75), of Philadelphia, and J. Mason Warren (1811–67), of Boston, were able hospital surgeons, whose contributions to the literature of the art are of permanent value. Other eminent names are those of Gross, Pancoast, and Agnew, of Philadelphia; of Van Buren, Hamilton, and Post, of New York; of Nathan R. Smith, of Baltimore, Eve, of Nashville, Hodgen, of St. Louis, and Bigelow, of Boston.

*Advances in the Art.*—The boundaries of nationality seem to be vanishing from the domain of surgery. With marvelously increased facilities of intercommunication, all advances are speedily known throughout the civilized world. At no former period, assuredly, was there greater scientific activity. One result of the emulative ardor with which surgery has been latterly cultivated is the prevalent tendency to pursue special branches of the art. Ophthalmology, invoking the aid of physical science, has been revolutionized, and in many other directions light has been thrown upon branches of surgery until lately enveloped in the deepest obscurity. The discoveries and improvements in surgery in the nineteenth century are not inferior to those of any preceding age. The practical use of anæsthetics, introduced in the shape of ether-inhalation by Morton in 1846, and by the use of chloroform by Simpson in 1847, constitutes an epoch-making advance in the art, while the employment of cocaine for securing local anæsthesia is a discovery of real though minor importance. The introduction of ovariotomy (1809) by McDowell, of lithotrity (1822) by Civiale, and of litholapaxy (1878) by Bigelow, are improvements of the first order. The extensions of reparative surgery to the relief of cleft palate, vesico-vaginal fistula, and a great variety of deformities, have been of much value. The employment of metallic sutures and ligatures (Levert, 1829), of immovable apparatus in the treatment of fractures (Seutin, 1842) and spinal affections (Sayre, 1877), and of manipulation in the reduction of luxations (W. W. Reid, 1855), are most important innovations. The bloodless method of Esmarch (1873) and the antiseptic method of Lister (1869) are of far-reaching application. The great advances made in the treatment of diseases of the joints, of blood-vessels and nerves, of the brain and spinal cord, eye, ear, larynx, thoracic and abdominal viscera, urethra, and rectum, and of outgrowths and tumors, are most creditable.

It would be impossible within the limits of this article even to enumerate, still less to describe, the many triumphs of the surgical art which have been won during the latter half of the nineteenth century, but a few of them may be briefly referred to. Beginning with the external integument, the introduction of *skin-grafting* has rendered it possible by the transplantation of small portions of cuticle, taken from the patient himself or borrowed from other individuals, to secure the healing of large ulcerated surfaces after burns or other injuries, which formerly would have been abandoned as totally incurable. The dread which the older surgeons felt in dealing with *nerves* has been replaced by a boldness which enables the modern operator to sew or splice nerves which have been accidently severed, thus restoring function and preventing loss of power, and on the other hand to relieve intractable neuralgia by nerve-stretching or nerve-section; and for this purpose surgeons have not hesitated to open the skull or vertebral column, so as to attack the diseased nerve directly at its origin from the base of the brain or spinal cord. Operations on the *blood-vessels* have become so much safer since the general adoption of aseptic methods that the surgeon now ties without fear the largest veins when they are accidentally wounded, thus preventing death from hæmorrhage, while the lessened risk attending the ligation of large arteries enables him to attack internal aneurisms which a few years since were not thought amenable to surgical interference. Aneurisms of the thoracic aorta and innominate artery are successfuly treated by simultaneous ligation of their principal branches; a subclavian aneurism has been successfully dissected out and removed bodily, as if it had been a solid tumor; and even abdominal aneurisms have been cured by firm pressure continued for many hours while the patient was kept in a state of anæsthesia, and in at least one instance by abdominal section and the introduction into the aneurismal sac of a coil of silver wire.

*Diseases of the Joints.*—In the treatment of these affections surgery has made marvelous progress. It is no longer thought needful, unless in exceptional cases, to amputate the thigh for scrofulous or tuberculous disease of the knee (white swelling); but the surgeon cuts out the offending articulation, preserving a useful limb, or in milder cases simply opens the joint and scrapes out the diseased tissue, or even effects a cure by the injection of iodoform and glycerin. Hip disease is no longer the opprobrium of surgery which it was; it is often curable in its milder forms by fixation and extension, followed by the use of judiciously planned orthopædic apparatus, and in its worst forms, osteotomy, or even excision, is successfully resorted to, and the patient is often restored to the duties of an active life with a limb somewhat shortened, but strong and enduring. Orthopædic surgeons deal with the distressing deformities due to rickets with a boldness which a few years since would have been thought almost criminally reckless. Knock-knees and bowlegs are straightened by cutting across the deformed bones with an osteotome or chisel, and the limbs are encased in plaster-of-Paris bandages with confidence that they will quickly and surely regain their firmness in their improved position. Relapsing or inveterate club-foot is successfully treated by boldly cutting through and separating all the contracted tissues, or even by cutting out the malshaped bones, thus making the foot both symmetrical and useful. Ununited fracture and false joint, after an arm or a leg is broken, are no longer dreaded as they were by our ancestors; the surgeon cuts boldly down upon the seat of injury, drills the bones, and joins them with a thick silver wire, or secures them with a silver splint directly applied to the fragments themselves and held in place by screws, and then closes the wound with the expectation that it will heal soundly over the inserted metal, which will supply the needed firmness to the broken bone and remain indefinitely, quietly buried in the surrounding tissues.

Surgery can no longer be considered as an equivalent term for external medicine, for the modern surgeon opens without hesitation all the great cavities of the body, explores with sight and touch the condition of the internal organs, and subjects them to such operative measures as may seem indicated. The *skull* is opened to permit the arrest of intracranial bleeding, the evacuation of intracranial abscesses, and the removal from the brain of tumors the exact site of which has been determined beforehand by the rules of cerebral localization. The *thorax* is cut into for the relief of empyema, or even morbid conditions of the lung itself, and after evacuation of the pleural contents reaccumulation is prevented by securing free drainage, cutting away, if necessary, considerable portions of the ribs in order to permit contraction and healing.

*Abdominal surgery* has perhaps made more striking progress than any other department of the art; hardly any organ of the abdominal cavity but is subjected to exploration, and, in cases otherwise incurable, to complete or partial extirpation. The surgeon cuts into a kidney, removes stones from its interior, stitches it into its proper place when it is dislocated, and when hopelessly disorganized removes it entirely from the body. The spleen is excised, as is the pancreas; wounds of the liver are sewed up or plugged to prevent hæmorrhage; stones are removed from the gall-bladder, or the latter is itself removed, or, if occlusion of the duct prevents the natural escape of bile into the intestine, an artificial passage is established into a neighboring portion of the bowel. Wounds of the stomach and bowel are closed by sutures, malignant tumors of these organs are boldly cut away, and the continuity of the alimentary canal is reestablished, sometimes after the removal of many inches or even several feet of intestine. Suppurative inflammation of the appendix vermiformis is now known to be the condition present in many of the cases formerly known as typhlitis, and is successfully dealt with by prompt excision of the diseased organ.

The triumphs of special surgery—ophthalmic, aural, laryngeal, vesico-urethral, and gynæcological—are no less brilliant than those which have been enumerated. The great success which attends surgical operations at present is to be attributed to a combination of causes, of which the discovery of anæsthesia and the introduction of aseptic and antiseptic methods of wound-treatment are the most prominent; but great importance is to be attached also to the general diffusion among practitioners of surgery of sound physiological, pathological, and therapeutic knowledge, thus enabling the surgeon not only to operate with facility and protect the wound from injury, but also judiciously to treat the patient after the operation and thus promote speedy and permanent recovery. See DENTISTRY, ORTHOPÆDIC SURGERY, etc. Revised by JOHN ASHHURST, Jr.

**Su′ricate** [from the Dutch (S. African) name. Cf. Fr. *surikate*], or **Zenick** [Anglicized form of native (S. African) name]: a carnivorous viverrid mammal of South Africa, the *Suricata zenik* or *S. tetradactyla.* It is about 12 inches long, with a tail a little more than half that length, and closely resembling the ichneumon; of a grayish-brown color, tinged with yellow, and with faint darker bands across the back. Its habits are nocturnal, it dwells in burrows, and is often domesticated, being very useful as a destroyer of vermin.

**Surinam′**: See GUIANA (*Dutch*).

**Surmullet**: See MULLET.

**Surname**: See NAME.

**Surplice** [from O. Fr. *surplis, surpeliz* < Late Lat. *superpellicium*; *super*, over + *pelli′cium*, a fur garment, pelisse]: a clerical garment worn in churches by priests and all clerics, and even by acolytes and choir-boys. It is considered to be a shortened style or a modification of the alb, and dates back to the twelfth century. It is worn by clergymen of the Church of England during the celebration of service, and at the performance of all ecclesiastical offices, as also by clergymen of the Danish, Norwegian, and Swedish churches, but by them only during the celebration of the Lord's Supper. The use of the surplice, however, was strongly objected to by the Calvinistic and Zwinglian Reformers on the Continent and by the Puritans in England, who regarded this vestment as a relic of popery and made it the subject of vehement denunciations. Both in the Church of England and in the Protestant Episcopal Church in the U. S. its use has become general, and all connection in the popular mind of the surplice with Romanizing tendencies has passed away. Revised by W. S. PERRY.

**Surrey**: inland county of England, bordering N. on the Thames, which separates it from Middlesex; area, 758 sq. miles. It is intersected from E. to W. by a range of low hills (its highest point, Botley Hill, being 880 feet), which slopes gently northward to the Thames, while to the S. the ground is more elevated and broken. In the northern part the soil is very fertile; in the southern it consists mostly of clay, chalk, and iron-sand; in the whole western part the land is heath. Wheat, hops, and vegetables are raised; hogs and poultry are extensively reared. Near London manufacturing industry is carried on. The county contains much wood, and the beauty of the scenery and the facility of communication with London have attracted many residents to Surrey, which is consequently studded with mansions and villas. Pop. (1901) 519,522.

**Surrey**, HENRY HOWARD, Earl of: soldier and poet; b. about 1516; was the eldest son of Thomas Howard, Duke of Norfolk; passed his youth at the court of Henry VIII., and was one of the most accomplished noblemen of the time. In 1544 he commanded the English forces in France; was made field-marshal, and subsequently governor of Boulogne. In Jan., 1546, he suffered a reverse at St.-Étienne, in consequence of which he was recalled and committed to the Tower, from which he was soon released, but in December was again arrested upon charge of treason for having quartered the royal arms upon his escutcheon with the design of securing for his family the honor of the regency. Upon his trial he proved conclusively that he had a right to bear these arms together with his own, but was notwithstanding condemned, and beheaded upon Tower Hill, Jan. 21, 1547. His works consist of sonnets, amatory poems, elegies, paraphrases of the Bible, and translations of the second and fourth books of the *Æneid*. They present the earliest instances of the use of blank verse in English poetry, and have been several times republished, the latest edition being G. F. Nott's (1871). Revised by F. M. Colby.

**Surrogate** [from Lat. *surroga'tus*, perf. partic. of *surroga're*, put in another's place, substitute; *sub*, under + *roga're*, ask]: one appointed as a substitute for another; and particularly an officer appointed to act in the place of a bishop, or of a judge, in matters relating to marriages and to probate jurisdiction. In England, since the abolition of the probate jurisdiction of ecclesiastical courts, and the establishment of a civil court of probate, the surrogate's principal function is dispensing licenses to marry without banns. He is prohibited by statute, unless "a qualified practitioner," from preparing for a fee any papers on which to found a grant of probate.

In some of the U. S. the term is employed to designate the officer upon whom probate jurisdiction is conferred. It is a survival from the colonial period, during which the governor of a colony was vested with full authority and jurisdiction over matters of probate, but exercised them through local delegates or appointees. The Supreme Court of Massachusetts declared in an early case that, before the Revolution, the judges of probate were considered as surrogates of the Governor and council, who derived from the royal charter the authority to prove wills and to grant administration. In New York the title of surrogate seems to have been first assumed by the Governor's delegate shortly after 1702. Later the Governor appointed a delegate in each county to act in his stead in probate affairs; and from that period to the present, with the exception of a few years, the county officer exercising probate jurisdiction has been known as surrogate. In New Jersey probate jurisdiction is vested in the orphan's court, of which the surrogate is a subordinate officer. In other States the courts exercising such jurisdiction bear various titles, such as probate courts, parish courts, county courts, or courts of the ordinary. As a rule, they are tribunals of limited jurisdiction, whose organization, procedure, and authority are prescribed by statutes, which should be carefully examined. It is generally declared that the surrogate, or corresponding officer, of the county in which the deceased had his legal residence at the time of his death shall have exclusive jurisdiction of administering his estate, although provision is made for granting letters of administration in foreign States, where such a course is necessary to the control of property in such States.

In some jurisdictions surrogates or probate courts have the power to appoint guardians for infants and imbeciles, to hear and determine disputes affecting estates before them for administration, to entertain and dispose of proceedings for the sale of real estate, and even to administer the estates of insolvent debtors. As a rule, these courts do not possess a general equity jurisdiction. In some States they are not allowed to exercise any equity powers, but in others it is held that where an estate is in settlement before a court of probate, and an equity arises between the persons interested in such estate, the court may exercise the fullest equity powers if necessary to do justice to all parties.

Francis M. Burdick.

**Surveying** [from Anglo-Fr. *surveer* : O. Fr. *surveoir* < Lat. *supervide're*, oversee, look over; *super*, over + *vide're*, see]: the art of measuring land for the purposes of determining areas, locating lines, and making maps. Surveying is supposed to have originated in Egypt, where property lines were annually obliterated by the inundation of the Nile, and its theory was then identical with geometry (Greek, γῆ, land + μέτρον, a measure), which still furnishes the most important part of the theoretical principles.

Plane surveying is confined to areas so small that the surface of the earth may be regarded as plane, the curvature being inappreciable. It is divided into land-surveying, whose object is the determination of property lines and areas of fields; topographical surveying, which produces maps showing the undulations of the surface, the forests, swamps, and waters; hydrographic surveying, which locates rocks, shoals, and all the features of bays and rivers; mining surveying, which locates the underground passages and shafts of mines; railway surveying, which establishes the best routes and grades for railway lines; and city surveying, which deals with streets, sewers, and water-supplies. Geological surveying notes the outcrops of rock formations, and lays them down on topographical maps, the field operations being usually of the nature of a rough reconnoissance.

Geodetic surveying extends over areas so large that it is necessary to take into account the curvature of the earth. For this branch of the subject, see the articles Coast and Geodetic Survey and Geodesy.

*Instruments.*—The Gunter's chain of 66 feet, the engineer's chain of 100 feet, and tape-lines of various lengths are used for measuring distances, and it would be possible by these alone to obtain all the results required in ordinary plane surveying. By the use of the compass and transit, however, for measuring angles, many distances can be computed from a few measured ones, and the work thus greatly expedited and economized. The compass determines the bearings of lines with respect to the magnetic meridian, while the transit measures angles on a graduated limb. The theodolite, of which an illustration is given in the article Hypsometry, is a form of the transit used in Great Britain. Leveling instruments and rods (see Levels and Leveling) are needed for determining elevations and differences of heights. In topographical work the plane-table and stadia-rods are used in connection with a triangulation, distances being measured by the spaces intercepted on the stadia-rods by wires in the telescope. See Stadia Measurement and Plane-table.

*Chain-surveying.*—A few elementary problems in the determination of distances and areas by means of linear measurements alone may here be noted, but others in great variety will be found in treatises on surveying. Instead of using a chain the distances may be approximately found by pacing, or by walking over the lines, and counting the steps, the length of a step being first ascertained by going over a distance which is accurately known.

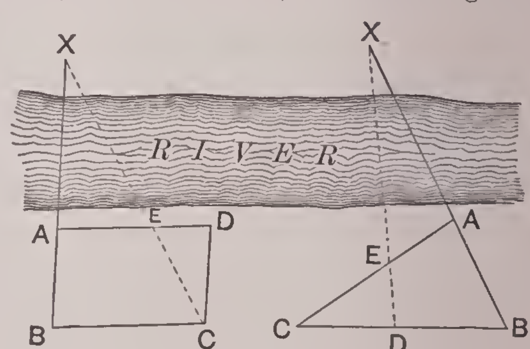



Fig. 1.

Two methods of finding the distance $AX$ across a river are shown in Fig. 1. By the first method a parallelogram, $ABCD$, is laid out, $AB$ being a prolongation of $XA$; then $E$ is marked on $AD$ at its intersection with $CX$. The distances $AB$, $AE$, $DE$ being measured, the distance $AX$ is computed by multiplying together $AB$ and $AE$, and dividing the product by $DE$. By the second method $XA$ is produced to $B$, and a stake, $C$, placed at any convenient point; then $D$ and $E$ are taken on $BC$ and $AC$, so that they are in line with $X$. The distances $AB$, $BD$, $DC$, $CE$, and $EA$ being measured, the distance $AX$ is equal to

$$\frac{AB \times AE \times CD}{BD \times CE - AE \times CD},$$

which will be somewhat simplified if $D$ be taken in the middle of $BC$.

A method of finding the length of an inaccessible line, $XY$, is shown in Fig. 2. A stake is first placed at any convenient point $A$, two stakes, $B$ and $C$, at points on $AX$ and $AY$, and a fourth stake, $D$, so as to make $ABDC$ a parallelogram. Then $E$ and $F$ are placed on $BD$ and $CD$ at their intersections with $CX$ and $BY$ respectively. The distances $AB$, $BD$, $DF$, and $EF$ being measured, the distance $XY$ is equal to

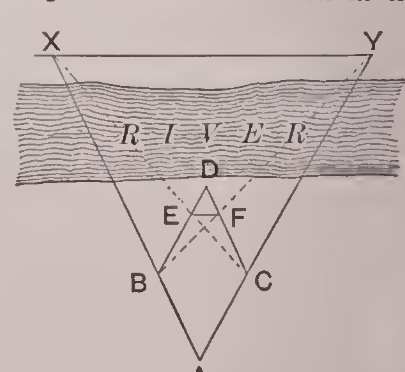



Fig. 2.

$$\frac{AB \times BD \times EF}{DE \times DF}.$$

The area of a field, as $ABCDE$ in Fig. 3, may be found by dividing it into triangles by either of the methods

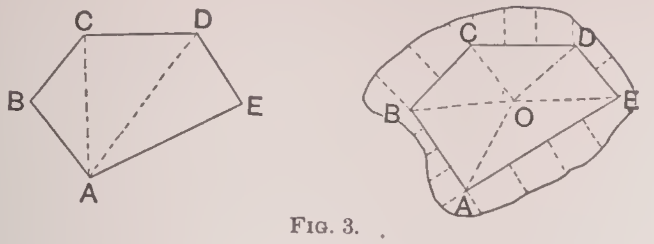



FIG. 3.

shown, measuring all the lines, and then computing the area of each triangle separately. To find the area of a triangle whose three sides are known, add the three sides together, and take half the sum; from the half sum subtract each side separately, multiply together the half sum and the three remainders, and the square root of the product will be the area.

A map of an island or irregular field, as in the second diagram of Fig. 3, may be made by staking out a polygonal area $ABCDE$, and measuring either its diagonals or the distances to a central point. Then perpendicular lines, called offsets, are set off from each side to the boundary and their lengths measured, thus giving all the data for mapping and computing the area.

*Compass-surveying.*—By means of the compass the angles or bearings which each line makes with the magnetic meridian are read, and thus a smaller number of linear measurements is required. For instance, in the case of Fig. 1, the line $AE$ may be measured, and the bearings of $AX$, $AE$, and $EX$ be read; then the angles $EAX$ and $AEX$ are known, and the distance $AX$ can be computed by the rules of trigonometry.

The area of a field is determined in compass-surveying by measuring the lengths and bearings of the sides. For example, for the case shown in Fig. 4, the field-notes would be as follows:

| LINE. | Bearing. | Distance. |
|---|---|---|
| $AB$........................... | N. 52° E. | 532 feet. |
| $BC$........................... | S. 29¼° E. | 204½ " |
| $CD$........................... | S. 31¼° W. | 389 " |
| $DA$........................... | N. 61° W. | 362 " |

From these data the distances $Ab$, $Ac$, $Ad$, called latitudes, and the distances $Bb$, $Cc$, $Dd$, called departures, are computed, and from these, in turn, the areas included between each line and its projection on the meridian $NS$. Then the area of the field is the sum of the areas $BbcC$ and $CcdD$, diminished by the sum of the areas $BbA$ and $DdA$.

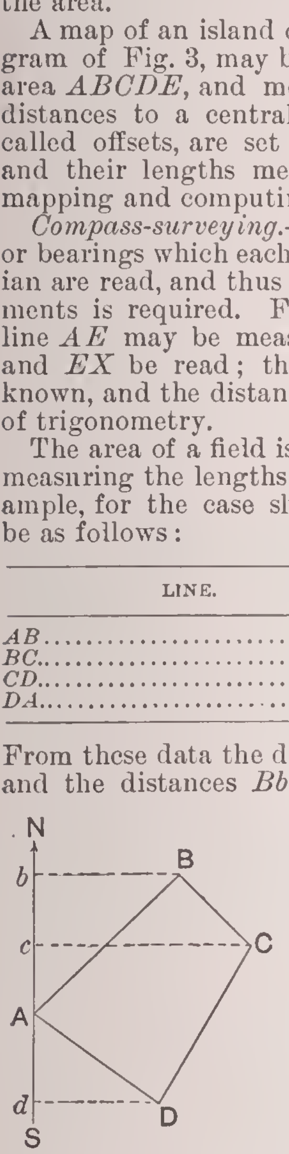



FIG. 4.

The method of balancing the latitudes and departures so as to eliminate errors of observations, and the computations of areas by means of double-meridian distances, given in most text-books on surveying, was perfected by David Rittenhouse (1732–96), and was formerly called the Pennsylvania method.

On account of oscillations in the forces of magnetism and of local attractions the compass is not an accurate instrument, and should be used only for rough reconnoissance or for farm surveys, where precision is not important. In all town or city work, as also in the surveying of railways and mines, the transit is generally employed for the direct measurement of angles.

*Topographical Surveying.*—A topographical survey of a region embracing more than a few square miles should be based on a triangulation which locates the positions in latitude and longitude of a number of stations. Then, starting from these stations, lines are run in various directions, and the location of roads, houses, streams, and other features, is made by offsets or by stadia sights. Levels are also run by which the contours or lines of equal elevations are determined, and thus a picture of the relief of the surface may be obtained. Rough topographical work, much of which is sketching, may be done for $5 per square mile, but good work will cost four or five times as much. Photography is an aid in this class of work, views being taken from different points which enable the contours of the surface to be sketched in the office. See also TOPOGRAPHY.

In the survey of a railway topographical work is done on each side of the line, and this is necessarily of a precise character so as to enable computations of excavation or comparative estimates of the cost of different locations.

*Public-land Surveys.*—The public lands consist of tracts of territory that belonged to the U. S. after the Revolution, together with all ceded by individual States soon after the formation of the Constitution, with the additions since made by treaty with Indians or by conquest. In 1802 Col. Mansfield, then surveyor of the Northwestern Territory, inaugurated a plan, which with slight alteration is still in use, for surveying and recording such portions as were offered for sale. Its general features are as follows: The entire public domain is first divided into parts called land districts, each of which is put in charge of a surveyor-general, who controls all the surveys in his particular district. In each district a meridian-line is run, extending through the entire district, and from some point of this meridian an E. and W. line is run, which also extends through the district. These lines are determined astronomically, and when located serve as axes to which the subdivisions of the district are referred. Parallel to the axes, and on each side of them, other lines are run 6 miles apart, dividing the whole territory into squares, each containing 36 sq. miles, and called townships. To take into account the obliquity of the meridians, suitable offsets are made in accordance with an established system. The townships lying between two consecutive meridians 6 miles apart constitute a range, and the ranges are numbered from the principal meridian, both E. and W. In each range the townships are numbered both N. and S. from the principal E. and W. line. Thus if a township lies 12 miles E. of the principal meridian and 18 miles N. of the principal E. and W. line, it is called township 3 N., range 2 E. Each township is divided by meridians and E. and W. lines into squares having (as near as may be) a mile on each side. These are called sections, and each contains approximately 640 acres. The sections of a township are numbered from the northeast corner, running along the northern tier of sections to No. 6, thence backward to section No. 12, which lies exactly S. of No. 1, and so on alternately, running from right to left and from left to right, to the southeasterly corner, which is No. 36. The four middle sections are numbered respectively 15, 16, 21, 22. In some of the Western States section No. 16 is set apart for school purposes.

LITERATURE.—Among the numerous text-books on surveying may be mentioned Bellows's and Hodgeman's *Manual of Land Surveying*, Gillespie's *Treatise on Surveying*, Johnson's *Theory and Practice of Surveying*; and on railway surveying, Searles's *Field Engineering* and Shunk's *Field Engineer*. A journal published by the German Association of Surveyors is *Zeitschrift für Vermessungswesen*, mainly devoted to precise methods. MANSFIELD MERRIMAN.

**Surveyors and Surveys**: See the Appendix.

**Surveys, Geological**: 1, systematic investigations of the character, arrangement, and distribution of the rock formations of a district; 2, state organizations or bureaus for the conduct of such investigations. In 1823 the Legislature of North Carolina provided for the geological survey of the State by Prof. Denison Olmsted, appropriating the sum of $250 a year for four years. In 1830 Massachusetts followed the example of North Carolina, making a somewhat larger appropriation, and placing Prof. Edward Hitchcock in charge of the work. Between 1830 and 1840 similar surveys were instituted in Tennessee, Virginia, Maryland, New Jersey, New York, Pennsylvania, Maine, Ohio, Michigan, Delaware, and Kentucky; and before 1895 all the States of the Union E. of the Great Plains, as well as California and Oregon on the Pacific coast, had made similar provision for the investigation of the rocks and minerals within their borders. Some States, after a few years of continuance, abandoned the work, or it was discontinued for a period. Others completed the investigations according to the original plan, and the results were communicated to the citizens in a series of final reports. Pennsylvania completed the survey first planned, and then after a lapse of years executed a second survey upon a more elaborate plan. New Jersey, Ohio, and Alabama maintain small permanent geological corps in the interest of the development of their mineral resources. New York, which early published systematic reports on the stratigraphy and structural geology of its territory, has since carried forward an elaborate study of its fossils, continuously maintaining therefor a small corps, and publishing a series of paleontologic monographs, which have been of the utmost service to the geological corps of other States.

The U. S. early established the custom of attaching geologists to parties sent out for the exploration of little-known portions of its territory. Expeditions having geological inquiry for their primary purpose were instituted under Featherstonehaugh in 1834, Owen in 1839, Burt and Hubbard in 1845, Owen in 1847, Jackson in 1847, and Foster and Whitney in 1848. The work under Owen and Foster and Whitney should perhaps be classed as surveying rather than reconnoissance. In 1867 Ferdinand V. Hayden, who had previously been connected with exploratory parties, was authorized to make a geological survey of Nebraska, and his work was afterward continued in other Territories. In the same year provision was made for the survey of a belt of country, including the 40th parallel, under the direction of Clarence King. In 1871 John W. Powell, who had previously explored the Colorado cañons under Government authority, was authorized to begin the geological survey of a tract bordering the river, and this work also was continued. In the same year explorations under the direction of Lieut. George M. Wheeler assumed the character of a topographical and geological survey, In 1879 the U. S. Geological Survey was created, being made to replace the Hayden, Powell, and Wheeler surveys. Two years later its field of operations, which had originally included only the Territories, was enlarged so as to comprise the entire republic, and its corps was gradually enlarged until it came to be the most important of all governmental organizations for the prosecution of geological investigation.

Great Britain was the first European country to establish a geological survey, De la Beche being placed in charge of the work in 1832. Austria and Spain followed her example in 1849, and works of this character are now in progress in nearly all the countries of Europe as well as in the British colonies. The first reports of the surveys of New Brunswick and Newfoundland were published in 1839, and the official survey of Canada, which is (1895) still in progress, was begun in 1842.

Geological surveying, or the work of a geological corps, consists primarily in the preparation of maps showing the horizontal distribution of the various formations, and of sections showing their vertical arrangement. The facts exhibited by maps and sections are called respectively the areal geology and structural geology. For their compilation it is necessary that the rocks be classified, and the study of the formations for the purpose of classification involves the determination of their position and other physical characters, and also the determination of the fossils they contain. In extensive geological surveys it has been found advantageous to differentiate the work, employing specialists for the chemical analysis of rocks, for their petrographic determination, and for the study of fossils. In regions not previously provided with topographic maps on which to delineate the outcrops of the formations, the geological corps has performed topographical as well as geological work, and in large organizations the topographical work also is performed by a special corps. In Great Britain and most of the countries of continental Europe topographical map-work was well advanced before geological mapping was begun, and the geological corps have no topographical divisions. In the U. S. the State surveys have, as a rule, executed little or no topographic work, but have made use of such maps, usually inaccurate, as happened to be available. The national survey prepares its own topographical base-maps, employing for that purpose a large corps of engineers.

G. K. GILBERT.

**Survival of the Fittest**: See EVOLUTION (*Struggle for Existence*).

**Survivorship**: (1) the state of outliving another. Whether A outlives B is, as a rule, an easily determined question of fact. If they are the victims of a common disaster, however, no evidence as to survivorship may be obtainable. In such a case the Roman law, and some modern codes founded upon it, establish presumptions for its determination, which are based upon the assumption that survivorship depends upon the comparative physical strength of the victims. For example, if a father and son perish, the father is presumed to survive, if the son is under puberty, while if the latter is above that age he is presumed to survive. (See 4 Burge, *Colonial and Foreign Laws*, ch. 1, § 1; Code Civil, Des Successions, §§ 720–722; Code of La., §§ 936–939; Code of Civ. Proc. of Cal., § 1963.) English law recognizes no artificial presumption on this subject. It will not balance "probabilities either that there was a survivor or who it was. We may guess, or imagine, or fancy, but the law of England requires evidence," and evidence which goes beyond that of the sexes, the relative ages and physical powers of the persons who are victims of a common disaster. In the absence of other evidence than the above, the fact of survivorship is deemed unascertainable, and property rights are disposed of as if death occurred at the same time. *Newell* vs. *Nichols*, 75 New York 78; *Ehle's Estate*, 73 Wis. 445.

(2) The devolution of rights or obligations upon the survivor by the death of a joint owner or a joint obligor. The survivorship of rights is often termed *jus accrescendi*, "because the right upon the death of one joint tenant accumulates and increases to the survivor." Such a doctrine was favored by the common law, for the reason that it tended to prevent a division of tenures, and to secure the continuance of the feudal system. It was not favored in equity, and was repudiated by mercantile law. Modern statutes have almost abolished it. This branch of the topic is discussed in the articles JOINT AND SEVERAL, JOINT OWNERSHIP, and PARTNERSHIP.

FRANCIS M. BURDICK.

**Sus**: See SUIDÆ.

**Susa** [= Lat. = Gr. τὰ Σοῦσα]: capital of the ancient kingdom of Elam, and afterward one of the residences of the kings of Persia; in lat. 32° N., lon. 48° E. It was taken by Asshurbanipal (668–626 B. C.), and, as appears from Ezra iv. 9, 10, some of its inhabitants were sent to live in Palestine. When Alexander took the city, 331 B. C., he found great treasures of gold. Susa is the scene of several interesting biblical narratives: (1) The vision of Daniel (viii. 2); (2) Nehemiah's office as cupbearer to the king (i. 2, ii. 1); (3) the feast of Xerxes (Esther i. 2). One of the buildings at the place is reverenced by the natives as the tomb of Jonah. The site, which is marked by ruins, was excavated for the Louvre by Marcel A. Dieulafoy, 1884–86, who was aided in the work by his wife. (Cf. Jane Dieulafoy, *La Perse, la Chaldée et la Susiane* (Paris, 1887); Jane Dieulafoy, *À Suse, Journal des Fouilles 1884–86* (Paris, 1888); Marcel A. Dieulafoy, *L'Acropole de Suse d'après les Fouilles executées en 1884, 1885, 1886*, etc. (Paris, 1890–92); B. T. A. Evetts, *New Light on the Bible and the Holy Land* (London, 1892, pp. 229–257).) The ruins are in the form of three large mounds. In one of these Dieulafoy excavated the palace which was built by Darius Hystaspes (521–485 B. C.), damaged by fire in the reign of Artaxerxes Longimanus (465–424), and restored by Artaxerxes Mnemon (405–362). The art treasures brought thence to the Louvre are most remarkable. Specially noteworthy are the capitals of the columns, the procession of the "immortals" (raised figures in enamel, of various colors, on the surface of the brick-work), and the figures of lions (also in enamel).

D. G. LYON.

**Susa**, or **Sous**: town of Northern Africa; 70 miles S. S. E. of Tunis; is surrounded with olive-groves, and has an extensive trade in oil and manufactures of woolen fabrics. Pop. estimated at 12,000, of whom 2,000 are Europeans and 2,000 Jews.

M. W. H.

**Susan'na, History of**: a short book, considered by the Roman Catholic Church to be canonical, and regarded as the thirteenth chapter of Daniel, but put among the Apocrypha in the English Bible. It relates the attempt on the virtue of Susanna, a beautiful Jewish matron, her false accusation, her final rescue from death, and the overthrow, by the judgment of young Daniel, of the wicked men who designed her ruin. It is probably a fiction of neo-Hebrew origin.

Revised by S. M. JACKSON.

**Susemihl**, soo'ze-meel, FRANZ: Greek scholar; b. at Laage, Mecklenburg-Schwerin, Germany, Dec. 10, 1826; studied in Leipzig and Berlin; private docent at Greifswald 1852; Professor of Classical Philology at the same university since 1856. His works chiefly relate to Plato and Aristotle. Among them are *Genetische Entwickelung der Platonischen Philosophie* (2 vols., 1860); Aristotle's *Poetics*, with translation and notes (2d ed. 1874); text editions of the *Politics* and *Nicomachean Ethics*. In 1891 he published his profoundly learned *Geschichte der griechischen Literatur in der Alexandrinerzeit* (2 vols.), the standard work on the subject.

ALFRED GUDEMAN.

**Suso**, or **Seuse**, HEINRICH (otherwise known as St. Amandus and Heinrich von Berg): mystic; b. at Ueberlingen, in the present grand duchy of Baden, 8 miles N. of Constance, Mar. 21, 1295. His father was a rough soldier of the name of von Berg, but after his mother's death in his eighteenth year he took her name, Süss or Süss. He studied first at Constance, then at Cologne; and became a Dominican monk at Constance 1308. He was greatly influenced by Eckart. At first his religious life was in the dark, and he led for several years a life of seclusion and the severest asceticism; but coming into the light, meeting as he believed with the Eternal Wisdom, he reveled in the newly found joy and peace and became then an itinerant preacher, and wrote several religious works of a mystical character, which made a deep impression, and of which the chief is *Buch von der ewigen Weisheit* (*Horologium Sapientiæ Æternæ*), which was partly translated into English at Douay, 1500. D. in the Dominican monastery at Ulm, Jan. 25, 1366. His collected works were translated into new High German by M. Diepenbrock (Regensburg, 1829; 4th ed. 1884); but his writings have not so much interest as those of the other German mystics—Eckart, Tauler, etc. F. H. S. Denifle has published selections in his *Das geistliche Leben* (Gratz, 1873; 2d ed. 1879; also his works, 1878, *seq.*). For Suso's biography, see his collected works, also his autobiography, *The Life of Blessed Henry Suso by himself*, translated from the German by T. F. Knox (London, 1865); also F. Bevan, *Trois Amis de Dieu* (Lausanne, 1890), and T. Jaeger (Basel, 1893). Revised by S. M. JACKSON.

**Suspension** (in music): See MUSIC.

**Suspension Bridge** (town): See NIAGARA FALLS (city).

**Suspension Bridges**: See BRIDGES.

**Susquehan'na**: borough; Susquehanna co., Pa.; on the Susquehanna river, and the N. Y., Lake Erie and W. Railroad; 22 miles S. E. of Binghamton, N. Y., 38 miles N. of Carbondale (for location, see map of Pennsylvania, ref. 2–I). It is a manufacturing place, with steam-heater factory, chemical works, and locomotive and railway-car shops, and contains a public library, 2 national banks with combined capital of $150,000, a private bank, and a daily, a tri-weekly, and a weekly paper. Pop. (1890) 3,872; (1900) 3,813.

**Susquehanna River**: a river formed by the union of its eastern and western branches at Northumberland, Pa. The eastern branch, the larger, rises in Otsego Lake, Otsego co., N. Y., at an elevation of about 1,300 feet. The western branch rises in Cambria co., Pa., and has a very tortuous and generally eastward course through a region abounding in timber and coal, but less celebrated for its fertility and beauty than the valley of the eastern branch, a portion of which, called the Wyoming valley, is renowned for the historic events of which it has been the scene, as well as for the mineral wealth which it contains. The main Susquehanna flows through a wide, open, exceedingly fertile, and very picturesque country of Devonian slates and limestones. It reaches the head of Chesapeake Bay at Port Deposit, Md. It is a wide and stately stream, but is shallow, and is nowhere navigable to any extent, save in the spring, when the freshets bring down great rafts of logs and lumber and some loaded boats. The length of the main stream is 150 miles, of the western branch 200 miles, of the eastern (or northern) branch 250 miles. The branches afford great water-power. Canals have been built along the main stream and both branches, but have been rendered useless to a great extent by railways. Revised by ISRAEL C. RUSSELL.

**Sussex**: county of England; S. of Surrey and bordering on the English Channel. Area, 1,458 sq. miles. It is intersected from E. to W. by a range of low hills, called the South Downs, consisting of chalk covered with fine turf and affording excellent pasturage, where the celebrated breed of sheep called the Southdowns is reared. To the N. of the range are extensive woods; to the S. the ground is wholly under tillage, and large crops of wheat, barley, beans, turnips, and hops are raised, and hogs, fowls, and rabbits are reared. Pop. (1901) 413,231.

**Susu**: See SOOSOO.

**Sut'cliffe**, MATTHEW, LL. D.: dignitary and author; b. in Devonshire about 1550; entered Trinity College, Cambridge; took holy orders, and became archdeacon of Taunton in 1586, dean of Exeter in 1588, and prebend of Wells in 1592. He founded a college at Chelsea, of which he was the first provost, the fellows of which were to devote themselves to writing the annals of their times and to combating popery and Pelagianism; but the institution fell into decay, became an asylum for invalid soldiers, and finally a part of Chelsea Hospital. He wrote many polemical works, chiefly against Bellarmine and Robert Parsons, among which are *A Treatise of Ecclesiastical Discipline* (London, 1590); *Disputatio de Presbyterio* (1591); *De Catholica et Orthodoxa Christi Ecclesia* (1592); *De Pontifice Romano, eiusque iniustissima in Ecclesia dominatione* (1599); *De Purgatorio* (1599); *De Vera Christi Ecclesia* (1600); *De Missa papistica* (1603); *The Unmasking of a Masse-monger*. D. in 1629. Revised by S. M. JACKSON.

**Sutech**: an Egyptian deity, usually regarded as the equivalent of SET (*q. v.*). He was adopted by the HYKSOS (*q. v.*), as their special divinity, and afterward, apparently, was transplanted to the East. It is somewhat doubtful whether the identification of Set and Sutech is justifiable in the earlier times, since as late as the eighteenth dynasty the name of Set appears as the principal part of the royal name of SETI (*q. v.*), which would scarcely have happened if the identification of Set with the foreign Sutech were then complete or generally recognized. At a later period both Set and Sutech are regarded as identical, and as foreign gods as well as gods of foreigners. CHARLES R. GILLETT.

**Sutherland**: a northern county of Scotland; bounded W. and N. by the Atlantic Ocean, E. by Caithness, and S. by the North Sea; area, 2,028 sq. miles, only 3 per cent. of which is under cultivation. The surface is elevated, mountainous, and rugged, especially toward the N. W., interspersed with large tracts of moorland or covered with extensive forests, where herds of red-deer roam wild. Rearing of cattle and sheep, and salmon and herring fishing are the principal occupations. Pop. (1901) 21,389. Chief town, Dornoch; pop. (1891) 514. Sutherlandshire sends one member to Parliament.

**Sut'lej** [Sanskr. *Satadru*, or the "hundred-channeled," the *Zaradros* of Ptolemy and *Sydrus* or *Hesidrus* of Pliny]: the most eastern and southern of the "five rivers" of the Punjaub, British India, and the one which receives the other four before it joins the Indus. It rises in Western Tibet, not far W. of the sources of the Brahmaputra and S. of those of the Indus proper, and takes a course first W., breaking through the Himalayas, thence S. W. to the Indus in lat. 29° N. The Tibetan valley of its upper course is highly picturesque and contains many hot springs. After passing the mountains it traverses the arid plains of Southern Punjaub, where its waters are much used for irrigation. It has no large southern affluents. On the N., the Bias enters at the turn in its course, and 50 miles from the Indus it is joined by the combined Jhilam, Chinab, and Ravi, from which junction to its mouth it is called the Punjaub. Its lower course is shifting. The annual floods occur in June, July, and August, and its volume of water is nearly equal to that of the Indus. Length about 970 miles, but the flow is intermittent from Rakas Tal, a lake 40 miles below its source. Boats of 40 tons burden ascend to Firozpur, 370 miles from the mouth. MARK W. HARRINGTON.

**Sū'tra**, in Pāli **Sutta** [Sanskr. *sūtra*, a thread or string; deriv. of √ *siv*, sew]: in Sanskrit literature, a short rule or aphorism, or a string of such aphorisms. Sūtras constitute an important part of Hindu literature, including all the ritual, grammatical, metrical, and philosophical works. They consist of brief sentences to be memorized, and were usually written separately on palm-leaves tied together by a string. One of the three "baskets" or "collections" of the Buddhist Tripitaka is composed of sūtras, which profess to be the very words of the Buddha. Each sūtra or string of aphorisms begins with the words, "Thus have I heard."

**Sutro**, ROSE and OTTILIE: See the Appendix.

**Sut'tee** [from Sanskr. *satī*, faithful wife, liter., femin. of *sant-* (pres. partic. of *as-*, be), being, existing, real, true, faithful]: the voluntary burning of a widow on the funeral pile of her husband, a practice formerly prevalent among Hindus in India. In the event of the husband dying in a distant land, the widow would place his sandals on her breast and cast herself alive into a fire. The practice is said to have been unknown to the primitive Aryans, but it is authorized by several passages in the *Puranas* (see Colebrooke's *Digest of Hindoo Law*), although the custom is not sanctioned by the laws of Manu. For some time the custom was permitted in India under British rule, and between the years 1815 and 1826 more than 7,000 cases of suttee were reported in the province of Bengal alone. In 1829 suttee was suppressed by the British Government in India, and in 1847 the prohibition was extended to all native states under the protection of the Government. T. P. HUGHES.

**Sutter**, John Augustus: pioneer; b. at Kadern, Baden, Feb. 15, 1803, of Swiss parentage; was educated at the military college at Berne; entered the French service as an officer of the Swiss guard and served, 1823–24, through the Spanish campaign; emigrated to the U. S. 1834; carried on a trade with Indians and trappers at Santa Fé; crossed the Rocky Mountains 1838; traded in a vessel along the Pacific coast; founded 1839 a settlement on the site of Sacramento; received a grant of land from the Mexican Government, and was appointed governor of the northern frontier country; encouraged the annexation of California to the U. S.; was a delegate to the convention to form a State constitution; and after the admission of California as a State was elected first alcalde of his district. In Feb., 1848, gold was discovered on his estate in Coloma, his lands were invaded by gold-diggers, and the claim he had filed for 33 sq. leagues was decided against him on appeal to the Supreme Court. Being reduced to poverty, he was pensioned by the State Legislature; in 1873 removed to Litiz, Lancaster co., Pa. D. in Washington, D. C., June 17, 1880.

**Sutter Creek**: town; Amador co., Cal.; on Sutter creek; 4 miles N. W. of Jackson, the county-seat, 45 miles E. S. E. of Sacramento (for location, see map of California, ref. 6–D). It is in a gold-mining and agricultural region, and has a weekly newspaper. Pop. (1880) 1,324; (1890) 1,351; not returned separately in 1900.

**Sutton**: village; Brome co., Quebec, Canada; on the Canadian Pacific Railway, near the U. S. boundary (for location, see map of Quebec, ref. 6–C). Near the village is Sutton Mountain, over 1,000 feet high, the slopes of which are covered with magnificent maple groves. It is the center of the maple-sugar export trade. Pop. of parish (1891), 3,362.

**Sutton**: town (incorporated in 1714); Worcester co., Mass.; on the N. Y., N. H. and Hart. Railroad; 9 miles S. of Worcester (for location of county, see map of Massachusetts, ref. 3–G). It contains the villages of Sutton, West Sutton, South Sutton, Manchaug, Wilkinsonville, Pleasant Valley, Woodbury, and Marbleville; has 5 churches, high school, 15 public schools, public library, and is principally engaged in agriculture and the manufacture of cotton goods. Pop. (1880) 3,105; (1890) 3,180; (1900) 3,328.

**Suture** [from Lat. *sutu'ra*, seam, deriv. of *su'ere*, *su'tum*, sew; Eng. *sew*]: in anatomy, the line of union of two bones between which there is no motion. Where motion is intended, the union is a joint or diarthrosis. The general term for an immovable joint is synarthrosis; this includes the suture (*sutura*), or linear articulation; the schindylesis, in which a thin lamina of bone is received between two laminæ of another bone; and the gomphosis, in which a long process is inserted into a socket. A serrated suture is one between bones whose edges have projections and indentations fitting into each other; a squamous suture is between bones whose edges overlap. In surgery, suture is either the uniting of the edges of a wound by means of stitches, or it is one such stitch. The most common materials for sutures are prepared catgut, silk, and silver wire.

**Suwa'row**, or **Suvo'roff**, Alexei Vasilievitch: soldier; b. in Moscow, Nov. 24, 1729; entered early the Russian army, and was made a colonel after the battle of Kunersdorf, 1759, and a general in 1783, after the campaign against the Lesghians on the Kuban. In the second Turkish war he defeated the Turks in several important battles, and in 1790 captured the fortress of Ismail. In 1794 he commanded in Poland, and took Praga Sept. 24, 1794, after which Catherine II. made him field-marshal. His most brilliant exploit was his Italian campaign in 1799. He had fallen into disgrace under Paul I., and had even been deprived of his rank, but on the demand of the Emperor of Austria he was, nevertheless, made commander-in-chief of the Russian army which was sent to Italy to co-operate with the Austrians against France. He defeated the French on the Trebbia and at Novi, and then crossed the Alps to join Korsakoff and the Austrians under Hotz. Both the generals had been defeated, however, and Suwarow was compelled to retreat. Shortly after the Russian-Austrian alliance was dissolved, and the Russian army withdrawn from the theater of war. He died a few days after his return to St. Petersburg, May 18, 1800. His *Autobiography*, written in French, was edited by Glinka in 2 vols. (Moscow, 1819). See biographies by Polevoi (1853) and Spalding (1890). F. M. Colby.

**Svarabhakti** [Sanskr., vowel-fragment; *svara-*, tone, vowel + *bhakti-*, division, deriv. of *bhaj-*, to allot, divide]: a technical term of Indian grammar (Prātiçākhyas) applied to a subsidiary vowel-sound inserted between *r* or *l* and a following consonant. This term has been adopted into modern grammar to denote the vowel appearing in the various familiar forms of anaptyxis with *r* or *l*; as in Lat. *familia* for **famlia*; *sæculum* for *sæclum*; O. H. Germ. *miluh* to *melchan*, to milk; Eng. *eləm* for *elm*. B. I. W.

**Sveaborg**: See Sweaborg.

**Svend**: See Sweyn.

**Sven Tröst**: pseudonym of Snoilsky (*q. v.*).

**Světlá**, Karolina (pseudonym of Johanna Mužáková, wife of Prof. Peter Mužák, of Prague): a Czech writer of novels of considerable fame; b. at Prague, Feb. 24, 1836. She published in 1858 her first novel, *Double Awakening*, in the Czech almanac *Máj*, and continued to enrich Bohemian literature with some fifty novels and tales. Her material is mostly drawn from the popular life and the modern society of her native country; her popular types, framed after French models, are very delicate and artistic. She also wrote many essays on education and literature, and memoirs which are widely read. Among her best novels are *Láska k básnikovi, román z časů novějšich* (Poet's Love, Novel of the Present Time, Prague, 1860); *Prnvi Ceška* (Prague, 1861; also published in the collection of novels *Slovanské besedy*); *Vesnicky roman* (The Village Romance, 1869); *Frantina* (1870); *Kriz a potoka* (The Cross near the Brook, 1871); *The Atheist* (1873). Karolina Světlá is, besides Eliška Krásnohorská (pseudonym for Henriette Pech), the author of the cycle of epic songs *To the Slavic South*, the foremost woman representative of modern Czech literature. Many of her novels have been translated into Russian, German, Polish, and French. Hermann Schoenfeld.

**Svir**: a river in the government of Olonetz, Russia. It issues from the southwestern extremity of Lake Onega, and enters, after a course of 130 miles, the eastern part of Lake Ladoga. It is navigable throughout its whole course, and forms part of the great system of rivers and canals which connects the Baltic with the Caspian and White Sea.

**Swa'bia**, or **Suabia** (Germ. *Schwaben*, Mod. Lat. *Sue'via*): a former territory of Southwestern Germany, corresponding nearly to the present Würtemberg and Baden, and bounded S. and W. by the Rhine, which separated it from Switzerland and France, and N. and E. by the Palatinate, Franconia, and Bavaria. Its original name was *Alemannia*, but when, in 496, the Alemanni were conquered by Clovis, the country received the name of Swabia after the Suevi, who inhabited large parts of it. In 1080 the Emperor Henry IV. made it a duchy, and bestowed it as an hereditary fief on Frederick of Hohenstaufen. Under this family Swabia prospered and became the seat of a flourishing civilization; but when the family became extinct with Conradin, who, as the head of the Ghibelline party, was executed at Naples in 1268, Swabia was broken up into many small dominions and free cities. From 1563 to 1806 Swabia was one of the ten circles into which the German empire was divided.

Revised by M. W. Harrington.

**Swain**, George Fillmore, B. S.: civil engineer and educator; b. in San Francisco, Cal., Mar. 2, 1857; graduated at the Massachusetts Institute of Technology in 1877, and then spent three years in study in Germany. Since 1883 he has been Professor of Civil Engineering in the Massachusetts Institute of Technology, and has also served as expert on the tenth census and as engineer of the railway commission of Massachusetts. He is the author of valuable articles in technical journals, of papers on the water-power of the U. S. in the *Reports of the Tenth Census*, and of discussions in the *Reports of the Massachusetts Railroad Commission*.

Mansfield Merriman.

**Swainson**, William: naturalist; b. in Liverpool, Oct. 8, 1789; served in the commissary department of the British army 1807–15; accompanied the German naturalist Köster in his travels in South America 1815, after which he settled in London, and began in 1820 the issue of his works on natural history. In 1841 he emigrated to New Zealand, where he was attorney-general, and subsequently published several works on the natural history and social and political condition of that colony and Tasmania. Among his works are *Zoölogical Illustrations* (1st series, with 318 colored plates, 1820–23; 2d series, with 136 plates, 1829–33); *Exotic Conchology* (1821–22; new ed. 1841); *The Naturalist's Guide for Collecting and Preserving all Subjects of Natural History and Botany, particularly Shells* (1840); 11 vols. on zoölogy, etc., in Lardner's *Cabinet Cyclopædia* (1834–40); *Birds of Western Africa* and *The Natural Arrangement and History of Fly-catchers* (in Jardine's *Naturalist's Library*, 1837–38); *Ornithological Drawings*, of birds from Brazil and Mexico (1834–41); *Observations on the Climate of New Zealand* (1840). He assisted Sir John Richardson in the ornithological portion of *Fauna Boreali-Americana*. Few of his day knew more about birds and no one excelled him as a delineator of them. D. in New Zealand in 1855.

**Swallow** [O. Eng. *swaleive*, *swealwe*: O. H. Germ. *swalawa* (> Mod. Germ. *schwalbe*): Icel. *svala*]: any bird belonging to the family *Hirundinidæ*, distinguished by the wide deep gape, allusion to which is evidently conveyed in the name. They have the neck rather short; the head full; the bill short, but comparatively broad and depressed; the gape very deep, and continued backward nearly as far as, or quite under, the eyes. There are no distinct rictal bristles; the wings are very long and pointed, and have only nine primaries, of which the second is generally longest, but the first is nearly or quite equal to it; the tail is forked or emarginated, and normally consists of twelve feathers; the legs are weak and small, the toes are long and slender, and with the normal number of joints; the claws curved and acute, but slender. The anatomical features demonstrate the close relationship of the family with the ordinary singing birds (such as the sparrows, thrushes, etc.), and the great differences from the swifts, which resemble them so much as formerly to have been generally united with them. There are over 125 species, and representatives are found in almost every land and every zone save the extreme polar regions. The several genera have been differentiated into two subfamilies—*Hirundininæ*, in which the outer edge of the wing is smooth-feathered, containing almost all of the species; and *Psalidoprocninæ*, in which it is serrated or armed with stiff recurved hooks, represented by the African genus *Psalidoprocne* and the American *Stelgidopteryx*. The species are among the most active and graceful of birds, and their circling and sweeping flight is well known to observers. They feed almost exclusively on insects, which they take on the wing. Their mode of nesting is various (for the nest of the barn-swallow, see NESTS OF BIRDS), the eggs five or six. The most common North American species are the purple martin (*Progne subis*); the cliff-swallow (*Petrochelidon lunifrons*); the barn-swallow (*Chelidon erythrogaster*); and the bank-swallow or sand-martin (*Cotyle riparia*). The so-called chimney-swallow is a swift. See SWIFT and MARTIN.

Revised by F. A. LUCAS.

**Swamp'scott**: town; Essex co., Mass.; on Massachusetts Bay, and the Boston and Maine Railroad; 2 miles N. E. of Lynn, and 13 miles N. E. of Boston (for location, see map of Massachusetts, ref. 1–I). It is a noted watering-place with an excellent beach and large accommodations for season and transient guests; contains the villages of Swampscott, Beach Bluff, Phillips Beach, and Mountain Park; and has a high school, 14 district schools, public library, 3 hotels, and 5 churches. In 1894 the assessed valuation was $5,000,000. Pop. (1880) 2,500; (1890) 3,198; (1900) 4,548.

**Swan** [O. Eng. *swan*: O. H. Germ. *swan* (> Mod. Germ. *schwan*): Icel. *svanr*]: any one of those swimming birds of the family *Anatidæ*, sub-family *Cygninæ*, which have a bill nearly equally broad throughout and as long as the head; the cere soft and extending to the eye; neck long and slender, consisting of twenty-two to twenty-six vertebræ; the front toes with a large web; the hind toe without a lobe; the tail short and rounded; the second and third wing-quills the longest. They are the largest species of the family, and among the largest of birds. Some authorities place all swans in one genus, *Cygnus*; others admit four genera, *Cygnus*, *Olor*, *Chenopis*, and *Sthenelus*. Omitting the Coscoroba swan (*Coscoroba coscoroba*), which probably belongs with the ducks, there are nine species, all but two inhabitants of the northern hemisphere. The exceptions are the black-necked swan (*Sthenelus melancorypha*) of Chili and the black swan (*Chenopis atrata*) of Australia. The North American swans, whistling swan (*Olor columbianus*) and trumpeter swan (*O. buccinator*), are fine birds, both white. The tame swans are of two European species—red-billed swan (*Cygnus olor*) and Polish swan (*C. immutabilis*). The former is found in a wild state throughout a great part of Europe, while comparatively little is known of the second species, some authors considering it to be a mere variety of the first. *Cygnus immutabilis* is so named from the fact that the young—or cygnets—are white, while those of other species are gray. Though once held in considerable esteem for the table, domestic swans are now bred merely for ornament. F. A. LUCAS.

**Swan**, JAMES: soldier and author; b. in Fifeshire, Scotland, in 1754; went to Massachusetts at an early age; was a clerk in Boston; published a *Dissuasion to Great Britain and the Colonies from the Slave Trade to Africa* (1772); became captain of artillery, secretary to the Massachusetts board of war, member of the Legislature in 1778, and afterward adjutant-general of the State. In 1787 he went to Paris; wrote *Causes qui sont opposées au Progrès du Commerce entre la France et les États-Unis de l'Amérique* (1790); acquired a large fortune; returned to the U. S. in 1795; returned to Europe in 1798; in 1815, upon the suit of a German with whom he had transactions, he was arrested and thrown into a prison in Paris, where he remained fifteen years. He also published *On the Fisheries* (1784); *Fisheries of Massachusetts* (1786); *National Arithmetick* (1786); and an *Address on Agriculture, Manufactures, and Commerce* (1817). D. in Paris, Mar. 18, 1831.

**Swan-p'an**: See ABACUS.

**Swan'sea** (Welsh, *Abertawe*): seaport in Glamorganshire, South Wales; at the mouth of the Tawe; 216 miles W. of London (see map of England, ref. 12–E). Owing to the rich coal-fields in the vicinity, and its position on the bay affording safe anchorage, Swansea has developed into one of the most important manufacturing towns in Great Britain. Nearly half the entire exports are tin-plates, the rest being coal, coke, iron, steel, zinc, copper, alkali, etc. The imports include copper, zinc, lead, silver, tin, iron, and their ores; also sulphur, grain, timber, etc. The total tonnage of vessels entered and cleared in 1893, exclusive of that coastwise, was 1,320,144. The parliamentary borough returns two members. Pop. of municipal borough (1901) 94,505.

**Swansea**: town (incorporated in 1668); Bristol co., Mass.; on Mt. Hope Bay, and the N. Y., N. H. and Hart. Railroad; 4 miles N. W. of Fall River (for location, see map of Massachusetts, ref. 5–I). It contains the villages of Swansea, North Swansea, South Swansea, Center Swansea, and Hortonville; has ten public schools, a public library, and a Protestant Episcopal church; and is principally engaged in agriculture and in bleaching and dyeing. Pop. (1880) 1,355; (1890) 1,456; (1900) 1,645.

**Swanton**: town; Franklin co., Vt.; on the Missisquoi river, near the north end of Lake Champlain, and on the Cent. Vt. and St. Johns and Lake Cham. railways; 9 miles N. of St. Albans, the county-seat (for location, see map of Vermont, ref. 2–B). It contains a union public school, a national bank with capital of $50,000, a weekly paper, quarries of white and variegated marble, and spring-bed and other factories. Pop. (1890) 3,231; (1900) 3,745; village 1,168.

**Swarga**, or **Svarga** [Sanskr.]: in Hindu mythology, the heaven over which Indra presides. It is the residence of beatified mortals and of the inferior gods, and is supposed to be situated on Mt. Meru. See INDRA and MERU.

**Swarthmore College**: a coeducational institution at Swarthmore, Delaware co., Pa., opened in 1869. It was founded by the Society of Friends belonging to the Yearly Meetings of Philadelphia, New York, and Baltimore, for the purpose of furnishing opportunities for higher education to its own members and to persons of other denominations. Women as well as men are members of its faculty and of the board of managers. It offers four courses of study—arts, letters, science, and engineering—for the completion of each of which a separate degree is given. In 1900 it had 28 instructors, 200 students, and 19,462 volumes in its library. The presidents have been Edward Parrish, Edward H. Magill, William Hyde Appleton, Charles De Garmo, and William W. Birdsall. Besides the main college building, in which are the dormitories, libraries, the biological laboratory and museum, and class-rooms for the departments of ancient and modern languages, mathematics, history, and economics, there is a spacious science building containing the chemical laboratory, the physical laboratory for teaching electrical engineering, the draughting-room, and shops of the engineering department. There is also an astronomical observatory and two gymnasiums, one for the young men and one for the young women. CHARLES DE GARMO.

**Swatow**: a port of China, opened to foreign trade by the treaty made at Tientsin in 1858. It is situated on the north or left bank of the river Han, about 5 miles within its mouth, in the province of Kwangtung but near the borders of Fuh-kien; lat. 23° 20′ 43″ N., lon. 116° 39′ E. (see map of China, ref. 8–J). It is the shipping-port of the city of Ch'ao-chow-foo, 35 miles inland, and of San-ho-pa, 40 miles farther up the Han. The site of the native town is but little raised above the level of the river, which is here about a mile wide. The southern bank, on which the foreign settlement is located, is bold, and lined with hills of an average height of 400 to 500 feet. The foreign community is small. The natives, who in both features and language resemble the people of Fuh-kien rather than those of Kwangtung, are noted for their turbulence and their hostility to foreigners. Their dialect, which is unintelligible to natives of Canton, approximates closely to that of Amoy. Sugar-making is the great industry of the neighborhood. The trade of Swatow, which is considerable, is mostly in the hands of natives, and is chiefly with Hongkong (180 miles distant), Shanghai, and Niuchwang. In 1893 917 vessels, with a tonnage of 883,695 tons, entered, and the same number cleared. The net foreign imports for that year amounted to 8,238,721 Haikwan or custom-house taels, and the net native imports to 9,512,749 taels. Of the foreign goods imported, 7,486,902 taels came from Hongkong, 383,617 taels from Cochin-China, Tonquin, and Annam, 96,975 taels from Russia, and 40,320 taels from the U. S. The chief imports were opium, value 2,888,740 taels; rice, 3,473,247 taels; bean-cake (used for manure in the sugar-plantations), 253,786 taels; raw cotton, cotton and woolen goods, metals, matches, and kerosene oil. The exports included tea (about 7,000 piculs), sugar (valued at 3,125,009 taels), grass-cloth, liquid indigo, prepared tobacco, joss-sticks, and joss-paper, and amounted to 6,445,682 taels, or about $676,966 U. S. gold. In the same year 93,095 native passengers left the port, but only 56,217 entered. More than half of the native emigration, for which the port is noted, is directed to the Straits Settlements. Pop. 22,500. R. LILLEY.

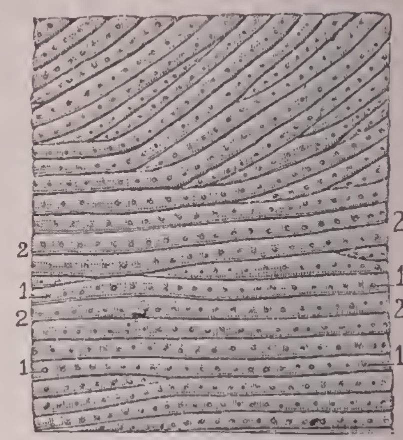
**Swayne**, JOHN WAGER: soldier and lawyer; son of Noah H. Swayne; b. at Columbus, O., Nov. 10, 1834; graduated at Yale College in 1856; studied law and practiced at Columbus; major of the Forty-third Ohio Volunteers 1861; became colonel; served through the Atlanta campaign; lost a leg at Salkahatchie, S. C.; breveted brigadier-general U. S. Vols. Feb. 5, 1865, promoted brigadier-general Mar. 8, 1865, and major-general June 20, 1865; mustered out of the volunteer service Sept. 1, 1867. He was a commissioner of the Freedmen's Bureau in Alabama, where he commanded the U. S. forces and administered the reconstruction acts; retired July 1, 1870. In 1880 he removed to New York.

**Swayne**, NOAH HAYNES, LL. D.: jurist; b. in Culpeper co., Va., Dec. 7, 1804; was clerk in an apothecary's shop in Alexandria; studied law; was admitted to the bar in 1823, and began practice at Coshocton, O.; in 1826–29 was prosecuting attorney of Coshocton County; in 1829 was elected to the State Legislature; removed to Columbus, O.; was U. S. district attorney 1831–41; was chosen judge of the court of common pleas in 1833, but declined the office; was again elected to the Legislature in 1836, and was prominent in organizing asylums and institutions for the deaf and dumb, the blind, and the insane; joined the Republican party on its formation; in 1861 was appointed a justice of the U. S. Supreme Court; resigned 1881. D. in New York, June 8, 1884.

**Swaziland**: See SOUTH AFRICAN REPUBLIC.

**Sweaborg**, or **Sveaborg**, svā'ă-borg: a fortress of Russia, on the northern coast of the Gulf of Finland (see map of Russia, ref. 5–C). The place was originally fortified by Sweden. When Finland became a province of Russia (1809), the latter made it a military and naval dépôt. The isle of Vargoe is the central or principal fortress; the isle of Great Oester-Svartoe the principal naval dépôt and dockyard. See HELSINGFORS. Revised by M. W. HARRINGTON.

**Sweat**, or **Perspiration** [*sweat* is deriv. of *sweat* (verb) < M. Eng. *sweten* < O. Eng. *swǣtan*, deriv. of *swāt*, sweat: O. H. Germ. *sweiz* (> Mod. Germ. *schweiss*): Icel. *sviti*; cf. Lat. *suda're*, to sweat: Gr. ἵδρως, sweat: Sanskr. *svid-*, to sweat]: the fluid exuded through the pores of the skin, consisting of water with numerous solids in solution. The amount of water excreted from the skin either in the form of the insensible perspiration, which maintains its softness and moisture, or in perceptible sweat, is but little less than the volume of the urine or the equivalent in water of the moisture exhaled from the lungs in breathing. It varies with the seasons and climate, sweat being most profuse in summer and the warmer regions. The action of the skin is complementary to that of the kidneys, chilling of the integument producing renal hyperæmia. The amount of solid excretory matter and carbonic acid gas eliminated by the skin is small, but can not be suppressed without danger to life. Experiments of closing the pores by a coating of varnish or tin-foil, both in man and lower animals, have induced alarming depression and death. Reversely, the artificial stimulation of the perspiration is a valuable channel for eliminating morbific matter in impaired health or disease. Bathing, friction, and clean clothing, by favoring activity of the sweat-glands and open pores, are means of preserving health. The sweat is secreted by the sudoriparous or sweat-glands, coiled tubular masses beneath the skin, with excretory tubules terminating on the surface. (See HISTOLOGY, *The Skin and its Appendages.*) The tube is about $\frac{1}{870}$th of an inch in diameter, the coils or glands vary from $\frac{1}{125}$th to $\frac{1}{25}$th or $\frac{1}{12}$th of an inch in diameter. The number of sweat-openings varies on different surfaces; thus, as enumerated by Krause, the palm of the hand (see figure) has 2,736 to the square inch, the back of the hand 1,490, sole of the foot 2,685, top of the foot 924, forehead 1,258, cheek 548. The number of sweat-glands in the body is estimated at 381,248, and the aggregate length of tubules as $2\frac{1}{3}$ miles. Revised by W. PEPPER.



Surface of the palm of the hand; a portion of the skin about half an inch square, magnified four diameters (*Sappey*): 1, 1, 1, 1, openings of the sweat-ducts; 2, 2, 2, 2, grooves between the papillæ of the skin.

**Sweating Sickness**: one of the prevalent and fatal epidemics which occurred during the fifteenth, sixteenth, and early part of the seventeenth centuries. It was also known as pestilent sweat and as the English ephemera, as the English people both at home and abroad were chiefly attacked. In Germany, Holland, Sweden, and Denmark it prevailed more mildly. It first appeared in England in 1485. It was of brief period, both in individual cases and in duration of single epidemics. Fully half of the population in infected towns had the disease, and the mortality was great, but where death did not result all danger was past in twenty-four or forty-eight hours, and epidemics rarely lasted a month. The other great English epidemics were in 1506, 1517, 1528, and 1551. In the last two the disease for the first time left English soil, appearing in various parts of Western Europe. After 1551 no further epidemics were met with till the beginning of the eighteenth century, since which numerous outbreaks of the disease, now generally known as *miliary fever*, have occurred. Miliary fever is of common occurrence to the present day, scarcely a year passing without an epidemic in some part of the world; but it is mild in character and very rarely spreads to any considerable distance. The attack consisted of a febrile and sweating period. It began with pains in the back, shoulders, and limbs, flushes of heat, oppression at the liver and stomach, pain in the head, delirium, palpitation, followed by heaviness and desire to sleep, which in fatal cases tended to become profound coma or stupor. Profuse sweating then set in, in favorable cases leading to speedy convalescence. Often there was an eruption in the skin, which afterward desquamated in cases which recovered. The patient was liable to one or many relapses. The disease spared the aged and young, attacking chiefly middle-aged, plethoric men of all classes and of every rank. Both in England and on the Continent the greater prevalence of this disease among Englishmen was attributed to their peculiarly gluttonous, excessive diet. By Hecker, Guy, and others the several epidemics of this disease are ascribed to preceding periods of atmospheric and telluric insalubrity, the influence of gathered armies, and to the absence of house and street drainage in the larger cities and towns. Its period of incubation, rapid progress, and speedy convalescence disconnect it from epidemics of the typhus class. The nature of sweating sickness has been the subject of much conjecture. Doubtless it is some special infection and not influenza, malaria, or rheumatism, as older writers were disposed to think. Probably various diseases have been described under this name. The treatment consists mainly in rest and tonics. WILLIAM PEPPER.

**Sweating System**: in popular usage, a term applied to the practice followed in certain trades of sub-contracting for a low class of work, which is done sometimes on the premises of the laborers, sometimes on the premises of the sub-contractor, and often amid unsanitary surroundings and with excessive hours of labor. This use of the term, however, is erroneous, for sub-contracting may be, and often is, practiced without the injurious results popularly associated with it. The system of sub-contracting obtains largely in iron and steel rolling, in which trades labor is as highly paid as in any others. The practice is coincident with but not inseparable from what is meant by sweating. An accurate definition of this term can not be given. The House of Lords' select committee in their report attempted several, but none is satisfactory. Indeed, the chairman, Lord Derby, said later: "We endeavored . . . for some years to ascertain what meaning attached to the word 'sweating,' and we never could find any." The reason is that, while the evils which the term sweating has been selected to describe undoubtedly exist, there can properly be no such thing as a sweating system. The so-called system is characterized by the absence of system, by the lack of those very features which denote the factory system or general industrial organization. Hence it must be regarded as an excrescence, an abnormal phase of industrial development, which when properly understood may be regulated, and, so far as environment is concerned, rectified. The term "sweating" is in this connection a term of reproach, and was first applied to tailors who took home work that their wives and children might assist them. Later, as Charles Booth pointed out, they found it profitable to do all their work at home. Then they began employing others, thus becoming sweaters instead of being sweated. Among boot-makers the "sweater" is known as the "chamber" or "garret" master. Among other trades it is the sub-contractor or middleman who has been thus nicknamed.

*Extent of the Practice.*—Sweating is an effect of the survival of domestic industry. Factory labor is not subject to it. One must not understand that it can exist only with domestic industry. Before the introduction of organization and protective legislation, factory employees were subject to most of the evils associated with sweating; while to-day, in much of the "house industry" of Germany, whether the workman is his own master or comes in direct relations with the employer-in-chief, there is no complaint. Sweating is common in certain trades—in Europe in tailoring, boot-making, furriery, needlework of all kinds, nail and chain making, and dock labor; in the U. S. the practice is almost exclusively confined to tailoring and other kinds of needlework, the preparation of feathers, the manufacture of cigars, artificial flowers, and fancy leather goods.

The tailoring trade is the employment in which sweating is chiefly practiced. To describe the process will be of most service. The wholesale clothier supplies the cloth, which in many cases also is cut and trimmed in his own workshops. The goods are then farmed out to contractors, for the most part Jews, to be made up and returned at a fixed price per garment. The contractor is generally the lessee of a small room, usually attached to his own lodgings in a tenement-house. In this room two or three "teams" of workers are employed—a machine-man, a baster, and a finisher constituting a "set." Wages are fixed on a piece basis. Where, for example, $7 is allowed for making up two dozen coats, $3 goes to the machine-man, $2.50 to the baster, and $1.50 to the finisher. The laborer must frequently work sixteen or eighteen hours in order to earn a nominal day's pay. The sweater works with his hirelings, overseeing them and often, doubtless, driving them to do their utmost. Sometimes his own margin of profit is so small that he is compelled to do this for protection against loss; but he is not always a pitiless taskmaster, and is besides on a footing of fair equality with his employees. Larger sweaters receive the cloth from wholesale clothiers, and cut and trim it in shops of their own, making up part of it on the premises and distributing the remainder among families working in their homes.

The essential features are as follows:

1. *Sub-contracting.*—The profits of the middleman are dependent upon the service he employs. Sub-contracting applied to unskilled or poorly skilled work makes competition painfully acute, and irresistibly reduces both contract and piece prices to the lowest possible minimum. Sub-contracting has developed particularly in the clothing business because the trade remains to a large extent a domestic industry, and can be pursued by women with other household occupations, because this method enables the wholesaler to save the cost of rent and superintendence, and to hold back his capital from investment in goods till the last moment, because it permits him to meet seasonal requirements by letting a large or small number of contracts as his exigencies demand, and because a very few dollars is all a middleman needs to start business. There is a tendency to do away with the middleman altogether, as is shown by large houses in London establishing workshops in the East End, and by New York dealers opening shops in outlying country districts, where rentals to home-workers will be less than in the tenements.

2. *Irregularity of Employment.*—This is common to all domestic industries. Large and well-organized establishments find it cheaper to run continuously than to stop during the dull seasons. No such condition exists in the sweated trades. Coupled with this is the evil of abnormally long hours of labor, which follow partly as a consequence of the above and partly because the small master works with his employees.

3. *Low Wages.*—These are due to several causes, among which are competition among sub-contractors, remuneration made to depend upon profits, the presence of a surplus of unskilled labor in cities, and the fact that much of the work can be performed by women who are only auxiliary supporters of the family. In certain cities of the U. S. there is the additional factor of an immense immigrant population, many of them Jews, and all having a relatively low standard of existence as well as endowed with patience and subserviency. It must be borne in mind that all persons working under the sweating system are not paid starvation wages. The skilled contingent commands fair remuneration. Because so much of the work is bad, and need only be so, is one reason why it is cheap. The proportion being large, the number of laborers in receipt of meager earnings is naturally also large. Failure to discern this fact has led to confused notions in reference to sweated trades. Low wages accompany inferior efficiency. The sweating system furnishes aggravated cases.

4. *Insanitary Conditions.*—These naturally result from using the dwelling as a workshop, particularly if lodgers are taken to make up the required "set." The evil is probably augmented in cities where this class of people live in tenement-houses.

What are the remedies, and how shall they be applied?

1. The most important is reorganization of the sweated trades. The main features of such reorganization are the development of large shops, substitution of superintendents remunerated by fixed salary for middlemen contracting by the job, and trades-union organization among workers. The second feature is especially important, and will probably come about as the first one grows. Large sweat-shops, which not uncommonly are severely condemned, are in reality not only better conducted than "gang-sweating" or "home-working," but are performing a useful step in the evolution of the industry from house to factory. Labor organization among unskilled and over-crowded occupations is a difficult matter, but the London dockers and the boot and shoe operatives in Massachusetts furnish evidence that it is feasible, and that much may be thereby accomplished.

2. Licensing by municipal authority, under stringent regulations as to cleanliness, use of sleeping apartments for work-rooms, employment of persons outside the family, and precautions against infectious diseases. Tagging tenement-made garments under penalty of a good-sized fine is also an effective provision.

3. Adequate inspection service for sweat-shops, large and small. Only in this way can health and morality be subserved.

There are no reliable statistics showing the extent to which sweating is practiced. The evils associated with the system are concomitants rather than products. Most of them are incident to lack of skill, physical inefficiency, moral weakness, and other factors which make for poverty.

E. R. L. Gould.

**Sweden** [deriv. of *Swede*: Fr. *Suède* (*Suédois*): Germ. *Schwede*. Cf. Swed. *Svear*: Icel. *Svīar*: O. Eng. *Swēon*, Swedes]: one of the confederated kingdoms of Sweden and Norway, occupying the eastern slope and southern end of the Scandinavian Peninsula, with Öland and Gothland islands (see map of Norway and Sweden). Area, including lakes, 172,876 sq. miles; pop. (1899) 5,097,402, or 29·5 per sq.

mile. The most of the boundary with Norway is formed by the watershed of the Kiölen Mountains, and that with Finland by the Torneå river and its branches.

*Topography.*—The coast is 4,740 miles long, of which 4,100 are on the Baltic and Gulf of Bothnia, the remainder on the Cattegat and Skager Rack. The fiords are few, and the adjoining seas generally shallow, with gentle slope. The coast is bordered by a narrow ribbon of islets called the *skärgård*, rocky and bare on the west coast, but green and fertile on the east. The Sound, 2½ miles wide at its narrowest part, separates Sweden from the nearest point of Denmark. The islands are most numerous about Stockholm.

The Baltic slope of the peninsula is gentler than the Atlantic one, and in Norrland (the northern part of Sweden) it descends in a series of terraces, giving its rivers alternately gentle courses, when they expand into lakes, and rapids, or cataracts. The southern part of Sweden or Gothland has a good development of rocky hills, and is separated from the central part, or Svealand (Sweden proper), by a broad low land filled with great lakes. The extreme south is ancient Skania, and is very fertile. Northern Gothland is relatively arid. Beyond Stockholm is Upland, the classic ground of Sweden, consecrated to ancient traditions. Dalecarlia, N. W. of Stockholm, and on the Norwegian frontier, is a beautiful and picturesque land with gay, hardy, and independent inhabitants; here Gustavus Vasa found the support necessary to overthrow the tyrannical Christian.

The highest mountains are in or near the Norwegian frontier, from 66° to 68° N. lat. The highest known is Kebnekaise, or Ivanstenen, in lat. 68° N.—more than 7,000 feet high. Sulitelma, 2° farther S., and long considered the highest mountain in Sweden, is 6,154 feet high. The culminating points of Norway are considerably higher. Sweden is not properly mountainous; it only descends a long and relatively gentle slope. Glaciers are very numerous in the north, covering a total area of 150 sq. miles. The largest are about Sarjektjokko (6,825 feet high, and between the two mountains above named), where on a surface of 460 sq. miles they cover 70. The glaciers are reported as growing.

*Rivers and Lakes.*—A score or more of rivers descend the slopes, form lakes in their course, have a length of 150 to 250 miles, and empty into the Bothnia or Baltic. The quantity of water they pour into the Bothnia keeps it almost fresh. The innumerable lakes occupy one-twelfth of the entire surface. They are generally small, but about thirty have an area of 40 sq. miles or more. The largest is the Wener, between Gothland and Svealand; area, 2,150 sq. miles; 144 feet above the sea; greatest depth, 295 feet. The second in size is Lake Wetter, a few miles S. E. of the preceding; area, 733 sq. miles; 290 feet above the sea; greatest depth, 410 feet. It is celebrated for the beauty of its shores, the clearness of its waters, its fogs, and its sudden storms. Lake Mälar, the third in size, and penetrating Stockholm, fiord-like in form, is only a few inches above the Baltic, and is divided into a series of levels but a few inches apart. It is said to have 1,200 islands.

*Climate.*—The climate is very mild for the latitude, and storms pass usually W. or S. The annual precipitation is from 10 to 40 inches, and is greatest on the southwest coast. It is said that the harvests are fifteen days later than in the eighteenth century.

*Geology and Mineral Products.*—Primitive crystalline and azoic rocks cover the most of the country, and the chief metalliferous beds are in the upper layers of these. Cambrian and Silurian rocks are not rare, and some Triassic and Cretaceous exposures are found. The Glacial period was an important one in Sweden, and has left traces everywhere. Mining is an important industry, and the production of iron is large. The chief districts are the Gellivara, within the Arctic Circle, and the Dannemora, in Upsala. In 1899 the chief mineral products were as follows: Pig iron, 489,231 tons, and bar iron, 335,706 tons; iron ore, 2,434,606 tons (1,400,801 exported in 1898); coal, 239,344 tons: gold, 234 lb.; silver, 5,047 lb.; lead, 3,540,396 lb.; copper, 394,196 lb. Zinc and manganese are also produced, and cobalt and nickel are found.

*Fauna and Flora.*—The fauna and flora must have migrated into Sweden after the Glacial period, and are more Finnish than German. The forests are very extensive, covering two-fifths of the area, and are characterized by spruces and birches to the north, pines and oaks in the center, and beeches in the south. The reindeer are nearly all domesticated, but the large pasturage area they require and their tendency to epizoötic diseases greatly limit their usefulness. The bear, wolf, lynx, and glutton are disappearing, while the fox and elk appear to be increasing, and the roe-deer is extending its range farther N. The swan is a common visitant of the lakes.

Food-fish are very abundant, and include, in fresh water, the salmon (by far the most important), the eel, pike, perch, and turbot; in salt water, the herring (by far the most important), flatfish, cod, mackerel, and sprats. The herring of the east coast are much smaller than those of the west.

*Products.*—The climate and soil are not very favorable for agriculture, but this is made up by the care given to the art. Only one-fifteenth of the area is cultivated; one part in ninety-two in Norrbotten, but one-third in Malmöhus. Barley and potatoes reach 68° N. lat.; rye passes N. of Haparanda, at the north end of Bothnia; wheat, formerly cultivated only S. of Stockholm, reaches the Dal river, 75 miles farther N. The farms are generally small, but they give occupation to about half of the population. The largest area is in oats, but the largest agricultural crop is potatoes. Horses are relatively numerous (one to every ten persons), due to the character of the roads. The stock generally is of poor native races, but the dairy industry is growing rapidly, as London is an accessible and profitable market.

*Divisions.*—The country is divided into twenty-four governments besides the city of Stockholm, as follows:

| GOVERNMENTS (LÄN). | Area, square miles. | Est. pop. Dec. 31, 1899. |
|---|---|---|
| Stockholm (the capital) | 13 | 302,462 |
| Stockholm (rural district) | 3,015 | 167,053 |
| Upsala | 2,051 | 123,774 |
| Södermanland | 2,631 | 166,363 |
| Oster Gothland | 4,267 | 277,553 |
| Jönköping | 4,447 | 201,572 |
| Kronoberg | 3,825 | 158,938 |
| Kalmar | 4,443 | 227,730 |
| Gothland | 1,219 | 52,586 |
| Blekinge | 1,164 | 145,563 |
| Christianstad | 2,486 | 219,407 |
| Malmöhuus | 1,866 | 404,306 |
| Halland | 1,900 | 141,954 |
| Goteborg and Bohus | 1,948 | 331,841 |
| Elfsborg | 4,938 | 278,589 |
| Skaraborg | 3,280 | 241,922 |
| Wermland | 7,435 | 254,175 |
| Orebro | 3,498 | 193,993 |
| Westmanland | 2,625 | 147,227 |
| Kopparberg | 11,522 | 214,861 |
| Gefleborg | 7,614 | 234,348 |
| Westernorrland | 9,837 | 229,011 |
| Jemtland | 19,712 | 110,492 |
| Westerbotten | 22,754 | 141,830 |
| Norrbotten | 40,870 | 129,852 |
| Lakes Wener, Wetter, Mälar, Hjelmar | 3,516 | ........ |
| Totals | 172,876 | 5,097,402 |

*Population.*—The population has shown for 150 years a considerable surplus of females (1,065 to 1,000 males); it has also shown a steady growth of nearly 1 per cent. per annum. The last is in spite of a considerable emigration to America, and is due to the high birth-rate, and not to immigration, which is very small. About 10 per cent. of the births are illegitimate, due not to immorality but to thrift and narrow circumstances; the parents usually marry later. The Finns number about 17,000; Lapps, 6,500; Jews, 3,000; other foreigners, 15,000. Aside from these, the Swedish type is pure and unmixed, and the ancient division into Göta (Goths) and Svea (Swedes) has about disappeared. The Lutheran is the state church, and other religions, though tolerated, are few. Education is compulsory, schools of all grades are numerous (including two ancient and highly esteemed universities, at Upsala and Lund respectively), and the percentage of illiteracy is evanescent. Serious crimes are relatively rare, but pauperism is large and increasing.

*Imports and Exports.*—The value of the annual imports is about $100,000,000, chiefly textiles, colonial wares, and coal; the annual exports are valued at $90,000,000, chiefly timber, animals and their products, and ores. Germany is the chief importer, Great Britain the chief buyer. The merchant navy consists of about 1,500 craft of over 100 tons burden, one-third steamers. Gothenburg is the most frequented port, Stockholm next, and 22,000 vessels visit Swedish ports annually.

*Railways.*—The railways have a length of 6,433 miles (1898), of which 2,283 miles belong to the state. The most noteworthy railway is that which connects Stockholm and Trondhjem in Norway, and the most northern railway in the world is the one which extends from the head of Bothnia northward to Gellivara and beyond, and is in process of construction to Ofoten Fiord, on the Norwegian Polar Sea.

*Government.*—Sweden has her own constitution, and governs herself, except for foreign affairs. Her system of government is the outgrowth of centuries of history, like that of Great Britain. The king is intrusted with the executive, and is aided by a council of state of ten ministers. Taxation and legislation (the latter subject to the king's veto) are intrusted to the two elective houses of a parliament, one of 150 unpaid members holding for nine years, the other 230 paid members holding for three years. The government of the twenty-four provinces is in the hands of prefects appointed by the king, but local affairs are administered by communal and municipal councils. The municipalities are limited to cities of over 25,000 inhabitants, and are at present Stockholm, Gothenburg, Malmö, Norrköping, and Gefle. The total revenue is about $27,000,000, collected chiefly from customs ($10,000,000), from land taxes and state property ($5,000,000), internal revenue (as stamps, spirit licenses, income tax), from the post-offices, and from the profits of the national (Riks) bank. One-third is expended on the army and navy; one-fortieth only on the royal household. The public debt is $85,000,000 (1899), contracted for state railways. The army is small, and the navy is intended only for coast defense. See ARMY and SHIPS OF WAR.

*History.*—The early mythical history of Sweden is dignified and attractive, and the gods of the Northmen displayed their chief activity in Svealand. The Goths, who played so important a part in the downfall of the Roman empire and the reconstruction of Europe, seem to have come from Gothland. Authentic history begins about 1,000 A. D., when Olaf became a Christian. The people did not accept Christianity for 150 years, and pagan ideas and customs lingered long after. The dissensions between Goths and Swedes were healed about 1300, and their amalgamation has continued since without serious interruption. The early history was terminated in 1389 by the battle of Axelwalde, when Queen Margaret of Denmark and Norway, a striking historical figure, took the Swedish king Albert prisoner, and the union of the three Scandinavian countries was confirmed in 1397 by the act called the Union of Calmar.

Sweden was very restive under the union, and tried repeatedly to break away, but without permanent success, until led by Gustavus Vasa (1523). With this king began the brilliant period of history which made Sweden one of the first powers of Europe, gave her extensive lands to the S. and E., and made her at one time the leader and defender of Protestantism. During this period appeared his grandson, Gustavus Adolphus, one of the most gallant figures in all history, and by far the greatest of Swedish kings, and the period ended with the resignation of his daughter Christina in 1654. Then follow 150 years of decline, during which Sweden was robbed both of her influence and her foreign possessions, until Gustavus IV. (1792–1809) proved so impotent and perverse that he was dethroned and his posterity repudiated.

Charles XIII. was then elected (1809–18), but was childless, and Marshal Bernadotte was invited to become crown prince. He accepted and founded the present line, under which Sweden's progress has been steady and secure. See SWEDEN, HISTORY OF, in the Appendix.

See article SWEDEN AND NORWAY; also NORWAY and DENMARK. See also Wood's *Sweden and Norway* (1882) and Löfström's *Swedish Statistics* for the World's Columbian Exposition (1893). MARK W. HARRINGTON.

**Sweden and Norway**: a federated kingdom occupying the Scandinavian Peninsula. The combined area is 297.321 sq. miles, and the population at the beginning of 1891 was 6,785,898; Sweden has nearly three-fifths of the area and three-fourths of the population. For details, see the articles NORWAY and SWEDEN. The federation was formed in 1814, and goes little further than allegiance to a common king and a common interest in foreign affairs. The king is Oscar II. of the house of Ponte Corvo founded by Bernadotte. The law of succession is the same in the two countries. The common affairs are decided upon by a council of state composed of Swedes and Norwegians. The federation is not without political friction, and is less satisfactory to Norwegians than to Swedes. MARK W. HARRINGTON.

**Swe′denborg**, EMANUEL: theologian; b. in Stockholm, Sweden, Jan. 29, 1688. His father, Jesper Swedberg, was Bishop of Skara in West Gothland, and was charged with the care of the Swedish churches in England and in the North American colonies. His family was ennobled by Queen Ulrica in 1719, and took the name of Swedenborg. He was educated at Upsala and then traveled widely through Europe. He attained to great eminence by his writings upon mathematics and mechanics, and later on the natural sciences and on finance. In 1716 he was made assessor of the board of mines by Charles XII. He assisted the king at the siege of Frederickshall in 1718 by transporting some vessels over 14 miles of land by machines he invented.

He had always been a thoroughly religious man, but for a few years before 1745 his diaries and note-books (which have been published to the extent of twelve or more 8vo vols.) show that he was changing the direction of his studies from the physical and natural to the psychical and spiritual. In that year, he tells us, he "was called to a new and holy office by the Lord himself, who manifested himself to him in person, and opened his sight to a view of the spiritual world, and granted him the privilege of conversing with spirits and angels." In 1747 he resigned his office of assessor, which he had held for thirty years, requesting that half of his salary might be continued to him. The king accepted his resignation, and granted him a pension for life equal to his full salary. He wrote to a friend: "My sole view in this resignation was, that I might devote myself to that new function to which the Lord had called me. On resigning my office a higher degree of rank was offered me, but this I declined, lest it should be the occasion of inspiring me with pride." From 1749 to 1756 he published the *Arcana Cœlestia* in eight 4to vols.; in 1758, *An Account of the Last Judgment and the Destruction of Babylon*; *On the White Horse mentioned in the Revelation*; *Heaven and Hell*; *On the Planets in our Solar System and in the Starry Heavens*, and *On the New Jerusalem and its Heavenly Doctrines*; in 1763, *The Doctrines of the New Jerusalem concerning our Lord*, same *Concerning the Sacred Scriptures*, same *Concerning Faith*, same *Concerning Life*, a *Continuation concerning the Last Judgment and the Destruction of Babylon*, and *Angelic Wisdom concerning the Divine Love and Wisdom*; in 1764, *Angelic Wisdom concerning the Divine Providence*; in 1766, *The Apocalypse Revealed*. He had written a much larger work, *The Apocalypse Explained* as far as the tenth verse of the nineteenth chapter, which he did not publish, nor, as far as is known, finish—it has been published since his death; in 1768, *The Delights of Wisdom concerning Conjugial Love*; in 1769, *A Brief Exposition of the Doctrine of the New Church*, and a small work entitled *The Intercourse between the Soul and the Body*, which is called in the English translation *A Treatise on Influx*. In 1771 he published his last work, *The True Christian Religion, containing the Universal Theology of the New Church*. He also left voluminous manuscripts, of which Dr. J. F. S. Tafel, professor and librarian in the University of Tübingen, published many. After the publication of the *True Christian Religion* he went to London, and while there, on Christmas Eve in 1771, he was struck with hemiplegia. After a few weeks he recovered his speech, and his faculties were clear to the last. His strength gradually declined, and he died Mar. 29, 1772.

He has never been charged with imposture, and they who think he was insane must rest that opinion on the fact that for more than twenty-five years, with brief intermissions, he claimed that he was in the spiritual world whenever he wished to be there, and published what would fill volumes of things there seen and heard. The best edition of his works is by R. L. Tafel (10 vols. fol., Stockholm, 1869–70); many are published in English translation by the New Church publishing societies (e. g. New York). See his *Life*, by B. Worcester (Boston, 1883). For an abstract of his doctrines, see NEW JERUSALEM, CHURCH OF THE.

Revised by S. M. JACKSON.

**Swedish Green**: See SCHEELE'S GREEN.

**Swedish Language**: genetically, a member of the Scandinavian division of the Teutonic group of languages. With Danish it forms the minor group East Norse, as distinguished from West Norse, made up of Icelandic and the modern popular dialects of Norway. Its present territory is the kingdom of Sweden, together with neighboring parts of Russian Finland and Esthonia. Chronologically, two main periods are recognized in the history of the language, viz., Old Swedish, from the end of the Viking age to the Reformation, in round numbers from 1050 to 1540; and Modern Swedish, from the Reformation to the present time.

The linguistic separation of the Scandinavian north falls within the Viking age (700–1050). Down to the year 1000, however, although local differences are visible even early in the period, the language is still, to all purposes, homogeneous, and only after the introduction of Christianity, at the middle of the eleventh century, do distinct dialects arise; namely, Swedish-Danish and Norwegian-Icelandic. The latter was not strictly differentiated until the beginning of the thirteenth century, the former not until its end. The material for the history of the earliest period of Swedish is contained in runic inscriptions, in all nearly 2,000, most of them from the eleventh and twelfth centuries. The oldest extant MS. is from the end of the thirteenth century (1281), after which time a native literature began to appear. The linguistic territory of Old Swedish comprised modern Sweden, with the exception of parts of the west which were Norwegian, and the southern provinces of Skaane, Halland, and Blekinge, which were Danish, besides, and to a greater extent than at present, coast regions of Finland, Esthonia, and Livland. The language of the period shows numerous local differences, but only in one case, the dialect of the island of Gothland, which is frequently described in contradistinction to Old Swedish as Old Gutnic, are they sharply defined. A common national language, a movement toward which is distinctly visible after 1350, gradually developed itself in the main out of the middle Swedish dialect of Södermanland.

Modern Swedish is the continuation, in direct descent, of the Old Swedish dialect of the midland provinces of Södermanland and Ostergöthland, which even in Old Swedish shows few local differences. Its beginning is coincident with the Reformation, and its first important literary monument is the translation of the Bible, the so-called Gustavus I. Bible of 1541. The language may be said to have assumed its present appearance early in the eighteenth century. The important external modifications from Old Swedish down were first the introduction of a multitude of Low German words into the vocabulary during the fourteenth and fifteenth centuries, principally as a consequence of commercial connection with the Hanseatic League. A Danish influence, the result of political conditions under the Danish sovereigns from the end of the fourteenth century to the beginning of the sixteenth, made itself widely felt, not only in the vocabulary by the introduction of Danish words, but in phonology and inflections. A second influx of German words came in with the Reformation. A reactionary tendency which looked toward the displacement of foreign elements and the rehabilitation of older words and forms has several times shown itself. This movement was directed at the beginning of Modern Swedish in the sixteenth century against Danicisms. In the latter half of the seventeenth century many words were introduced from Old Swedish and Old Icelandic, a process repeated in the nineteenth century by the further reinstatement of Old Swedish forms and the adoption of words from the spoken dialects.

Internally, the general tendency of the language from the fourteenth century down has been toward weaker phonetic conditions and simpler inflectional forms. At the beginning of the eighteenth century the Old Swedish system of inflections had to a great extent disappeared, and present conditions already prevailed. Some of the changes then observable date, however, from an earlier period. In the fifteenth century, for instance, falls the use of the ending *-s* for all genitives, and the displacement of the first plural of verbs by the third. In the sixteenth and seventeenth centuries all case-declension was lost in adjectives, and nominative, dative, and accusative in substantives were merged in a single form.

Swedish and Scandinavian language is distinctively characterized by the use of the suffixed definite article with substantives, and the formation of a passive voice of verbs by the addition of the reflexive pronoun, Swedish *-s*, to the corresponding active form. As an East Norse dialect it has, in common with Danish, as important characteristics the change of the diphthongs *ei*, *au*, and *ey* to the long vowels *e* and *ö*, respectively; the almost total absence of *u*-umlaut, and the passive form in *-s* (Icel. *-st*). In contradistinction, however, to Danish, which has throughout weakened the vowel of the inflectional ending to a voiceless *e*, Swedish has, in many instances, retained *a* and *o*; final *k*, *t*, *p* remain in Swedish after a vowel where they are weakened to *g*, *d*, *b* in Danish. Swedish has, in point of fact, on the whole much better preserved archaic phonetic conditions, although it has gone almost as far as Danish in the simplification of its grammar. As in Danish, but a single case-ending, genitive *-s*, occurs with substantives; neither the strong nor the weak adjective has inflection for case. Unlike Danish, where there is throughout no distinction of person in the verbal conjugation, Swedish has a distinctive form in the second person plural, and the threefold gender of substantives has been retained.

Swedish is still spoken in a number of dialects, some of which, like forms in Dalecarlia and the island of Gothland, notably deviate from the literary language. Generically, they may be arranged in a northern, middle, southern, and Gothland group. The northern or Norrland group includes, besides North Swedish proper, the dialects of Finland and Esthonia. The southern group is spoken in language territory once Danish, to which it is morphologically akin. Middle Swedish, out of which the literary language proceeded, shows the least dialectic differentiation, and now, as always, most nearly approximates the literary form.

For the pronunciation of Swedish, see Henry Sweet, *A Handbook of Phonetics* (Oxford, 1877). An exhaustive scientific treatment of the older language is contained in the chapter by Adolf Noreen, *Geschichte der nordischen Sprachen*, in Paul's *Grundriss der Germanischen Philologie* (vol. i., Strassburg, 1891); E. C. Otté, *A Simplified Grammar of the Swedish Language* (London, 1884). See also S. E. Rydquist, *Svenska språkets lagar* (4 vols., Stockholm, 1850–70), an historical grammar of the Swedish language, in Swedish. WILLIAM H. CARPENTER.

**Swedish Literature:** the literature of the Swedish people.

*Heathen Age.*—Although few fragments remain, it may be assumed that Sweden produced various literary works before the introduction of Christianity. The laws, which were given a written form in the following period, were composed much earlier, several runic inscriptions and figures, notably those of *Röksten* and *Ramsundsborg*, point to poetical works similar in character to the poetry of Iceland-Norway, and finally in the preface to *Þidreks saga af Bern* reference is made to the existence of a great body of lays in Denmark and Sweden.

*Mediæval Period.*—The influence of Christianity on the literature of Sweden made itself felt even later than on that of Denmark. Not until the middle of the thirteenth century did any Christian writings appear, but from that time great activity was displayed in the cloisters. The earliest theological writer of importance is Magister Matthias (d. about 1350), canon of Linköping and St. Birgitta's teacher, who is supposed to have made the first translation, or rather paraphrase, of a portion of the Old Testament (before 1340). During this century and the two following centuries other books, both of the Old and the New Testament, were put into Swedish. (See G. E. Klemming, *Svenska Medeltidens Bibelarbeten* 1848–55.) Matthias was also the author of commentaries on the Bible, originally written in Latin but afterward translated into Swedish. The only other religious prose work from this period that deserves special mention is *Heliga Birgittas Uppenbarelser* (The Revelations of St. Birgitta), "the first Swedish work that entered into the world's literature." (See BIRGITTA, SAINT.) It is full of warmth and originality and abounds in bold images. Of far greater importance is the influence exerted by Birgitta throughout the North, both on religion and literature. In the cloisters of her order a great mass of native writings was preserved and produced. The efforts of her followers were directed mainly toward translating continental mystical writings into Swedish. She encouraged the use of the Swedish language in the pulpit, and consequently a great mass of sermons, both in Danish and Swedish, must have been produced during this period, comparatively few of which, however, have been preserved. Of these only one, the Danish *Postille*, was printed before the Reformation. For specimens of Swedish sermons, see Klemming's *Svenska Medeltids-Postillor* (1879).

Swedish literature is remarkably rich, as compared with Danish, in legendary compositions. The most important collections are the so-called *Fornsvenskt Legendarium*, a translation of the *Legenda aurea* of Jacobus de Voragine, made shortly after the appearance of the original, but preserved in a MS. from 1350 (ed. by George Stephens, 1847–74), and *Vitæ Patrium*, in a MS. from 1385 (ed. by Klemming). Somewhat similar in character to these legends are the collections of miracles, of which a great number existed, both in Denmark and Sweden. Here may also be mentioned the narratives *Barlaam och Josaphat* and *Sju vise mästare* (The Seven Wise Men). These last two and many other mediæval prose works are contained in Klemming's *Prosadikter från Medeltiden* (1889).

Of secular prose literature the most important work is *Om Styrelse Kununga ok Höfdinga* (Concerning the Government of Kings and Princes; ed. with Latin translation and notes, Copenhagen, 1669), an adaptation in part of Egidius Romanus's *De Regimine principum*, written about the middle of the fourteenth century. See K. F. Söderwall, *Studier öfver Kununga-Styrelsen* (1880).

In historical writings Sweden must yield the palm to Denmark. The earliest prose history is the *Chronica Gothorum* (1470) of Ericus Olai (d. 1486), a dry annal written, like all the works of this class, in Latin, but later translated into Swedish. Of far greater interest are the rhymed chronicles, in which Sweden anticipated her sister kingdom of Denmark by a century. The oldest of these is the *Erikskrönika*, which treats of the strife between King Birger and his brothers Erik and Waldemar. It is undoubtedly the work of one who lived at the time the events described occurred. These close with the year 1320. Others are *Nya Krönika* and *Lilla Rimkrönika*, all written in Swedish. See Klemming's *Svenska Medeltidens Rimkrönikor* (1865–69).

In addition to the *Eufemia viser* (see DANISH LITERATURE), Swedish translations of a number of other romantic works exist from the Middle Ages. The first of these, following shortly after the *Eufemia viser*, is *Alexander*, made in 1380 under the direction of Bo Jonsson Grip from the Latin prose tale *Historia de Proeliis*. All have been edited by Klemming.

The principal original poetical production of this period in Swedish is found in the popular ballads (*Folkvisor*). It may be assumed that at least some of them were composed as early as the twelfth or thirteenth century in Denmark on Saxon models, and from there carried into Sweden. The later development of the ballads is practically the same in Sweden as in Denmark. The best collections of Swedish ballads are Geijer and Afzelius's *Svenska Folkvisor* (3 vols., 1814–16). Later edition by Bergström and Höjer (1880) and A. I. Arwidsson's *Svenska Fornsånger* (3 vols., 1834–42).

The oldest Swedish works in the vernacular are the provincial laws, which are derived in their original form from the heathen period, although they were not reduced to writing until much later. (See SCHLYTER.) The earliest of these and the oldest Swedish MS. in existence is the *Vestgötalag*, codified at the beginning of the thirteenth century, and preserved in a MS. from the end of that century. Besides the provincial there were also town laws, guild laws, and court laws.

*From the Reformation to 1640.*—Although the new doctrines were officially introduced into Sweden at the parliament of Vesterås (1527), they met with much opposition from all classes, and were not finally accepted by the people until 1593. Their influence upon the literature, however, was immediate and far-reaching. As in Denmark, this showed itself in the beginning chiefly in theology. In 1526 the New Testament was translated into Swedish by Laurentius Andreæ (1482–1552), the earliest leader in the movement, and in 1540–41 the whole Bible was given a native dress under the direction and largely by the actual labor of Laurentius Petri (1499–1573). Olaus Petri (1497–1552), a brother of Laurentius, rendered good service to the language as well as to religion by *Een liten postilla* (A Short Sermon) and *Den svenska messan* (The Swedish Mass, 1531), the foundation of the present Swedish Church service. He is the author of the first Swedish hymnal, *Någre Gudhelige Wisor, utdragne af den Heliga Skrift* (1530), which was followed by two other collections, partly original, partly translated from the German. His brother also composed a number of hymns; with these exceptions the period is extremely bare in religious poetry. A similar poverty is shown in secular poetry, the only works of any importance being the rhymed chronicles, of which may be mentioned the later redaction of *Lilla rimkrönika* (1520), Daniel Hansson Hund's (d. 1611) *Konung Erichs den XIV.'s Krönika, etc.*, and Karl IX.'s *Rimkrönika*. The separation from Denmark and the triumphs of Gustavus Vasa served to arouse the national enthusiasm, which found expression in numerous histories and chronicles, both in Latin and the vernacular. Olaus Petri's *Svenska krönika* is the first attempt to bring into discredit the claims of earlier writers for the antiquity of Swedish history. Although extremely uncritical, it may be regarded as the precursor of later historical methods. Its effects, however, were not immediately apparent, as Johannes Magnus (1488–1544) in his *Historia de omnibus Gothorum Sueonumque Regibus* (Rome, 1554) traces the royal line back to the Flood. The most prominent historian is Johan Messenius (1579 or 1581 to 1637), author of *Scandia illustrata* (14 vols.), written in Latin verse and prose. Minor historians are Peder Svart (d. 1562), Erik Tegel (d. 1636), Ægidius Girs (about 1580–1639), and Axel Oxenstjerna (d. 1654). The only prominent name in the first half of the seventeenth century is that of Johan Bure, or Bureus (1568–1652), the founder of the study of northern antiquities in Sweden. His influence upon the following period, especially through his connection with Stjernhjelm, was very great.

The only known specimen of dramatic literature in Sweden before the sixteenth century is a translation of the Latin *De uno peccatore, qui promeruit gratiam*. The earliest original school-drama preserved is *Tobiæ Comödia* (1550), attributed to Olaus Petri (ed. by Manderström, Stockholm, 1849). This was followed by a number of others, all in the vernacular, the subjects being taken from the Old Testament. The best of these is *Holofernis och Judiths Comödia*, by an unknown author. Gradually the original didactic element gives place to the æsthetic, the subjects being taken from profane history and from legends. A still further advance is marked by the treatment of national history. In this latter respect the Swedish drama is in strong contrast to the Danish, which with one exception shows no choice of national subjects until the middle of the eighteenth century. The earliest profane drama is *Een lustigh Comœdia vid namn Tisbe* (A Merry Comedy by the Name of Thisbe), probably by Magnus Olai Asteropherus (d. 1647), produced in 1610 (ed. by C. Eichhorn, Upsala, 1863). In this play the moralizing of the school drama is for the first time wholly absent. The most original dramatic author of the period is Johan Messenius. He planned to represent Swedish history in fifty plays, only six of which were completed. The first of these, *Disa* (1611), marks the beginning of the Swedish national drama. The national character of the plays is increased by the introduction of ballads, many of them original with the author, and the representation of peasant types (ed., with the exception of *Gustavus I.*, by H. Schück, Upsala, 1886–88; see also G. Ljunggren, *Johan Messenius som dramatisk författer*, Nord. Univ. Tidskr., 1862). Andreas Johannes Prytzz (1590–1655) wrote two religious-historical plays, *Olof Skottkonung* (1620) and *Comœdia om konung Gustaf I.* (1621), which display considerable satirical power. The school-dramas continued to be written and performed until the end of the seventeenth century.

*Period of Sovereignty* (*Stormakt*), *1640–1719.*—The political brilliancy of Sweden during the seventeenth century was reflected in education, literature, and science. Gustavus Adolphus was not only a great soldier and statesman, he was also a patron of letters and a writer of decided ability. Through his efforts elementary and high schools and gymnasiums were established, the University of Upsala was given new dignity and importance, and the intellectual formalism of the Reformation was replaced by a real culture. His example was nobly followed by his successors, Queen Christina, Charles XI., and Charles XII. The University of Lund was founded (1668), several scientific institutions were established, foreign scholars, among others Descartes and Hugo Grotius, were invited to Sweden, and many of the leading men of the country both encouraged learning and made contributions of their own. As a result of the newly acquired national pride, great interest was displayed in history, especially that of Sweden, but with the exception of Olof Rudbeck, the principal historical writers of this period were foreigners—Chemnitz, Puffendorf, and others. Attention was also directed toward the study of archæology, linguistics, and similar subjects. Olof Verelius (1618–82) translated many of the Icelandic sagas, and Johan Peringskiöld (1654–1720) translated the *Heimskringla*. The investigation of Sweden's legal system was begun in this period under the direction of Johan Stjernhöök (1596–1675), called the father of Swedish jurisprudence. Philosophy was almost wholly under the influence of Descartes, but Bishop Anders Rydelius (1671–1708), the first great Swedish philosopher, displays considerable originality. In anatomy and botany Rudbeck made many important discoveries. Urban Hjärne (1641–1724) did good service in attacking the superstitions of his time, especially the belief in witchcraft. The great mystic EMANUEL SWEDENBORG (*q. v.*) was in early life distinguished for his studies in mathematics and mineralogy. The most marked feature of the literary and scientific production of this period is originality.

The interval between 1640 and 1740 is often called the Stjernhjelm period, partly from the fact that Georg Stjernhjelm (1598–1672) was its greatest poet, but far more because the influences introduced by him continued to prevail long after his death. He has with sufficient accuracy been called the father of Swedish poetry; he might more properly be called the creator of modern Swedish literary expression, for it is due chiefly to his efforts that Swedish has become the most melodious of the Scandinavian tongues. It was not until after he had reached middle life that Stjernhjelm discovered his poetical genius in the long didactic poem *Herkules*. Filled with an enthusiasm for classic literature and his native tongue, he introduced his countrymen to the teachings of the Renaissance and showed them how this foreign element could be welded with the national language and character. He was the first in Sweden to make use of the hexameter, the alexandrine, the sonnet, the epigram, and the humorous lyric. The latter, in the hands of Bellman, was destined to become one of the distinguishing marks of modern Swedish poetry. His successors, while continuing his efforts to refine and expand the language, contributed but little of real poetic worth. Among them may be mentioned Samuel Columbus (1642–79), a pupil of Stjernhjelm, called the Swedish Flaccus from his *Odæ Suethiecæ*; Peter Lägerlöf (1648–99), author of a number of graceful songs and hymns; Johan Runius (1679–1713), whose collection of poems *Dudaim* was the most popular of his time; and Lasse Johansson (*circa* 1640–74), called from his pseudonym *Lucidor den olycklige*. By the side of this classical school appears a pseudo-romantic, largely influenced by the second Silesian school and by the later Italian poets, which sought to oppose the formalism of Stjernhjelm's successors. In spite of this, however, the poetry of its first prominent representative, Gustaf Rosenhane (1619–84), owes its value to the form rather than to the content. He resembles Stjernhjelm, furthermore, in his warm love of country and in his attempts to introduce new verse-forms, among others the French variety of the sonnet. Gunno Eurelius Dahlstjerna (1658–1709) was possessed of far greater originality, but his talents were hampered by their foreign influence. He also introduced a new verse form, the *ottava rima* with Alexandrines, exemplified in his principal poem *Kungaskald* (The King's Skald). The best hymnists of this period are Håkon Spegel (1645–1714), called the Wallin of the seventeenth century, and Jesper Svedberg (1653–1735). The most interesting prose work of that period is Rudbeck's *Atlantica*.

*Period of Freedom, 1719–72.*—In this period the activity of the preceding time was continued; a number of academies and learned societies were founded, the royal theater was opened, and scientific investigation was carried still further. Among the many scientists were the naturalist Karl von Linné (1707–78), the chemists Torbern Olof Bergman (1735–84) and Karl Vilhelm Schéele (1742–86), the physicist Anders Celsius (d. 1744), and the medical writer Nils Rosén von Rosenstein (1706–73), called the father of Swedish medical science. The most prominent linguist was Johan Ihre (1707–80).

The prevailing foreign influence during this period was the French. This was due to many causes, but its advance was hastened by the marriage of Louisa Ulrika, sister of Frederick the Great, to the Swedish king Adolphus Frederick III. The French influence made itself felt not only on the literature, but also on the whole culture of the period. The dominating figure is Olof von Dalin (1708–63), after whom the latter part of it, from 1740, is frequently named. In spite of his French prejudices Dalin rendered a real service to Swedish prose through the publication of *Den Svenska Argus* (1732–34), modeled on *The Spectator*, the first serious attempt at periodical literature in Sweden. His poetical productiveness was forced by the requirements of his position as court poet. Of Dalin's contemporaries may be mentioned Karl Gustaf Tessin (1695–1770), Anders Johan von Höpken (1712–89), both famous for their eloquence; Jakob Henrik Mörk (1714–63), author of the first Swedish novel, *Adalrik och Göthilda*; Jakob Wallenberg (1746–78), whose *Min son på galejan* (My Son on the Galley) is influenced by Swift and Holberg; Karl Gyllenborg (1679–1746), author of the first modern Swedish comedy; Fru Hedvig Charlotta Nordenflycht (1718–83), who received the title of the Swedish Sappho. Of special interest as illustrating the taste of this period is Gustaf Philip Creutz (1731–85), whose pastoral *Atis och Camilla* was for a long time the most popular Swedish poem. Belonging as much to the following period as to this is Karl Mikael Bellman (1740–95), the first great humorous poet of Sweden. In his treatment of subjects he stood entirely alone, and the moral undertone of his apparently reckless songs fell on deaf ears. His genius did not receive full recognition until after his death, when the frivolous spirit of the French school had given place to the earnestness of the romanticists. He is the only Swedish poet of the eighteenth century who enjoys general popularity.

*Gustavian Period, 1772–1809.*—The pseudo-classic style continued to be cultivated. The Swedish Academy, founded in 1786, was a French Academy in miniature, while the national theater, revived by the king, was as conventional as the Théâtre Français. Opposed to this French movement was a group of writers who sought to develop the national spirit. The leading spirit among the academicians was Johan Henrik Kellgren (1751–95), poet and critic, who deserves the title of the literary dictator of his time. His literary criticisms were published in *Stockholmsposten*, of which he was editor from 1788. After Kellgren's death his place was taken by Karl Gustaf af Leopold (1756–1829), who had the misfortune to outlive his time. He excelled in didactic poetry, his *Predikaren* (The Preacher) being his most popular effort in this direction. Among other poets of this group are Johan Gabriel Oxenstjerna (1750–1818), who translated *Paradise Lost*, and Anna Maria Lenngren (1755–1817), the foremost Swedish poetess. In opposition to the Academy and the principle it represents are Thorild, Bellman, Bengt Lidner (1757–93), a poet of feeling, and Karl August Ehrensvärd (1745–1800). The Finnish poet Frans Mikael Franzén (1772–1847) belongs in part to this period.

*1809–30.*—After the revolution of 1809 and the restoration of the freedom of the press, the revolt against the academic school took definite shape, and went to the furthest extreme of romanticism. The first leaders in the movement were the two young poets Per Daniel Atterbom (1790–1855) and Vilhelm Fredrik Palmblad (1788–1852), who in 1807 formed a literary society called Auroraförbundet, among the other members of which were Samuel Johan Hedborn (1783–1849), P. A. Sondén (d. 1837), and Karl Fredrik Dahlgren (1791–1844). The main principles of this society were those of the new romantic school in Germany. In philosophy they followed blindly the system of Schelling. Their literary discussions and original works were published in the periodicals *Polyfem* (Stockholm, 1809–12) and *Phosphorus* (Upsala, 1810–13), from the latter of which they were called Phosphorists. In spite of the many absurd features of their poetry and criticisms, the Phosphorists rendered a real service to Swedish literature by preparing the way for a sounder conception of the nature of poetry. Their faults are those of their German models. The discussion between the Academy and the Phosphorists was conducted with fierceness and brutality. The leading disputants were Per Adam Wallmark (d. 1858), the representative of the Academy, and the members of the Aurora Society already mentioned. The discussion continued until about 1825. In many respects it resembles the contemporary Baggesen-Oehlenschläger feud. (See DANISH LITERATURE.) In opposition to the Phosphorists, though also representing a romantic movement, are Göterna (The Goths), who sought inspiration in the culture of their Scandinavian ancestors. They differed from the Phosphorists, too, in avoiding a quarrel with the Academy. The representatives of the school formed a society in 1811 called Götiskaförbundet, with *Iduna* (1811–24) as its organ. Among the charter members were Jakob Adlerbeth (d. 1844), Erik Gustaf Geijer (1783–1847), and Leonard Fredrik Rääf (1786–1872). The most valuable service rendered by the society was in arousing public interest in early Scandinavian literature and culture, especially through the publication by Geijer and Arvid August Afzelius (1785–1871) of the first collection of Swedish ballads. The absurd side of the movement is displayed in the epics and tragedies of Per Henrik Ling (1776–1839). Standing apart, as its name implies, is still another school, Neutrer (Neutrals), who represented the principles of Goethe, Schiller, and Herder. Its organ was *Lycæum*, and its leading writers were Johan Olof Wallin (1779–1839), the greatest Swedish hymnist, Franzén, and Benjamin Höijer (1767–1812).

Esais Tegnér (1782–1846), the Swedish Oehlenschläger, is sometimes regarded as a Goth, sometimes as a Neutral. In reality he was neither. For the exquisite form of his prose and verse he is indebted to his academic training; in his love for the Northern past he resembles the Goths; in the catholicity of his genius he is a Neutral, in the best sense of the word. Of one thing only was he intolerant. His clear, logical mind could not endure the obscurity of the Phosphorists, and he opposed them fiercely as long as they continued to assert themselves as an independent school. Tegnér, more by the example of his writings than by the force of his arguments, succeeded in establishing modern Swedish poetry on a firm basis, and through his *Frithiofs Saga* his name was carried beyond the bounds of the North. The three lyric poets Erik Johan Stagnelius (1793–1823), Erik Sjöberg (Vitalis, 1794–1828), and Karl August Nicander (1799–1839), though at first influenced by the Phosphorists, occupied an independent position.

*Since 1830.*—The strife of literary parties having ceased, Swedish literature began a more peaceful development, which has been continuous. The most distinguished writers in the beginning were Karl Jonas Ludwig Almqvist (1793–1866), author of poems, plays, novels, and critical essays; the Finn Johan Ludvig Runeberg (1804–77), whose poetry is characterized by a healthy realism; Karl Vilhelm Böttiger (1807–78), poet, translator, and biographer; Bernhard Elis Malmström (1816–65), poet and critic. Of later writers may be mentioned the poets Karl Vilhelm August Strandberg (Talis Qualis, 1818–77), Gunnar Wennerberg (b. 1817), an imitator of Bellman, and Oskar Patrick Sturzenbecker (Orvar Odd, 1811–69), who was also a critic. Of the Swedish novelists of the nineteenth century the most popular is undoubtedly Fredrika Bremer (1801–65), at one time almost as much read in the U. S. as in Sweden. Other novelists are Magnus Jakob Crusenstolpe (1795–1865), Karl Anton Wetterbergh (Onkel Adam, b. 1804), Emilie Carlén (1807–92), Karl Fredrik Ridderstad (1807–86), Zacharias Topelius (b. 1818), and Maria Sofia Schwartz (1819–94). Of the newest authors may be mentioned Viktor Rydberg (b. 1829), the leading living Swedish prose-writer, Karl Johan Gustaf Snoilsky, the most original living Swedish poet, and Karl David af Wirsén (b. 1842), all academicians. The leading realist is August Strindberg (b. 1849), the Swedish Zola.

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**Sweet**, HENRY: philologist; b. in 1845; graduated at Oxford in 1873. He has edited a number of Old English texts for the Early English Text Society: *King Alfred's West Saxon Version of Gregory's Pastoral Care* (1871–72); *King Alfred's Orosius* (1883); *The Epinal Glossary* (1883), etc.; has published *A History of English Sounds* (1874; 2d ed. 1888); *A Handbook of Phonetics* (1877); new *English Grammar, Spoken English*, etc.; an original and very ingenious system of shorthand, *Current Shorthand, Orthographic and Phonetic* (1892); and several readers and primers of Anglo-Saxon, Middle English, and Icelandic. He received honorary Ph. D. from Heidelberg. H. A. BEERS.

**Sweet**, JOHN EDSON: inventor, mechanic, and engineer; b. at Pompey, Onondaga co., N. Y., Oct. 21, 1832. After working at carpentry and joinery for a time, he practiced architecture until 1861, when he gave his attention to the designing of machinery. In 1873 he became the manager of the workshops of the mechanic arts department of Sibley College, Cornell University, and remained there until 1879. Meantime he had designed the "straight-line engine," and had built, with the aid of his pupils, in the Sibley College shops, the first engines of that type, which has as its characteristic features a straight-line frame, provisions for the reduction of engine-friction, and a simple and efficient governor. He has written for the technical journals, principally for *The American Machinist*. He is a past-president of the American Society of Mechanical Engineers.

R. H. THURSTON.

**Sweet Bay**: See BAY.

**Sweetbread**: the PANCREAS, or THYMUS GLAND (*qq. v.*) of an animal, used as food. The former is usually called stomach-sweetbread and the latter throat-sweetbread.

**Sweetbrier**: See EGLANTINE.

**Sweet-flag**: See ACORUS CALAMUS.

**Sweet-gale**: See GALE.

**Sweet-gum**: See GUM-TREE.

**Sweet Potato**: a trailing vine (*Ipomœa batatas*, formerly called *Batatas edulis*) of the morning-glory family, producing large thickened edible roots. The plant is widely cultivated for food in the tropics and the warmer portions of temperate countries. Its native country is unknown, but the evidence points strongly to an American origin. Its aboriginal American name was *batatas*, whence comes the word *potato*, later applied to the Irish or round potato (*Solanum tuberosum*). The sweet potato is a staple crop in the southern parts of the U. S., where it thrives in the sandy or loose soils. It is propagated by suckers or sprouts which spring from the tubers. It very rarely blossoms. There are many diseases of the sweet potato, for an account of which the reader should consult the bulletins of the New Jersey experiment station. Fitz's *Sweet Potato Culture* is the only general manual devoted to the plant in the U. S.

L. H. BAILEY.

**Sweet-sop**: the soft, sweet, and aromatic fruit of a small tree, the *Anona squamosa* of tropical America, cultivated not only in Brazil and the West Indies, but also in Hindustan and the East Indies. The fruit is greenish and resembles an artichoke in size, in form, and in its scaly covering. The pulp is soft, somewhat mealy, sweet, and luscious, though with a musky, aromatic odor and flavor. It is extensively used as an article of food, and it has proved the staff of life to the people of Hindustan in seasons of famine. Its seeds have an acrid, perhaps a poisonous, quality, shared by the leaves, which have also a disagreeable smell. In India it is called custard-apple, though the true custard-apple is *A. reticulata*. Revised by L. H. BAILEY.

**Sweet Springs** (formerly BROWNSVILLE): city; Saline co., Mo.; on the Blackwater river, and the Mo. Pac. Railway; 23 miles N. W. of Sedalia (for location, see map of Missouri, ref. 3–F). It is in an agricultural and stock-raising region, and has several sweet medicinal springs, 2 State banks, and a weekly newspaper. Pop. (1890) 1,137; (1900) 1,080.

**Swenson**, CARL AARON, Ph. D.: clergyman; b. at Sugar Grove, Pa., June 25, 1857; educated at Augustana College and Theological Seminary, Illinois; pastor of the Swedish Lutheran church at Lindsborg, Kan., since 1879, and founder (1881) and president of Bethany College at the same place. He was a member of the Kansas Legislature 1880–90, and has been editor of several Swedish journals. In 1885 he was elected English secretary, and in 1893 president of the General Council. H. E. J.

**Swete**, HENRY BARCLAY: See the Appendix.

**Sweyn**, swān, **Swegen**, or **Svend**: King of Denmark and father of Canute the Great; invaded England to avenge the massacre of the Danes by the English in 1002, and ravaged a great part of the country. In 1013 he made another invasion and this time reduced the Anglo-Saxon kingdom, forcing Ethelred to flee. He proclaimed himself king, but died (1014) before he had firmly established his power, leaving Canute as his successor. F. M. C.

**Swift**: a common name for the birds of the family *Micropodidæ* (or *Cypselidæ*), probably first bestowed on the European species from its rapid flight. In external appearance the swifts much resemble the swallows, but the bill is decidedly smaller, and the tarsi are not scaly, but simply covered with skin. The primaries are ten in number, the first and second being of equal length; the tail is variable in shape, deeply forked in some, almost square in others, but always composed of ten feathers. The first toe is directed more or less forward, and in the more typical swifts (*Cypselinæ*) the second, third, and fourth digits have but three joints each, owing to a fusion of the basal phalanges. Anatomically the swifts are very different from the swallows, and do not belong to the same order. There are about fifty species distributed over the greater portion of the globe; with the exception of the East Indian tree-swifts (*Macropteryx*), which are prettily clad, they are mostly of somber plumage. They are insect-eaters and pass the greater portion of their time on the wing, and some, like the chimney-swift or chimney-swallow (*Chætura pelagica*) of the U. S., even gather the materials for their nests in full flight. They build in caves, crevices of the rock, nooks of old buildings, hollow trees, or adapt themselves to civilization in chimneys, while an African swift suspends its nest to the fronds of a palm. The nests are gummed together with saliva, and the famous edible birds'-nests, built by the little swifts of the genus *Callocalia*, consist entirely of a peculiar salivary secretion. The eggs are white, two in number in many species, four or five in others, while the tree-swifts (*Macropteryx*) lay but one egg. One species of typical swift (*Micropus melanoleucus*) is found in the western parts of the U. S., while the common chimney-swift abounds in the Eastern States. The common species of Europe (*Micropus apus*) ranges from Great Britain to India, occurring also in Northern Africa. The swifts are usually divided into two subfamilies, according to the number of phalanges, but the tree-swifts (*Macropteryx*) are by their numerous peculiarities entitled to rank as a separate family (*Macroterygidæ*). In the western parts of the U. S. the name swift is applied to a small fox (*Vulpes velox*), and in the southern parts to a small lizard (*Sceloporus undulatus*). F. A. LUCAS.

**Swift**, JONATHAN: satirist and divine; b. in Dublin, Ireland, Nov. 30, 1667. He was the posthumous son of Jonathan Swift, an Irish official, and of his wife Abigail Erick, of Leicester. Of his birth in Dublin, the dean remarked in after-life, "I happened by a perfect accident to be born here, and thus I am a Teague, or an Irishman, or what people please," but his descent was purely English. He was kidnaped, as an infant, by his nurse, who carried him to Whitehaven, in Cumberland, where he remained nearly three years, when his mother took him away to Leicester. At the age of six he went to Kilkenny School, and on Apr. 24, 1682, entered Trinity College, Dublin. He was an idle scholar, often censured, and in 1688, on his twenty-first birthday, he quitted the university in disgrace. He went to his mother at Leicester, and was presently glad to accept the position of amanuensis in the family of his eminent kinsman, Sir William Temple, at Moor Park. There Swift remained, with two intermissions, until Temple's death in 1699. His health was bad, and after a surfeit of golden pippins in 1689, he began to suffer from the mysterious complaint of his lifetime, which, as is now conjectured, must have been a labyrinthine vertigo. In 1692 he received the degree of M. A. from Oxford, and to the same date belong his earliest existing compositions, his awkward and prosaic *Pindaric Odes*. In 1694 he left Temple and returned to Ireland; early in 1695 he took priests' orders and the small Ulster living of Kilroot. The solitude weighed upon him, and in the spring of 1696 he went back to Temple's service. In 1696 he began *A Tale of a Tub*, and in 1697 he wrote *The Battle of the Books*, which was first published in a joint volume in 1704, although prepared for the press in 1698. At the death of his patron Swift applied to William III., whose favorable attention he had attracted, but the petition failed to reach the king. He therefore was glad to accept the post of secretary to Lord Berkeley, but was dismissed in Dublin. In Feb., 1700, the living of Laracor, to which were presently appended two other small incumbencies and a prebend, secured for him a scanty competence. He was now invited by an old flame, Miss Waring, "Varina," to marry her, but he refused to do so in a strangely violent letter. He was more interested in "Stella," Sir William Temple's orphan ward, Esther Johnson; in 1701 she and her friend Mrs. Dingley came over to Ireland to be near Swift. When he was absent from Dublin, and his visits to England were frequent and lengthy, these ladies occupied his chambers. In 1701 Swift made his first appearance as an author, by the publication of the anonymous pamphlet *Contests and Dissensions in Athens and Rome*. This was successful, and the *Tale of a Tub* volume, in 1704, raised a storm of notoriety, but Swift took little part as yet in literary or political life. In 1708 he became suddenly a great power in the Whig party, and published a succession of vigorous and brilliant tracts. These, and other anonymous publications in prose and verse, were collected in a volume of *Miscellanies* in 1711, in which *Baucis and Philemon*, written in 1706, and the *City Shower* are to be found. Meanwhile Swift had risen to the highest level of London society. In 1705 Addison had addressed him as "the most agreeable companion, the truest friend, and the greatest genius of his age," and Swift was accepted on these terms by most of the leading wits and statesmen of the court of Anne. His influence on behalf of others was boundless, and most generously exercised, but he could secure no preferment for himself. A very clear light upon all his movements and his sentiments is presently thrown by the famous *Journal to Stella*, a correspondence kept up with Esther Johnson and Mrs. Dingley from Sept., 1710, to Apr., 1713. Of his profusion of political pamphlets poured out at this time, the best known is *The Conduct of the Allies*, which, published in Nov., 1711, went through four editions in one week. This gives, however, a very poor idea of Swift's importance in English politics during the administration of Harley. When he returned to London from a temporary retirement at Laracor in Sept., 1710, he was received by the Whigs with enthusiasm; but they had failed him before, and he repulsed their advances and rejected their "clumsy apologies." He threw in his lot with the Tories, and was received into the innermost councils of the new ministry. A satire, *Sid Hamet's Rod*, on the fallen Godolphin, enjoyed a prodigious success, and in Nov., 1710, Swift took the editorship of the Whig newspaper *The Examiner*, and made it the organ of the new Tory party. He proved himself a journalist of the very first order. His success culminated in the ministerial crisis of Dec., 1711, and he found himself one of the most powerful men in England. His health, indeed, began to trouble him, but throughout 1712 "Dr. Swift was the principal man of talk and business" in London. He was able to secure for his friends and *protégés* all the places and the favors they required; yet in the midst of his greatness his old ill luck assailed him, and in spite of his authority with the ministry he was refused the bishopric of Hereford. This was a blow to him, but he recovered from it; the death of Queen Anne in 1714 annihilated his hopes. As Arbuthnot said, Swift was "like a man knocked down," and in wrath and bewilderment he retired to Dublin. His fall was broken by his having been appointed in the previous summer to the deanery of St. Patrick's. His spirits languished in this enforced retirement, and his relations with Stella and with Vanessa (Miss Vanhomrigh) became closer and more mysterious. In 1716, so it has been alleged, Swift secretly married the former, and the latter died in 1723, in consequence of the furious resentment showed by Swift at her having endeavored to force the secret from Stella. Meanwhile Swift interested himself in the local politics of Ireland, and, having outlived the dislike which he originally inspired, became the most idolized of patriots. His political writing culminated in 1724 with the publication of the *Drapier's Letters*, in which he attacked the currency scheme for allowing a William Wood to supply Ireland with a copper coinage. The vogue of these *Letters* was so great, and the indignation they aroused in Ireland so vociferous, that the Government withdrew Wood's patent, and failed in an attempt to prosecute the author. Swift's popularity in Dublin knew no bounds, and when George II. came to the throne it was hoped by his English friends that the dean would recover his influence; but a visit to London in 1727 had no result, and Swift went back for good to "wretched Dublin in miserable Ireland." Two years later his foiled ambition made him describe himself to Bolingbroke as ready to "die here in a rage, like a poisoned rat in a hole." Meanwhile he had been more fortunately engaged in certain literary labors. As early as 1722, at least, he had received Pope's encouragement in the outline of a satire on society, which was to take the form of "very extraordinary voyages into very extraordinary nations," and to "manifest the most distinguishing marks of a philosopher, a politician, and a legislator." He brought the completed MS. of this work, the famous *Gulliver's Travels*, to England with him in 1726, and it appeared anonymously during the succeeding winter. With the exception of Defoe's *Robinson Crusoe*, which had been issued seven years earlier, no romance had been written in English which approached this wonderful book in originality or vigor. The first hint of the design has been traced to Pope's *Memoirs of Scriblerus*, while the hand of Arbuthnot has been detected in the speculations of the third part; it is plain that the whole scheme had been discussed in the brilliant coterie of men of letters with whom Swift loved to associate in London, and from whom he found exile so terribly irksome. It has been conjectured with probability that the voyage to the Country of the Houyhnhnms was written during the last illness of Stella, and that the mental anguish of the author gave ferocity to this appalling satire; but although, after the summer of 1726, Stella ceased to be capable of companionship, she lingered until Jan., 1728. Swift then hated Dublin more than ever; he described it as his "wretched, dirty dog-hole, and prison," and could give the deanery of St. Patrick's no higher praise than that it was "a place good enough to die in." He adopted of set purpose a contemptuous attitude toward literature and politics. Yet he continued to write some of the most highly finished and forcible of his compositions, especially in verse. Of the latter class are *The Journal of a Modern Lady*, which dates from 1728; *The Lady's Dressing-room* (1730); the admirable and extraordinary *Ode on the Death of Dr. Swift*, finished in 1731; *The Beast's Confession* (1732); and, best of all, the vigorous "rhapsody" *On Poetry* (1733). It is believed that about 1729 he wrote what has been called that "extraordinary passage of willfully inane chatter," *The Polite Conversation*, which was published by Mrs. Barber in 1738, soon after the vertigo, which had so long distracted him, combined with the distress of deafness and melancholy to cloud his reason. An excellent cousin, Mrs. Whiteway, finding him at the mercy of servants, came to take care of him, but he became hopelessly insane. From 1741 to 1743 Swift was a raving maniac, under restraint; he then sank into a sort of stupor, the vigor of his constitution long supporting his frame and lengthening the struggle. At last on Oct. 19, 1745, he died in Dublin. He was privately buried in St. Patrick's, and when his will, drawn up in 1740, was opened it was found that he had left his fortune to endow a lunatic asylum for Ireland, wishing to

> . . . show by one satiric touch
> No nation needed it so much.

The personal character of Swift deeply impressed the age, and innumerable anecdotes preserve the tradition of his wild humor, his tumultuous bursts of arrogance, his admirable perspicuity, and his curious inconsistencies of conduct and temper. His person was athletic and commanding, his eyes of the clearest blue, and all his life he was endeavoring by violent exercise to subdue his mysterious physical maladies. History has dwelt to excess on his ferocity, and has said too little about his prevailing charm of address, his occasional but exquisite outbursts of sympathy. In literature, although he scarcely produced anything that was not more or less of an occasional nature, his is the greatest figure between Dryden and Johnson. The earliest life of Swift was that published in 1751 by Lord Orrery. This book contained valuable documents, but was prejudiced and inaccurate, and it was supplemented by a very important volume of *Observations*, by Dr. Delany, in 1754. Hawksworth first collected the works in 1765. In 1785 Thomas Sheridan, the son of one of Swift's most intimate friends, published a life, although his personal knowledge of the dean had been very slight. Sir Walter Scott founded upon these and other materials his entertaining *Life of Swift* in 1814, and published a very full and excellent edition of the works, which he still further improved in 1824. John Foster published a fragment of a yet more minute biography in 1875, and among later writers on Swift, Leslie Stephen (1882) and Henry Craik have been the most competent. In 1883–84 a new issue of Sir Walter Scott's large edition of the works was published. EDMUND GOSSE.

**Swift**, LEWIS: astronomer; b. at Clarkson, N. Y., Feb. 29, 1820. He was first a business man, began studying astronomy in 1855, and constructed a telescope; gave special attention to comets, and discovered comets in 1862, 1869, 1874, etc. For these discoveries he received in 1882 the Lalande prize from the French Academy of Sciences. He also received three gold medals from the Imperial Academy of Sciences at Vienna. He removed to Rochester, N. Y., in 1872, and became director of the observatory there, specially fitted up for him by the citizens. In 1894 he removed his instruments to Echo Mountain, Cal., in order to get the advantage of the purer air of the Pacific coast. S. N.

**Swift**, WILLIAM HENRY: engineer; b. at Taunton, Mass., Nov. 6, 1800; was a cadet at the U. S. Military Academy from 1813 to 1819. He was assigned when a cadet to Maj. Long's Rocky Mountain expedition, with which he served until 1821, having meanwhile (1819) received his commission as second lieutenant of artillery; from 1821 to 1832 served on topographical duty in making surveys of military defenses of the Atlantic coast; of the Chesapeake and Ohio Canal; of the Florida Canal, and rivers and harbors of the Gulf of Mexico; in constructing a map of the post-offices and post-roads of the U. S.; and surveyed several railways. In 1832 was appointed brevet captain and assistant topographical engineer, and for ten years was employed as assistant in the U. S. coast survey upon the Atlantic coast, being in charge of river and harbor improvements from Maine to Connecticut 1837–42; from 1836 to 1840 was also resident and constructing engineer of the Massachusetts Western Railroad, from Worcester to the western boundary of Massachusetts, becoming captain topographical engineers, July, 1838; was assistant to the chief of topographical engineers 1843–49; was engaged 1847–49 in constructing the iron-pile lighthouse at Minot's Ledge, Massachusetts Bay, which was destroyed by a great gale in Apr., 1851. In 1849 he resigned from the army. D. in New York, Apr. 7, 1879.

**Swift**, ZEPHANIAH, LL. D.: jurist; b. at Wareham, Mass., in Feb., 1759; graduated at Yale College in 1778; studied law, and practiced at Windham, Conn.; was Representative in Congress 1793–97; appointed judge of the Supreme Court of Connecticut in 1801; was chief justice 1806–19; was several times elected to the State Legislature, a delegate to the Hartford convention, and a member of the commission to revise the laws of the State. He published an oration on *Domestic Slavery* (Hartford, 1791); *System of the Laws of Connecticut* (1795–96); *Digest of the Law of Evidence in Civil and Criminal Cases* and a *Treatise on Bills of Exchange and Promissory Notes* (Hartford, 1810); and *Digest of the Laws of Connecticut* (1822–23; new ed. 1848–53), which last work is the standard treatise on that subject, and is often called the Connecticut lawyer's Blackstone. D. at Warren, O., Sept. 27, 1823. Revised by F. STURGES ALLEN.

**Swimming** [O. Eng. *swimman*, swim: O. H. Germ. *swimman* (> Mod. Germ. *schwimmen*), float, swim: Icel. *svimma*]: the act of progressing in the water by means of strokes with the hands and feet. As the specific gravity of the human body is only slightly greater than that of water, swimming is easily learned, with or without an instructor. The density of salt water being greater than that of fresh, it is much easier to swim in it. Indeed, if the saturation is very great, as in the Dead Sea or the Great Salt Lake, the specific gravity is greater than that of the human body and a man can not sink in it.

A great variety of mechanical devices have been in use both to assist in acquiring the art and for making swimming safer, easier, or more rapid; but the presence in the water of a competent instructor to give the necessary support will give better results to the beginner than any attachment of floats or other supports which buoy the body too high in the water, and teach the swimmer to place his dependence on something other than his own floatage. One of the best methods in beginning is to wade out until breast-deep in the water, turn toward the shore, and throw a white pebble or any other object easily discernible a short distance before him and plunge after it. The resistance offered by the water to this effort will buoy him up, and the moment he has acquired sufficient confidence and command of his limbs to strike out regularly, he has learned to swim. The common forms of stroke are the broad, dog-paddle, and side, or Indian. The first two are much the more natural and easy to acquire. In the broad stroke after bringing the body nearly horizontal, the arms and legs are drawn slowly toward the body and then extended, alternately, with a quick and strong impulse. The hands should be kept flat and the fingers closed, the legs should be well apart at the beginning, and at the conclusion of the act of kicking brought together. In the tread the body is kept perpendicular and hands and feet beat downward. In the dog-paddle the body lies nearer horizontal, and hands and feet are moved rapidly and alternately with a paddling movement. The side-stroke is found represented in mosaics in Pompeii, and was popularized in England by Trudgeon. It is the stroke commonly used in racing, and consists, briefly, in turning the body on one side and reaching far ahead with the under hand while the other sweeps by the chest and belly.

Swimming races, especially in Great Britain, have become carefully regulated athletic events. Prior to 1869 there were few clubs to manage these contests, but on Jan. 7 of that year a swimming congress met at the German Gymnasium, King's Cross, London, where was formed an amalgamation called the Associated Metropolitan Swimming Clubs. The name was changed shortly after to the London Swimming Association, and again changed in 1874 to the Swimming Association of Great Britain. The Amateur Swimming Association of Great Britain was formed Mar. 3, 1886. It has a membership of over 300 clubs, and is the largest organization of the kind. New Zealand and New South Wales both have flourishing amateur swimming associations, the former being formed in 1890.

Both Oxford and Cambridge have clubs with intercollegiate and inter-'varsity matches, and official recognition of swimming as a subject of instruction was secured in the elementary board schools in England in 1891.

This art is not so general in the U. S. as in Great Britain, nor is club organization at all thorough.

SWIMMING RECORDS.

| | | |
|---|---|---|
| 25 yards, open water,* | W. C. Johnson, | $14\frac{4}{5}$ seconds. |
| 100 yards, bath,* | J. H. Derbyshire, | 1 min. $\frac{1}{5}$ sec. |
| 220 yards, bath, | J. Nuttall, | 2 min. 37 sec. |
| 440 yards, bath,* | J. H. Tyers, | 5 min. $43\frac{1}{5}$ sec. |
| 880 yards, bath, | J. Nuttall, | 12 min. $13\frac{3}{4}$ sec. |
| 1 mile, open water,* | J. A. Jarvis, | 25 min. $13\frac{2}{5}$ sec. |

* Indicates an amateur performance.

E. HITCHCOCK, Jr.

**Swin'burne**, ALGERNON CHARLES: poet; b. in London, Apr. 5, 1837; son of Admiral Swinburne; received his education partly at Eton, partly in France, and in 1857 entered Baliol College, Oxford, where he remained only a short time. His life has been mainly spent in London. He has published *Rosamond* and *The Queen Mother*, two dramas (1861); *Atalanta in Calydon*, a tragedy constructed after the Greek model, in which he first manifested his peculiar powers (1864); *Chastelard, a Tragedy* (1865); *Poems and Ballads*, which were so severely criticised for their erotic character that the English publisher endeavored to suppress them, and which were put forth in New York under the title *Laus Veneris* (1866); *A Song of Italy* (1867); *Ode on the Proclamation of the French Republic* (1870); *Songs before Sunrise* (1871); *Bothwell* (1874), a dramatic sequel to *Chastelard*; *Essays and Studies* (1875); *Studies in Song* (1881); *A Century of Roundels* (1883); *Life of Victor Hugo* (1886); *Locrine, a Tragedy* (1887); *The Sisters*, a tragedy (1892), and other works. See ENGLISH LITERATURE.

Revised by H. A. BEERS.

**Swine**: any artiodactyl mammal of the family SUIDÆ (*q. v.*). The wild species of *Sus* are variously enumerated by zoölogists. Of these, the wild boar (*Sus scrofa*) of Europe, North Africa, and Asia Minor is the best known, and is generally regarded as the original of the common domestic forms. The validity of many of the other species, which are found mostly in the East Indies, is open to question, as they may be feral descendants of introduced domestic specimens. A small species (*Sus salvianus*) of Nepal, the Terai, and Bhutan has been separated generically as *Porcula*. The river-hogs of the genus *Potamochœrus*, the babirussa, and the wart-hogs are other swine. The chief seat of the world's swine-rearing industry is in the more northerly States of the Mississippi valley, where favoring conditions of soil and climate encourage the production in enormous quantities of Indian corn, which is chiefly relied on to feed the swine during both their growing and fattening periods. In the U. S. swine, when very young, are designated as pigs, when partly grown as shotes, and later as hogs. In Jan., 1895, the number of swine in the U. S., as given by the Department of Agriculture, was 44,165,716, worth $219,501,267; of these, Iowa alone had 5,516,485, or 50 per cent. more than the United Kingdom, which in its numbers does not vary widely from Missouri. In the U. S. the number doubled in seventeen years following 1876. Prior to 1850 swine had little uniformity except that they were white and slow in maturing; there were innumerable varying breeds, each a favorite in some county or section of a State, and those growing to the largest size were esteemed best, regardless of excessive offal or cost of production. At present nine-tenths of the hogs in the U. S. are black, with small markings of white on the face, feet, and tail, and sometimes elsewhere. These are of the Poland-China and Berkshire breed, or a mixture of the two; the next most prominent breed is the Chester White. Other breeds, equally distinct, but reared in limited numbers, are the Essex, black; Duroc-Jersey or Jersey, red, sandy, or reddish; Victoria and Suffolk or Small Yorkshire, white. The Essex and Yorkshires are from England, the Duroc-Jerseys are of uncertain origin, and the Victorias originated since 1860 in Indiana. The predominant breed, the Poland-China, originated in Butler and Warren cos., O., between 1838 and 1840 in the crossing of various families there known as Big China, Russia, Byfield, Bedford, and Irish Grazier, and the offspring was a large black and white spotted kind called by many names, from which a national convention of swine-breeders in 1872 selected that of Poland-China. These were crossed with imported Berkshires to give refinement and propensity to earlier fattening, and incidentally they acquired the Berkshire's black color and white markings. The Berkshire in its improved form originated (as did the Essex) in England—Italian and Spanish swine being crossed with the coarser native stock—between 1780 and 1800, but although first introduced into North America about 1830 it did not obtain general favor until 1870–80. Chester Whites are the result of mating some large white stock from Bedfordshire, England, with the white hogs common in Chester co., Pa., about 1818–30; the descendants being swine that gradually improved by selection, and have maintained their popularity in North America better than any other of their color. Hogs of a dark color are most largely reared because of a belief that they are hardier and less susceptible to affections of the skin incident to sudden changes of temperature and the muddy quarters, severe winds, and burning suns to which they are too often continuously subjected. Poland-Chinas, Berkshires, Chester Whites, and Duroc-Jerseys are classed as large breeds, weighing, when properly reared, from 300 to 450 lb. at twelve months, and from 500 to 600 and even more at eighteen months, and they have been bred to a degree of fineness in bone, smallness of offal, compactness of form, and early maturity which makes them well-nigh perfect. Essex, Victorias, and Suffolks or Small Yorkshires are termed small breeds, and, although of excellent quality, do not grow to such weights as others, and mature more quickly.

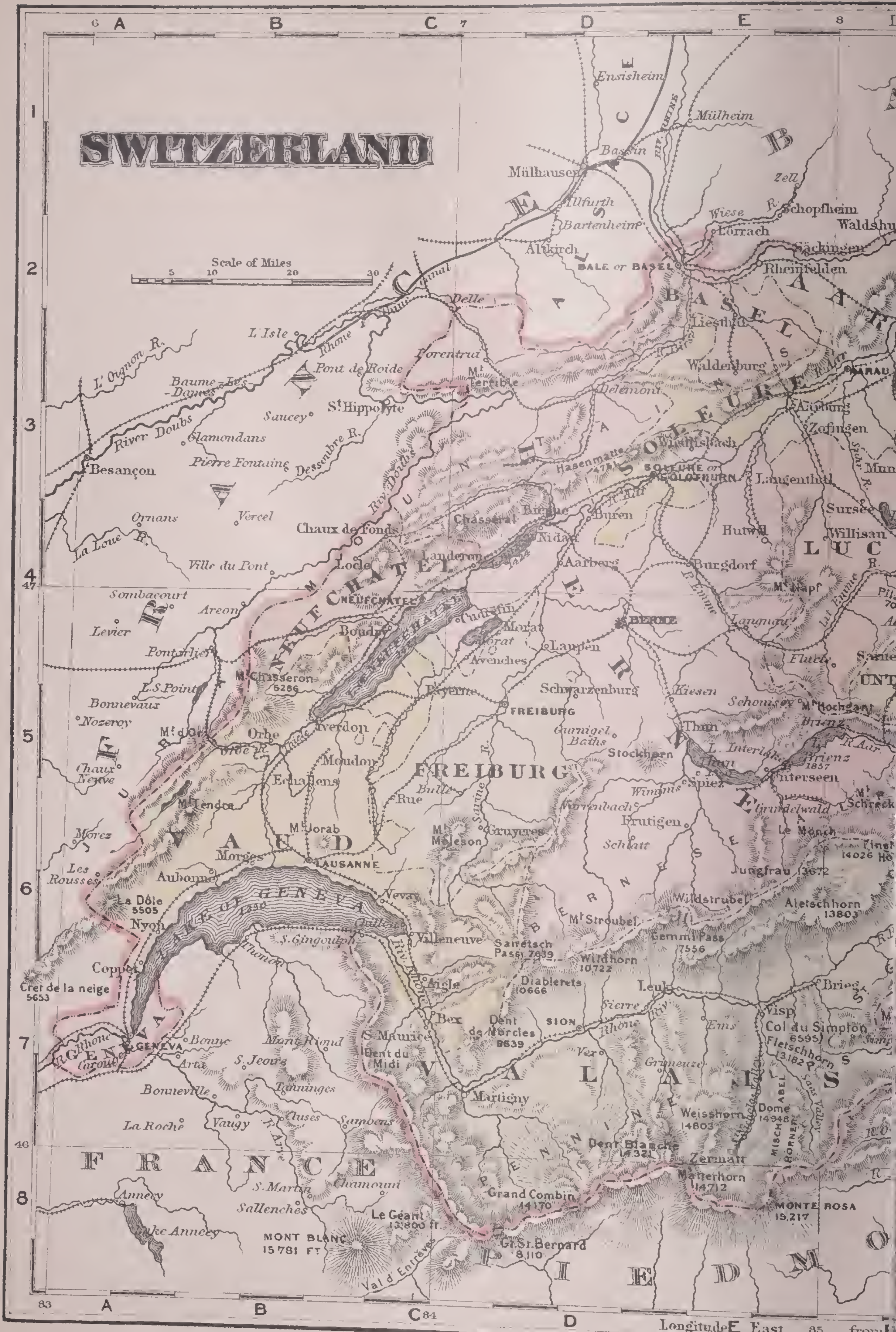
*Preparation of Hog Products.*—The two principal markets, slaughtering and packing points, for swine are Chicago, Ill., and Kansas City, Kan. There were marketed in the former city in 1894 7,483,228 head, and in the latter 2,547,077. Chicago packed in the year ending Mar. 1, 1895, 5,293,202, and Kansas City, 2,105,333; these numbers have been largely exceeded in some previous years when the supply was more plentiful. The average live weight of 16,003,645 hogs packed in the U. S. in the year ending Mar. 1, 1895, was 231·22 lb.; average weight of their lard, 33·31 lb.; and average cost alive, $4.67 per 100 lb. Careful calculation of the per capita rate of domestic consumption in recent years indicates 55 to 57 lb. of pork and about 8 lb. of lard. Next to cotton and wheat the swine interests furnish the largest values in exports from the U. S., which for the year ending June 30, 1894, were as follows:

| | |
|---|---|
| Bacon and hams | 503,628,148 lb. |
| Pork | 64,744,528 lb. |
| Lard | 447,566,867 lb. |
| Total | 1,015,939,543 lb. |
| Value | $93,433,582 |
| Average per pound | 9·19 cents. |

Counting on the customary basis of 175 lb. of product to equal one hog, the exported product for the year mentioned was equivalent to 5,805,369 hogs. Of the total exports for the twelve months indicated the United Kingdom purchased the following quantities:

| | |
|---|---|
| Bacon and hams | 408,979,637 lb. |
| Pork | 14,273,057 lb. |
| Lard | 149,691,959 lb. |
| Total | 572,944,653 lb. |

The British provinces of North America pack annually from 350,000 to 500,000 hogs, and import from the U. S. from 30,000,000 to 65,000,000 lb. of product. All other countries of the world produce from 40,000,000 to 45,000,000 swine, of which Russia has one-fourth, followed by Germany, Austria-Hungary, France, and Spain respectively, which have from 7,000,000 to 4,000,000 in the order named. They give but little attention to breed, quality, or pedigree. In the five years ending with 1840 the U. S. sold in Europe hog products to the value of $1,533,522 annually, or the equivalent of 92,154 hogs at $16.65 per head. Forty years later the



SWITZERLAND
Scale of Miles
Mülhausen
Basel
Besançon
Neufchatel
Berne
Freiburg
Lausanne
Geneva
Lake of Geneva
Vaud
Valais
Sion
Jungfrau
Matterhorn 14712
Monte Rosa 15,217
Mont Blanc 15781 ft
Gt. St. Bernard 8110
France
Piedmont
Longitude East from

ude East from Greenwich
G
H
I
J
K
1
2
3
4
5
6
7
8
WURTEMBURG
BAVARIA
TYROL
LOMBARDY
SCHAFFHAUSEN
THURGAU
ZURICH
ZUG
SCHWYTZ
GLARUS
APPENZELL
GRISONS
WALDEN
Waldsee
Mochenwangen
Leutkirch
Ueberlingen
Ravensburg
Oberhofen
Kempten
Isny
Tettnang
Friedrichshafen
Radolfszell
CONSTANCE
LAKE OF CONSTANCE
Weinfelden
Romanshorn
FRAUENFELD
Bischofszell
Arbon
Lindau
Immenstadt
Sonthofen
Bregenz
Rorschach
Wyl
Flawyl
ST GALL
Trogen
Altstetten
Herisau
Gais
Winterthur
Kaisersthul
Bulach
Andelfingen
Lagern 2828
Gruningen
Rapperschwyl
Horgen
Einsiedeln
Wesen
Wallenstadt
Flum
Sargans
VADUZ
Feldkirch
Bludenz
ARLBERG TUNNEL 6½ miles
Rhaetikon
Meyenfeld
Zizers
Vattis
CHUR
Davos
Elvis
Vorder Rhine
Ilanz
Tusis
Albula
Albula Pass 7589
Julier Pass
Bivio 5827
Septimer P. 7582
Silvaplana
Bernina Pass 7644
Piz Bernina 13,294
BERNINA ALPS
Poschiavo L.
Chiavenna
M^t della Disgrazia
Sondrio
Morbegno
R. Adda
VALTELINA
Splugen Pass 6946
Rhemwaldhorn 11148
S. Bernardino Pass 6768
Malvaglia
BELLINZONA
Locarno
Ascona
Domo d'Ossola
Lugano
LUGANO
Capo di Lago
Como
Lecco
LAKE OF LECCO
Varese
Lake d'Orta
Orta
Faido
Lukmanier Pass 6292
Oberalp Pass 6732
Andermatt
Schneestock 11920
Furka
Gotthard Pass
Airolo
Brunnen
Sissigen
Tells Platte
ALTORF or ALTDORF
Burglen
Engelberg
Tödi
M^t Titlis 10627
STANZ
Glarnisch 9538
Linththal
Naefels
Murg
Wallenwyl
Arth
Zug
Bremgarten
Washington
86
87
46
47

exports for a single year equaled 7,045,805 head, worth $104,660,065, or $14.85 per head. In 1860 hog product exports had increased 700 per cent., and in 1880 nearly 7,000 per cent. Since 1891 all swine products intended for export have been inspected at the point of slaughter as to healthfulness—and especially freedom from trichina—by veterinarians and microscopists appointed by and under supervision of the U. S. Department of Agriculture. The chief scourge among swine is a contagious fever little understood as to causes or treatment, popularly called cholera, which each year rages in various localities, destroying entire herds, including those supposed to be in the best condition, amounting to millions of dollars in value. Faulty sanitary and hygienic surroundings, and insufficient variety of food tending to an enfeebled constitution, are regarded as encouraging its development. Its incubation is from one to two weeks in cold weather and three or four days in warm; it is fatal in from one to six days, or ends in a tedious, uncertain, or unsatisfactory recovery. F. D. COBURN.

**Swing**, DAVID: clergyman; b. in Cincinnati, O., Aug. 23, 1830; graduated at Miami University, Oxford, O., 1852; studied theology; taught Greek and Latin, and became principal of the classical school of Miami University; became pastor of the Fourth Presbyterian church in Chicago 1866; was tried for heresy in 1874, and acquitted by the presbytery, but became an independent minister, and pastor of Central church, Chicago. He was an editor of *The Alliance*, and published *Club Essays* (1880) and other works. D. in Chicago, Oct. 3, 1894.

**Swinton**, JOHN: journalist; b. at Salton, Scotland, Dec. 12, 1830; brother of William Swinton. He emigrated to Canada and then to the U. S. in 1843; was educated at Williston Seminary, Massachusetts; removed to New York in 1857, where he was connected editorially with the *Times*, and afterward with *The Sun*. In 1883–87 he published *John Swinton's Paper*, a weekly journal in the interest of labor reform. He has written and lectured much on various aspects of the labor question, and has published among other pamphlets *New Issue: the Chinese-American Question* (New York, 1870); also *A Eulogy on Henry J. Raymond* (1870); *John Swinton's Travels* (1880); and *An Oration on John Brown* (1881.) H. A. BEERS.

**Swinton**, WILLIAM, A. M.: author; b. at Salton, Haddingtonshire, Scotland, Apr. 23, 1833; removed to the U. S. in 1843; studied at Knox College, Toronto, and at Amherst College; in 1853 taught in a female seminary at Greensboro, N. C., and subsequently in a private school in New York; during a considerable part of the civil war was the correspondent, mainly with the Army of the Potomac, of *The New York Times*; in 1866 received the degree of A. M. from Amherst College, and in 1869 was appointed Professor of Belles-Lettres in the University of California. In 1874 he resigned and went to Brooklyn, N. Y., where he prepared text-books. For these he was awarded a gold medal at the Paris Exposition of 1867. He published *Rambles among Words* (New York, 1859; London, 1861); *Campaigns of the Army of the Potomac* (1864; revised ed. 1886); *The Twelve Decisive Battles of the War* (1867); *The History of the New York Seventh Regiment during the War of the Rebellion* (Boston, 1870); *Word Analysis* (1872), and other works. D. in New York, Oct. 24, 1892.

**Swiss Guards**: bodies of mercenary Swiss troops employed as body-guards and for duty about courts. Swiss mercenaries have frequently been hired by foreign powers since the time of the Swiss struggle for independence, which brought the valor and hardihood of that people into notice. The term Swiss Guards, however, especially refers to the royal body-guard of the kings of France. This force, which was organized in 1616, showed remarkable courage and loyalty in the service of the Bourbons. In 1789 they were roughly handled by a mob, and Aug. 10, 1792, almost every man was killed in the heroic defense of the Tuileries. They numbered about 2,000. Their heroism is commemorated by Thorwaldsen's *Lion of Lucerne*, carved from the living rock in a cliff near one of the gates of Lucerne. Louis XVIII. reorganized the Swiss Guard in 1815. In the Revolution of 1830 they were defeated and dispersed. F. M. COLBY.

**Swiss Stone-pine**: See CEMBRA PINE.

**Swithin, Swithun**, or **Swithum**, SAINT: bishop and patron of Winchester; b. of noble parentage; became a monk in the Old Monastery in Winchester; later provost; private chaplain to Egbert, King of the West Saxons; his adviser and tutor to the king's son Ethelwolf, and later his adviser also; Bishop of Winchester 852. He was remarkable for piety and great activity in building churches. D. at Winchester, July 2, 862. "His body was buried, according to his order, in the churchyard, where his grave might be trodden on by passengers" (*Butler*). In 971 his relics were transferred to the church. On this translation "such a number of miraculous cures of all kinds were wrought as was never in the memory of man known to have been in any other place." One of his arms was "kept in the abbey of Peterborough." His day in the Roman calendar is July 2—his death-day—but in the English calendar July 15, the day of the translation of his relics, and it is commonly said in England that if it rains on St. Swithin's day it will rain for forty days thereafter, a saying which is supposed to have originated in the alleged fact that the translation of Swithin's remains was delayed by heavy rains. See John Earle, *Gloucester Fragments* (London, 1861) and Butler's *Lives of the Saints* under July 15. SAMUEL MACAULEY JACKSON.

**Switzerland**, or **Helvetic Confederation** [*Switzer-* is from Germ. *Schweizer*, a Swiss, deriv. of *Schweiz*, Switzerland; cf. Fr. *la Suisse*, Ital. *Svizzera*, Switzerland]: a confederated republic of twenty-two cantons, occupying the Alps; between Germany, Austria, Italy, and France; of oval form, 221 miles long E. and W., and 140 miles broad N. and S.; boundary irregular and only in part natural. Area, 15,976 sq. miles.

*Physical Features.*—It occupies the Central and Northern Alps; the Western are in France, the Southern in Italy, and the Eastern in Austria. The highest point is Mont Blanc (15,781 feet), at the angle of France, Italy, and Switzerland. The proper central mountain is Monte Rosa (15,217 feet), 45 miles E. on the Italian boundary. The hydrographic center (where arise the Ticino flowing through the Po to the Adriatic, the Rhône flowing to the Gulf of Lyons, the Rhine flowing to the North Sea, and the Inn flowing through the Danube to the Black Sea) is St. Gothard, 60 miles farther N. E. The chief range is the Pennine Alps, making the western part of the southern boundary; N. of it and nearly parallel is the range of the Bernese Alps with the Rhône valley between them, and containing peaks somewhat lower (Finsteraarhorn, 14,026 feet, and Jungfrau, 13,672 feet). To the E. the main ranges are in the Rhætic Alps with culminating point at Mt. Bernina (13,191) on the Italian frontier. (See ALPS.) The plain of Switzerland lies on the N. W., between the Jura Mountains and the Alps, and between Lake Geneva and Lake Constance; average elevation, 1,200 to 1,500 feet. Between it and the Bernese Alps is the higher plateau called the Bernese Oberland. The remainder of the inhabitable part of the republic consists of mountain valleys and lake margins, sometimes with small alluvial plains, but often narrow, wild, and inaccessible.

The chief river is the Rhine, which winds around the northern side of Switzerland and penetrates to St. Gothard from the E. With its tributaries it drains over 70 per cent. of the area and most of the lakes of the country; length in Switzerland, 216 miles. The Rhône leaves at the W., is 71 miles long in Swiss territory, and drains 16 per cent. of the area. The Inn leaves at the E., has 54 miles in the confederation, and drains 9 per cent. of the area; and the Po sends the Ticino 44 miles into Swiss territory and drains 5 per cent. A small part of the southeast is drained by the Adige.

Many beautiful lakes are situated in whole or part within Swiss territory. Some details as to the largest of these are tabulated below:

| NAME. | River basin. | Area in sq. miles. | Mean height of surface, feet. | Greatest depth known, feet. |
|---|---|---|---|---|
| Geneva | Rhône | 225 | 1,230 | 1,017 |
| Constance | Rhine | 208 | 1,306 | 410 |
| Neuchâtel | Aar, Rhine | 93 | 1,427 | 472 |
| Lago Maggiore | Ticino, Po | 83 | 646 | 1,230 |
| Lucerne | Reuss, Aar, Rhine | 44 | 1,434 | 853 |
| Zurich | Limmat, Aar, Rhine | 34 | 1,342 | 469 |
| Lugano | Tresa, Ticino, Po | 19 | 889 | 902 |
| Thun | Aar, Rhine | 18 | 1,837 | 712 |
| Bienne | Aar, Rhine | 16 | 1,424 | 256 |
| Zug | Reuss, Aar, Rhine | 15 | 1,368 | 1,321 |
| Brienz | Aar, Rhine | 12 | 1,857 | 856 |

The lake area of Switzerland is 520 sq. miles, but the area of glaciers (perpetual ice and snow) is 710 sq. miles. This is confined to eleven cantons and principally to four—viz., Valais (375 sq. miles), Grisons (139), Berne (111), and Uri

(44). The Swiss glaciers number 471, and of these 138 are of the first rank (having a length of $4\frac{3}{4}$ miles or more). The largest is the Aletsch, on the southern slope of the Jungfrau, 15 miles long and covering 42 sq. miles. The Pennine Alps alone have 140 or more glaciers, and the Rhône, just N., is fed by 263. The lowest point reached by a glacier in Switzerland is 3,225 feet, in 1818 by the Grindelwald on the northern slope of the Jungfrau. The line of perpetual snow varies between 9,023 feet and 9,259 feet. The Aletsch begins at 9,820 feet and descends to 5,000 feet. The Eastern Alps have many glaciers, but they are generally of the second rank. See GLACIERS.

*Geology.*—Notwithstanding the mountainous character of Switzerland its geology is simple. Eruptive rocks are few and belong to very early geologic times. The core of the Central Alps is made up of primitive, azoic, crystalline rocks, and these make the ridge of this roof of Europe. To them are applied a series of schistose Carboniferous rocks semi-crystalline in character. The Triassic is found only at the east and west ends of this ridge. The whole was raised out of the sea in Jurassic times (named from the Jura Mountains on the N. W. of Switzerland), and the Jurassic rocks are applied next outside the Carboniferous composing some of the secondary ranges. In them are found some of the most interesting fossils ever discovered. Next in succession from the azoic ridge are found well-developed layers of Cretaceous and then extensive Tertiary beds, especially the Miocene. The Glacial period and the more recent glaciers have left their traces and remains over all Switzerland, and the alluvial work of the present age has been and is still active in filling up lakes and making plains.

*Climate.*—The Swiss climate has been studied with special care, and presents features of great interest. There are four meteorological stations at heights from 6,290 to 8,215 feet, and the Mont Blanc station is just beyond the boundary. The southern slope is remarkably mild, but the northern part has a rigorous continental climate. The mean temperatures run from 35° F. to 55° in the inhabited portions, about equal to the range from Winnipeg to Cape Charles in North America. The decrease of temperature with each 1,000 feet of increased altitude is 3·2° on the northern slopes and 2·8° on the southern. The contrast of the seasons is greatest in the valleys, where winter temperatures of −25° F. sometimes occur. The precipitation is large (40 to 60 inches), and is greatest at an elevation of about 6,500 feet. The run-off is particularly large, and causes rapid and sometimes destructive accumulation of sediment and wash. The most noteworthy wind is the foehn, which, coming from southerly directions, descends on the leeward side so dry and warm that the snow disappears as if by magic, and the parching greatly increases the danger of fires.

Like the temperature, the population decreases with the height. There are no villages beyond 5,000 feet, except the little hamlet of Juf at 7,000 feet, the highest in Europe. On the Great St. Bernard the hospice is at 8,110 feet, and the Alpine Club has some retreats, the highest of which (on the Matterhorn) is at 12,800 feet. The inhabitants of the high valleys have larger bodies and feet than those below, and are more free from several maladies, notably phthisis. Pneumonia and pleurisy are more common and more dangerous than below, as are also asthma, scrofula, and rheumatism. In the deep, moist valleys, with little sunshine, goiter and cretinism occur in large ratio, but increasing attention to cleanliness and general comfort diminishes this.

*Natural Productions.*—Switzerland is not productive in metals. There are several mines of anthracite, lignite, ordinary coal and salt, and one of graphite. Quarries of building-stone are more numerous and important. The flora falls easily into five zones, defined by the elevation; the zone of the vine goes up to 2,000 feet; that of cereals to 3,000 feet, and includes most of the plain; that of the forests to 6,000 feet; the sub-Alpine to 8,000 feet; and the Alpine above 8,000 feet. The arable land is chiefly confined to the first two. The forests occupy 3,032 sq. miles of area, and include the oak, beech, and spruce. They are valuable not only for the ordinary uses of trees, but also to protect the lower levels from destructive overflows; forestry is carefully practiced. Peat exists in large quantities, and forms an important resource for fuel. The sub-Alpine zone is rich botanically; in the Alpine region a species of violet and the much-praised edelweiss reach the very margin of perpetual snow.

The fauna is not rich, and animals suitable for hunting are protected by stringent game-laws. Wolves and deer are very rare; a few bears still remain in the wilder recesses of Valois and the Grisons; the wild boar survives in the Jura; the chamois can be hunted only twenty days in the year, and is increasing in number; the fox is common. The best-known bird is the lammergeier. Fish are very abundant, and fish-culture is much practiced.

*Agriculture.*—Of the total area 72 per cent. is classed as productive, and of the productive part 36 per cent. is in grass and meadow, 29 in forests, 19 in fruit, and 16 in crops and gardens. There are about 300,000 peasant proprietors, representing 2,000,000 of the population. Rye, oats, and potatoes are the chief crops, but the importation of foods is large. Cheese and condensed milk are manufactured in large quantities for export. About 22,000,000 gal. of wine are produced annually. In 1896 there were 108,969 horses, 1,306,696 cattle, 271,901 sheep, 415,817 goats, and 566,974 swine; and in 1893 there were imported 10,198 horses, 65,199 cattle, 51,386 swine, and 92,461 sheep.

*Industry.*—The soil does not yield sufficient for the support of the population, and a large percentage finds employment in industries, generally small, occupying only the family. The larger ones subject to the factory law only are enumerated. Of these on Jan. 1, 1896, there were 4,933 devoted to the manufactures of textiles, leather, articles of food, chemical, metal, and wood products, paper and printing, pottery, glass, watches, etc. See SWITZERLAND in the Appendix.

Switzerland has over 1,400 hotels, employing 16,000 people, representing a capital of $64,000,000, and giving a gross annual income of $10,500,000.

*Population.*—The population from 1880 to 1888 increased at the annual rate of 0.4 per cent. In 1888 it was 2,917,514; and there were 1,041 females for every 1,000 males. The density of population was least in the Grisons (34 per sq. mile), Uri (41·5), and Valois (50·3); greatest in the canton of Geneva (977), of Basel (674), and of Zurich (506); all of the latter have cities of considerable size. German is spoken by the majority, and is hence the official language in sixteen cantons, French in five, and Italian in one. In the Grisons about 46 per cent. of the population use German, about 40 per cent. Romansh, and 14 per cent. Italian. Italian and Romansh are receding, French is growing in use, and German remains about stationary. The official French is full of Teutonisms. The birth-rate is high, and 4·5 per cent. of the births are illegitimate. The annual emigration amounts to about 3,000, and is decreasing; the emigrants are generally agriculturists and unmarried. They are chiefly from Bern, Zurich, St.-Gall, and Ticino, and nearly all go to the U. S. There is absolute freedom of conscience; about 60 per cent. of the population is Protestant, the remainder Roman Catholic. The Protestantism is Calvinistic in doctrine and Presbyterian in government. Education is compulsory, primary education is free, and the percentage of illiteracy nearly evanescent. There are 6,395 schools of all grades, with 13,877 teachers and 572,334 pupils; also five universities (at Basel, Zurich, Bern, Geneva, and Lausanne, the last since 1891), with 600 teachers and 25,000 pupils, of whom nearly a half are aliens. The principal towns (with the communal population for 1900) are Zurich (150,239); Basel, Basle, or Bâle (112,842); Geneva (104,044); Berne (63,994); Lausanne (55,973); Luzerne, or Lucerne (29,145); Neuchâtel (20,697); St. Gallen (36,344); and Chaux-de-Fonds (31,134).

*Commerce.*—The imports (including precious metals) for 1899 were valued at $248,321,795, and the exports at $167,073,709. The chief imports were foodstuffs, tobacco and spirits, silk, wools, cottons, and other textiles, metals, minerals, and chemical colors, bullions, and coin. The chief exports were textiles, timepieces, and colors. Wheat and flour are largely imported. The trade is chiefly with Switzerland's immediate neighbors, Germany first, but a considerable proportion of the exports goes to Great Britain and the U. S.

There were 2,347 miles of railway in operation in 1899, with a total cost of $235,000,000, and a gross income in 1892 of $25,219,419, and expenses of $14,910,504; also 5,707 miles of telegraph and 8,368 miles of telephone line. The number of post-offices was 1,505.

The unit of money is the franc of the same value (19·3 cents) as that of France. Swiss coin makes only about 5 per cent. of that circulated; the remainder is chiefly Italian and French. The *pfund* = 1·10 lb. avoirdupois; the *centner* = 100 pfund; the *arpent* of land = 8·9 acres.

*Cantons.*—Switzerland is composed of twenty-two cantons, although the splitting of each of three cantons into two demi-cantons makes the total number of federative units twenty-five. These, with the date of admission, area, and population for Dec. 1, 1900, are as follows:

| CANTON. | Date of admission. | Area in square miles. | Pop. Dec. 1, 1900. |
|---|---|---|---|
| Uri | 1291 | 415 | 19,701 |
| Schwytz | 1291 | 351 | 55,497 |
| Unterwalden | 1291 | .... | ...... |
| Upper | .... | 183 | 15,280 |
| Lower | .... | 112 | 13,088 |
| Lucerne | 1332 | 579 | 146,474 |
| Zurich | 1351 | 666 | 430,135 |
| Glarus | 1352 | 267 | 32,397 |
| Zug | 1352 | 92 | 25,045 |
| Bern | 1353 | 2,657 | 586,918 |
| Freiburg | 1481 | 644 | 127,719 |
| Soleure | 1481 | 302 | 100,838 |
| Basel | 1501 | .... | ...... |
| City | .... | 14 | 112,246 |
| Rural district | .... | 163 | 68,451 |
| Schaffhausen | 1501 | 114 | 41,523 |
| Appenzell | 1573 | .... | ...... |
| Outer Rhodes | .... | 101 | 55,284 |
| Inner Rhodes | .... | 61 | 13,480 |
| St.-Gall | 1803 | 779 | 230,066 |
| Grisous | 1803 | 2,773 | 104,510 |
| Aargau | 1803 | 542 | 206,460 |
| Thurgau | 1803 | 381 | 113,110 |
| Ticino | 1803 | 1,088 | 142,719 |
| Vaud | 1803 | 1,244 | 279,152 |
| Valais | 1815 | 2,027 | 114,980 |
| Neuchâtel | 1815 | 312 | 125,804 |
| Geneva | 1815 | 108 | 131,674 |
| Totals | .... | 15,976 | 3,312,551 |

*Administration.*—The constitution is thoroughly federal in character, with some novel features. (See LAW-MAKING, METHODS OF.) Supreme legislative and executive authority in federal matters rests in a federal assembly of two houses: a state council of forty-four members (two for each canton or one for each demi-canton) elected by the cantons, and a national council composed of 147 members—one for each 20,000 population, elected every three years by direct ballot. Each member receives $4 for each day when present, and 5 cents per kilometer for traveling expenses. Executive authority is deputed to a federal council of seven, elected by the assembly for three years, and its president and vice-president are the chief magistrates of the nation. There is a special tribunal for trial of cases between the confederation and cantons, or between cantons. The confederation can levy no direct taxes, and its chief source of revenue is the customs. The revenue for 1900 was $17,499,507, and the expenditures $19,832,262. The public debt (federal) in 1900 was $17,377,650, mostly at 3½ per cent., but there is state property worth $17,963,675. No standing army may be maintained within the confederation, and the individual cantons have certain independent rights in carrying on war. Fortifications have been constructed at St.-Gothard, are being constructed at St.-Maurice, and are in contemplation at Martigny.

Each element of the confederation (canton and demi-canton) is sovereign and independent in local affairs and in such others as are not limited by the federal constitution. The cantonal governments agree only in the absolute popular sovereignty, and differ much in organization and details. In a few smaller ones the public will is given by popular meetings without representative machinery. The *referendum* is most fully developed in Zurich, where all laws and even the chief matters of finance must be submitted to the popular vote. Communal government is well developed for local affairs. In 1890 the combined budgets of the cantons gave a revenue of $16,000,000, and an expenditure slightly greater. Several cantons have only indirect taxation—duties, stamps, etc.—while others tax income and property also. The cantonal debts are inconsiderable, and are covered by cantonal property. In many towns and parishes the octroi also exists.

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**Switzerland, History of:** Though many traces of the ancient race known as lake-dwellers remain in Switzerland (see LAKE-DWELLINGS), the Helvetii were the first inhabitants whose name has been transmitted to us by history. They were continually involved in war with Gauls, Germans, or Romans, and on one occasion even dared to attack Cæsar's army, but were beaten back to their native valleys, and from this time to the period of the Teutonic invasions enjoyed the protection of Rome. They served as a bulwark for Rome against the Germans, and their country became a Roman province. The time came, however, when the Romans had to withdraw their forces and make room for other invaders, the Ostrogoths, the Alemanni, the Burgundians, and the Franks. The western part was included in the Burgundian kingdom. The last of the Burgundian kings parted with his sovereignty in favor of the Emperor Conrad II. in the year 1032, so that the greater part of what is now Switzerland was placed under the immediate rule of the emperors. At the beginning of the twelfth century the emperor granted to the Dukes of Zähringen, as vassals, besides many other lands, the greater part of Western Switzerland and the Lesser Burgundy. At the death of the last Zähringen (1218) Switzerland was again put under the paramount authority of the emperor, who, however, conferred several parts thereof on other vassals. The Swiss were willing to submit themselves to the emperors as their paramount lords, but bore uneasily the rule of the imperial vassals. Following the example of the leagues of the nobles and of the free cities the three forest-cantons, Uri, Schwytz, and Unterwalden, formed in 1291 a league, known as the Old League of High Germany, which was the nucleus of the twenty-two cantons of the present confederation.

The house of Hapsburg, which had been instituted by the Duke of Zähringen protector of the Lands—for such the forest-cantons were called—attempted to increase its rights and domains; the Lands opposed, and tried in their turn to free themselves from the dominion of the house of Hapsburg. The Swiss war of independence is memorable for the bravery and vigor of the League. In the battle of Morgarten Pass (1315) Duke Leopold of Austria was utterly defeated, and for seventy years no serious attempt was made by the Dukes of Austria to force their rule upon the Swiss. In 1386 the Swiss gained another victory over the Austrians at Sempach, and this battle, which was soon followed by another victory for the Swiss at Näfels (1388), placed the growing power of the League on a firm footing. In the meanwhile new districts were added to the League, which after the accession of Bern in 1353 contained eight members. The period that succeeded the battle of Sempach was marked by the gradual destruction of the Austrian power over the members of the League, and in 1474 their independence of the house of Hapsburg was formally recognized. Another feature of this period was the undermining of the house of Savoy, which up to that time had almost as complete authority over the western part of the country as the house of Austria had over the central and eastern portions. In the fifteenth century another powerful foe appeared in the person of Charles the Bold of Burgundy, but the Swiss won victories at Grandson and Morat in 1476 and in 1477 under the walls of Nancy, where Charles was slain. By 1513 the number of the cantons was increased to thirteen. In the next few years Protestantism spread rapidly throughout the country, under the impulse given to it by the great Reformer Zwingli, and in 1531 war broke out between the Protestant and Roman Catholic cantons. In that year the Protestant canton of Zurich was defeated by the forest-cantons at Kappel, and Zwingli was killed. This reverse was in part offset by the spread of Protestantism in the west, where Geneva became the seat of Calvinism and where the Pays du Vaud, long subject to Savoy, was conquered in 1536 by the Protestant canton of Bern.

After each of the religious wars treaties of peace were made, but peace did not return. During the Thirty Years' war Switzerland remained neutral, and by the Treaty of Westphalia (1648) her independence of the German empire was formally recognized.

Up to the time of the death of Louis XIV. the greatest disorder existed in Switzerland, and this disturbed condition of things continued until the outbreak of the French Revolution, the principles of which gained ground easily in Switzerland. The number of malcontents increased, and the Swiss were to be seen in opposing armies. The canton of Bern, the largest of the states, fought valiantly to the last against the new ideas and the foreign republican armies, but without success. Switzerland was to be converted into a republic, "one and indivisible," according to the views of the French Directory. This was known as the Helvetic

Republic and lasted four years. To that form of government succeeded a sort of league based upon federal principles. Under this constitution Switzerland recovered an appearance of peace, but the mediator of that "mediation act" (Feb. 13, 1803) was a meddlesome neighbor and a despotic ruler. The mediation lasted ten years, and came to an end at the fall of the French empire. The European reaction against France took place, and Switzerland had to participate in it; her soil was invaded by the allies, as it had been so often and so long by the French armies. By the Congress of Vienna (1815) her independence and neutrality were acknowledged and guaranteed. The spirit of self-preservation and sense of dignity developed in Switzerland, and new efforts were made to give the country a stronger and more independent basis. Switzerland was led to it by new internal disturbances and external occurrences—notably the revolutions in France in 1830 and 1848. In the latter year a new constitution was adopted without foreign interference; this gave place on May 29, 1874, to that now in force.

F. M. Colby.

**Sword** [O. Eng. *sweord* : O. Sax. *swerd* : O. H. Germ. *swert* (> Mod. Germ. *schwert*): Icel. *sverð*]: a weapon of offense, consisting of a long blade and a handle large enough for the grasp of one hand or, rarely, of both hands. The characteristic of the weapon is that the blade is not mounted on a long handle or staff, while yet it is larger than the dagger or poniard.

*Sword* is the general term, and includes weapons as unlike one another as the cavalry saber and the slender triangular-bladed court sword worn by gentlemen at the close of the eighteenth century. It is, however, well to separate the saber in all its varieties from the sword proper.

*The saber* has one edge only and has a thick, broad back. Toward the point a few inches of the back may be sharpened, though this is uncommon. The edge invariably curves backward to meet the back in a sharp point, which is practically a triangular point; moreover, the whole blade usually curves backward, the back concave and the edge convex. Some cavalry sabers are straight. The cavalry and artillery sabers of the U. S. service are slightly curved, the curve being about one in twenty. The northern nations of Europe in the early Middle Ages used sabers as well as swords; that is, both their long and their short weapons of this kind often had but a single edge and a broad back. These weapons, really long and heavy knives, were called scramasaxes, and were probably the arms most constantly in use. The celebrated Japanese weapon is curved about as much as the U. S. saber, but is mounted very differently on its handle. The Eastern blade slopes backward from the handle at the very point of junction, but the Western one is set so that the blade slopes forward. The Japanese two-handed saber had a blade about 3 feet long; this, or a somewhat shorter weapon, formed the principal badge of the Samurai or military class, and was worn in the sash with a much shorter weapon of almost exactly the same general form. These Japanese sabers deserve their great reputation, as the blades are of extraordinary, perhaps unequaled, excellence. The scimiter of the Mohammedan nations is a light saber with the blade very much curved backward, the curve of a Persian scimiter of the eighteenth century and earlier being one in seven or one in eight. In these the blade is set almost exactly tangent to the straight line formed by the handle. Earlier scimiters seem to have had the blade made heavier and broader near the point than at the hilt, perhaps with the view of striking a heavier blow upon armor; but so little is known of the system of fencing or saber-practice in use among the Moslem nations that this is only offered as a suggestion. The drawing cut with the sword arm kept bent, which is supposed to be the favorite manner of attack, would not seem to require a heavy blade or one weighted toward the point. The steel of which the scimiter is made is or affects to be of the famous steel of Damascus, that is, of a steel wrought in such a way that the surface is covered with delicate waving lines in its substance. A weapon almost exactly like the Mohammedan scimiter was carried by officers of high rank in the French service during the first republic. Oriental blades and Oriental scimiters complete were worn indifferently in exchange with similar weapons of French make. English field-marshals are represented as late as 1885 carrying sabers of a like curvature. A modification of the saber used only in some parts of India has its sharpened edge concave and the back convex. One form of this, the deadly koukri of the Goorkhas, is weighted toward the point. The yataghan of the Mohammedan nations on the Mediterranean Sea, from the Danube to Morocco, has also its sharp edge concave; the form varies greatly. The cutlass is the saber shortened and roughly and cheaply mounted, as for sailors, both in the navy and in private service. The düsack or tesack is nearly the same weapon, and especially one forged in a single piece, the handle being a mere hole in a plate. This simple weapon was used in Germany in the later Middle Ages and down to the seventeenth century.

The ordinary hunting-knife, of which the famous American bowie-knife is one form, is a shortened saber; these weapons are to the saber what the European dagger of the Middle Ages is to the sword proper.

*Swords among Ancient Nations.*—The special weapon of the ancient Roman infantry was, at least after the beginning of the second century B. C., straight, double-edged, sharp-pointed, and much longer and heavier than had been in use in earlier times or at any time among the Greeks. Little is known of its exact character, as the steel blades have been destroyed by rust, but the general shape is known from such sculptured representations as are found on the columns of Trajan and Marcus Aurelius at Rome. The length of the blade may be put at from 20 to 24 inches. It was used mainly for thrusting, but we are not to imagine a legionary thrusting like a modern fencer with the hand high and the fingers uppermost; a more common way of "giving point" was certainly with the hand very low and the point higher, the thrust being upward. The bronze swords of the northern nations were often what is called leaf-shaped, that is, they were broad toward the point and narrowest at a distance of 3 or 4 inches from the handle, and symmetrical in shape, that is, both of the edges had the same elongated S-curve, but reversed, the two meeting at a sharp point. The sword of the Gauls at the time of the Roman conquest seems to have been sometimes of bronze, sometimes of steel; it was long, very heavy, and often retained the leaf-shape of earlier times. Among Eastern nations, whether ancient or modern, the most important weapon which can be called a sword is the Malayan creese. This has a blade about 18 inches long, sometimes shorter, sharp-pointed, and having on each side a waved edge, the undulations being very decided, one in five or one in six of their length. Another important peculiarity is the setting of the blade, often not at all in the prolongation of the handle, but at a decided angle with it, the angle varying in different weapons. These blades form a great contrast with the smooth, close-grained, highly finished Japanese blades. The Malayan steel is, as it were, a carrying further of the Damascus waved or watered steel: it is extremely rough and with depressions between the lines of the waving nearly like the graining of wood which has been exposed to the weather. The straight sword used by the Hamran Arabs in hunting as well as war seems to be of European origin, perhaps a lingering on of the knightly sword described below.

*In the Middle Ages.*—With the appearance of what is known as chivalry, after the firm establishment of the feudal system, the sword of the knight was broad-bladed and straight, symmetrical in shape. From the beginning to the end of the age of heavy armor and knighthood the peculiar weapon of the knight was the sword with a thin, flat blade and both edges alike. The well-known sword of Childeric, found in his tomb and now in the Louvre, could not have had a blade more than 18 inches long, judging by the sheath, which is in good preservation. The sword of the ninth century had a blade nearly or quite 3 feet in length. That of the twelfth century was often shorter. Some swords of the thirteenth century had a blade 45 inches long; but the sword of the knight, intended to be wielded by one hand, could hardly exceed this length, and when heavy armor was to be broken or wrenched apart a mace or a horseman's axe was used. The two-handed swords of the later Middle Ages may have been used on occasion by mounted knights; thus the famous bronze statue of King Arthur in the Church of St. Francis in Innsbruck, which dates from about 1520, is furnished with a sword whose grip has two distinct holds for the two hands; but the two-handed sword was essentially a weapon of foot-soldiers, having a blade 4 feet or more in length and a handle about 16 inches long, weighted at the butt to partly counterpoise the blade. It is probable that but little delicate sword-play was used during the Middle Ages. Each combatant struck hard and caught his enemy's blows on his shield or trusted to his armor.

*In Later Times.*—With the gradual disappearance of armor the gentlemen of Europe introduced swords which, though still heavy, were much lighter than those of the fourteenth century. The rapier was brought into use by the Spaniards and adopted by men of family toward the close of the sixteenth century, and was as long as the knightly sword of an earlier time, but much lighter. The broad, thin blade of the knight's sword gave place to a much narrower blade in which can be seen the beginning of the dueling sword of the seventeenth century. These, however, were the arms of the nobles and their imitators; the private soldier still carried a blade for cutting as well as thrusting, and this passed into the heavy broadsword of the seventeenth century, such as became famous in the hands of Cromwell's cuirassiers. A similar weapon, carried by the Scotch Highlanders under Montrose and Charles Edward Stuart, is often called claymore, but this is erroneous. The claymore proper was a huge two-handed sword, such as is described in Scott's romance *The Fair Maid of Perth.*

The rapier had always a straight, narrow blade, and when used for systematic and ordinary fighting, as in the duel, was generally accompanied by the dagger, which was held in the left hand and parried the adversary's thrusts. As the science of fencing was developed the dagger was given up and the sword became lighter and shorter. A duel under Louis XV. was fought with swords whose blades did not exceed 3 feet in length, and were sometimes two-edged and flat, sometimes three-cornered or bayonet-shaped.

One very curious form of the sword was the hunting-sword of the seventeenth century and later—a thin, two-edged blade curved about like a saber, one edge convex, one concave. Such blades were from 16 to 24 inches long.

In modern armies officers of certain ranks are supposed to wear a slender straight sword. Thus in the U. S. army in the civil war staff officers should have carried such weapons, but they generally preferred a saber.

As the sword has always been the weapon of ceremony and the typical badge of a soldier and commander of armies, so *swords of honor* and *sabers of honor* are often presented to successful officers. Moreover, swords of mere ceremony are carried before officials of high rank, or are held by them on certain occasions; thus among the regalia of Great Britain is the curtana, or pointless "Sword of Mercy," and the "Sword of Justice." Somewhat in a ceremonial way the *city-sword* or *walking-sword* of the eighteenth century was considered the distinctive badge of a gentleman.

*The Hilt.*—The sword-hilt consists of grip, guard, and pommel. The long tang forged with the blade, straight, tapering, and of square-edged section, passes through a hole in the guard, is covered by the grip, and is held fast at the end by the pommel, or else is held fast in the grip by pins or the like, while the pommel is put on separate. The grip is a mere enlarging and rounding of the tang, sometimes by laying plates of bone or wood against its sides, sometimes by means of a tube of wood or of shark-skin, or even metal. Wire is sometimes wound around the grip to allow of a firmer hold. The guard is the part that varies most. In Roman swords it was small, a mere plate sufficient to stop the edge of another sword which might slide along its own blade, but no more. The Japanese saber has but a small guard, approximately oval in shape, a flat plate of iron or bronze. The mediæval sword had a large and long cross-guard, each arm of it several inches long; those of the two-handed sword sometimes a foot across. The most elaborate of all sword-hilts is that of the sixteenth and seventeenth centuries, which was applied to broadswords and rapiers alike; this had a very elaborate protection for the fingers and knuckles, consisting of several curved bars or of a plate of steel. In connection with this was a complicated cross-guard; that is to say, a fine and carefully made sword of 1600 would have a long cross-guard, a secondary or upper guard 3 inches farther toward the point of the blade and composed of rings or flat plates or "shells" one on each side, and a "knuckle-bow" curving from where the cross-guard meets the grip to the pommel. Sometimes the guard took the form of a cup, with the open part toward the hand. Sometimes the basket-hilt was a bowl so solid and unpierced as to hold liquid. Modern sabers have generally a curved guard which protects the knuckles and sweeps around to meet the pommel, to which it is secured. This is a mere modification of the basket-hilt, as above described.

See Demmin, *Die Kriegswaffen* (Leipzig, 1886; trans. into French and English); Egerton Castle, *Schools and Masters of Fence* (London, 1885); Lacombe, *Les Armes et les Armures* (trans. by Boutelle, *Arms and Armour*, London, 1874); *La Collection Spitzer*, vol. vi. RUSSELL STURGIS.

**Swordfish**: any fish of the family *Xiphiidæ*, remarkable for having the upper jaw prolonged forward in the shape of a bony sword. The common swordfish (*Xiphias gladius*) ranges from the Atlantic coast of North America eastward to the Mediterranean. It is often from 10 to 16 feet long, has very fine scales, no ventral fins, a long broken dorsal fin, and a large and deeply forked caudal. It is a very rapid swimmer, and is said to assail the largest whales with its sword. It sometimes strikes ships with such force as to penetrate several thicknesses of plank, and the sword is frequently broken off and left *in situ*, but the fish which most often assaults vessels is a smaller species of the genus *Tetrapturus.* The swordfish is generally esteemed as food, and is taken by the harpoon, thus affording an exciting and dangerous sport, but is too scarce to be of much commercial value. The use of the sword is not clearly ascertained. In all probability the fish employs it in gaining its subsistence, but the precise method is not known. The food of the swordfish consists of cuttlefish, especially the squid, and of small fishes. See FISHERIES. Revised by F. A. LUCAS.

**Syagrius**, sī-ā'gri-ŭs: the last Roman ruler in Gaul; was a son of Egidius, from whom he inherited what is known as the kingdom of Syagrius, embracing the country around Soissons, between the Seine, the Marne, and the Oise. The Franks encroached upon his domains, and finally, under their chief Clovis, gained a decisive victory over him at Soissons in 486, thereby destroying the last remnant of Roman power in that region. Syagrius fled to Toulouse, but was afterward surrendered to Clovis, by whose command he was put to death. F. M. COLBY.

**Syb'aris** (in Gr. Σύβαρις): city of Magna Græcia, in Lucania; founded by Achæans and Trœzenians about 720 B. C.; 3 miles from the Tarentine Gulf, between the rivers Crathis and Sybaris, the modern Crati and Coscile. It rose rapidly to a great prosperity, founded other colonies—Posidonia, Laüs, and Scidrus—covered a space of 6 miles in circumference, and was notorious for the luxury and effeminacy of its inhabitants. In 510 B. C. Sybaris was completely destroyed by the Crotonians and never recovered, but in 443 B. C. the descendants of the conquered and exiled Sybarites founded the city of Thurii in the immediate neighborhood of the old site of Sybaris. Revised by J. R. S. STERRETT.

**Sybel**, HEINRICH, von: historian; b. at Düsseldorf, Prussia, Dec. 2, 1817; studied at Berlin and at Bonn; became Professor of History at Marburg in 1845, and director of the Royal Prussian Archives in 1875. He took an active part in politics, and was a member of the Hessian Legislature and of the Prussian Landtag. Among his writings are *Geschichte des ersten Kreuzzugs* (1841); *Die entstehung des deutschen Königthums* (1844); *Geschichte der Revolutionszeit* (1853–74; Eng. trans.); *Die deutsche Nation und das Kaiserreich* (1862); and *Die Begründung des deutschen Reichs durch Wilhelm I.* (1885–90; Eng. trans. 1891). D. at Marburg, Germany, Aug. 1, 1895. F. M. COLBY.

**Syc'amore** [(by analogy of *sycamine*) from O. Fr. *sycomore* < Lat. *syco'morus* = Gr. συκόμορος, mulberry-tree; σῦκον, fig + μόρον, black mulberry]: a tree (*Ficus sycomorus*, or *Sycomorus antiquorum*) which is a near relative of the fig. It is a widespreading, shady tree, much planted in the Levant for its shade. Its light, fragile wood is reputed to be indestructible. Its fruit is inferior in quality to that of the fig, but is abundant and palatable. In some parts of the U. S. the buttonwood or plane-tree is improperly called sycamore, and in Great Britain that name is applied to a maple (*Acer pseudoplatanus*). Revised by L. H. BAILEY.

**Sycamore**: city (founded in 1836); capital of Dekalb co., Ill.; on the Chi. and N. W. and the Chi. Gt. West. railways; 56 miles W. of Chicago (for location, see map of Illinois, ref. 2–E). It is in an agricultural, dairying, and stock-raising region; has manufactories of agricultural implements, flour, water-motors, insulated wire, brick, tile, varnish, furniture, carriages and wagons, and soap, works for preserving fruit and vegetables, and 2 creameries; also 11 churches, 3 graded public schools, a seminary for young ladies, high-pressure water-works, electric lights, a national bank (capital $50,000), a private bank, and a semi-weekly and a weekly paper. Pop. (1880) 3,028; (1890) 2,987; (1900) 3,653. EDITOR OF "TRUE REPUBLICAN."

**Syd'enham**, THOMAS: physician; b. at Winford Eagle, Dorsetshire, England, in 1624; educated at Oxford, and in 1648 became a fellow of All Souls' College, having meanwhile served as an officer in the parliamentarian army; studied medicine at the college of Montpellier. France; took his degree of M. D. at Cambridge, and established himself about 1660 as a physician in London, where he soon attained the foremost place. He abandoned the mere routine system of practice then prevalent, basing his own upon the theory that there is in nature a recuperative power which it is the province of the physician to aid. He was especially acute in observing and describing the symptoms of diseases, and carefully studied the relations between epidemics and the conditions of the atmosphere. Among the services which he rendered to medical practice were the treatment of intermittent fever by cinchona and the administration of cooling remedies in smallpox. His works, which are not numerous, were written in Latin, but have been frequently translated. Among them is *Methodus Curandi Febres* (1666; 3d ed., *Observationes Medicæ*, 1676). In 1843 was founded the Sydenham Society, for the purpose of printing important medical works in English and other languages. Its first issue was the complete works of Sydenham, in Latin (1846; English trans. by Dr. Greenhill, with a memoir by Dr. Latham, 1848). D. in London, Dec. 29, 1689.

**Sydney** [named after Thomas Townshend, first Viscount Sydney]: capital and chief port and railway center of New South Wales, Australia, and the oldest city of Australasia; on the southern side of Port Jackson, in lat. 33° 52′ S., lon. 151° 12′ E. (see map of Australia, ref. 7–J). The climate is temperate and generally healthful. The mean temperature is 62° F., ranging from a minimum of 35° to a maximum of 106°. The mean annual rainfall is 52 inches. Port Jackson is a long, slender inlet on the east coast, of irregular form, with numerous bays and coves, forming a magnificent harbor with a water front of more than 100 miles. The entrance is only a mile wide, but just inside is a bar with only 20 feet of water at low tide, increased by dredging to a few feet more. At the opposite end of the port enters George's river, navigable to Liverpool, a distance of 14 miles.

The city proper is about 4 miles from the heads, on a peninsula between Rushcutter Bay on the E., and Blackwattle Bay on the W. It has a water front of 8 miles, of which 6 are available for the use of commerce. The surface is undulating, with a maximum height of 230 feet. The streets are often crooked and steep, but this gives the city an old-fashioned appearance unique in Australia, and affords frequent and charming vistas over the waters of the bay and to the opposite shores. There are many public parks (3,800 acres), including the Domain (130 acres), extending to the water front, along the most densely populated and busiest part of the city, and Moore Park (500 acres), to the S. E. of the city. The suburbs are numerous and contain a large population. The more fashionable suburbs are toward the E., while the business portion is extending westward. The entire distance to Parramatta, about 15 miles, is practically suburban along the railway. The manufactories are more on the southern side, and population is rapidly extending toward Botany Bay, 6 miles to the S. There are also considerable suburbs on the north shore of the bay, which are connected with the city by steam-ferries and by rail.

The water-supply was first obtained from the small Tank stream flowing into Sydney Cove, along which the nucleus of the town was first formed. Later it was derived from a stream flowing into Botany Bay, brought to the city by a long tunnel. As this proves insufficient, a plan is under way to bring water from the Nepean river, taken at a point 63 miles distant and conducted to a large storage reservoir near Parramatta. The sewage is conducted to the water front, but as the size of the city renders this unsanitary, a large sewer is under construction to a headland on the ocean shore, where the sewage will be delivered into deep water and carried away by the current from the N.

The public and many private buildings are of fine style and good aspect, and are generally made of a fine sandstone found in the vicinity. The university is the most important edifice in Australia, the principal façade being 500 feet in length. Together with the affiliated colleges of St. Paul's and St. John's, it lies in a domain of 150 acres. With regard to its degrees it has the status of the English universities. The metropolitan cathedral of St. Andrew's and the Roman Catholic Cathedral of St. Mary are two of the finest structures in Australia. The royal branch mint at Sydney issues nearly £3,000,000 worth of coin annually, mostly gold, but with a little silver and bronze. The city is in the center of a large coal-basin, and the beds probably pass under the city itself. Coal is cheap and abundant, and the commercial advantages are great. The manufactures include all the products of the pastoral industry, and especially boot and shoe making, railway manufactures, carriage and wagon making, manufactures of glass, pottery, furniture, stoves, tobacco, etc., and distilling and brewing. In 1893 1,323 vessels cleared from Sydney, as compared with 1,593 from the other ports of the colony.

The city was founded in 1788 by Capt. Phillip as a penal station, and long remained a humble village. In 1861 it had 56,845 inhabitants, 93,685 with the suburbs. In 1891 the census gave the city and suburbs 383,386 inhabitants, which was 34 per cent. of that of the entire colony. At the end of 1895 it had, with suburbs, 1,415 miles of streets, and a population of 408,500.

MARK W. HARRINGTON.

**Sydney**: chief port of Cape Breton, Nova Scotia, and capital of Cape Breton County, formerly capital of the province of Cape Breton; on the east side of Sydney Harbor, lat. 46° 18′ N., lon. 60° 12′ W. (see map of Quebec, etc., ref. 1–D); station on the Intercolonial Railway, 275 miles N. E. of Halifax. The harbor is one of the best in the provinces, but it is ice-bound during the long winter. It is the principal port for the coal-mining district northeast, with which it is connected by rail. The harbor was originally the rendezvous of the Spanish fishing-fleet, and was then called Spanish Bay. Later it was a center for British military activity, and so remained until the Crimean war. France has, by treaty, coaling privileges here, and utilizes them to make this the station of her naval squadron on the North Atlantic. Regular connection is kept up with Newfoundland by steamer in summer. Pop. 4,000. MARK W. HARRINGTON.

**Sydney**: See SIDNEY.

**Syene**: See ASSOUAN.

**Sy'enite**: granular crystalline rock, consisting of alkali-feldspars (mostly orthoclase) with some lime-soda-feldspar, one or more ferromagnesian silicate: biotite, amphibole, or pyroxene; and little or no quartz, besides other minerals. According to the kinds of minerals accompanying the alkali-feldspars varieties are distinguished as quartz-syenite, augite-syenite, mica-syenite, hornblende-syenite (syenite proper), zircon-syenite, sodalite-syenite, etc. Its texture varies from coarse-granular to fine-granular, often exhibiting lath-shaped feldspars on the surface of fracture. Occasionally porphyritic, passing into syenite-porphyry and orthoclase-porphyry. With increasing quartz it grades into granite, and with more lime-soda-feldspar it grades into diorite. Varieties low in silica carry nephilite and sodalite, and grade into eleolite-(nephelite)syenite, which properly constitute a separate rock-group. (See ROCKS.) This variety is relatively high in soda and potash, which characterize the feldspars and feldspathic minerals, and enter into the ferromagnesian minerals, producing arfvedsonite, barkevikite, acmite, ægerite. This rock usually carries rare minerals, containing the rarer elements cerium, lanthanum, thorium, yttrium, etc.

The name syenite was first used by Pliny for the rock from Syene (Assouan) in Egypt. It was subsequently applied by Werner to the rock from the Plauensche Grund, near Dresden, from which it has grown into its present significance. It has been found that the rock from Syene is rich in quartz, and therefore a granite. Until recently the name syenite has been applied to hornblende-granite to distinguish it from mica-granite.

Syenite proper is much less common than granite, and has been identified in comparatively few localities in the U. S. outside of New Hampshire. Eleolite-syenite is somewhat better known, occurring in Arkansas, New Jersey, Maine, and Canada. It is known in Brazil, and especially in Norway, where numerous rare minerals associated with it have been described by Brögger. See GRANITE.

J. P. IDDINGS.

**Sykes**, GEORGE: soldier; b. at Dover, Del., Oct. 9, 1822; graduated at the U. S. Military Academy in 1842; served in the war with Mexico; was on frontier and garrison duty 1848–61; was in May, 1861, appointed major of the Fourteenth Infantry; commanded the regular troops in the battle of Bull Run; commanded as brigadier-general the regular infantry in the defenses of Washington during the winter of 1861–62, and in the Virginia Peninsular campaign of 1862 the division of regulars (Porter's corps) which so stubbornly maintained its position on the right at the battle of Gaines's Mill. He commanded this division at the second battle of Bull Run; also at Antietam, Fredericksburg, and

Chancellorsville, having been promoted major-general of volunteers Nov. 1862, and on the appointment of Gen. Meade to the command of the Army of the Potomac (June, 1863) Sykes succeeded to that of the Fifth Corps, which a week later was engaged at Gettysburg, and at the head of which he continued during the ensuing operations of the Army of the Potomac until Dec., 1863, when ordered to duty in the department of Kansas. He was breveted colonel for gallantry at Gaines's Mill; brigadier-general for Gettysburg, and major-general for gallant services. Mustered out of the volunteer service in Jan., 1866, he returned to duty with the Fifth Infantry, of which regiment he had been appointed lieutenant-colonel in Oct., 1863. In Jan., 1868, he became colonel of the Twentieth Infantry. D. at Fort Brown, Tex., Feb. 8, 1880.

**Sylla**: See SULLA.

**Syl'labus** [= Late Lat., from Gr. συλλαμβάνειν, συλλαβεῖν, take together; σύν, together + λαβεῖν, take]: a list of eighty propositions condemned by Pius IX. in his encyclicals, allocutions, and other official utterances. It is annexed to the bull "Quanta Cura," and was published by Cardinal Antonelli Dec. 8, 1864. The errors are grouped under ten heads, and concern pantheism, naturalism, and absolute rationalism; moderate rationalism; religious indifference and latitudinarianism; the ecclesiastical condemnation of socialism, communism, Bible societies, secret societies, and clerico-liberal unions in Italy; the rights of the Church; the rights of the state; natural and supernatural ethics; Christian marriage; the temporal power of the pope; and modern liberalism.

The document is purely negative in form, and states only the propositions to be rejected; but it is very well understood that the contradictory of the condemned propositions is to be held, and not the contrary. Failing to grasp this distinction many have given false and absurd interpretations to the syllabus. So understood, it is evident that the syllabus does not claim for the Church "supreme control over public education, science, and literature," but merely denies such control to the state (Proposition 45). Among Roman Catholic theologians the specific character and doctrinal value of the syllabus are still a matter of dispute. Some contend that it is infallible, but not *de fide*; others that it is also *de fide*; others that it is simply a list of errors drawn up for convenience of reference for bishops, theologians, etc., each proposition having only that specific kind of censure on it in the syllabus which was put upon it in the original document from which it was drawn. When in 1871 Dr. Schulte, professor at the University of Prague, contended that the syllabus is *de fide*, Dr. Fessler, Bishop of Pölten in Austria, wrote in refutation a work for which he received a letter of congratulation from Pope Pius. The Church has not decided that all the propositions in the syllabus are heretical (but only that they are to be rejected); therefore it does not follow that the contradictory propositions are all so many articles of faith. The Roman Catholic Church is accustomed to condemn some propositions as heretical, others as erroneous, others as rash, others as impious, others as dangerous, others as scandalous, others as offensive, others again as merely historically false. So, too, each proposition in the syllabus deserves some censure, but not necessarily the worst—viz., of heresy. Some propositions in the syllabus do not refer to doctrine at all, but only to matters of fact—viz., propositions 12, 23, 34, 38, 72. See Cardinal Hergenroether's *Catholic Church and Christian State*; Gladstone's *Vatican Decrees*, and the replies of Cardinals Newman and Manning; also Gladstone's rejoinder, entitled *Vaticanism*. The text of the syllabus is found in the *Acta et Decreta Concilii Vaticani*, Herder (Freiburg im Breisgau, 1871). JOHN J. KEANE.

**Syllogism**: See LOGIC.

**Sylvanite**: See TELLURIDES.

**Sylves'ter**: the name of two popes and an antipope. St. Sylvester I. (314–335) governed the Church during the reign of Constantine I. The basilicas of the Lateran, St. Peter, St. Paul, the Sessorian basilica, and many churches were completed under his pontificate. Much of the ancient Church legislation is referred to him. The original documents for his life are not extant. It is no longer maintained that he baptized Constantine, or that the latter's donation to Sylvester is genuine. Nevertheless he exercised much influence over the emperor, and received from him many gifts of land and church plate. (See Duchesne, *Liber Pontificalis*, i., pp. cix. 170, 187; Hergenroether, *Kirche und Staat*, p. 357.)—SYLVESTER II., whose true name was GERBERT, was born in Auvergne; studied in Spain under Bishop Hatto of Barcelona, and with the Arabs at Seville and Cordova; traveled in Italy; acquired a great reputation for learning, and was appointed by Otto II. teacher to his son, Otto III. While director of the school of Rheims, to which he attracted many students, he was elected archbishop of that diocese in 991 by a synod which deposed Archbishop Arnulf, but he was not confirmed by the pope, and had to give up his see to Arnulf. He then left Rheims, and repaired to Otto III., by whose aid he became Archbishop of Ravenna in 998, and in the following year pope. His knowledge of mathematics, astronomy, and physics led people to consider him a magician, and it was a popular rumor (see Doellinger's *Fables respecting the Popes in the Middle Ages*, Eng. trans., pp. 267–272) that he had sold his soul to Satan.—SYLVESTER III. was for three months the antipope of Benedict IX. and Gregory VI., and was deposed by the Synod of Sutri 1046.

Revised by J. J. KEANE.

**Sylvester**, JAMES JOSEPH, LL. D., D. C. L., F. R. S.: mathematician; b. in London, Sept. 3, 1814; studied at Cambridge, but could not take a degree on account of being a Jew; became Professor of Natural Philosophy at University College, London; went to the U. S. in 1841, and was in 1841–42 a professor in the University of Virginia. He soon returned to England, and in 1855 became Professor of Mathematics at the Military Academy at Woolwich. In 1876 he was invited to the chair of Mathematics in the Johns Hopkins University, where he remained until 1883. He then returned to England as Savilian Professor of Geometry at the University of Oxford. D. in London, Mar. 14, 1897. He wrote hundreds of memoirs in the *Transactions* of the Royal Society, *Proceedings* of the London Mathematical Society, *Crelle's Journal*, *Quarterly Journal of Mathematics*, *Comptes Rendus*, and many other journals, and in *The American Journal of Mathematics*, of which he was the founder. He enunciated a theory of versification in a volume, *Laws of Verse* (London, 1870), and invented several kinematic instruments. S. N.

**Sylvester**, JOSHUA: author; b. in England in 1563; became eminent as a linguist; was a member of the Company of Merchant Adventurers at Stade, Holland. D. at Middelburg, Holland, Sept. 28, 1618. He is best known as the translator into English of Du Bartas's *Divine Weekes and Workes* (1605; 7th ed. 1641). The original was by a French Huguenot nobleman; Sylvester's version had great popularity among the Puritans of Old and New England, and was one of the sources of inspiration to Milton when writing *Paradise Lost*. The quaint "conceited" style of Du Bartas was, if anything, exaggerated in the translation. In 1615 Sylvester published a singular anti-tobacco tract—*Tobacco Battered and the Pipes Shattered, etc.*—intended to please James I., who hated the weed. H. A. BEERS.

**Sylvicol'idæ**: an earlier name for the *Mniotiltidæ*. See WARBLER.

**Sylviculture**: See FORESTRY.

**Sylvi'idæ**: See WARBLER.

**Syl'vius**, JACOBUS (JACQUES DUBOIS): anatomist; b. at Louville, near Amiens, France, in 1478; studied medicine at the University of Paris, where he was appointed professor in 1550. He was the first to practice injection of the blood-vessels during their dissection; a fissure of the cerebrum is called the fissure of Sylvius. D. in Paris, Jan. 13, 1555. His *Opera Medica* were collected by René Moreau, and appeared at Geneva in 1630.

**Symbio'sis** [Gr. συμβίωσις, companionship; cf. συμβιωτής, partner; σύν, with + βίος, life]: a kind of COMMENSALISM (*q. v.*), in which the associated forms are intimately connected with and dependent upon each other. Thus the plants known as lichens are composed of symbiotic associations of algæ and fungi. The association of "yellow cells" (plants) in the *Radiolaria* (animals) is an example in the animal kingdom. J. S. K.

**Symbolic Logic**, or, better, **Algorithmic Logic**: a form of logic characterized by an artificial language composed of symbols with their laws of combination, and possessed of peculiar advantages in giving of actual relations representations which can be manipulated according to rules of operation and procedure, experimented upon to give new knowledge, according to organized processes.

Before George Boole logic always dealt with its materials directly and by intuitive perception, as did the old Greek geometry. What Descartes's analytic geometry did for the science of space, that Boole's algebra did for logic. His discoveries, startling as they appear, yet rest upon a principle well known to the modern mathematician. Though he had noteworthy forerunners, algorithmic logic, as a practical system, owes its creation wholly to his genius. He was, in a sense, the outcome of his time, the period when algebra was given a real plural. His discoveries in the algebra of linear substitutions are regarded as the foundation of the present vast theory of invariants. His *General Method in Analysis*, discovered in his researches on differential equations, reads like a prelude to his *Symbolic Logic*. His remarkable pamphlet, entitled *The Mathematical Analysis of Logic, being an Essay towards a Calculus of Deductive Reasoning*, by a curious coincidence made its appearance on the very same day as De Morgan's *Formal Logic*. In this he shows that by simply assuming 1 to signify what is, and 0 what is not, he can, without any further assumption, express the premises of a syllogism as two equations from which, by ordinary algebraic procedure, the conclusion can be deduced. This is a pregnant connecting of the concepts of being and nothing with a number system. Still more profound and unexpected is his developing a function of a general logical symbol by Maclaurin's theorem:

$$\phi(x) = \phi(0) + \phi'(0)x + \frac{\phi''(0)}{1.2}x^2 + \text{etc.}$$

Thus at a touch Boole changed a dead into a living science. Moreover, to the old synthetic logic he added a new analytic logic, namely, that the validity of the processes of an algebra does not depend upon the interpretation of the symbols which are employed, but solely upon the laws of their combination. Every system of interpretation which does not affect the formal operational laws is equally admissible, and so the same piece of symbolic algebra may, under one scheme of interpretation, represent the solution of a question on the properties of numbers, under another that of a geometric problem, under a third that of a problem of kinematics, under a fourth that of a new question in logic.

This principle, so fundamental that Boole assigns it as the definitive characteristic of a true calculus or algebra, may be illustrated as follows: If we define a sect as the piece of a straight between two definite points; if we indicate sects by the symbols $x$, $y$, $z$, etc.; if we define the product of two sects, $xy$, as the rectangle of those sects (not the *area* of the rectangle of the sects, but the *surface* of the rectangle determined by them); if we define the product of three sects, $xyz$, as the cuboid of those sects (not the *volume* of that cuboid), then all the theorems of Euclid's Book II. are rigorously demonstrated by the little equations usually appended to the propositions as mere numerical illustrations (e. g. in Playfair); and that, too, without any introduction of the idea of measurement or ratio. Moreover, each proposition may at once be generalized for space of three dimensions, and the mere algebraic statement of the generalization will contain its rigorous demonstration.

This general principle likewise explains why a professional mathematician in working out a way of accurately expressing by an algebra the operations and valid processes by which reasoning is ordinarily performed should make it as similar as possible to the ordinary algebra for number; not because thinking in its general character has any reference to number, but simply to get the benefit of as many as possible of the results and procedures produced by centuries of algebraic advance.

The aim of Boole's investigations was, in the first instance, confined to the expression of the antique logic, and to the forms of the Aristotelian arrangement, but he soon found that restrictions were thus introduced which were purely arbitrary and had no foundation in the nature of things. Feeling with the instinct of genius the high importance of his work, Boole applied his best powers to an elaboration, which appeared in 1854 under the title *An Investigation of the Laws of Thought on which are Founded the Mathematical Theories of Logic and Probabilities*, a work of which Herbert Spencer has said that it "constitutes a step far greater in originality and importance than any taken since Aristotle." The following is a summary of Boole's actual working method:

Convene to represent any class by a letter, as men by $a$ and good things by $b$. Combined in thought one acts as a selective adjective, and whichever this be the result is the same; so that $ba$, or "good men," gives us the same collection of individuals as $ab$, or "human good beings." Using the sign $=$ as meaning, in the most general way, identity, coexistence, or equality, we say $ab = ba$. "We are permitted, therefore, to employ the symbols $x$, $y$, $a$, $b$, etc., in the place of substantives, adjectives, and descriptive phrases, subject to the rule of interpretation that any expression in which several of these symbols are written together shall represent all the objects or individuals to which their several meanings are together applicable, and to the law that the order in which the symbols succeed each other is indifferent." Again, to form the aggregate conception of a group of objects consisting of partial groups, we use the conjunctions "and," "or." Convening that the classes so joined are quite distinct, so that no individual is added to himself, we see that these conjunctions hold precisely the same position *formally* as the sign $+$ in algebra, and are representable by that sign.

As the order of addition is indifferent, we have $x + y = y + x$. Again, to separate a part from a whole, we express in common language by the word "except," as "All men, except Asiatics."

This is our minus sign. As it is indifferent whether we express excepted cases first or last, we have $x - y = -y + x$.

But just as the algebra of quaternions differs in one fundamental law from the algebra of number, namely, in its multiplication being non-commutative, so that $ab$ does not equal $ba$, so Boole's algebra for logic differs in a law equally fundamental: in it $a^2 = a$; and from this comes the fact that, in it, every equation can be solved and every solution interpreted. Only two symbols of number obey this formal law. They are 0 and 1. Their interpretation for logic is *nothing* and *universe*, the two limits of class-extension. This law $x^2 = x$ it is which in Boole's algebra makes division indeterminate; but his genius overcomes this indefinitude by his expansion theorem. For example, from the proposition "All men are all the rational animals," $m = ra$, what can we get about animals? By developing, $a = \frac{m}{r} = f(m.r)$ $= f(1, 1)\, m.r + f(1, 0)\, m.r' + f(0, 1)\, m'r + f(0, 0)\, m'r'$. Hence all animals consist of all men and some irrational things ($r'$) not men ($m'$).

If we would use trial references to the premises the coefficients of the expansion are no longer needed, and by making these trial references mechanical we have from Boole's one theorem the interesting logical machines of Jevons and Marquand. In the latter, the premises being reduced to the form of the combinations to be excluded, as suggested by Boole, the operation of excluding these combinations is performed mechanically by the machine, and the conclusion exhibited. Boole's wonderful creation was so strange that it germinated slowly.

In 1864 Jevons began using $+$ to unite different terms into one aggregate, whether they be mutually exclusive or not. McColl and C. S. Pierce gave slightly varying algebras, adding a new sign to express *existence*. In 1877 Ernst Schröder, in his *Operationskreis des Logikkalkuls*, gave a beautiful simplification of the Boolian calculus, in which appears a duality like that of modern synthetic geometry. In 1879 Dr. Alexander Macfarlane published an algebra of logic which is particularly powerful for handling questions of probable inference and relationship.

Leslie Ellis, De Morgan, Joseph John Murphy, Alexander Macfarlane, and particularly C. S. Pierce, have developed a highly interesting symbolic logic of relatives. Prof. Peano, of Turin, is publishing a formulary containing the known propositions of the various subjects of mathematics, all written in a general symbolic language formed on the basis of algorithmic logic.

Finally, Dr. Ernst Schröder has collected in two encyclopædic volumes a systematic and critical account of all that makes the present status of algorithmic logic, including his own exceedingly important developments of many essential parts. In the first volume of this great work, *Vorlesungen über die Algebra der Logik (exakte Logik)* (first vol., Leipzig, 1890), the logical operations called identical multiplication and addition are shown to deserve these names, since all laws of addition and multiplication in general arithmetic which hold as general formulas, that is, without reference to the nature or individuality of the combined numbers, hold also for these logical operations; while the inverse operations may always be replaced by a simpler operation, *negation*, which appears as a common special case of each. The method of using the logical calculus is thus surprisingly simplified.

GEORGE BRUCE HALSTED.

**Symbols, Chemical**: See CHEMISTRY.

**Syme**, JAMES, M. D.: a noted Scottish surgeon; son of a Fifeshire lawyer; b. in Edinburgh, Scotland, Nov. 7, 1799; educated at Edinburgh University, and graduated in surgery therein 1821; was lecturer and Professor of Surgery at Edinburgh many years, and originated many improvements, including the resection of diseased joints in place of amputation, the process known as Syme's operation for amputation of the foot at the ankle-joint, and the removal of large tumors of the lower jaw by excision of the entire bone. He was the author of *The Excision of Diseased Joints* (1831) and *Principles of Surgery* (1832), both reprinted at Philadelphia (1866). D. in Edinburgh, June 26, 1870. See the *Memorial* by Dr. Robert Patterson (Edinburgh, 1874).

**Sym'machus** (Gr. Σύμμαχος): one of the three chief translators of the Old Testament into Greek who attempted to improve upon the LXX. Fragments of his translation have been preserved in that which remains of the *Hexapla* of Origen. According to Epiphanius (*De Mens. et Pond.* 16), he was a Samaritan living at the time of Severus (193–211). Eusebius (*Hist. Eccl.*, 6, 17) and Jerome (*Opp.*, ii., p. 894) say that he was an Ebionite. (Cf. also Nestle, *Theol. Stud. und Krit.*, 1879, p. 733.) Geiger (*Jüd. Zeitschr.*, i., p. 62) tried to prove that he was a Jew. He must have lived later than Irenæus, who in 180 A. D. (*Adv. Hær.*, 3, 24) does not mention him. Symmachus translated freely, and attempted to write a polished Greek. See also Field, *Hexapla*, i., chap. iii.; Bleek-Wellhausen, *Einleitung*, p. 582; F. Buhl, *Kanon des Alt. Test.* (Leipzig, 1891, § 54).

RICHARD GOTTHEIL.

**Symmachus**: pope (498–514); a Sardinian by birth; consecrated Nov. 22, 498, after the death of Anastasius II., but his election was contested, and Laurentius was on the same day made antipope. Symmachus was supported by Theodoric, King of Italy, and Laurentius by the Byzantine emperor. The contest lasted about seven years, but was decided in favor of Symmachus. Of more interest are the enactments of the synods which were held during his reign, and which contributed much to the systematic organization of the papal administration. Some seven councils were held (499–504) in which the election of the pope was regulated, the free disposition of Church goods forbidden to laymen and made more difficult even for the clergy, the principle proclaimed that the occupant of the Roman see could be judged by no inferior, etc. He was distinguished for his zeal in building and restoring churches, in redeeming captives, and aiding the needy. D. July 19, 514. See Duchesne, *Liber Pontificalis*, i., p. cxxxiii., 260. JOHN J. KEANE.

**Symmachus**, QUINTUS AURELIUS: author and orator; b. about 350 A. D.; educated in Gaul; held some of the highest civil offices in Rome in the latter part of the fourth century A. D. Of his works, the *Epistolarum Libri X.* are extant, and are of considerable historical interest; editions by Juretus (1580), Scioppius (1608), and Pareus (1651). Fragments of his speeches were discovered by Cardinal Mai, and published in *Scriptorum Veterum nova Collectio* (1815) and in Meyer, *Orat. Rom. Fragm.*, pp. 627–636. The best edition of all the works is by O. Seeck (Berlin, 1883); smaller edition by Kroll (Leipzig, 1893). Symmachus was one of the last champions of paganism, and a noble and pure character. D. about 405 A. D. Revised by M. WARREN.

**Symonds**, JOHN ADDINGTON: critic, biographer, and literary historian; b. at Bristol, England, Oct. 5, 1840; educated at Harrow School and Baliol College, Oxford, where he took the Newdigate prize; was elected a fellow of Magdalen in 1862. Ill health necessitated his residence for several years at Davos-Platz, Switzerland. Among his writings are *An Introduction to the Study of Dante* (1872); *Studies of the Greek Poets* (1873–76); *Sketches in Italy and Greece* (1874); an exhaustive work in seven volumes on *The Renaissance in Italy* (1875–86); *Sketches and Studies in Italy* (1879); *Essays* (1890); *In the Key of Blue* (1893); *Shakspere's Predecessors* (1884); *Walt Whitman* (1893); besides several volumes of verse, original and translated, lives of Shelley, Michelangelo, Ben Jonson, and Sir Philip Sidney, and a translation of the *Autobiography of Benvenuto Cellini* (1887). D. in Rome, Italy, Apr. 19, 1893. H. A. BEERS.

**Symons**, GEORGE JAMES, F. R. S.: meteorologist; b. in London, England, Aug. 6, 1838; educated by private tutors. From 1860 to 1864 he was assistant to Admiral Fitzroy in the British Meteorological Office. In 1860 he established the annual publication entitled *British Rainfall*, and in 1865 the monthly called *Symons's Meteorological Magazine*, both of which he still conducts (1895). He established a rainfall service of his own, and this now extends over the British islands. He was chairman of the Krakatoa committee of the Royal Society (1884), and editor of their *Report*. MARK W. HARRINGTON.

**Sympathy** [from Gr. συμπάθεια, community of feeling, deriv. of συμπαθής, affected by like feelings; σύν, together + πάθος, feeling]: the emotion aroused by any presentation which suggests suffering or pleasure.

1. It is aroused by states clearly pleasurable or painful. There is no occasion for sympathy with one who does not need it; that is, with one who is not in a state of positive feeling, good or bad. Further, the study of the first sympathies of children shows that they extend to things as well as to persons, and only gradually get narrowed down to objects which feel. Sympathy as an emotion is shown before the child makes any distinction between things that feel and those that do not. But whatever the object be, the emotion is called forth only by such happenings as have before excited the child's own feelings of pleasure or pain.

2. Some degree of interest is necessary to sympathy. The confirmation of this appears broadly in everyday experience. For example, a man reads in the morning paper that thousands of people perish in a Chinese flood, and the cup of coffee that follows it up is much more important to him than their bereaved families; but a single death in his own community makes him at once solicitous in reference to the deceased man's relatives. Yet mere exploring interest when it comes upon suffering always starts the sympathetic feelings.

3. A person's sympathy is in a rough way proportionate to the nearness of the individual's connection with himself. This, again, needs no detailed proof; if one's brother breaks his leg one feels more sympathy than if a casual comrade meets the same misfortune; and the difference is greater still if the latter be only an animal, as, for instance, a favorite horse.

4. Sympathy is aroused, not merely by real beings, but by any idea of suffering. It is not necessary that one believe in the object of one's sympathies. Pictures in memory win sympathy, imaginations in fiction arouse it, vague forebodings of misfortune to others excite it. Whenever there arises in consciousness an idea of a conscious creature—be he fact, memory, fancy, illusion, reality in any of its kinds, that is, be he a possibility in any form—his fortune as suffering or enjoying moves our sympathy. This is true in spite of our efforts—often successful as they are—to suppress sympathetic emotion by dwelling upon the unreality or ill desert of the subject of it. *Little Dorrit* will move some readers in spite of their sense that the character is fictitious. We all feel the stirrings of fellow-feeling for the condemned criminal, even though we be convinced of the justice of his sentence. In cases in which we do suppress the emotion it is by getting rid of the idea, turning the attention to something else, exciting some new interest, that we do it; not by depriving the subject in question, the idea of suffering, of its force to affect us.

In this definition several further considerations are involved. By the use of the word "suggestion" an important distinction is intended between the object on which sympathy terminates and that by which it is caused. A suggestion is a stimulating idea which is brought into consciousness from without, or comes by an association, in such a way that it does not belong in the course of my real life. A suggested pain, for example, is a pain which a person is led to think of, but which he is not really suffering. Suggested suffering, therefore, is the idea of pain as far as it differs in consciousness from the actual pain of the experience presented.

But the question arises: Does such a suggestion excite sympathy? Suppose a cruel father who punishes his child by pinching, the presentation of the father may suggest pain to the child; but this does not seem to be sympathy—it may be fear, or memory of pain. Yet, on looking closer and observing children, we find that if the father take the attitude which the pain before accompanied, real sympathy is excited. Let him pinch a piece of wood, paper, even his own finger, and the child a year old gives clear expression to its sympathetic emotion. The child does not need the notion of another person who suffers, nor even of another object that suffers; he only needs two things: first, a presentation which suggests vivid pain, and second, the absence of the coefficient of reality which his own suffering had. In other words, the emotion of sympathy does not *require* an object at all. It *acquires* an object, and then maintains itself by the emphasis of this object; but in the first place it attaches to any convenient presentation in close connection with its exciting cause.

*Kinds of Sympathetic Suggestion.*—We may sympathize, therefore, without sympathizing with anything, and at first this is the experience of the young child. But its sympathy gets an object, and so maintains and develops itself. The child inherits a susceptibility to a social response to others' actions, and also by *imitating* their expressions he learns how similar organic conditions feel.

*Altruistic Element in Sympathy.*—The much discussed question of egoism *versus* altruism in the sympathetic emotion may receive partial consideration here. If it be true that suggested suffering excites sympathy, and that it is only suggested suffering that excites it, namely, suffering not present as real suffering is, and for that reason attributed, when knowledge is sufficiently advanced, to some one else—then we must believe that sympathy is not entirely egoistic. Suggested suffering is at first neither egoistic nor altruistic, because neither the *ego* nor the *alter* exists in consciousness when sympathy at first arises. The reference of real pain to self, and of suggested pain to another, seem to be both late acquirements. But as it is true that the child gets his external objects clearly presented—especially his external personal objects—before he clearly presents himself, so sympathy must be a conscious emotional motive before self-seeking is.

*Varieties of Sympathetic Emotion.*—A large number of varieties or shades of emotion may be classed as sympathetic, i. e. kindness, benevolence, charitableness, etc. When felt toward an equal in character or station, we call it congratulation, fellow-feeling, fellow-suffering, companionship, common well or ill desert, solicitude, heartache; toward an inferior, compassion, pity, mercy; toward one much superior, it approaches *awe*, but differs from it in an unnamable way. J. Mark Baldwin.

**Sym'phony**, or **Sinfo'nia** [*symphony* is viâ O. Fr. and Lat., from Gr. συμφωνία, a chording, unison, symphony, deriv. of σύμφωνος, harmonious, chording; σύν, with + φωνή, sound, voice. *Sinfonia* = Ital. < Lat. *sympho'nia* = Gr.]: in music, an elaborate composition designed for performance by a full orchestra, and consisting of several distinct movements (usually four in number), each of which has its own individual character, as the *allegro*, *andante*, *adagio*, *minuet*, *scherzo*, etc., while the whole unite in forming one symmetrical and complete work of art. There appears to have been no important difference between the symphony and the overture until about the end of the eighteenth century. Revised by Dudley Buck.

**Sympho'sius**: a Latin writer of the fourth or fifth century, about whom nothing definite is known. A collection of 100 riddles, each in three hexameters, is extant under his name. See Baehren's *Poet. Lat. Minores*, vol. iv., pp. 364–385, and Corpet's *Énigmes de Symposius revues sur plusieurs manuscrits et traduites* (Paris, 1868). M. W.

**Sym'phyla** [Mod. Lat., from Gr. σύμφυλος, of the same stock; σύν, together + φυλή, tribe]: in entomology, the group containing the peculiar myriapod *Scolopendrella*. The name was given under the impression that it united the characters of the Myriapoda and Thysanura (*qq. v.*). *Scolopendrella* is really an aberrant diplopod, and has no other affinities. J. S. K.

**Symphytum**: See Comfrey.

**Sympiesom'eter** [Gr. συμπίεσις, compression (deriv. of συμπιέζειν; σύν, together + πιέζειν, press) + μέτρον, measure]: an instrument for indicating the amount and variations of atmospheric pressure, consisting of a vertical glass tube, terminated above by an oblong bulb, and bent upward at its lower extremity, where it expands into a cistern open at the top. The bulb and upper part of the tube contain hydrogen, the cistern and lower part of the tube colored oil of almond. As the pressure of the atmosphere varies, the inclosed hydrogen expands or contracts by proportional but large quantities, and the liquid consequently rises or falls in the tube through large spaces; the scale attached is corrected also for temperature, and its indications correspond to those of a mercurial barometer.

**Symplegades**, sim-pleg'ă-dēez, or **Cya'nean Rocks** (anc. Συμπληγάδες or Κυάνεαι): two small islands at the Black Sea mouth of the Bosphorus, on opposite sides of the strait; famous in mythology. When any living thing was passing between them they were supposed to come together immediately and then separate. Jason with the Argo by a stratagem eluded their collision, and they have since been immovable. That on the Asiatic side has disintegrated and almost entirely disappeared. That on the European side is about 550 feet long and 70 wide, consisting of three masses of volcanic rock. On its highest point is a marble pedestal with the inscription "Divo Cæsari Augusto." E. A. Grosvenor.

**Symptoms** [from Mod. Lat. *sympto'ma*, symptom, from Gr. σύμπτωμα, mischance, casualty, symptom, deriv. of συμπίπτειν, fall in with, meet with; σύν, with + πίπτειν (perf. πέπτωκα), fall]: in medical diagnosis and prognosis, the phenomena by which the physician judges of the nature and probable course of the disease he deals with. Symptoms are *objective*, that is, perceptible to the physician's senses, or *subjective*, perceptible only to the patient's senses, such as pain, deafness, etc. Each may be valuable, but the former are, as a rule, much more to be depended upon. These are by some writers called *physical signs*, as distinguished from *vital symptoms*, but these are sometimes objective, and practically all are classed as symptoms. Few symptoms are absolutely *pathognomonic*, or infallible signs of some one disease; but in general the import of symptoms can be learned only by the use of careful observation and patient and logical thought, guided by experience. In early times, when the knowledge of diseases was less advanced than at present, certain symptoms were regarded as diseases. Thus dropsy, asthma, diarrhœa, and the like have passed from their position as diseases to their proper station as mere symptoms of various and often quite dissimilar affections. It is still necessary to regard certain symptoms as diseases, particularly in the case of the nervous system, but advancing knowledge makes these fewer and fewer. William Pepper.

**Synæresis**: See Synizesis.

**Syn'agogue** [= Fr. < Lat. *synago'ga*, from Gr. συναγωγή, a bringing together, collecting, (in Septuagint and New Testament) assembly, synagogue; σύν, together + ἄγειν, lead. The Hebrew name was *Kenēseth* or *Bēth Hakkenēseth*; Aram. *Kenishtā*. Other Greek names are συναγώγιον, προσευχή, προσευκτήριον, σαββατεῖον]: a congregation or assembly of Jews met for the purposes of religious instruction and worship; also the building devoted to such purposes.

*Origin.*—It is impossible to fix with any accuracy the date at which the synagogue took its rise. Despite rabbinical traditions, its beginnings probably do not go beyond the Babylonian captivity. Far away from the national religious center, prayer became for the Jews a substitute for sacrifice, and a study of the traditional literature a religious exercise. Upon its return to Palestine the new community regarded the Law as an end in itself, and a knowledge of its contents of supreme importance (Josephus, *Contra Apion.*, ii., 17). The first synagogues were established for the reading and study of the Law, and Philo distinctly calls them διδασκαλεῖα (*Vita Mosis*, iii., 27). It is thought by some that Psalm lxxiv. 8 has reference to such assemblies. In the New Testament the synagogue is already a fixed institution (Matt. iv. 23, Luke iv. 15, etc.).

*Development.*—Side by side with the temple numerous synagogues were established in Jerusalem. Acts vi. 9 mentions those of the Libertines (freedmen), Cyrenians, Alexandrians, Cilicians, and Asiatics. They seem to have spread over the whole of Palestine. Ruins of synagogues have been found in Galilee, in Kasium, Kefr Birim, El-Jish, Meiron, Nabartein, Kedes, Tell-Hum, Keraze, and Irbik. Judging from the architectural remains, these belong to the time between the first and fourth centuries of our era. According to rabbinical law, ten men are sufficient to form a congregation. But also in the Diaspora, wherever the Jews went, they built synagogues (Philo, *De Septenario*, chap. vi). In Alexandria there were a number (Philo, *Legat. ad Caium*, § 20). Inscriptions found in Rome tell us of nine different synagogues in the city (Berliner, *Gesch. der Juden in Rom*, 1893, p. 62).

*Form and Constitution.*—According to express rabbinic law, the synagogue was always to be built on the highest point of the city, though there are traces of some which must have been built outside the limits of the city or village. Some services (as on fast-days) were held in the open market-place. The style of the early synagogues is largely

Græco-Roman. In Palestine they were built with the entrance (front) at the S. They were given into the charge of a body of elders who in Palestine—at least in the smaller places—were also the political heads of the community. In places of mixed population and in the Diaspora a special body (πρεσβύτεροι) was appointed for that purpose, the head of which was called γερουσιάρχος. To this body was also delegated the power of hurling the ban. For the reading of the service there were no stated functionaries, though throughout the Roman empire we find the ἀρχισυνάγωγος (*Rosh Hakkenēseth*), who watched in general over the service and selected the readers and preachers for each office. As collections for charity were regularly made, there were specially appointed almoners (*gabbāē tsedākāh*). The beadle (*Chazzan Hakkenēseth*, Ὑπηρέτης) had charge of the building.

*Service.*—The most important object in the synagogue was the Ark (*Tēbhāh*), which contained the scrolls of the law, wrapped in linen and deposited in boxes (θῆκαι). The readers and preachers officiated from a raised platform (βῆμα). On New Year's day and on fast-days horns were blown (*Shoferōth, Chatzōtzerōth*). The congregation was seated according to a certain order of precedence. The service, which was in Hebrew (though in the Diaspora Greek seems also to have been used), consisted originally of the recitation of the *Shema* (Deut. vi. 4–9, to which xi. 13–21, Numb. xv. 37–41 were added later); the reading of the Law (*Tōrāh*), which was done by at least seven men, in a three-year (later on in a yearly) cycle; a reading from the Prophets or Hagiographa (*Haftārāh*); and the priestly blessing. The portions from the Tōrāh and Haftārāh were also translated aloud into Aramæan by a specially appointed officer (*Meturgemān*). Gradually other prayers were added; the first and last three of the so-called *Eighteen Benedictions* have their origin in the times of the Mishnāh. Expositions of the weekly Tōrāh readings were given by any prominent teacher present (διδάσκειν ἐν ταῖς συναγωγαῖς, Matt. iv. 23), from which the Christian sermon and the Jewish MIDRASH (*q. v.*) were evolved. The one who was invited to act as reader was called "Messenger of the Congregation" (*Shelīach Tsibbūr*). Services were also held on Saturday afternoon, and on the mornings of Tuesday and Thursday, the chief market-days of the week. It will be seen how closely the organization of the early church followed that of the synagogue.

*Further Development.*—The building of new synagogues in the Roman empire, though technically illegal, was persistently carried on, and every community of Jews had one or more. During the Middle Ages the synagogue was used as a treasury and as a refuge-place from impending death (Stobbe, *Die Juden in Deutschland*, p. 168). The services grew in number. Minor local festivals were added; the old ones (the Day of Atonement excepted) being celebrated in all places outside of Palestine for two days instead of one. The ritual was developed by the addition of Psalms and of poetical compositions. (See JEWISH LITERATURE—*Characteristics of Hebrew Poetry.*) The best of the Jewish poets of Spain (1030–1230 A. D.) worked in the interests of the synagogue. Though the framework of the liturgy, the prayer *par excellence*, remained the same, each country, and almost each city, had its peculiar additions (*Minhag* = custom, rite). It is customary to distinguish two chief rites, the Spanish-Portuguese and the Polish-German; though there are special African, Arabian, Italian, Greek, Spanish, Provençal, German, etc., rituals. The old custom of preaching on every Sabbath gradually fell into disuse. It was relegated to the afternoon service or confined to festivals and special occasions. The rabbi became more of a teacher than a minister, so that by his side there grew up the Mōchīach and Maggīd, the moral preachers. The Chazzan developed into the reader and intoned the service. Women were rigidly separated from men. The reform movement in the Jewish Church, which began with Moses Mendelssohn, chiefly concerned the synagogue. His translation of the Pentateuch into literary German (1783) induced the desire for the translation of the prayers into the vernacular. These had grown to intolerable lengths; and, owing to the protracted misfortunes of the Jews, the whole service had become somewhat ungraceful and uncouth. With a view to remedying these evils, the Reform congregations in Berlin and England have modified the synagogue service to some degree, and have in a few synagogues introduced hymn-books in the vernacular, though nearly all the synagogues in Europe and a large number of orthodox and conservative ones in the U. S. still hold to the old ritual. In the U. S., where the congregational system has been carried to its furthest extent among the Jews, the advanced Reform synagogues have largely curtailed the ritual, have introduced many English prayers, have laid aside the hat and the praying-scarf (*Talīth*), have emphasized the importance of the sermon, and administer the rite of confirmation to both boys and girls, which was first introduced in Berlin in 1817. A number of these synagogues have also added to the Friday evening and Saturday morning services a short service and lecture on Sunday morning.

LITERATURE.—See especially Schürer, *Gesch. des Jüd. Volkes im Zeitalt. Jesu Christi*, ii., § 27 (Eng. trans. div. ii., vol ii.), where the older literature will be found. Cf. also Stapfer, *Palestine in the Time of Christ* (New York, 1885, p. 333); C. G. Montefiore, *The Hibbert Lectures* (1892, p. 388); Herzfeld, *Geschichte des Volkes Jisrael* (iii., pp. 129, 183); Zunz, *Die Gottesdienstlichen Vorträge der Juden* (2d ed. 1892); Zunz, *Die Ritus des synagogalen Gottesdienstes* (Berlin, 1859); Löw, *Der Synagogale Ritus* (*Mntschr. für Gesch. und Wissen. des Judenth.* (1884); Hamburger, *Real-Encyclopädie für Bibel und Talmud* (part ii., 1883, *s. v. Synagogue*); Holdheim, *Gesch. der Jüd. Reformgemeinde* (Berlin, 1857).

THE GREAT SYNAGOGUE (*Kenēseth Haggedhōlāh*) was an assemblage of 120 men which, according to Jewish tradition, Nehemiah brought together for the reorganization of religious worship and the maintaining of civil order. They are supposed to fill up the gap between the last of the prophets and the first of the rabbis. To this body are ascribed the reconstitution of public worship, the final collection of the canon of the Old Testament, and the introduction of certain prayers. Many other ordinances are referred to their initiative. Richard Simon (*Histoire Crit. du Vieux Test.*, i., chap. viii.) was the first to question the authenticity of this tradition. Abraham Kuenen's treatise on the subject seems to have removed all doubts that we have here simply a myth based upon the assembly of the people mentioned in Nehemiah viii.–x., which solemnly accepted the Law, and that there never existed a legal or religious body known as the Great Synagogue.

LITERATURE.—Kuenen, *Over de mannen der groote Synagoge* (*Verslag. en Meded. der Kon. Akademie*, Amsterdam, 1876; trans. by K. Budde in *Gesamm. Abhand. von A. Kuenen* (Freiburg, 1894), p. 125); Zunz, *Gottesdienst. Vorträge* (2d ed., p. 34); Grätz, *Die Grosse Versammlung* (*Mntsch. für Gesch. und Wissensch. des Judenth.*, 1857, p. 31); D. Hoffmann, *Ueber die Männer der grossen Versammlung* (*Mag. für Wissensch. des Judenth.*, 1883, p. 45); Ginsburg, *Kitto's Cyclopædia s. v.*; Schürer, *Gesch. des Jüd. Volkes* (ii., p. 291); Bleek-Wellhausen, *Einleitung in das Alte Testament* (4th ed., p. 558); Buhl, *Kanon und Text des Alte Testament* (Leipzig, 1891, § 9); Ed. König, *Einleitung in das Alte Testament* (1893, p. 445).

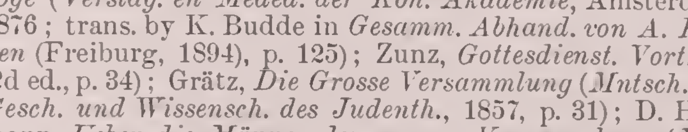
RICHARD GOTTHEIL.

**Synap'ta** [from Gr. συναπτός, joined together, fastened]: a genus of HOLOTHURIANS (*q. v.*), embracing worm-like transparent forms noticeable for the anchor-like plates in the skin, which are favorite objects with microscopists.

**Synaptase**: See EMULSIN.

**Synchronograph**: See the Appendix.

**Syncopa'tion** [from Lat. *syn'cope* = Gr. συγκοπή, syncope (in med. and in gram.); σύν, together + κόπτειν, strike, cut]: in music, an arrangement of notes which often checks the rhythmical movement, disturbing the accent, and rendering emphatic that part of a bar or measure which would otherwise be unaccented. See *a*, *b*, and *c* in the example:




Syncopation of a simpler kind occurs when the last note of any bar and the first note of the bar succeeding are tied together by a "bind," and thus form in reality only one note. Formerly, instead of writing two notes separately with a bind, it was usual to write only one (equal to the sum of both), and place it directly across the bar-stroke.

Revised by DUDLEY BUCK.

**Syncope** [Gr. συγκοπή, deriv. of συγκόπτειν, chop up, squeeze together; σύν, together + κόπτειν, chop]: the shortening of a word by a syllable through the omission of a medial vowel or a medial vowel and one or more consonants. This is the strictest and proper meaning of the term, but it is sometimes loosely applied also to the omission of a medial consonant. Examples of syncope are *hemp* for O. Eng. *henep*, *mint* for O. Eng. *mynet*, *church* for O. Eng. *cyrice*, *p'lice* for *police*, *b'lieve* for *believe*, *s'pose* for *suppose*; Germ. *glauben* for **ge-lauben*, *gleise* for **ge-leise*. The omission of an initial vowel is called *aphaeresis*; of a final vowel, *apocope*. BENJ. IDE WHEELER.

**Syncope**: See FAINTING.

**Syn'cretism** (Gr. *συγκρητισμός*): said by Plutarch to have originated as the designation of a custom characteristic of the inhabitants of Crete, who forgot or overlooked all their internal dissensions as soon as a controversy occurred with any foreign country. In the sixteenth century the word was used to denote those attempts which were made by Pico de Mirandola, Bessarion, and others to reconcile the philosophy of Aristotle with that of Plato. But a still more extensive use for the name was found in the seventeenth century, it being applied to the views of George Calixtus and his followers, who hoped to heal the schism of the Christian Church by acknowledging the traditions of the first Christian centuries besides the Bible, and declaring the *Symbolum Apostolicum*, the common basis of the various Christian denominations, as sufficient for the definition of true Christianity. Revised by W. T. HARRIS.

**Syndicate**: See TRUSTS.

**Synec'doche** [= Lat. = Gr. *συνεκδοχή*, liter., an understanding of things together or of one thing with another; deriv. of *συνεκδέχεσθαι*; *σύν*, with, together + *ἐκδέχεσθαι*, understand, liter., take from; *ἐκ*, from + *δέχεσθαι*, receive, take]: a figure of speech which displaces an ordinary term by one which naturally suggests it, on account of the relation whole to part or part to whole, genus to species or species to genus; thus *city* for *people* of the city, *blade* for *sword*, *bald-head* for *bald-headed man*, *bird* for *fighting-cock*, *man* for *humankind*, etc. See METAPHOR and METONYMY. BENJ. IDE WHEELER.

**Syn'ergism** [deriv. of *synergy*, from Gr. *συνεργία*, a working with, assistance, deriv. of *συνεργεῖν*, work with, assist, deriv. of *σύνεργος*, working with or together; *σύν*, with, together + *ἔργον*, a work]: in theology, the view that God and man share in the work of regeneration, the human will responding to the Spirit of God. So Melanchthon taught, opposing the view of Luther as to the bondage of the will and its complete passivity in conversion. Flacius and his party charged Melanchthon with teaching that the human will had the initiative in conversion. This misunderstanding was repudiated by Melanchthon, who endeavored to make his meaning clearer by employing other phraseology. This difference of opinion in regard to the will led to vehement and long-continued controversies, and divided the Lutherans into the Flacians, or the orthodox, and the synergists. The former carried the day in the Formula of Concord (1577), but few modern Lutherans defend their view. See REGENERATION and CONCORD, FORMULA OF.
SAMUEL MACAULEY JACKSON.

**Syne'sius**: bishop, philosopher, and poet; b. in Cyrene, the civil metropolis of the Libyan Pentapolis about 375; studied philosophy in Alexandria under Hypatia, of whom he became an enthusiastic disciple; was sent at the head of a provincial embassy to the Emperor Arcadius at Constantinople in 397, and stayed there for three years, which time he describes as exceedingly painful; visited Athens in 402, but found himself greatly disappointed, and spent most of his time in rural retirement near the frontier of Cyrenaica, occupied with the study of philosophy and literary pursuits. In 410 he was elected Bishop of Ptolemais, the ecclesiastical metropolis of the province, but his relation to Christianity previous to his election is rather obscure, and it can not be made out with certainty whether he was baptized or not. He accepted the election with great reluctance. Many of the Christian doctrines he could not reconcile with the ideas of the Neo-Platonic philosophy which formed his innermost conviction. The date of his death was about 415 (Zeller). Of his works are extant several essays, among which are *De Insomniis*; several orations, among which that held before Arcadius (*De regno*); a number of hymns, often translated into modern European languages, and considered to be the finest specimens of mysticism in its highest flights; and letters of great interest. Collected edition, with Latin translation, by Petavius (Paris, 1612; 2d ed. 1640); critical editions by Krabinger of separate works. See H. N. Clausen, *De Synesio* (Copenhagen, 1831); C. Thilo, *Commentarii in Synesii Hymnos* (Halle, 1842–43); and Volkmann, *Synesius von Cyrene* (Berlin, 1869).
Revised by W. T. HARRIS.

**Syngnath'idæ** [Mod. Lat., named from *Syn'gnathus*, the pipe-fish, the typical genus; Gr. *σύν*, together + *γνάθος*, jaw]: a family of marine lophobranchiate fishes. The form is much elongated with little flesh, the body is almost covered with partially ossified plates, the head and snout are long and tubular, and the males have pouches in which the eggs of the female are hatched. They attain a length of 2 or 3 feet, live upon small marine animals and the eggs of other fishes, and have great affection for their young, which often return to the egg-pouch of the male parent for protection. Not all the pipe-fishes belong to this family, that name being often given also to the fishes forming the family *Fistularidæ*, also called pipe-mouths and flute-mouths.

**Synize'sis** [Gr. *συνίζησις*, deriv. of *συνίζειν*, sit down together, sink together; *σύν*, together + *ἵζειν*, to sit]: the blending of two vowels into one syllable. The term is generally used of vowel-contractions not indicated in the written form of language. Thus when in Homer the words *τεύχεα*, *ἡμέας* are scanned as disyllables without change of written form, the phenomenon is called synizesis, but when, as in Attic Greek, the written form presents *τεύχη*, *ἡμᾶς*, the change is called contraction, or synæresis, the opposite of diæresis. It is only in terms therefore of the written and not of the spoken language that synizesis differs from contraction. Contraction between vowels of different words is called *crasis*. BENJ. IDE WHEELER.

**Synod** [viâ Fr. from Lat. *synodus* = Gr. *σύνοδος*, a coming together, meeting, synod; *σύν*, together + *ὁδός*, way]: an ecclesiastical assembly or council. Synods may be local, diocesan, or œcumenical; for the last, see COUNCILS, ŒCUMENICAL. The supreme body of the Russian Church is the Holy Governing Synod. In the Presbyterian Church the synod is the ecclesiastical court, composed of lay and clerical representatives, which comes between the presbytery and the General Assembly. In the Northern Presbyterian Church it takes in, generally speaking, the presbyteries of only one State, and is composed of delegates chosen by these presbyteries. In the Reformed Church (Dutch and German) the highest court is called the General Synod, the next in rank the Particular Synod. The word synod is also used in the Lutheran Church, both on the Continent and in the U. S., for a church court composed of clerical and lay delegates. The synods in Reformation times in Germany were exclusively clerical; but the earliest in which the lay element, now an integral part, appeared was that held in Paris in 1559. S. M. J.

**Synodites**: See CŒNOBITES.

**Synod of Dort**: See DORT, SYNOD OF.

**Syn'onyms** [from Fr. *synonyme* < Lat. *synonymum* = Gr. *συνώνυμον*, synonym, liter., neut. of *συνώνυμος*, having the same name or meaning; *σύν*, together + *ὄνομα*, name]: words so nearly equivalent in meaning as to be in some of their uses interchangeable. In a thoroughly organized and digested language it is doubtful whether two words are ever perfect synonyms for all purposes. The superfluous material which tends to accumulate in a language, especially a literary language, through the formation of new derivatives, the widening and shifting of signification, and the introduction of loan-words (see DOUBLETS), is either applied by differentiation to the indication of special phases or shades of meaning or is discarded in the survival of the fittest. Conscious discrimination of the exact values of synonyms is often a most difficult task. Books which aid in this are: Smith, *Synonyms Discriminated* (4th ed. London, 1890); Crabbe, *English Synonyms Explained* (revised ed. 1891); Roget, *Thesaurus of English Words and Phrases* (n. e. London, 1883, a particularly useful book); Schmidt, *Synonymik der griech. Sprache* (5 vols., 1876–86, the best work of its kind); Döderlein, *Lateinische Synonymik* (6 vols., 1838); Shumway, *Handbook of Latin Synonyms* (based on the German of Meissner, 1884; this, as well as preceding, unsatisfactory); Trench, *Synonyms of the New Testament* (11th ed. London, 1890); Eberhard, *Synonym. Handwörterbuch der deutschen Sprache* (2d ed. 1888); Sanders, *Bausteine zu einem Wörterb. der sinnverw. Ausdrücke im Deutschen* (1890); Lafaye, *Dictionnaire de Synonymes Franç.* (1878, good); Tommaseo, *Dizionario dei Sinonimi della lingua Italiana* (1867). BENJ. IDE WHEELER.

**Syno'vial Membranes** [*synovial* is from Gr. σύν, with + Lat. *o'vum*, egg]: connective-tissue membranous structures which surround the closed cavities connected with the joints, or occur about certain tendons or between opposed movable surfaces; they resemble serous membranes in structure, but are distinguished from them by the viscid or glairy character of the synovial fluid or synovia with which they are lubricated, in contrast to the thin watery secretion bathing the serous surfaces. The synovial membranes consist entirely of connective tissue, between the closely felted bundles of which numerous branched or spindle cells are situated; the free inner surfaces of these membranes are invested with an imperfect layer of flattened cells, which, in places, closely suggest an endothelium, while, in other localities, thin plate-like elements are replaced by loosely grouped branching cells. There are three classes of synovial membranes in the human body: (1) The articular line the walls of the closed cavities of the joints, and secrete a fluid to lubricate the opposed cartilaginous surfaces of the articulating bones, over whose surfaces of contact, however, no part of the synovial membrane extends, as it fades away and terminates a short distance before reaching the articular facets. (2) Vaginal or sheath-like synovial membranes surround the tendons when passing through osseofibrous canals or grooves in the surface of bones, as is the case in the hand and foot. (3) Bursæ (Gr. βύρσα, a bag), little synovial sacs or cushions, are interposed between parts moving one upon the other with friction, as where a tendon glides over or presses directly upon a bony prominence. The synovial fluid consists of nearly 95 per cent. of water, rendered viscid by mucus, endothelioid cells, fat, albumen, and salts. The synovial membranes are frequently the seat of disease. Acute synovitis, acute inflammation, may attack any joint as the result of violent injury, exposure to cold, rheumatic taint, or less often from vitiated blood in the course of fevers and other diseases. The symptoms are local swelling, extreme tenderness upon touch or pressure, pain when moved, and often persistent agonizing pain caused by the distension of the sensitive inflamed cavity by a hypersecretion of fluid. Penetrating wounds of the large synovial cavities, whether gunshot, incised, or occurring in connection with fractures, are serious, often necessitating the loss of a limb. Chronic synovitis is often a product of tubercular or scrofulous hereditary taint with injury or over-use as the exciting cause. The destructive process often involves the ends of the bones and the ligaments, which are softened and disintegrated. Abscess, partial dislocations, and ankylosis, or stiff joint, are the chief misfortunes which result. The synovial bursæ often become swollen and prominent by hypersecretion, and also by injury and inflammation; such is the "weeping sinew" of the back of the wrist, which resembles a cystic tumor. Its contents must be evacuated and the membranous sac irritated or lacerated to obliterate it by adhesive inflammation. The occurrence of distended bursæ, and difficulty of cure in many cases, are due to their connection with the cavity of an adjacent joint. Revised by G. A. PIERSOL.

**Syntax** [Gr. σύνταξις, arrangement, organization, the organization of elements, as the elements of speech, into a larger whole; commonly used by the Greek grammarians in the stricter sense of the arrangement of words to form the sentence; σύν, together + τάσσειν, to arrange]: the science which treats of the sentence and its organization out of its constituent parts. In the following article it is not the purpose to consider the syntax of languages in general, but only that of the Indo-European languages, and that, too, only in so far as it admits of a comparative treatment. In the vast field of the literatures of the Indo-European peoples there appears only at two points the independent beginning of a grammatical science, as well as of a syntax, namely, in India on the one hand, and in Greece on the other. The Hindus failed to recognize syntax as a distinct department of grammar, but scattered their syntactical observations at various points in the body of their grammatical doctrine. It is possible even for one not versed in Sanskrit to gain some impression of this body of doctrine through Otto Böhtlingk's second edition of Pāṇini, in which the rules laid down by this prince of Indian grammarians are given in accurate German translation. (O. Böhtlingk, *Pāṇini's Grammatik*, Leipzig, 1887; cf. also Th. Benfey, *Geschichte der Sprachwissenschaft*, Munich, 1867, pp. 35 ff.) In order to gain a correct appreciation it must be remembered that from very early times Sanskrit, i. e. the language of the upper classes, which stood in contrast with the language of the people, was a subject of instruction. That is to say, a Hindu was shown by means of grammatical instruction what forms were to be used in polite speech, when he had a particular thing to say. Thus, for instance, he was taught that when he wished to report something that had occurred that day he was to use the aorist; when he wished to indicate the agent, which accompanies a verb, the nominative or the instrumental. Thus the Indian syntax takes its starting-point with that which one wishes to say, the necessity for the expression of ideas, whereas we in our modern discussions choose the external form as the starting-point. Though our procedure is unmistakably the more correct, we may nevertheless learn much from the Hindus, for they were accurate observers, good logicians, and insisted upon precise and clearly intelligible expression. The Hindus would never, for instance, be guilty of so absurd a rule as that familiar to the German schools—"Auf die Frage 'wem?' steht der Dativ," "the dative answers to the question to whom? or for whom?"—which in reality expresses nothing more than that a dative in the question is often matched by a dative in the answer. As the best contributions which the Hindus have furnished in this field may be regarded their doctrine concerning composition, a subject which we commonly discuss at the end of the inflexions, but which may fairly claim a place also in the syntax, and their theory of the cases which is set forth in Delbrück's *Comparative Syntax* (i., 172 ff.). The Indian method of regarding language was denied a permanent influence upon modern grammar, if for no other reason, because of the late period at which it became known, or at least became generally accessible. Concerning the grammatical system of the Greeks we have, besides numerous monographs, a compendious work by H. Steinthal, *Geschichte der Sprachwissenschaft bei den Griechen und Römern* (2d ed. Berlin, 1890). The first part embraces the theories of the Greek philosophers, in which was found the source equally of instruction and confusion for syntactical theory. The second source of the Greek grammatical system was the study of the Greek classics which reached its learned acme in the Alexandrian period. From the Greek grammatical system, resting upon these foundations, is derived the entire grammatical structure used by the modern world, as well as also the greater part of the syntactical concepts. (Cf. Introduction to *Comparative Syntax*, vol. i.) The term σύνταξις, *syntaxis*, was used very early, namely, in the *Techne* of Dionysius Thrax, written probably in the first century B. C., where the definition of a part of speech reads as follows: λέξις ἐστὶ μέρος ἐλάχιστον τοῦ κατὰ σύνταξιν λόγου, i. e. a λέξις is the smallest division, or the unit of the organized sentence. Syntax first appears as a special part of grammar in the well-known work of Apollonius Dyscolus (probably middle of second century A. D.). For a correct understanding of the work Περὶ συντάξεως, it is necessary to remember that there already existed definitions of the parts of speech, and that in single cases certain expressions had already been noted as grammatically correct or incorrect. Apollonius sought, however, to determine wherein the grammatical correctness or incorrectness inhered. It depends with him upon whether the *katallelia*, the correspondence of the forms, has been recognized or not; for instance, whether with a singular noun the singular or perchance the plural of a verb has been used, whether or not the case representing the correct idea has been used with the verb or not. He treats therefore of what is later brought together under the head of *agreement* and of *government*. This constitutes, however, only the central topic of his work; connected therewith are careful discussions concerning the character of various parts of speech, e. g. of the article. The later syntax adopted from him not only various definitions of fundamental grammatical concepts, but also the outlines of the doctrine concerning enallage and ellipsis. Through the Roman grammarians, particularly Priscian, his syntax (*constructio*) was handed down to the Middle Ages. Here it fell naturally into the hands of philosophy, where, until the beginning of the nineteenth century, it remained. In the introduction to the *Comparative Syntax* cited above it has been shown how one after another the scholastics, then Locke, Kant, Hegel, Herbart, exercised a determining influence upon the development of grammatical conceptions; but with the opening of the nineteenth century three currents of influence, all independent of philosophy, combined to reshape the methods of syntactical research, namely: (*a*) The more accurate study of the Greek and Latin texts, by which a purely empirical treatment of syntax became possible, as it, e. g., appears in the Greek grammar of Matthiæ (A. Matthiæ, *Ausführliche griechische Grammatik*, Leipzig, 1807); (*b*) the awakening impulse of Teutonic philology, connecting itself with the name of Jakob Grimm, who first taught how grammar, including syntax, can be treated historically; and (*c*) the science of comparative philology, which established for the study of syntax as well as of all linguistic phenomena a foundation reaching down into most primitive times.

The representatives of the comparative science of language occupied themselves first with the cases. Here it was at once observed that Sanskrit contains, besides the cases occurring in Latin, also the locative and the instrumental. This led directly to the conclusion that these cases, and perhaps still others. must have existed in primitive times. What now has become of these extra cases in the different languages, e. g. in Greek? The idea readily suggests itself that they had been absorbed into the other cases; for instance, the ablative into the genitive, the instrumental and locative into the dative. It is difficult to say who first gave expression to this conception, which is summarized under the term syncretism; it was certainly first developed in detail by Delbrück (B. Delbrück, *Abtativ, Localis, Instrumentalis*, Berlin, 1867). Here follows, besides a variety of monographs, the important work of Hübschmann (*Zur Casuslehre*, Munich, 1875), which contains not only a good history of the theory of the cases, but also adds a treatment of Iranian case-usage, to which Delbrück had given little or no attention. Then follows Gaedicke, *Der Accusativ im Veda*, (Breslau, 1880), a superb piece of work, full of ideas and covering a larger field than the title promises, a book which every syntactician is recommended to study. A first attempt in the study of the structure of the sentence was made by Ernst Windisch in an article on the origin of the relative pronoun (*Curtius' Studien*, ii., Leipzig, 1869). Even though the main idea, namely, that the relative was developed only in the separate languages, may perhaps be incorrect, yet the presentation of the pronominal usage in the different languages was important and suggestive. The syntax of the verb is the general subject of a series of works which appeared in the *Syntaktische Forschungen* (Halle, 1871–), published first by Delbrück and Windisch conjointly, later by Delbrück alone. In these the attempt is made to trace through the usage of the two languages compared the uniform fundamental idea of *will* for the subjunctive and of *wish* for the optative, in doing which it was necessary of course to construct a theory for the development of the different forms of the sentence. In this work the presentation of the actual existing facts of Vedic syntax was notably insufficient. This it has been the purpose of the *Attindische Syntax*, to be mentioned later, as far as possible to correct. In immediate connection with these first attempts there appeared in 1872 a work of Ludwig Lange, *Ueber den homerischen Gebrauch der Partikel* εἰ (*Abhandlungen der sächsischen Gesell. d. Wiss.*, 1872, vol. vi.), in which Delbrück's theories concerning the sentence-types were corrected and complemented, and an example given of statistical treatment of an individual phenomenon which has seldom been paralleled. A foundation for the study of tense is presented in the second volume of the *Syntaktische Forschungen*, *Die attindische Tempuslehre*, by B. Delbrück (Halle, 1876), in which was especially demonstrated that the Sanskrit has an aorist usage which, as may be shown, though not shown in this work, corresponds in substance with the Greek and the Slavic usage. In reference to the verb is to be added the work of Julius Jolly, *Geschichte des Infinitivs im Indogermanischen* (Munich, 1873). The infinitive is nothing more than a case introduced into the verb system.

Of prime importance for comparative syntax is the *Vergleichende Syntax der slavischen Sprachen*, by Franz Miklosich (Vienna, 1868–73). Though the theoretical outlines of this work are in many regards unsatisfactory, and the comparison of the different Slavic languages with each other and of the Slavic with other languages is not sufficiently true to historical method, yet all the defects of this excellent work are redeemed by the presentation of an inexhaustibly fresh body of language-material, from which all subsequent writers have drawn and continue to draw. In Miklosich's syntax the idea of the sentence scarcely claimed a proper place. Thus there is lacking, for instance, a chapter on the order of words. How much is to be observed, however, in this field has been illustrated in an article of A. Bergaigne, *Mém. de la soc. de linguistique* (vol. iii., Paris, 1875), and in the third volume of the *Syntaktische Forschungen*, *Die altindische Wortfolge aus dem Çatapathabrāhmaṇa* (Halle, 1878), which limits itself, however, to the Sanskrit. The fifth volume of the *Syntaktische Forschungen*, *Altindische Syntax*, by B. Delbrück (Halle, 1888), deals also with the Sanskrit, while the fourth volume contains sketches in Greek syntax.

All these works, and such others as might be added, contain only special discussions, and seldom venture upon the field of theoretical inquiry. A summarizing treatment is attempted in Delbrück's *Vergleichende Syntax* (part i., Strassburg, 1893; Engl. transl. *Comparative Syntax*), which forms the continuation of Brugmann's *Grundriss der vergleichenden Grammatik der indogermanischen Sprachen*. Theoretical discussions appear in an earlier work of Ludwig Lange, *Ziel und Methode der syntaktischen Forschung*, an address at the *Göttinger Philologenversammlung*, 1852; also in the *Principien der Sprachgeschichte*, by Hermann Paul (2d ed. Halle, 1886); and finally in the above-mentioned introduction to Delbrück's *Comparative Syntax*. What follows will be devoted to a brief statement of certain theoretical considerations.

I. *Limits and Classifications of Syntax.*—As regards the question how syntax is to be defined and limited in reference to other departments of grammar, complete agreement has not yet been reached, as indeed it has not been reached regarding the mutual provinces of the grammar and the lexicon; it is, for instance, still customary to discuss in the grammar certain things like the numerals, which properly belong only in the dictionary. This need not, however, be regarded as strange. In questions of this sort are involved not only difficult matters of principle, in reference to which the stubbornness of scholars is wont to assume monumental proportions, but also practical considerations and necessities. Every author desires to present a comprehensive treatment of his material, and every one who wishes to avoid discourtesy feels himself hampered by the traditional views and usages of his readers. Apparently all are now of the opinion that one thing belongs with certainty to syntax, namely, the doctrine concerning the organization of the word-forms into the sentence, i. e. the doctrine of the sentence in the narrower sense. An exception appears, however, it must be admitted, in F. Miklosich, who expresses himself as follows concerning the conception of syntax: "That department of grammar which undertakes to set forth the signification of the word-classes and word-forms is called syntax; syntax is accordingly divided into two parts, of which the one deals with the signification of the word-classes, the other with the signification of the word-forms." Under this limitation of the conception, however, the author himself is often involved in embarrassment. Thus the verbs without a subject, which we commonly call the impersonal verbs, he has been obliged, inasmuch as he does not recognize a doctrine of the sentence, to include in an appendix to the nominative. The order of words he has not discussed at all, though there is undoubtedly a traditional type of word-order in the Indo-European languages as well as in the Slavic. Miklosich was evidently led to this view by an exaggerated empiricism. He insisted on recognizing only the facts of tradition, and the union of word-forms into the sentence did not seem to him traditional, but a product in each several case of the free choice of the speaker. This view is, however, incorrect. As already indicated, certain types of word-connection and word-order are transmitted as psychological realities, and even one who declines to recognize psychological realities must yet allow that there is an objectively perceptible part of a sentence, namely, the sentence accent, which is in and by itself a matter of actual tradition. That we do not indicate this in writing is a matter of accident. It is in no way less real than the accent of individual words. Certainly one can not doubt that the interrogative sentence differs in the traditional accent from the declarative sentence, or that the differences between dialects express themselves with especial distinctness in the different accentuations of the sentence.

Besides the doctrine of the sentence in the narrower sense, we commonly include under syntax the doctrine of the parts of speech. Many scholars, to be sure, decline to admit this, and prefer to classify grammar under the heads doctrine of sounds, doctrine of forms, doctrine of signification, doctrine of sentence-structure. This is at bottom largely a matter of terminology. It is of slight importance whether a given part of the grammar is classed as the first part of syntax or by itself as the doctrine of signification. It is a fact of more importance that there is disagreement concerning what may be included under the chapter on the parts of speech. Under the noun are, e. g., involved the different kinds of substantives—concrete, abstract, simple, compounded, etc.—gender, number, case. The different kinds of nouns were discussed by Brugmann under the head of stem-formation, but not the subject of gender, and so it happens that in Delbrück's *Comparative Syntax*, which supplements Brugmann's *Grundriss*, there is no chapter on the different kinds of nouns. Similarly with other points. In general, however, it is agreed that the treatment of the parts of speech falls under the syntax, or constitutes an introduction thereto. How is it with other points, which less frequently claim discussion? Where, for instance, shall the sentence-accent be treated? It is related to the sentence as the word-accent to the word. This would seem to assign it to the phonology (doctrine of sound), or to the inflexion (doctrine of form). It is impossible, however, to separate it from the doctrine of word-order, with which it is most intimately connected, except as one is ready to sacrifice comprehensiveness and intelligibility to the demands of a rigid schematism. The writer consequently has deemed it correct to treat of the sentence-accent under the syntax, thus, e. g., in his *Altindische Syntax*, pp. 26 ff. As it is with the definition of the boundaries of syntax, so with the question of arrangement and classification. It is unavoidable that here also theoretical and practical considerations should often cross each other's track. It must above all things, however, be remembered that the demands of a reasonable systematization by no means require that a given subject should receive mention but once. It is essential, for example, to treat all the cases together, so that forms of usage which have mutually influenced each other may not be torn asunder. It is, however, on the other hand, necessary to mention certain cases where the relation of subject and predicate is under discussion, i. e. in the doctrine of the sentence proper. Under these circumstances it must be no cause of surprise when the selfsame author adopts now one and now the other arrangement.

2. *The Office of Syntax.*—The conception which one forms of the office of syntax will depend upon his views of the aims of linguistic science as a whole. There have been leading scholars, for instance, August Schleicher, who classed the science of language with the natural sciences, and who regarded it therefore as their office to identify laws within language after the analogy of physics or chemistry. Whether such a possibility may exist in the field of phonology can not be investigated here, certainly for syntax such a thing is out of the question. For this reason, indeed, Schleicher proposed to separate syntax, as far as consideration of function is concerned, from the other parts of grammar. Most philologists regard the science of language, however, as an historical discipline. In connection herewith, the older scholars, e. g. Franz Bopp, attempted to push their investigations to the beginnings of everything. They had confidence in their ability to discover the origin of the Indo-European languages, or at least of the grammatical forms. Inasmuch now as the understanding of the origin of the grammatical form would yield at the same time a knowledge of the primitive meaning, these investigations concerning the origin of inflexion would furnish at the same time a point of departure for historical syntax. The hopes and claims of present-day scholars have, however, assumed much more modest proportions. We are now, it may be believed, universally convinced that but little can be learned of the origin of inflexion, and that even this scanty knowledge is too uncertain to serve as a foundation for a structure of syntax. We now recognize the object and office of the science of language to lie in tracing out historically a specific body of linguistic development, whether through direct observation, or, as is the case in the comparative science of language, through combination. In this is involved, then, the assertion that syntax is an historical science. Its office may be in detail somewhat more accurately defined, when we have considered the question what is actually handed down within a language from one generation to another. Self-observation shows directly that this is not limited to a series of words and forms, but includes also a vast number of word-combinations of various sorts, certain connections between verb and noun, proposition and case, agreement between substantive and adjective, word-orders, etc., in short, a great number of types, whose real existence may be proven by the fact that the speech-sense immediately revolts when an expression is attempted which offends against a traditional type, e. g. if one should attempt to put the adjective after the noun. The observation of these types is the proper office of syntax. Within the limits of an Indo-European language it is to be observed how these types contract, widen, melt away, etc. It is, namely, to be observed which types are handed down from primitive times, and which are relatively recent products. In an examination of this sort it would, for instance, be found for Greek that the most of the uses of the finite verb are handed down from primitive times, but not so the uses of the infinitive, also not the use of the accusative with the infinitive, and so with the whole system of construction in the indirect discourse, which last is therefore a special product of the Greek. It is different with the noun, where the construction-types of the different cases have blended together, and in the course of time the dual has been lost.

In these very simple considerations is involved a conclusion which is in point of method of high importance. When it has been shown, for instance, that the aorist of the Greek was not developed within that language, but is a primitive structure with a primitive type of usage, it then becomes impossible through observation of the Greek alone to establish the fundamental value of the aorist; so, therefore, the whole body of fundamental values assigned on the basis of a single language becomes untrustworthy.

In accordance with what has been said, the task of a syntactician in the field of Indo-European grammar may be briefly summarized as follows: He is to collect with all possible completeness the instances of the type of usage to be discussed, seek to trace its historical development within the individual language, compare the use of the corresponding form in the cognate languages, and seek to determine in this way the Indo-European value of the form in question. This oldest value is the fundamental conception. This may be simple or complex. As to how a form came to this use one can never, or almost never, say anything with certainty. For syntactical terms, see especially VERB; also NOUN, PRONOUNS, GENDER, DECLENSION, GENITIVE, PREPOSITIONS, and INDO-EUROPEAN LANGUAGES. B. DELBRÜCK.

Translated by BENJ. IDE WHEELER.

**Synthesis**: See CHEMISTRY.

**Synthesis, or Assimilation** [*synthesis* is from Gr. σύνθεσις, a putting together, combination; σύν, together + τιθέναι, place]: the fact of activity or unity in all mental operations. The principle of assimilation, made much of in recent discussions, clearly illustrates not only that an image may be so strong and habitual in consciousness as to assimilate new experiences to its form and color, but also that this assimilation or synthesis is the very mode and method of the mind's digestion of what it feeds upon. Consciousness constantly tends to neglect the unit, the *mal à propos*, the incongruous, and to show itself receptive to that which in any way conforms to its present stock. A child after learning to draw a full face—circle with spots for the two eyes, nose, and mouth, and projections on the sides for ears—will persist, when copying a face in profile, in drawing its circle, with two eyes and two ears, and fail to see its error, although only one ear is visible and no eyes. The external pattern is assimilated to the memory copy, or to the word or other symbol which comes to stand for it. The child has a motor reaction for imitating the latter; why should not that answer for the other as well? As everybody admits, in one way or another, such assimilation is at the bottom of recognition, and of illusions which are but mistaken recognitions.

It is commonly held that assimilation stands midway between absolute identity of presentations, on the one hand, and such difference of presentations, on the other hand, as is found in the relative independence of associated ideas (see ASSOCIATION OF IDEAS), such as, for example, the association "stable—horse." But this is not the true view of assimilation, for there is no such thing as absolute identity of presentation, or of mental content of any kind. Assimilation is always present. It is the necessary basis of the earliest association. For association is, on the organic side and at the start, only another statement for the consolidating of the different reactions which arise when the stimulations are multiple or not simple. These reactions are reduced to orderly habitual discharges—this is, association by assimilation, more or less adequate to give the sense of synthesis, or unity, or identity. Association has, accordingly, a motor foundation from the first. The elements hold together in memory because they are used together in action. And as the action becomes one, but yet complex, so the mental content tends to become one, but yet complex also.

This becomes more evident when we call to mind that the "objects" of the external world are very complex mental constructions. They are, for the most part, made by association. Objects have some very general aspects in common, such as color, resistance, odor, etc. But these bare qualities, taken alone, might go to constitute one object about as well as another; and really would constitute none. What kind of an object such or such a bare stimulus shall turn out to be—this is largely a matter of association and suggestion. Hence if the mind has to construct anyhow, in each case, and to depend largely upon memory of earlier instances for its material, then it falls back at once upon those habitual reactions by which groups of associated elements are reinstated together and as one content. These old groups thus usurp the new elements by assimilation, if it be within the range of organic possibility.

Generally, therefore, it may be said that assimilation is due to the tendency of a new sensory process to be drawn off into performed motor reactions; these preformed reactions in their turn tending to reinstate, by the principle of imitation, the old stimulations or memories which led to their preformation, with all the associations of these memories. These memories, therefore, tend to take the place or stand for the new stimulations which are being thus assimilated.

All perception is accordingly a case of assimilation. The motor contribution to each presented object is just beginning to be recognized in cases of disease called by the general term *apraxia*, i. e. loss of the sense of the use, function, utility, of objects. A knife is no longer recognized by these patients as a knife, because the patient does not know how to use it, or what its purpose is. The complex system of elements is still there to the eye, all together; the knife is a thing that looks, feels, etc., so and so. This is accomplished by the simple contiguous association of these elements, which has become hardened into nervous habit. But the central link by which the object is made complete, by which these different elements were originally reproduced together by being imitated together in a single act—this has fallen away. So the APPERCEPTION (*q. v.*), the synthesis which made the whole complex content a thing for recognition and for use, is gone in these cases. J. MARK BALDWIN.

**Syphax**: See MASINISSA.

**Syph′ilis** [Mod. Lat., from *Sy′philus*, name of a shepherd in the Latin poem of the Italian physician Fracastorius (1483–1553), *Syphilus, sive Morbus Gallicus*; (irregularly) Gr. σῦς, hog, swine + φίλος, loving]: a specific, chronic, contagious disease, peculiar to the human organism, and always more or less closely associated with the venereal act. It is always acquired through contact with a human being already suffering with the disease, or from some material which has been in contact with the discharges from a syphilitic individual. In the poem by Fracastorius *Syphilus* is afflicted with the disease by Apollo in punishment for paying divine homage to his king instead of to the god. Under various names the disease has been described in the earliest written history of every part of the globe. One Chinese account of it dates back to the writings of Hoan-Ti, B. C. 2637. In India its record appears in the Ajur Vedas of Sucrutas, A. D. 400. Hippocrates and later writers describe it as existing among the ancient Greeks. Celsus speaks of it among the Romans. The Abbé Brasseur de Bourbourg writes that numerous documents in the languages of the tribes of the valley of Anahuac have proved to him conclusively the existence of syphilis in America prior to the discovery of Columbus. Those who read the Old Testament attentively, particularly certain psalms of David, may find ample evidence of the existence of the disease among the nations and tribes of the Orient in biblical times. The existence of syphilis in very remote periods of the history of mankind is thus demonstrated; but the first well-authenticated record of its recognition in Europe dates from the year 1494, when a notorious outbreak occurred in the army of Charles VIII. of France, who was then besieging Naples. It was characterized by ulcers upon the genitals, pains in the bones, and eruptions upon the skin, and was known then as the morbus Gallicus or French disease. It spread to a fearful extent, and became a veritable terror in the land. Its cause was attributed to almost every imaginable influence except the right one. Later it was recognized as the result of venereal contact, and was then claimed to have been introduced into Europe by the followers of Columbus.

In the literature of those times, the disease was usually known in each country by the name of some other country, and was designated as the mal Anglais, morbus Gallicus, maladie de Naples, pox, lues venerea, etc. Later it was regarded as distinct from the contagious genital ulcers whose effects were simply local, and also from gonorrhœa, although so late as the time of John Hunter this distinction was not known to him, having been for a time lost sight of. The present accurate classification of venereal disease is in large measure due to Ricord, of Paris, who published extensively concerning the subject in 1831. Later, in 1852, his pupil, Bassereau, made clear the difference between the local ulcer i. e. "chancroid," the local lesion followed quickly by constitutional infection (see VENEREAL ULCER), syphilis, and the other local infection of mucous membranes known as gonorrhœa. Since this time and almost up to the present day a few writers have claimed, however, the unity of the poison producing the first two lesions. Others have stoutly maintained their duality or distinctness, and this view is now positively accepted by all writers of distinction.

*Effects of the Disease.*—The nature of syphilis and the manner in which the human system is infected by it are yet undetermined. Opinions concerning these subjects have been very numerous and variable. A number of investigators have at various times detected micro-organisms, some of these being bacteria, which they have thought to be the active agents in producing the disease, but research has shown that the presence of these micro-organisms does not account for the disease. The problem must be solved by different methods of investigation, yet higher powers of the microscope, or the introduction of some entirely new methods of studying the discharges.

When this poison of syphilis is inoculated upon a healthy surface, it shows no immediate signs of virulence, and healing of the wound takes place promptly, as if no such inoculation had occurred. Then ensues a period of complete rest, the so-called period of incubation, varying from ten to seventy days, when a thickening or induration of the integument or mucous membrane at the point of inoculation is noticeable. Soon a discharging lesion results, the discharge being extremely infectious. Inasmuch as this lesion is surrounded by a zone of tissue induration, i. e. cell proliferation, we have an ulcer or a papule, situated upon an indurated basis; and this is known as the chancre, or initial lesion of syphilis. Then occurs another period of apparent rest, the so-called secondary incubation, during which there is little or no consciousness on the part of the patient of the trouble brewing in his system, the local disease manifestation frequently healing with or even without the proper treatment. This secondary period continues for from four to six weeks, perhaps longer, when the lymphatic nodes in all parts of the body will be found enlarged and hardened, and there breaks out upon the surface of the body a rash or eruption, usually more or less resembling that of measles. This is seen most commonly upon the thorax and abdomen, from whence it may spread to all parts. This rash, usually known as syphilitic roseola, marks the second or constitutional stage of syphilis. Then, or within a short time, the patient begins to experience constitutional disturbances chiefly at night, including pains in the bones, increase of temperature and general discomfort, which is usually known as syphilitic fever. This stage is still further characterized by the tendency to engorgement and inflammation of those parts containing much lymphatic tissue, such as the tonsils, the pharynx, the soft palate, etc. If unchecked the eruption assumes more of a papular type, the papules varying in size from that of a pinhead to that of a split pea, occupying the upper part of the body usually, commonly symmetrically distributed, but not often ulcerating at this time. This is the papular or secondary eruption of syphilis, sometimes assuming rather the pustular type, or becoming pustular as the result of a depraved state of the system. The papules which occur upon the mucous membrane discharge a most infectious material, and are known as mucous patches. They may be found upon the membranes of the mouth, the inner surface of the nose, the eyelids, and about the genitals; while papules upon the skin wherever there is abundant secretion and moisture often assume the characteristics of mucous patches, and are spoken of as mucous tubercles. The secretions from both of these lesions being so highly inoculable constitute one of the most important dangers in dealing with the disease. Inoculation of a healthy person with syphilis frequently occurs through contact with the secretions of a mucous patch situated in the mouth, as in kissing, the only required condition being a crack, erosion, or simple eruption, like a cold-sore, on the part of the one who has not suffered previously from the disease. Numerous examples are recorded where the disease has been acquired from contact with a spoon, pencil, pipe, stick of candy, plug of tobacco, etc., which has been contaminated from such secretions. Chancres occur also in other parts of the body as the result of innocent contact on the part of persons who are totally ignorant, or at any rate unsuspicious. Syphilis thus acquired is known as syphilis insontium, or syphilis of the innocent. Fortunately, the syphilitic principle requires for its introduction and successful inoculation, in almost every instance, a pre-existing lesion of the skin or mucous membrane. But it has been transmitted through the instruments of the surgeon or dentist, by hypodermic syringe needles, and in other ways which are often difficult to trace. A specific inflammation of certain tissues of the eye, particularly of the iris, is a common occurrence in early constitutional syphilis, which is followed by more or less pain, often severe, by photophobia or fear of light, by irregularity of pupil, due to exudation and adhesion, etc. Later in the course of the disease the various structures of the eye may suffer seriously, and syphilitic affections of all the ocular tissues are known and carefully described.

Pains in the bones are often associated with the active or secondary period of syphilis. Sometimes these are of wandering character; again, they are localized. The periosteum, or covering membrane of the bone, is often thickened, as the result of which bony elevations, termed nodes, result. The nails and the hair also are frequently affected, the hair losing its luster and falling out, often in spots; at other times complete baldness results. The nails may become dry, lusterless, and brittle, with arrest of growth. The lymph nodes and lymphatic structures throughout the body suffer persistently during the active manifestations of the disease, and the former will be found enlarged in all of these cases. The lymph nodes in the neck are most easily investigated; and a chain of nodules of this kind may be felt on either side of the neck in distinct cases of syphilis. A small lymph node just above the inner condyle, known as the supracondyloid, is almost invariably involved in this disease, and seldom in any other affection, except in septic infection of the arm. The more active manifestations of syphilis covering the first and second stages extend over a period of rarely less than one, nor more than two, years, during which time all the secretions from all ulcerative lesions are inoculable, as well as even the blood. Its course is marked by the gradual invasion of the organism, and always in the line of the lymphatic distribution. Cases vary much, however, in degree, since in one the disease may be so slight that even the lymphatic enlargements are not easily recognized, and in another so severe that even death may be the result. The causes of these differences appear to depend upon degrees of virulence in the material inoculated, and upon the condition and antecedents of the patient. Syphilis may be transmitted to offspring through the influence of a syphilitic parent during the active period of the disease. From this stillbirths and arrests of development may result, and uterine and ovarian changes may depend upon antecedent syphilis for a long time subsequent to the termination of active syphilis. As a rule, however, syphilis is transmitted by hereditary taint only while lymphatic enlargements and involvements remain. A complete disappearance of the latter, with or without treatment, is the sign of immunity from danger of hereditary transmission.

Commonly the most serious manifestations of syphilis terminate with the arbitrary second stage, either as the result of treatment or by a natural evolution. All writers, however, recognize the existence of a so-called third, or "tertiary," stage, although no exact length of time can be named between it and the second. The tertiary is, in some instances, a gradual merging of the second stage; while in other instances it is separated from it by an interval of more or less perfect health, varying from a few months to a number of years. The products of tertiary lesions are seldom infectious. The lesions themselves are less symmetrically arranged also than are those of the second stage. They are characterized by infiltration or deposit of lymphatic elements in the various tissues of the body, which produce tumor formations, commonly known as gummata, or syphilomata. These tumors or new formations are of course composed of cellular aggregations, which, however, are quite prone to break down and ulcerate. Hence many of the tertiary lesions are of the ulcerative type. In the skin there are a variety of deposits, tending always to ulceration, by which eruptions of characteristic appearance are produced. The larger lesions of this character are usually discolored; the smaller are multiple, and are often widely disseminated. Very extensive ulceration sometimes results from lesions of this character. These are all more likely to occur in alcoholics, in the debilitated, and in the dissipated. The gummy tumors, or gummata, may form in or beneath the skin, or in any other part of the body; and they cause the organ affected to enlarge, presenting nearly all the appearances of ordinary tumors, assuming even malignant characteristics. They are, perhaps, most common in the skin, the liver, the bones, and the brain. In any one of these places they may break down with resulting abscesses or ulcerations.

*Treatment.*—The treatment of syphilis has been from the earliest times a subject of controversy, and is to-day a subject on which very great ignorance prevails, especially among the laity. There can be said, however, of this disease, that there is no other serious affection which involves the human body which can be so positively influenced for good as this: in other words, there is no other disease which in most respects it is so satisfactory to treat. It is necessary, however, to combat a great many popular superstitions regarding the disease, and to insist that the only certain and reliable remedies are mercury and iodine, which can be combined with various others often with good effect, whose action always needs watching, but without which little or nothing can be done. Certain mild forms of the disease, to be sure, will tend toward spontaneous recovery, and these may be aided by absolutely vegetable remedies, or by absence of treatment; but the more serious forms of the disease can not be successfully treated without the two remedies named above, and the public should be warned against men who advertise or profess to cure this disease without these measures; they are either ignorant or dishonest who make these claims. As the result of rash medication in years gone by, a legitimate dread of mercury was engendered, but now, under proper watching, no evil effects need be dreaded, and the manifestations of the remedy can be controlled with as much certainty as those of the disease, when using one against the other. It is possible that both of these elements—mercury and iodine—act by causing metamorphosis of tissue and influencing cell growth, perhaps also by introducing into the system some antidotal or antiseptic influence. There should be emphasized also the fact that syphilis is, so far as most cases are concerned, a curable disease, which offers an element of hope hitherto usually lacking. Too much pains can not, however, be taken to impress upon patients the fact that, in order to effect a cure, it is necessary to keep them continuously under the influence of these remedies for a period of time averaging about thirty months in duration. Less may answer in some cases; more may be required in others. This period of time, moreover, must begin with the last visible manifestation of the disease. Thus if a patient has been under ineffectual treatment already for three years, it will be necessary to begin then and to keep him for at least two years longer under treatment, watching its effects in such a way that neither the disease nor the remedies shall get the upper hand, but that the one shall be administered in just sufficient doses to counteract the effect of the other. Many patients treated in accordance with these principles have remained absolutely well, have married, and have propagated families in which there is not the slightest trace of any inherited affection. It is well, therefore, to maintain as publicly as possible that syphilis is, in proper hands, a curable disease, providing only that the right directions be insisted on and scrupulously followed. Syphilization, the proposed treatment of the disease by repeated inoculation of the purulent secretion of venereal sores, originated by Auzias of Turin in 1844, met with some favor in Italy and Sweden, but elsewhere was discredited, and since 1875 has fallen into disuse. ROSWELL PARK.

**Syphon**: See SIPHON.

**Syra**, or **Syros** (Gr. Σύρος): an island; one of the Cyclades; belonging to Greece. Area, 44 sq. miles (see map of Greece, ref. 17–L). Seldom mentioned in ancient times, it became important during the Greek revolution, when it served as a place of refuge for fugitives from the mainland and islands. Its favorable situation, good though diminutive harbor, and the enterprising spirit of its people have since rendered it the commercial center of the Ægean Sea. The island is rocky, mountainous, and generally sterile, but produces some grain, fruit, and wine, though insufficient to support its inhabitants. Hermoupolis, the capital, built of glaring white houses, presents a striking appearance as it rises amphitheatrically and almost precipitously from the water. It has dockyards, machine-shops, hospitals, good schools, and a college. Pop. (1890) 22,104.

E. A. GROSVENOR.

**Syr'acuse** [from Lat. *Syracu'sæ* = Gr. Συράκουσαι; Ital. *Siracusa*]: chief town of the province of Syracuse, Sicily; on the east coast of the island, in lat. 37° 0′ N., lon. 15° 20′ E. (see map of Italy, ref. 10–G). The modern town occupies the rocky islet Ortygia (1 mile in length, ½ mile in breadth), which serves as an irresistible breakwater to protect the large harbor on the W., across the mouth of which it lies. This harbor was formerly one of the finest in the world, and is even now the best, perhaps, in Sicily. Ortygia, though at some periods united to the main island by a viaduct or causeway, is now connected with it only by bridges. According to Thucydides, Ortygia was colonized by the Corinthians 734 B. C., though the Phœnicians had probably made an earlier settlement here. (See GELO, HIERO, DIONYSIUS THE ELDER, and DIONYSIUS THE YOUNGER.) When, however, after long and cruel wars, the Romans obtained possession of the rest of Sicily, Syracuse, together with some important places in its neighborhood, was left to Hieron II. (275 B. C.), who had become an ally of Rome. Under this king the city rose to its highest point of magnificence, and is said to have contained an immense population within its walls, then, according to some authorities, 22 miles in circumference; according to others, 14 miles. The grandeur of the edifices and the artistic wealth and refinement of Syracuse were altogether worthy its colossal size; but in the course of the Second Punic war, Hieronymus, the successor of Hieron, broke off the alliance with Rome and joined the Carthaginians—a step which proved the ruin of his kingdom. After a long and desperate resistance, in which the celebrated Archimedes exerted all the powers of his wonderful mechanical genius in the defense of his country, Syracuse fell into the hands of the Romans under Marcellus (212 B. C.), by whom it was barbarously sacked and an immense booty carried off to Rome. From this time Syracuse, as well as the rest of Sicily, was but a subjugated Roman province, unscrupulously oppressed and plundered by that power for its own aggrandizement. The town at the time of its capture consisted of four distinct quarters—or five, if Epipolæ be included, as it no doubt was by those ancient writers who describe it as a *pentapolis*. Epipolæ, however, seems to have served rather as a citadel and fortress to defend the town on the N. W., and was probably never thickly inhabited. The four quarters proper were: (1) Ortygia, or the islet; (2) Achradine, occupying the eastern coast of the main island, N. of Ortygia; (3) Tyche, W. of Achradine; (4) Neapolis, S. of Tyche. The most important remains of ancient Syracuse are found on the main island, though some objects of interest are still to be seen in the modern town. Pop. (1893) 25,200. See Serradifalco, *Antichità di Sicilia*; Gregorovius, *Wanderjahre in Italien, Siciliana* (1872); Cavallari, *Sicilia artistica ed archeologica* (1889); Lupus, *Die Stadt Syrakus im Alterthum* (1887). Revised by J. R. S. STERRETT.

**Syracuse**: city; capital of Onondaga co., N. Y.; on Onondaga Lake, the Erie Canal, and the Del., Lack., and W., the N. Y. Cent. and Hud. Riv., the Rome, Water., and Ogdens., and the W. Shore railways; 147½ miles W. by N. of Albany, and 150½ miles E. of Buffalo (for location, see map of New York, ref. 4–F). It is at the foot of the Onondaga valley, though the southern part is embraced by hills on either side opening to the right and left, thus broadening the valley where it joins the city. There are highlands to the N. E. also which, with those on the S., are populated. The length of the city proper from N. to S. is about 4 miles; from E. to W. about 3 miles. Salina Street is the principal thoroughfare. The streets mainly cross at right angles; most of those otherwise laid out followed early Indian trails and wagon-roads. They contain so many trees that the city resembles a forest when seen from the adjoining hills. There are about 250 miles of streets, 52 miles of street-railway, 24 public parks (of which Burnet Park, of 100 acres, situated on the highlands W. of the city, is the chief), and 6 public squares. The city has a new water system, with its source at Skaneateles Lake, and with 90 miles of mains; it cost $4,000,000. There are 34 newspapers (6 daily) and periodicals.

*Public Buildings.*—The U. S. Government building, the county court-house, and the city-hall, all built of limestone; the county clerk's and surrogate's offices; the First Presbyterian, St. Paul's, and St. Mary's churches; the Onondaga County and the Syracuse Savings-bank buildings; the Kirk building, the Granger block, the Bastable block, Dey's and McCarthy's buildings, and the Wieting block, are among the most imposing structures. The State Asylum for Feeble-minded Children and the buildings and grounds connected therewith are attractive and interesting to visitors. The Onondaga penitentiary and jail has room for about 300 prisoners, is situated within the city limits on elevated ground, and its inclosure embraces about 40 acres. The Onondaga County Orphan Asylum, St. Vincent de Paul Orphan Asylum, the House of Providence, House of the Good Shepherd (hospital), St. Joseph's Hospital, St. Ann's Maternity Hospital, Shelter for Fallen Women, Women's and Children's Hospital, Old Ladies' Home, German Hospital, Needlework Guild, Employment Society, Women's Union, Bureau of Labor and Charity, Women's Aid Society, Deaconesses' Home, and King's Daughters are the principal charitable institutions and organizations.

*Churches and Schools.*—There are 84 churches (with a total seating capacity of about 52,000), as follows: Presbyterian, 9; Baptist, 8; Methodist Episcopal, 20; Protestant Episcopal, 7; Roman Catholic, 11; Lutheran, 7; Congregational, 5; Evangelical, 4; Jewish, 7; Unitarian, Universalist, Reformed, Disciples, Independent, and Scientists, each 1. The Y. M. C. A. owns the large and commodious building it occupies, together with its music-hall and athletic rooms. The SYRACUSE UNIVERSITY (*q. v.*) leads the educational institutions. The public schools are 31 in number, including the High School, and all are built of brick. The enrollment is over 16,000; average attendance, over 12,000; annual cost of maintenance, over $303,400; number of teachers, 320. The City Library, now independent of the board of education, has about 26,000 volumes, and occupies a city building. Keble School, which, with several others, has an attendance of about 300 pupils, is the principal private school.

*Finance and Banking.*—The assessed valuation is: real estate, $44,827,180; personal, $3,838,205—total, $48,665,385; receipts and expenditures, about $1,000,000; bonded indebtedness, $5,056,500. There are 9 commercial banks, with an aggregate capital of $1,705,000 and surplus of $1,100,000; 2 savings-banks, with assets of $19,000,000 and surplus of $2,110,000; and 8 national savings and loan associations, with aggregate assets of about $3,500,000.

*Business Interests.*—The manufacturing interests are extensive and cover a wide range of products. Iron and steel are extensively worked in various forms. Salt is no longer an important factor. The State took possession of the salt-springs in 1797; since then 361,200,742 bush. of fine and coarse salt have been produced. The largest quantity made in any year was 9,053,874 bush. in 1862; the smallest, 25,474, in 1797. Competition at home and abroad, with a low tariff aiding the latter, has nearly ruined the industry. At one time the investments were valued at $14,000,000; now they are scarcely worth $500,000. There are in all 245 incorporated manufacturing companies, of which one, making soda-ash, is the principal. In 1890 over $17,000,000 capital was invested in 1,175 establishments; about 15,500 persons were employed, to whom nearly $7,500,000 was paid in wages; material costing over $12,000,000 was used in manufacturing; and the output of the manufactories had a value of over $25,500,000.

*History.*—Syracuse was settled in 1797, and was known first as Bogardus Corners; afterward as Milan, South Salina, Cossitt's Corners, Corinth, and in 1824 Syracuse. In 1826 the village was incorporated; in 1847 the rival villages of Syracuse and Salina were brought under a city incorporation. The Jesuits, in 1654, were the first to visit the locality then inhabited by Indians, a remnant of 425 of whom now occupy a reservation 6 miles S. of the city, and 6 miles square. Pop. (1880) 51,792; (1890) 88,143; (1900) 108,374.

DWIGHT H. BRUCE.

**Syracuse University**: a coeducational institution at Syracuse, N. Y.; founded in the year 1848, but located at Lima, N. Y., and known as Genesee College until 1871, when it was removed to Syracuse. The removal was determined by a great convention held in Syracuse in Feb., 1870. The most prominent citizens of the city aided in its new founding, and the city gave $100,000 as its contribution. The first chancellor, Alexander Winchell, LL. D., was inaugurated Feb. 13, 1873. He was succeeded in 1874 by E. O. Haven, D. D., LL. D., he by C. N. Sims, D. D., in 1880, and the present incumbent, James R. Day, S. T. D., entered upon his duties in Apr., 1894. The campus comprises 50 acres; the principal buildings are the Hall of Languages (1880), the Holden observatory, the John Crouse Memorial College, containing the college of fine arts, the library building, containing the famous library formerly the property of the historian Von Ranke, and the Y. M. C. A. hall and gymnasium. The athletic field is one of the finest in the State. The medical college building is near the center of the city. The college was removed from Geneva in 1881. A college of law was opened in 1895. The number of students has steadily increased. The roll for 1899–1900 showed 1,700. The faculty numbers 130. The institution has enjoyed a healthful growth and expansion in every department. The value of grounds and buildings is $2,185,700, and the endowment fund is $1,313,610, and the total income $132,611. The volumes (including pamphlets) in the library number 61,618. F. SMALLEY.

**Syr-Darya**, **Syr-Daria**, or **Sir-Daria**, seer-daar′yaa, (anc. *Iaxartes*, Arab. *Sihun*): the principal river of Russian Turkestan. It rises in the T'ien-Shan in a glacier at the height of 15,000 feet; flows first W. passing through mountain valleys, and through several unexplored gorges, receiving all its affluents; is largest opposite Khojend, where it passes out on the plains; gives off a few branches and many irrigation canals, and is decreased by evaporation, until it reaches the Aral Sea, where it is only a half or a third of the size it has at Khojend. It is frozen three or four months a year, is in flood in late spring and early summer, and is unsuitable for navigation because of its shallowness and changeable channel, and the lack along its banks of fuel. Length, 1,290 miles; area of basin, 120,000 sq. miles. Herodotus and Strabo describe it as a great river flowing into the Caspian, and the ancient bed between the Aral and Caspian can yet be traced. MARK W. HARRINGTON.

**Syr-Darya**: province of Russian Turkestan; on the middle and lower course of the Syr-Darya river, N. of the Thian-Shan, W. of Semirechensk, and S. of Akmolinsk. Area, 194,853 sq. miles. Pop. (1889) 1,214,300, mostly Kirghiz and Sarts, and 35,000 Russians, of whom 15,000 were military, 11,500 peasants, and 4,600 small merchants. In 1897 the population was 1,479,902. Russia made an especial effort to colonize this province, and in 1889 there were forty-seven colonies containing 16,000 persons. The country is chiefly steppes, deserts, and marshes, but contains some forests near the streams, and much of the land is very fertile when irrigated. Capital, Tashkend. M. W. H.

**Syren**, or **Sirene**: See ACOUSTICS (*Length of Sound-waves*).

**Syr′ia** [=Lat. = Gr. Συρία, deriv. of Σύρος, Σύριος, Syrian, a Syrian; etymologically an abbreviation of *Assyria*. See ASSYRIA. (Heb. *Arām*; Arab. *Esh-Shām*; Turk. *Suristan*)]: a vilayet of the Ottoman empire in Asia Minor; bounded N. by the vilayet of Aleppo, E. and S. by the Syrian and Arabian deserts, W. by the Mediterranean (see map of Turkey, ref. 7-H). In a less restricted sense, Syria comprises also the larger part of the vilayet of Aleppo, thus including the territory bounded N. by Asia Minor, from which it is separated by the Akma Dagh (Amanus Mountains), E. by the Euphrates, and S. by the Arabian Desert. Its length on the W. is coterminous with the eastern shore of the Mediterranean Sea. Its situation may be roughly indicated as between 37° and 31° N. lat. and 34° and 41° E. lon. It comprises the historical divisions of Syria proper, PHŒNICIA, CŒLE-SYRIA, and PALESTINE (*qq. v.*).

*Physical Features.*—Two systems of mountain ranges, LEBANON and ANTI-LIBANUS (*qq. v.*), connected with the Taurus Mountains, run parallel southward, inclosing a long valley of varying breadth and depth, Cœle-Syria, and losing themselves to the S. in the rocky plateaus of the Arabian Desert. The three chief rivers of Syria are the ORONTES and JORDAN (*qq. v.*) and the Leontes (Litany), none of them over 250 miles in length. There are also a score of still smaller rivers and many river-beds, filled by rushing torrents in spring but dry in summer. The valley of Cœle-Syria narrows in the south to a gorge through which the Jordan forces its way into the Lake of Merom (El Huleh). There it is on a level with the Mediterranean, but at the Lake of Gennesaret it is 650 feet and at the Dead Sea 1,300 below it. Here, as in many other regions, the country has a strongly marked volcanic aspect, and throughout Syria earthquakes are frequent. It is a peculiar fact that they occur usually in summer and very rarely in winter. One (1759) caused the death of more than 20,000 persons; another (1778) destroyed Aleppo; those of 1783, 1819, 1822, 1837, and 1872 were notable. Wherever the supply of water is sufficient the soil, generally of a light and sandy character, proves very productive. Most plants of temperate and tropical climates grow luxuriantly. Nevertheless, at certain seasons almost the entire country, and at all seasons a large part of it, presents a barren and desolate appearance. This is in great part due to climatic causes. Summer rains are rare. The climate is parching and the heat oppressive save in the elevated regions, the thermometer often indicating above 100° F. The scourge of the country is the locust. Above all, however, the misfortune of Syria has been its geographical position, rendering it the battle-field of races and religions.

*Natural Products—Flora and Fauna.*—The mountain-slopes are covered with pine, fir, and oak. Cedars are still found in Lebanon; laurel groves are frequent in the valleys; on the table-lands are dwarf-oaks which yield excellent gall-nuts. Extensive forests are rare. Farming tools and implements of all sorts, as well as the system of cultivation and handicraft, are of the simplest. The common cereals are wheat, rye, and barley; rice, dhurra, sesame, lentils, and beans are raised. Cotton, hemp, madder, indigo, melons, cucumbers, and artichokes are extensively cultivated. The tobacco along the coast is of excellent quality. Plantations of fig, orange, lemon, mulberry, peach, pomegranate, and almond, and the vineyards yield excellent returns. The coffee-plant has been introduced at Latakia, the sugar-cane at Beyrout, and Damascus is surrounded by orchards and gardens. All the domestic animals of Europe are found in Syria, as is also the camel. Asses, horses, horned cattle, goats with fine hair, sheep, both broad-tailed and of fine fleece, are numerous. The wild animals are jackals, hyænas, antelopes, the Syrian bear, wolves, and especially wild boar, deer, and wild buffalo. The silkworm is extensively reared. Mining is hardly carried on; but bitumen, coal, iron, salt, and sulphur are found.

*Population.*—There are no reliable statistics as to population. It is probably not far from 1,500,000, and is made up of heterogeneous races, peoples of Semitic origin predominating. Arabic is the generally spoken language. The old Syriac or Aramaic is heard only in certain localities. Along the coast Greek is generally understood, and French much employed by the higher classes. Tribal divisions are rather on the score of religion than origin or race. The country swarms with sects, Mussulman, Jewish, and Christian, equally zealous and intolerant. The Druses (90,000), Mutualis (30,000), Ismaïlis (6,000), Yezidjis (25,000), Nusairieh or Ansyrieh (80,000), Chaldeans or Nestorians (40,000), Syrians or Jacobites (10,000), and Maronites (482,000) are the more prominent or the best known. Though in general these peoples are quiet, hospitable, and kindly, yet outbreaks of fanaticism are frequent, not only on account of their detestation of each other's belief, but through the intrigues of foreign powers. Such were the massacres of 1841, 1845, and 1860. There is no question that the condition of the people has bettered in many respects since 1875. Education, though in a backward state, has made substantial progress. This improvement is due in large measure to the labors of the Roman Catholic and Protestant missionaries, and especially to the wide and active influence exerted by the Syrian Protestant College at Beyrout. The chief cities, with populations, are as follows: Damascus, 200,000; Aleppo, 120,000; Beyrout, 105,000; Jerusalem, 41,335; Homs, 35,000.

*History.*—The earliest known inhabitants of Syria were Semites of various branches, living in separate social organizations. Such were the Canaanites, Phœnicians, Aramæans, the latter of whom held Damascus and ruled to the Euphrates. Such, too, were the Hebrews. Practically all Syria, except Phœnicia, became subject to the Hebrew monarchy under David. When, on the death of Solomon, the Hebrew empire divided into the two kingdoms of Judah and Israel, an independent Aramæan monarchy under Rezin was set up at Damascus. Its kings conquered Northern and Central Syria. Tiglath Pileser, King of Assyria, subdued this state, capturing Damascus (740 B. C.), and likewise Israel (720 B. C.). Judah was conquered by Nebuchadnezzar, the King of Babylon, in 587 B. C. Syria passed from the Assyrians to the Babylonians, then to the Medes, then to the Persians, and after the battle of Issos (333 B. C.) to Alexander and the Greeks. During these transitions many non-Semitic elements were introduced into the populations. On the death of Alexander the Seleucidæ founded a Syrian empire which they ruled from 301 to 64 B. C. Antioch, built by Seleucus I.

(301–281 B. C.), was their capital. For centuries it was the largest and most brilliant city of the East, and was further influential through the civilization therein developed. The Syrian empire at the height of its prosperity rivaled in extent that of Alexander. Antiochus III., the Great (223-187 B. C.), was a most formidable enemy to Rome. Antiochus XIII. (69–65) was overthrown by Pompey, who made Syria a proconsular Roman province (64 B. C.). It continued part of the Roman and then of the Byzantine empire, but (635–638) was gradually conquered by the Mussulmans. Damascus was made the capital of Syria in 654; under the Ommiade dynasty of caliphs it continued the capital of the entire Mussulman empire (661–752). The Abasside caliphs, hating all that was associated with their Ommiade predecessors, degraded Syria to the rank of a province and removed the capital to the newly founded Bagdad. Distracted by rebellions and by frequent wars between the caliphs and the Byzantine empire, the condition of Syria was deplorable during the three subsequent centuries, till it fell under the humane sway of the Seljuk sultan Malek Shah (1073–93). Next the crusaders deluged the country, and the succeeding two centuries—from 1099, when the Christian kingdom of Jerusalem was set up, until 1291, when Acre, the last Christian stronghold in Syria, was retaken by the Mussulmans—formed the most disastrous and destructive period Syria has ever known. From that time, except during the invasions of Tamerlane and his successors, Syria was ruled by the Mameluke sultans of Egypt until 1516, when it was conquered by Sultan Selim I. From 1832 to 1841 it was governed by Ibrahim Pasha under the authority of his father, Mehemet Ali of Egypt. With the exception of this brief period it has, since the days of Sultan Selim, formed an integral part of the Ottoman empire.

See Burckhardt, *Travels in Syria and the Holy Land* (London, 1822); Porter, *Five Years in Damascus* (London, 2 vols., 1870); Robinson, *Biblical Researches* (1841) and *Later Researches* (1856); Yanoski, *Syrie Ancienne et Moderne* (1848); Baedeker, *Palestine and Syria*; Haskett Smith, *Handbook of Syria and Palestine* (1892).

EDWIN A. GROSVENOR.

**Syriac Language**: See ARAMAIC.

**Syriac Literature**: the literary productions of the Syriac Church. Its rise is lost in the first centuries of the Christian era. It is at its best from the fourth to the seventh centuries, when Arab dominion begins to impose its language upon Syria and Mesopotamia. From the tenth century on Syriac is only a literary tongue. Productiveness in that language dies out in the thirteenth century, just after a short period of revived glory. From the sixth century the split in the Eastern Church into Nestorians and Jacobites makes itself felt in the literature. It is probable that at one time there existed a heathen Syriac literature, but none of it has come down to us. The first writer in Syriac (Bardesanes, the last Gnostic) was a convert to Christianity. The translation into Syriac of the Bible (see PESHITO) and of Greek theological and secular works laid the foundation upon which later scholars built. Learning had found a home in the great schools of Mesopotamia—Edessa (destroyed by the Persians in 489), Nisibis, Māchōzē, Dōr-Kōnī, Jerablis, Mosul, etc. The literature is largely a theological one, and of importance because of the many translations it contains.

In these schools the study of the Bible was the chief interest. It was necessary to fix accurately the wording and the pronunciation of the more difficult expressions in both the Old and New Testament. This Masoretic work seems to have centered in certain convents—e. g. in the Jacobite one of Karkaftha, near Rās'ain, whence the best of such MSS. come (Martin, *La Massore chez les Syriens*, Paris, 1880). With this there went hand in hand the writing of commentaries upon the Bible, which were, of course, more theological than critical. The great Syrian Father Ephraem (d. 373) wrote commentaries upon both Testaments and upon the Diatessaron of Tatian. Among Nestorians were Hannānā (d. 607), a determined opponent to the exegesis of Theodore of Mopsuestia; Bābai the Elder (610); Elias of Merv; Isho'dad of Merv (852). The Jacobites have names of greater prominence—Jacob of Edessa (640–708); Daniel of Salaḥ (eighth century); Moses bar Kēphā (813–903); and Daniel bar Salibī (d. 1171), Bishop of Mar'ash. More like the Jewish Midrash and the pseudepigraphic literature are such compilations upon biblical history as the *Cave of Treasures* (ed. Bezold, 1883–88), *The Book of the Bee* (ed. Budge, Oxford, 1886). Of purely theological interest are the collections of church and monastic rules (*Canones*) which were formulated at various times—those of the Jacobite Church by Jacob of Edessa and Gregory Bar 'Ebhrāyā, those of the Nestorian by Abhdishō. The great schism in the Church has called forth a large polemical literature. One of the best apologies on the Nestorian side was written by Elias of Nisibis (b. 975), ed. by Horst, Colmar, 1886; while the Monophysites were defended by that elegant writer Philoxenus of Mabug (485). The homily was a favorite form of religious exhortation. A large number of such homilies have come down to us from Ephraem (ed. Lamy, 3 vols., Mechlin, 1882–86); Ibas (435); Jacob of Nisibis, called Afraates the Persian Sage (d. 338), trans. into German by Bert (Leipzig, 1888); Philoxenus (ed. Budge, 1893); and Jacob of Lerug (503), who is said to have composed as many as 760.

Poetry was also known in the service of the Church, though even historical, philosophical, and grammatical works were put into verse. Bardesanes (b. 154) is the first poet; he is followed by Ephraem, Balai (431), Cyrillōnā, Isaac of Antioch (d. 460), Narsai (489), and the Nestorians George of Mosul (d. 987), George Warda (1225), whose hymns are largely used in the Nestorian ritual, and Chamis bar Ḳardāhē of Arbel. Syriac poetry can not lay claim to great originality. Its system of meter is based upon two principles—the rhythmic sequence of accented or unaccented syllables, the one the arsis, the other the thesis of the verse, and the counting of the syllables. See Grimme, *Der Strophenbau in den Gedichten Ephr. des Syrers* (Freiburg, 1893).

Syriac literature is rich in historical works which throw much light upon the ecclesiastical and political history of the Christian Church in Mesopotamia. The *Didascalia* and *Constitutiones Apostolorum*, the legends of Abgar and the apostle Addai, and the Edessenian chronicle (Hallier, *Unters. über die Ed. Chronik*, 1892) are of prime importance (Duval, *Hist. d'Édesse*, 1892). The ancient martyrologies (re-edited by Bedjān, 4 vols., Paris, 1890–95) are full of interesting material, as are also the Nisibene hymns of Ephraem, the poems of Isaac of Antioch, and the historical romance dealing with the persecutions under Julian the Apostate (*Zeit. der Deutsch. Morgenl. Gesellschaft* 28, 263). Other historical works deal largely with the war between Rome and Persia. An anonymous Monophysite has turned the ecclesiastical history of Zacharias Rhetor of Mitylene (560) into Syriac, and united it with other works. Very full and accurate is the ecclesiastical history of John of Ephesus (b. 505) in three parts. Other writers are Simeon Barḳāyā (591); George, Bishop of the Arabs (686); Jacob of Edessa, who finished in 692 a continuation of the chronicle of Eusebius; Dionysius of Tel Mahrē (817); Thomas of Marga (832), author of a monastic history (ed. Budge, 1893); Elias bar Shināyā; Michael (1163), whose work exists in an Armenian translation, etc.

Translations were made from the Greek at a very early time—e. g. the *Recognitiones* of Clement; the *Apology of Aristides* (ed. Harris, Cambridge, 1891); the discourses of Titus of Bostra; the *Theophania* of Eusebius; the commentaries of Theodore of Mopsuestia; the *Geoponica* (ed. Lagarde, 1860); the *Physiologus*; the works of Homer; the collection of *Leges Seculares* (ed. Sachau, 1880); the fables of Æsop; the medieal works of Galen and Hippocrates. Many of these are useful for text-critical purposes; some have not been preserved in the original Greek. Among translators known by name are Ma'na (430), Moses of Aghel (550), Athanasius II. (684). A great many of the works of Aristotle were also translated, especially the *Organon* (Gottheil, *Hebraica*, ix., 166). Probus (about 450), George of the Arabs, Sergius of Rās'ain (about 540), Jacob of Edessa, and Honain (873) are the leaders in this work. From the Syriac they were translated into Arabic, and from Arabic into the languages of Europe. The old Sanskrit stories of Kalilag and Damnag, of Sindban, and the history of Alexander the Great were done into Syriac from the Pahlavī. The translations of Aristotle formed the natural starting-point for all philosophical study, but the Syrians hardly got beyond commentating and excerpting their Greek master. To the names already mentioned may be added those of Paul of Persia (575), Severus Sabocht (d. 631), Mār Abhā II. (740), Antonius Rhetor, Moses bar Kēphā (b. 813), Bazūdh, and Severus bar Shakko (d. 1241). See Renan, *De Phil. Peripat. apud Syros* (Paris, 1852).

The only non-theological science that was really cultivated was that of philology. Syriac lexicography had its beginning in the necessity of determining accurately the meaning of words in the Bible and of the many Greek expressions which had been taken over into the translation of other works. Collections of such explanations were made by Anānīshō, Honain, Bar Seroshwai (tenth century), but especially by Bar Ali (835) and Bar Bahlūl (963), where the definitions are in Syriac and Arabic. In grammar the starting-point was Aristotle and the Syriac translation of the Τεχνή of Dionysius Thrax (Gottheil, *Treatise on Syriac Grammar*, Berlin, 1887, p. 5; Merx, *Hist. artis grammaticæ apud Syros*, Leipzig, 1889). In later times the influence of the grammatical studies of the Arabs was also felt. The chief grammarians are Joseph Huzāyā, Jacob of Edessa, Elias of Tirhān (1028), Elias of Nisibis, Joseph bar Malkōn (1200), John bar Zo'bi (thirteenth century), and Severus bar Shakko. Other branches of science were hardly cultivated except for the writing of such compendia as the Hexaemera of Jacob of Edessa, Emanuel (963), Moses bar Kēphā (Gottheil, *Hebraica*, viii., 65; Hjelt, *Études sur l'Hex. de Jacques d'Édesse*, Helsingfors, 1892). Duval has published some interesting Syriac works on alchemy (Berthelot, *La Chimie au Moyen Âge*, ii., Paris, 1893).

This short account may be fitly closed with a reference to two lights which illuminated the last days of Syriac literature. Abhdīshō (d. 1318), the Nestorian, was the first to attempt a history of his national literature (*Catalogus Librorum*, in Assemani, *Bibl. Orient.*, iii., 1). In his *Paradise of Eden* he attempted to imitate the Makāmāt of Hariri (ed. Cardāhī, Beyrout, 1889). He also wrote a work on theology (*The Pearl*) and a collection of canons (Mai, *Script. Vett. Nova Coll.*, x.). Undoubtedly the most learned of all the Syriac writers was Gregory bar 'Ebhrāyā (Bar Hebræus; Abul Faraj), b. 1226; d. 1286. There is hardly a province of literary activity which he did not cultivate. He wrote the most comprehensive native grammar (ed. Martin, 1872), and the most useful native commentary upon the Peshitta (*Storehouse of Secrets*). That he had some acquaintance with physical sciences is shown in his *Lamp of the Sanctuary*, a compendium of all sciences; in his *Ascent of the Mind*, a treatise on astronomy and cosmography: and in his translation of Dioscorides's Περὶ ὕλης ἰατρικῆς, his commentaries on works of Galen, and in a medical work of his own. He wrote a work on ethics, on the life of an ascetic (*Book of the Dove*), and a commentary on the mystical *Book of Hierotheus*. His historical writings are very valuable. His *History of the World* has been re-edited by Bedjān (Paris, 1890); his church chronicle by Abeloos and Lamy (Louvain, 1872–77). He also made an Arabic recension of his *History of the World*. Bar Ebhrāyā was a poet of some prominence. A number of his poems have been edited by A. Scebābī (Rome, 1877). See Nöldeke, *Sketches from Eastern History* (London, 1892).

See W. Wright, *A Short History of Syriac Literature* (London, 1895). R. Graffin has begun the publication of a complete *Patrologia Syriaca*, the first volume of which contains *Aphraatis Sapientis Persæ Demonstrationes* (Paris, 1894). RICHARD GOTTHEIL.

**Syrian Rite**: See UNITED SYRIANS.

**Syrin'ga** [Mod. Lat., from Gr. σῦριγξ, σύριγγος, a shepherd's pipe, tube]: a genus of Old World shrubs of the family *Oleaceæ*, to which the lilacs belong. (See LILAC.) Popularly, the beautiful shrub *Philadelphus coronarius*, of the family *Saxifragaceæ*, and often seen in gardens, is called sweet syringa. It is a native of Japan; its cream-colored, fragrant flowers somewhat resemble orange-blossoms, whence another popular name of mock orange.

Revised by CHARLES E. BESSEY.

**Syringe** [from Gr. σῦριγξ, σύριγγος, tube-pipe, liter., shepherd's pipe]: an instrument identical in principle with the ordinary suction-pump. A vacuum is formed, either by means of a piston or a compressible chamber of India-rubber, fitted with suitable valves. Water or some other fluid then rushes in and fills the vacuum, and a second application of pressure causes a jet of the contained liquid to be thrown out. The syringe is of many forms, chiefly employed in surgery, in horticulture, etc.

**Syro-Chaldæans** and **Syro-Orientals**: See CHALDÆAN CHRISTIANS.

**Syros**: See SYRA.

**Syr'tis, Major** and **Minor** [Lat., Greater and Lesser Syrtis]: the ancient names of the two large inlets, or rather of the two opposite angles (E. and W.) of the great almost rectangular re-entrant in the southern coast of the Mediterranean, of which the margins are the coasts of Tunis and Tripoli. They are now called respectively the Gulf of Sidra and the Gulf of Cabes. They are shallow and dangerous to navigate on account of quicksands and the uncertainty of the tides.

Revised by J. R. S. STERRETT.

**Syrus**, PUBLILIUS: See PUBLILIUS SYRUS.

**Sysran'**: town; in the government of Simbirsk, Russia; on the Sysran, near its influx into the Volga (see map of Russia, ref. 8–G), and in the center of a very fertile district, from which it exports large quantities of grain. Pop. (1897) 32,377.

**Systole**: See HEART.

**Szabadka**, so-bod'kō (Germ. *Maria-Theresiopel*): town; in the county of Bacs, Southern Hungary; on Lake Palicz (see map of Austria-Hungary, ref. 7–H). It has manufactures of linens and leather, important cultivation of tobacco and breeding of cattle, and a brisk trade in horses, cattle, sheep, wool, and hides. It consists of the town proper and sixteen suburbs, and is rather indifferently built, though it contains several handsome buildings, such as the Church of St. Theresa, the beautiful Greek church, the town-house, the barracks, etc. Pop. (1890) 73,526.

Revised by M. W. HARRINGTON.

**Szalay**, so'loi, LASZLO: historian; b. at Buda, Hungary, Apr. 18, 1813; studied at the University of Pesth, and was admitted to the bar in 1833; devoted himself to history, jurisprudence, and politics; became editor of various leading reform papers, and published a collection of political essays in 1847, and of political biographies 1847–52; was the most prominent member of the commission for the revision of the Hungarian penal code, a work which earned great admiration outside Hungary; succeeded Kossuth as editor-in-chief of the *Pesti Hirlap* in 1844; was sent as ambassador in 1848 to the provisional government of Germany in Frankfort; resided subsequently in London and Switzerland, occupied with historical studies; returned to Hungary in 1861. D. at Salzburg, July 17, 1864. Among his works are a *History of Hungary* (6 vols., 1850–63); *Eszterházy Miklós* (2 vols., 1862–66); and *The Book of Statesmen*, a collection of political biographies. F. M. COLBY.

**Szarvas**, sor'vosh: town of Hungary, on the Körös; 80 miles S. E. of Budapest (see map of Austria-Hungary, ref. 7–I). It was formerly fortified, but its fortifications have fallen into decay, and it derives its importance mostly from its trade in grain and cattle. It suffered severely during the sieges of 1595 and 1685. The surrounding country is swampy and marshy, but famous for its extensive bee-culture. Pop. (1890) 24,399. Revised by M. W. HARRINGTON.

**Szatmar-Nemet**, sot-mor'nā-met': town of Hungary, on the Szamos; 68 miles by rail N. E. of Debreczin (see map of Austria-Hungary, ref. 6–I). It has a Roman Catholic cathedral, and has extensive manufactures of slibowiz, a kind of brandy distilled from plums. The town was formed by the union of Szatmar and Nemet in 1715. Pop. (1890) 21,218.

**Széchényi**, sā'tshān-yē, ISTVÁN, Count: Hungarian statesman: b. in Vienna, Sept. 21, 1792, of an old and celebrated Hungarian family; served in the Austrian wars with Napoleon, but retired from the army in 1825, and devoted himself wholly to the material and spiritual development of his native country. He took a prominent part in the foundation of the Hungarian Academy of Science, of the first Hungarian theater, of the conservatory of music in Pesth, etc., and in the erection of the great bridge across the Danube at Pesth, in the regulation of the course of the Danube through the Iron Gates, in the establishment of steam-navigation on the Danube and the Theiss, etc. In political matters he desired reform, not revolution. He held that the progress of Hungary could not be effected unless by the aristocracy and in alliance with Austria, and he consequently opposed Kossuth very strongly. Nevertheless, in 1848 he consented to be a member of the Batthyanyi-Kossuth ministry, but on the outbreak of the war with Austria he became insane, and was taken to the asylum at Döbling, near Vienna. Here he nearly recovered, but in Mar., 1860, the Austrian police, suspecting him of being the author of a political pamphlet which criticised the Government very severely, undertook a search of his rooms and papers, and this excited him so violently that he relapsed, and killed himself Apr. 8, 1860. He was the author of several spirited pamphlets.

Revised by F. M. COLBY.

**Sze-chuen**, or **Ssŭ-chuen**, se′chwăan′ [literally, four streams]: the largest province of China, bounded N. by Kansuh and Shensi, E. by Hupeh, S. by Kwei-chow and Yunnan, and W. by Tibet; area, 166,800 geographical square miles, or 220,000 statute square miles. The portion lying W. of the river Min (an important affluent of the Yang-tse, regarded by some as the upper course of the Yang-tse itself) is little known. It has an area of 120,000 sq. miles, is exceedingly mountainous, and forms part of the great mountain lands of Central Asia. With the exception of some small inclosures it is little populated, is almost uncultivated, and of inferior importance as regards the value of its products. Here are found several Tibetan and aboriginal tribes, such as the *Man-tse* (a people considered by the Chinese to be the remnants of the ancient occupants and rulers of the province), the *Si-fan*, who are divided into numerous tribes, each with its own chieftain, and the *Lolos*, who are practically independent, and from whose frequent raids the Chinese settlers suffer greatly.

The eastern portion, which may be regarded as Sze-chuen proper, has been described by Baron von Richthofen as a large triangular-shaped basin surrounded by mountains (mostly of Silurian and Devonian age), some of which rise above the snow-line, and all of which are difficult to cross. The basin he calls the Red Basin, from the accumulations of red clayey sandstones and sandy clays which are found in it. The summit lines within the basin are nearly at a level with one another, and would if connected represent an undulating plain, 3,000 to 4,000 feet above sea-level, but owing to the fact that the bed of the Yang-tse is 1,500 feet or more below the level of the plain, and that rocks of the Red Basin are soft and easily destructible, the rivers have eroded deep channels, and converted the entire basin into a hilly country. With the exception of the plain of Ching-tu, Sze-chuen contains no level ground worth speaking of.

Sze-chuen can be approached from the E. by only two routes: (1) by the Yang-tse, up whose gorges boats and junks (never exceeding 70 tons burden) are dragged slowly and at great expense and risk, and (2) by the "Great North Road" over the mountains from Si-ngan-foo. Communication within the province is everywhere difficult (except in the plain of Ching-tu), and is kept up chiefly by utilizing the affluents of the Yang-tse and their numerous branches. Several pack-roads, paved with flagstones, have been constructed, and steps cut in the rocks at very steep places. That which connects Ch'ung-K'ing with Ching-tu-foo is a good example. The sedan-chair is the commonest mode of conveyance used by travelers, while goods are transported by coolies. Beasts of burden are little used.

Coal is found in Sze-chuen, but is not mined extensively. The manufacture of iron from its ores is perhaps the most generally distributed industry of the province. Salt is extensively made from brine raised from wells ranging in depth from 700 to 3,000 feet, and evaporated in some places by coal, but in many by natural gas. Petroleum is plentiful, but is not utilized. The value of the salt produced annually is about $63,000,000. On this the province receives a tax of $3,150,000, while the province of Hupeh, which levies a tax of 18 cash a catty, takes $2,100,000. The other chief products of the province are silk, opium, insect wax (see PEH-LA), tobacco (which is of excellent quality, and is used by the natives in leaves rolled up in the shape of cigars), tea (only green and of inferior quality), and t'ung oil.

The inhabitants are, as a rule, gentle in character and refined in manners, and are both industrious and prosperous. All the great commerce of the province, however, is in the hands of men from Shensi and Kiangsi, and banking and pawnbroking are controlled by men from Shansi. The population is about 67,000,000. CH'UNG-K'ING (*q. v.*) is the only river-port opened to foreign residence and trade, but missionaries, both Protestant and Roman Catholic, are found in many places. The capital is CHING-TU (*q. v.*). See Baber's *Travels and Researches in Western China* (London, 1882); Hosie's *Three Years in Western China* (London and New York, 1890); and Little's *Through the Yang-tse Gorges* (London, 1887). R. LILLEY.

**Szegedin**, sech-ed-een′: city; in Hungary, at the junction of the Maros with the Theiss; 118 miles by rail S. E. of Budapést; connected by a bridge of boats with Neu-Szegedin on the opposite bank (see map of Austria-Hungary, ref. 7-H). The houses are generally only one story high, with thatched roofs; the streets are broad, but mostly unpaved, and sometimes are rivers of mud. The old Turkish castle in the center of the town is the sole reminder that Szegedin was once an important fortress. In 1879 the town, with the surrounding country, was submerged by inundation; almost half the houses were destroyed, and nearly 2,000 persons perished from drowning or exposure. Soda, soap, and cloth are manufactured on a large scale, and an active trade is carried on in corn, wine, tobacco, salt, and lumber. At its annual fairs vast exchanges of goods take place. The town is famous for its floating mills and river-boats. The Hungarians were defeated here by the Austrians (Aug. 3, 1849). Pop. (1890) 85,569. E. A. GROSVENOR.

**Sze-ma** (or **Ssŭ-ma**) **Kwang**: one of the most prominent statesmen and writers of China, and as a historian second only to Sze-ma Ts'ien; b. in 1009; d. 1086. He was remarkable for precocious intelligence, and a story is told that illustrates his presence of mind and resourcefulness even when a boy. A playmate, having fallen into one of the large earthenware vessels in which the Chinese keep tame fish, was on the point of drowning, when Kwang dashed a large stone against the jar and broke it, thus letting the water escape and saving the life of his companion. He was employed at an early age in Government office, and rose to high rank in the ministry. He is noted, first, for his strenuous and successful opposition to the reforms advocated by his contemporary Wang An-Shih, usually called "the Innovator"; and, second, for his great historical work, in 294 books, *The Comprehensive Mirror of History*, on which he spent the leisure of nineteen years. It covers the period from the beginning of the fourth century B. C. to 960 A. D. He was also the author of several dictionaries. R. L.

**Sze-ma** (or **Ssŭ-ma**) **Ts'ien**: author of the first general history of China; b. at Lung-mŭn, in what is now the province of Honan, about 163 B. C. He early devoted himself to study, and at twenty entered upon an extended course of travel throughout the empire. After this he held several minor offices under the Government until 110 B. C., when he succeeded his father, Sze-ma T'an, as grand recorder and astronomer, and shortly thereafter entered upon the task of completing the great historical work begun by his father. This was finished in 91 B. C., and received the name of *Shih-ki*, or *Historical Records*. It extends from the beginning of the reign of Hwang-ti (B. C. 2697) to 104 B. C. It has become the model for all Chinese historical works, and is divided into five parts: (1) Imperial Records; (2) Chronological Tables; (3) Treatise on Rites, Music, Chronology, Astrology, Sacrificial Service, Watercourses, Weights and Measures, etc.; (4) Genealogical History of the Princes and Grandees; and (5) Narratives, or biographies, and accounts of foreign countries and their affairs. About the year 98 B. C. Sze-ma incurred the displeasure of the emperor, and was thrown into prison because of his defense of Gen. Li Ling, who, having foolhardily advanced far into the territory of the Huns with a body of 5,000 foot-soldiers, had been overthrown, and then, afraid to face the wrath of the emperor, had surrendered. Sze-ma is also noted for reforming the calendar, and the chronology determined by him still obtains in China. He died in disgrace about 85 B. C. For a specimen of his writings, see Giles's *Gems of Chinese Literature* (London and Shanghai, 1884). R. L.

**Szumowska**, ANTOINETTE: See the Appendix.

# T

**T**: the twentieth letter of the English alphabet.

*Form.*—The form T is inherited viâ the Roman alphabet from the early Greek T or + X X. The form of the Semitic original was that of a cross, + or X. It occupied the last or twenty-second place in the original alphabet adopted by the Greeks from the Phœnicians.

*Name.*—The Semitic name of the letter was *taw*, i. e. mark, cross, whence the Greek *ταῦ*. The Latin phonetic name *te* passed through the French *té* into English as *te*, now pronounced like *tea*.

*Sound.*—It commonly denotes a voiceless dental (or alveolar) explosive formed by breaking a closure between the tongue-tip and the alveolar terrace back of the upper front teeth as in *tar*, or by effecting a check at the same point as in *rat*. Generally there is in the latter case an additional after-puff caused by again breaking the closure; thus in *act* the after-puff constitutes the only characterization of the sound. The same sound is denoted also by *th* in *Thames, Thomas, thyme, phthisis*, and by (*e*)*d* in preterites and participles, as *asked, rushed*. The letter *t* is silent in *hautboy, hasten, listen, often*, etc., *bustle, thistle*, etc., *chestnut, Christmas, mortgage, bankruptcy, waistcoat, Matthew*; in the combination *ti* before vowels it often has the value of *sh* (*š*), as in *initial, action*, etc., but in *-sti-* it has the value of *tsh* (*tš*), as in *question, Christian*. In the combination *th* it represents a spirant, either voiceless, as in *thin*, or voiced, as in *then*.

*Source.*—The sound represents in Teutonic words an Indo-European *d*; cf. *ten*: Lat. *decem*; *tooth*: Lat. *dens*; *two*: Lat. *duo*; *heart*: Lat. *cor, cordis*; or when following *s, h*, or *f*, an Indo-European *t*, as in *stand*: Lat. *stare*; *night*: Lat. *nox, noctis*; *eight*: Lat. *octo*. Between *s* and *r* it is excrescent, i. e. a special development of Teutonic; cf. *stream*, Indo-European root *sreu-*, *sister* from *swesr-*, Lat. *soror*. It is also an excrescent product of Mod. Eng. after final *-s*, e. g. in *betwixt* < M. Eng. *betwix*; *against* < M. Eng. *ageines*.

*Symbolism.*—T = Tuesday, ton, Tullius; Ta = tantalum; Te = tellurium; Th. = Thursday, thorium; Ti = titanium; Tl = thallium. BENJ. IDE WHEELER.

**Taaffe**, taa'fe, EDUARD, Count: Austrian statesman; b. in Prague, Feb. 24, 1833, of an Irish family; was educated with the Emperor Francis Joseph; entered the public service in 1857; became Austrian Minister of the Interior in 1867; Minister President in 1869 and again in 1879. He was much opposed to the anti-Semite agitation, and sought to form a middle party which should unite conflicting nationalities and creeds. In 1893 he alienated the conservatives, the German liberals, and the Poles by his electoral reform measure, and was forced to resign Oct. 29. D. at Elischau, Bohemia, Nov. 29, 1895. F. M. COLBY.

**Tabas'co**: a southeastern state of Mexico, bounded N. by the Gulf of Mexico, E. by Campeche, S. E. by Guatemala, S. by Chiapas, and W. by Vera Cruz. Area, 9,844 sq. miles. The southern portion only is mountainous, the rest consists of extensive plains and low rolling lands bordering the river Grijalva and its tributary, the Usumacinta, both of which are navigable. There are extensive swamps and lagoons near the coast, much of the surface is covered with matted forest, and the roads, even in the most settled portions, are execrable. The climate is warm and damp; there is no true dry season, but rains are most copious from July to October and in December and January. The soil nearly everywhere is very fertile; besides the common crops of maize, etc., cacao and sugar-cane are raised, the former for exportation and the latter principally for the manufacture of rum. There are no mines of importance. In general, Tabasco is one of the least progressive of the Mexican states. Pop. (1893) estimated, 111,820. Capital, San Juan Bautista. HERBERT H. SMITH.

**Tabasco River**: See GRIJALVA.

**Tabasheer'** [from Pers., Hind., and Arab. *tābāshīr*; cf. Sanskr. *tavakshīra*]: a white variety of opal obtained from the hollow stems of certain bamboos. It appears to be the product of an exudation of the siliceous sap of the plant into its internal cavity, caused by disease or injury of the plant. It is very light, brittle, porous, and has hygrometric properties. There are several varieties. The transparent kinds have a very low refractive power. The Hindus ascribe to it valuable medicinal virtues.

**Tabatin'ga**: a town of the state of Amazonas, Brazil; on the north side of the river Amazon, close to the frontier of Peru (see map of South America, ref. 3-C). It is the terminal port for the regular Brazilian steamboat lines, and the point of departure for small steamers which ply on the Peruvian rivers; there is a growing trade, especially in rubber. Ocean steamships have ascended to this point, nearly 2,000 miles. Pop. about 3,000. H. H. S.

**Tab'ernacle** [viâ O. Fr. from Lat. *taberna'culum*, tent, (in Late Lat.) tabernacle, dimin. of *taber'na*, shed, booth, shop, used as transl. of Heb. *mish'kān*, dwelling-place, tent, tabernacle, or, *'ōhel*, tent, tabernacle]: a tent erected, under minute divine directions (Exod. xxv.-xl.), by the Israelites at Mt. Sinai, and carried with them into the Holy Land. It was set up at Gilgal (Joshua iv. 19), then at Shiloh (Joshua xviii. 1), next at Nob (1 Sam. xxi. 1), then at Gibeon, where it is last mentioned (1 Chron. xxi. 29). It was designed as the place where God should especially manifest his presence to his people, and where they should offer to him their sacrificial worship, and was replaced by Solomon's temple which exactly doubled its dimensions. It was a rectangle 45 feet long and 15 broad and 15 high. Its two sides and western end—the eastern end was left open—were made of acacia boards placed on end in silver sockets, and bound together by rods overlaid with gold; and the frame was covered with (1) linen, on which was embroidery representing cherubim; (2) black goats'-hair cloth; (3) rams' skins dyed red; (4) seals' skins (or porpoise-skins). It consisted of two adjoining rooms, with an outer court surrounding both. The inner room, which was an exact cube, contained the ark of the covenant, with its contents; over this were the figures of two cherubim, and between them the Shekinah. The only access to this room, which was called "the holy place," or "the holy of holies," "the holiest of all," "the second tabernacle" (Heb. ix. 3, 7), was from the outer room, which was called "the holy place," also "the sanctuary," "the first tabernacle" (Heb. ix. 6), of the same width and height, but just twice the length. Between them hung a veil, or rather double curtain, which was passed only by the high priest, and by him only on one day of the year, the great day of atonement. In the outer room was the golden censer, the golden altar on which incense was burned every morning and evening, the table of shew-bread, on which were twelve loaves of bread, replaced each week, and the golden candlestick, the lamps of which were trimmed every morning and lighted every evening. Into this the high priest and the priests entered daily, in the course of their regular ministrations, but no others. The entrance was at the eastern end from the court in front. In the court the principal object was the large brazen altar, on which all burnt-offerings and the appointed parts of other sacrifices were burned. Between this and the sanctuary itself was placed the brazen laver for the ablutions of the priests. This court was entered not only by the priests and Levites, but by all Israelites—who must be ceremonially clean—who came to offer sacrifices. The entrance to this also was by a hanging of curtains gorgeously wrought in colors, supported on pillars, and was 20 cubits in width. The three entrances were thus in one line, all facing eastward. The dimensions of the court were 100 × 50 cubits; it was inclosed on all sides by pillars of brass 5 cubits high and 5 cubits apart, resting in sockets of brass; and on these were hung, by hooks of silver, curtains, one for each side, of "fine twined linen."

Revised by S. M. JACKSON.

**Tabernacles, Feast of**: the last of the three great annual festivals, at which all the males of Israel were required to present themselves at the sanctuary (Lev. xxiii. 33-43). It began on the 15th Tisri, the first month of the civil and seventh month of the ecclesiastical year, corresponding to the last part of September or first part of October, and continued seven days, with a supplementary eighth day. On the first and on the eighth day there were "holy convocations," when no servile work might be done, although the other activities of life were allowable. On the remaining days there was no legal restriction on labor, but from the manner of keeping the feast it must have been largely suspended. It was also called the "feast of ingathering" (Exod. xxiii. 16), and was pre-eminently a thanksgiving festival after harvest, and was far more joyously kept than any of the other feasts. It was distinguished by two peculiar observances—(1) the dwelling in booths, in memory of their wilderness wanderings. These booths were to be constructed of the branches of "goodly trees," and were not tents. According to Jewish tradition, the sides were built up of boards, and only the roof made of branches. The booths were placed on the roofs and in the courts of the houses, and in any unoccupied places in the streets. As little furniture as possible was to be placed in them, and it was not required that women and children should dwell in them, but only men. Tradition interpreted the word dwell to mean taking at least two meals a day in them. (2) The singular manner in which the sacrifices were arranged (Num. xxix. 13–38). There was offered daily a kid for a sin-offering, with two rams and fourteen lambs for a burnt-offering; but besides this there was a further burnt-offering of bullocks, thirteen on the first day, twelve on the second, and so on diminishing by one on each successive day, until only seven were offered on the seventh day. On the eighth day the sacrifices were a goat for a sin-offering, one bullock, one ram, and seven lambs for a burnt-offering. The Law required that at the feast of tabernacles in the sabbatical year the Law should be publicly read to the whole people, men, women, and children.

Two other customs arose at an early date: (1) One of the priests drew water in a golden pitcher from the Pool of Siloam, and brought it through the water-gate of the temple to the altar. As he entered, the trumpets sounded. Then, just before the offering of the sacrifices, the water was poured upon the altar, amid the joyous chanting of Ps. cxviii. on the part of the great concourse of people, in holiday attire and carrying *lulabs* or green branches tied together. So great was the joyousness of the occasion that it became a rabbinical proverb, "He has never seen joy who has not seen the joy of the pouring out of the water of Siloam." To this custom allusion is made in John vii. 37, 38. In the evening of the day of "holy convocation" the men and women assembled in the courts of the temple expressly to rejoice over the drawing of the water of Siloam in the morning, and gave themselves up to unrestrained hilarity. (2) On this occasion two great lights were set up in the court, each consisting of four lamps, the oil for which was supplied by the sons of the priests, and the wicks made of cast-off priestly garments. The light is said to have reached over nearly the whole city. The passage John viii. 12 is supposed to allude to this light. Revised by S. M. Jackson.

**Tabernæmonta'na**: See Cow-trees and Forbidden Fruit.

**Ta'bes Dorsa'lis**, or **Locomotor Ataxia** [*tabes dorsalis* is Lat., liter., a wasting away (*tabes*) in the back; *locomotor ataxia* is in-coördination of movements; Mod. Lat. *locomotor* (Lat. *locus*, place + *motor*, a mover) + Gr. ἀταξία, disorder (ἀ-, not + adjec. τακτός, deriv. of τάσσειν, arrange)]: a chronic affection of the posterior columns of the spinal cord, characterized by in-coördination, sensory and nutritive disturbances, and a loss of the light reflex of the pupil. It is a disease of middle life, and is much more frequent in men than women. While syphilis is the most frequent cause, sexual excess, overwork with exposure, and possibly even injury may produce it. Alcoholism alone exerts but little causative influence. The disease usually begins with attacks of violent, stabbing pains in the legs, coming on suddenly and lasting only for a moment, recurring for months before the onset of other symptoms, and usually diagnosed as rheumatic. On examination the knee jerks are found to be absent, and later the superficial reflexes also disappear. The pupils are small, and while still contracting on accommodation cease to do so when exposed to light. This condition is called the Argyle-Robertson pupil. Optic atrophy may be present. Later the characteristic gait due to in-coördination appears. The foot is raised too high, is thrown violently forward, and the entire sole touches the floor at once. Walking is made much more difficult by closure of the eyes, and on attempting to stand with the feet close together and the eyes shut the whole body sways sometimes so violently as to throw the patient to the floor (Romberg's symptom). The gait greatly resembles that of a drunken man. In-coördination is also present in the hands. On trying to touch the nose or ear with the finger, the eyes being closed, it goes wide of the mark. It is difficult for the patient to button or unbutton his clothes, and to pick up small objects without the aid of vision. There is no true palsy, but simply this inability to direct muscular effort, until late in the disease. Sensation is delayed, sometimes ten seconds elapsing between a touch and its recognition. The ability to localize sensation may be lost. There are spots of anæsthesia. The patient often feels as if walking on wool. Numbness and tingling occur in the hands and feet. Often a tight band is felt around the body. Attacks of violent pain in the stomach, with vomiting (gastric crises), are frequent. Laryngeal crises are characterized by noisy inspiration, dyspnœa, and cough. Infrequently there are crises in other organs. There is apt to be difficulty in micturition. Sexual power is entirely lost. Trophic changes occur. The most frequent are perforating ulcer of the foot, skin eruptions, changes in the larger joints characterized by erosion of the cartilages and effusion into the joint cavity, and brittleness of the bones rendering them peculiarly liable to fracture. The disease extends over many years. Death usually results from some intercurrent affection. While locomotor ataxia never causes disease of the mind, one form of insanity (general paralysis) occasionally begins with identical spinal symptoms. Fully developed locomotor ataxia is incurable, but treatment may benefit and for a time even stay the progress of its course. Pathologically tabes dorsalis is a sclerosis of the posterior columns of the spinal cord, with involvement of the posterior nerve-roots, the meninges, and sometimes a peripheral neuritis. William Pepper and C. W. Burr.

**Table-land**: See Plateau.

**Tables**: See Furniture.

**Taboo'**, or **Tabu** [from Polynesian (Marquesas islands), *tapu*, forbidden, (as noun) taboo]: a Polynesian interdict which makes persons, places, or things sacred, so that certain persons can not touch or come near them without becoming defiled and outlawed. The system of taboo penetrates the whole social life of most of the unchristianized Polynesian islands, and is a powerful agent in the hands of chiefs and priests in controlling the people.

**Tabor**, Mount [*Tabor* is from Heb. *Tābōr*, liter., lofty place (or perhaps stone quarry)]: an insulated mountain of Northern Palestine, in Galilee, 6 miles S. E. of Nazareth, rising 1,053 feet above the plain and 2,018 feet above the sea, and commanding a large and beautiful view of the surrounding country. It is often mentioned in the Old Testament, and was from the fourth century generally regarded as the scene of the transfiguration of Christ, although it is now known that at the time when that event took place its summit was occupied by a fortified town.

Revised by M. W. Harrington.

**Tabor College**: a coeducational institution at Tabor, Fremont co., Ia.; incorporated under the name of Tabor Literary Institute in 1854 and reincorporated under the name of Tabor College in July, 1866. It is an outgrowth of a colony of Congregationalists from Oberlin, O., who formed the settlement at Tabor in 1852. Many citizens of Tabor gave largely of their property to the institution at the opening of the college department. The first nineteen donors gave in cash and notes 60 per cent. of the assessed value of their property. An academy was opened in 1857, and a college department in 1866. Tabor College includes classical, scientific, and literary courses of study of four years each, also a preparatory academy, an English course of four years, a conservatory of music, and a department of fine arts. The entire number of students in 1900 was 178. Rev. William M. Brooks, D. D., was principal of the academy and first president of the college; he was succeeded in 1896 by the Rev. Richard C. Hughes. Tabor College has five buildings, 13 acres of land, a library of over 12,000 volumes, and a cabinet of 12,000 specimens. The property is valued at $160,000. The number of students from the first exceeds 3,000. The faculty consists of 8 professors and 5 instructors, besides a number of assistants. William M. Brooks.

**Ta'borites** [from *Tabor*, one of their strongholds, 65 miles S. of Prague]: the radical wing of the Hussites (*q. v.*) organized in 1420 under Ziska. They opposed the Calixtines or Utraquists, no less than the Romanists, and waged long defensive wars. They finally took the name of BOHEMIAN BRETHREN (*q. v.*).

**Tabriz**, or **Tabreez**, tāā-breez′: capital of the province of Azerbijan, Persia; 40 miles E. of Lake Urumeyah (see map of Persia and Arabia, ref. 1–F). It is in the midst of a fertile and well-cultivated plain, where there are many orchards and vineyards. The city itself is surrounded by gardens that are irrigated by the adjacent streams. It is poorly built, with crooked, narrow, and dirty streets and no important public edifices, except the remains of the Blue Mosque, a marvel of Eastern architecture and decorative art that was destroyed by the earthquake of 1780, and the ark citadel, containing the palace of the heir-apparent. Its bazaars are mean buildings, but extensive, and there are important manufactures of silk, arms, shawls, tobacco, and leather, and a large transit trade. Though a Persian tradition tells us that Tabriz was built by Zobeida, the wife of Harun-al-Rashid, the town was known in antiquity under the name of *Gazaca*, and was the capital of the Median province, Atropatene. Marco Polo visited it about 1293. It has suffered severely by fire, earthquake, and by the invasions of Turks. Pop. estimated at 180,000.

Revised by M. W. HARRINGTON.

**Tabu**: See TABOO.

**Tabula′ta**: a name formerly given certain corals, both recent and fossil, from the fact that the pits (calyces) in which the animals lived are divided by transverse partitions or tables. The group is an unnatural one, some of the forms belonging to the *Hydrozoa*, the others to the *Scyphozoa*.

**Tac′ahout**, or **Mahu**: a nutgall which grows on a tamarisk (*Tamariscus indicus*). It is valuable as a prolific source of gallic acid. Large quantities are exported from India and Barbary.

**Tac′amahac**: the resin of various trees (1) of *Fagara octandra*, a tree of Curaçoa and Venezuela; (2) of the buds of the balsam-poplar, which grows in the U. S. (*Populus balsamifera*); (3) of *Calophyllum calaba*, *C. inophyllum*, and *C. tacamahaca*, Old World tropical trees, producing East Indian tacamahac; (4) the Mexican COPAL (*q. v.*). These articles are sometimes used in medicine; all but the second are employed in varnishes, incense, etc.

Revised by CHARLES E. BESSEY.

**Taché**, tāā′shā′, Sir ÉTIENNE PASCHAL: statesman; b. at St. Thomas, Quebec, Canada, Sept. 5, 1795; d. there July 29, 1865. He served in the war of 1812; studied medicine and practiced as a physician till 1841, when he entered Parliament; was commissioner of public works 1848–49; Speaker of the Legislative Council 1856–57, and was knighted in 1858. He wrote *Du développement de la force physique chez l'homme* (Montreal, 1829) and *Réflexions sur l'organisation des volontaires* (Quebec, 1863).—His son, JOSEPH CHARLES, author, b. at Kamouraska, Quebec, Dec. 24, 1820, graduated as a physician in 1844; was a member of the Legislative Council 1847–57; represented Canada at the Paris Exposition in 1855; at that in London in 1867, and was British delegate from Canada at the international sanitary conference at Washington in 1881. He wrote *Esquisse sur le Canada* (Paris, 1855); *Tenure seigneuriale en Canada* (Quebec, 1854); *La pléiade rouge* (1854); *Trois légendes de mon pays*; *Forestiers et voyageurs*, and other works.—Another son, ALEXANDRE ANTOINE, Roman Catholic archbishop, b. at Rivière-du-Loup, Quebec, July 23, 1823, graduated at the College of St. Hyacinth; studied theology at the Seminary of Montreal, and became a monk of the Oblate order. He served as a missionary among the Indians of the Red River country; was ordained a priest in 1845; consecrated Bishop of Arath *in partibus* in 1850; Bishop of St. Boniface in 1863, and in 1871, when St. Boniface was erected into a metropolitan see, Bishop Taché was appointed the first archbishop. While attending the council of the Vatican at Rome in 1869, the Canadian Government begged him to return and use his influence with the Métis of Manitoba, who were in a state of insurrection. He returned at once, and, empowered by the British and Dominion Governments to offer full pardon to the rebellious Métis, helped materially to restore peace and allay disaffection. D. at Winnipeg, Manitoba, June 22, 1894. He was the author of *Vingt années de missions dans le nord-ouest de l'Amérique* (Montreal, 1866); *Esquisse sur le nord-ouest de l'Amérique* (1869), and other works.

NEIL MACDONALD.

**Tachycar′dia**: See HEART DISEASE.

**Tachyglos′sidæ** [Mod. Lat., named from *Tachyglos′sus*, the typical genus; Gr. ταχύς, swift + γλῶσσα, tongue]: a family of Australasian mammals of the order *Monotremata*, represented by the so-called hedgehogs, which must not be confounded with the hedgehogs of Europe. *Echidna*, a name often used, is preoccupied in zoölogy. The face and jaws are produced into a long and tubular snout, at the end of which is the small mouth; teeth are entirely wanting, but on the palate are robust horny spines, pointing backward; the tongue is subcylindrical, and very long, flexible, and protractile, and armed with numerous horny warts; the surface of the body and head above and on the sides is armed with long, stout, tapering, and pointed spines, intermingled with coarse hair, and below is clothed chiefly with simple coarse hair; the limbs are short and robust, each provided with five toes; the males are provided with horny spurs to the hind feet; the tail is rudimentary. The *Tachyglossus* attains a length of about 18 inches, but the *Zaglossus* of New Guinea is much larger. They feed chiefly on ants and other small insects, as is indicated by the small mouth and extensible tongue, but sometimes take in grass. The ants are chiefly sought for by digging, for which the animals are eminently adapted. "In soft alluvial soil or sand an echidna will disappear before the observer's eyes, apparently without any effort, gradually sinking out of sight." (*Krefft.*) Like their relatives, the duckbills, they develop eggs of large size, compared with those of other mammals; but, instead of "laying" two, as the duckbill does, the female matures a single one, which is carried about in a pouch formed by a fold of the skin, somewhat like the pouch, or "marsupium," of an opossum and other marsupials. As to the species, differences of opinion prevail. Until recently only one was generally recognized. There are two very distinct genera, (1) *Tachyglossus* or *Echidna*, and (2) *Zaglossus*, *Acanthoglossus*, or *Proechidna*. Of the former, three closely related modifications (species or subspecies) exist—one in Australia, one in Tasmania, and one in New Guinea, known respectively as *E. aculeata*, *E. setosa*, and *E. lawesi*; and of the latter, two in New Guinea, *P. bruijni* and *P. nigro-aculeata*.

Revised by F. A. LUCAS.

**Tachyg′raphy**: See STENOGRAPHY.

**Tachypet′idæ** [Mod. Lat., named from *Tachy′petes*, the typical genus; Gr. ταχύς, swift + πέτεσθαι, fly]: a family of birds represented by the frigate bird or man-of-war of mariners. The form is somewhat the same as that of pelicans, but the neck is shorter, and the anterior position of the legs imparts to the bird a peculiar appearance; the bill is longer than the head, rather slender, and contracted toward the middle, and nearly straight, but with the end strongly hooked; its sheath is composite or grooved, as in all the *Pygopodes*; the edges are entire; the wings are very long and pointed; the tail is also very long, is very deeply forked, and has twelve feathers; the legs are inserted unusually far forward, and are small; the tarsus being, proportionally, the smallest in the entire class of birds; the toes are slender, and the web between them deeply indented. The sternum is small and short, the coracoids long, the furcula ankylosed with the sternum and coracoid. The family belongs to the same group (*Steganopodes*) with the *Phæthontidæ* (tropic-birds), *Plotidæ* (snake-birds), *Phalacrocoracidæ* (cormorants), *Pelecanidæ* (pelicans), and *Sulidæ* (gannets). As to habits of species, see FRIGATE BIRD.

Revised by F. A. LUCAS.

**Tac′itus**, MARCUS CLAUDIUS: Roman emperor 275–276; b. at Interamna (Terni), in Umbria, about 200 A. D.; was noted as one of the oldest senators and one of the wealthiest citizens when the senate, on the death of Aurelian, elected him emperor. He was a man of upright and pure character and of literary tastes, claiming descent from the distinguished historian whose name he bore. It was his ambition to reinstate the senate in its former authority, improve the morals of the people, and check the confusion in public affairs. He waged a successful war with the Alani, but died soon afterward at Tarsus or Tyana, in Asia Minor. According to some authorities he was murdered by his soldiers.

F. M. COLBY.

**Tacitus**, PUBLIUS CORNELIUS: author; b. about 54 A. D. His birthplace is not known; in some MSS. and by Sulpicius Apollinaris he is called Gaius, but the prænomen Publius is established by a Greek inscription found at Mylasa, first published in 1890, which also proves that late in life he was proconsul of Asia. He married a daughter of C. Julius

Agricola in 77 A. D.; was prætor in 88; consul suffectus in 98, and probably survived Trajan, who died in 117. He had already acquired great reputation as an orator when Pliny entered public life. They became intimate friends. Of Pliny's letters, eleven are addressed to him, and it is apparent that his friendship was considered by Pliny as a distinction. As an author he was much appreciated by his contemporaries, as well as by the writers of the following century. The Emperor Tacitus claimed relationship to him, and ordered his works to be placed in all public libraries, and ten copies to be made every year at the public expense and deposited in the archives. During the latter part of the Roman epoch and during the Middle Ages he was not much read, and most of his works have been handed down only in a mutilated and corrupted form. The dialogue *De Oratoribus* is his earliest work; its authenticity has been denied by some scholars, but is generally accepted. The *Agricola*, a biography of his father-in-law, is an artistic masterpiece, and of special interest on account of the fact that Agricola spent so much of his time in Britain. The *Germania* or *De Situ ac populis Germaniæ* is an ethnographical-geographical work, of the greatest value for its description of early Germany. Some scholars look upon it as a political pamphlet or as serving a moral purpose. Of his *Historiæ*, written before the *Annales*, only the first four and a half books are extant, giving the history of the years 69–70 A. D. Of the *Annales*, beginning at the death of Augustus—hence the proper title *ab excessu divi Augusti*—and ending at the death of Nero, 14–68 A. D., only the first four books, part of the fifth, the sixth, and from the middle of the eleventh to the middle of the sixteenth, are extant. The style of these writings is very peculiar. To the common reader it is harsh and obscure, yet at the same time exceedingly powerful. Scholars who are familiar with the author generally admire not only the intellectual and moral, but also the literary character which these works show. Editions by Bekker (Leipzig, (1831), Orelli (Zurich, 1846 and 1848, and revised by other scholars 1859, and Berlin, 1877), Ritter (1848), and Halm (1884). Of the *Annales*, Nipperdey-Andresen (Berlin, 1892); *Germania*, Zernial (Berlin, 1890); *Agricola* and *Germania*, Hopkins (Boston, 1893); *Dialogus*, Andresen (Leipzig, 1891); A. Gudeman (Boston, 1894); *Histories*, Spooner (London, 1891); *Annales*, Furneaux (vol. i., 1884; vol. ii., 1892, Oxford). English translations by Gordon (1728–31), by Murphy (1793), and by Church and Brodribb (London, 1876–77). Revised by M. WARREN.

**Tacking**: a doctrine of English equity whereby a subsequent mortgagee or incumbrancer for value is allowed on discovering the existence of intervening incumbrances, of which he was ignorant when he advanced his money, to purchase the first mortgage and compel the intervening incumbrancers to pay off not only the first mortgage, but also his own incumbrance under penalty of losing the property by a foreclosure. This inequitable doctrine of English equity, by which a subsequent incumbrancer is enabled to "squeeze out" intervening incumbrancers, is an unjustifiable exception to the rule that as between conflicting but equal equities that which is prior in point of time prevails, and has found no acceptance in the U. S. WILLIAM A. KEENER.

**Tacking and Wearing**: the common methods of working a vessel from one tack to the other; they differ in that while in tacking the vessel turns toward, in wearing it turns from the wind. Square-rigged vessels when close-hauled lie within about six points of the wind; fore-and-aft rigged vessels lie a point or two higher; therefore, in tacking a ship turns through twelve and in wearing through twenty points of the compass. A vessel wears when, through high winds or heavy weather, or some other reason, tacking is impracticable. If in tacking a vessel comes up into the wind and lies there, it is said to be *in irons*; it may then by shifting the helm be made to fall off on the other tack when stern-board is gathered, otherwise it may be boxed off on the same tack. See BOX-HAULING. CHARLES BELKNAP.

**Tac'na**: the northernmost province (provisionally) of Chili, bordering on Peru, Bolivia, the Chilian province of Tarapacá, and the Pacific. Area, 8,686 sq. miles. The Andes on the E. separate it from Bolivia, and there is a coast range rising in parts to 3,000 feet. Most of the intermediate space is a rainless desert; but this is crossed by the valleys of several streams, and wherever they afford sufficient moisture the land is well fitted for cultivation. The streams are scanty and intermittent, and there is no good system of irrigation. Some of the valleys are insalubrious, and the climate everywhere is hot; earthquakes are frequent. Silver, copper, etc., occur, but are mined only on a small scale. A portion of the commerce of Bolivia passes through Tacna, but railways are rapidly drawing it into other channels. The scanty population (24,160 in 1895) is nearly all gathered at Tacna, the port of Arica, and two or three other points. Tacna is divided into the departments of Tacna and Arica. Formerly these were provinces of the Peruvian department of Moquegua. They were occupied by the Chilians, after several battles, in 1880. By one of the clauses of the treaty of peace between Chili and Peru, ratified Mar. 31, 1884, it was agreed that the former republic should hold Tacna and Arica for ten years; at the end of that time the people of the territory so held to decide, by a popular vote, which country they will belong to; the country so chosen to pay $10,000,000 to the other. This decision should have been made in Mar., 1894. Owing to the disturbed state of Peru, and to financial difficulties in both republics the question has been postponed, and is still (1897) unsettled. HERBERT H. SMITH.

**Tacna**: capital of the province of Tacna, Chili; in a fertile valley near the western base of the Andes; 48 miles by railway from its port, Arica (see map of South America, 6–C). The plain is irrigated from the little river Tacna. The town is well built, has a seminary, hospital, and small theater, and a fine public promenade. The water-supply is scanty and bad. Tacna has many foreign merchants, who control the trade with Bolivia across the Andes. Formerly this was very important, and it is still considerable. During the first year of the war of the Pacific (1879), Tacna was the principal post of the allied armies of Peru and Bolivia. Here, on May 27, 1880, they were defeated by the Chilians, under Gen. Baquedano, abandoning the town and, soon after, the province. Pop. (1895) 9,418. H. H. S.

**Taco'ma** [from the Indian name for Mt. Tacoma or Mt. Rainier]: city; seaport; capital of Pierce co., Wash.; on Commencement Bay, the Puyallup river, the N. Pac., the Tac., Lake Park and Columbia Riv., and the Tac. and Eastern railways; 25 miles N. E. of Olympia, and 41 miles S. of Seattle (see map of Washington, ref. 4–D). It is on the western shore of Commencement Bay, on the east side and near the southern extremity of Puget Sound. The Puyallup river empties into the bay within the city limits, and aids in making a fine natural harbor, and the shipping facilities and regulations are excellent.

*Plan and General Appearance.*—Most of the manufacturing and railway industries are in the eastern part, on or about the level tide-flats at the head of the bay. The business and residence portions are on a bluff 80 feet above the water, on ground rising gradually to 320 feet, to a level plateau, over which the city is spreading. The principal streets are 100 feet wide, and the others 80 feet. The surrounding waters, forests, and snow-capped mountains are of unusual grandeur, with the Olympic or Coast Range in the west and the Cascade Range in the east; Mt. Tacoma (by some called Mt. Rainier) rises to a height of over 14,526 feet. Wright Park, containing 40 acres, and Point Defiance Park, 662 acres, are the principal parks. The region immediately S. of the city, interspersed with numerous lakes, is a park land of much beauty. The city owns the water and electric-light plants, on which have been expended about $2,000,000; cable and electric street-car lines reach all sections of the city and several suburban resorts and other towns. There are about 120 miles of graded streets, and 60 miles of sewers. Notable buildings include the county court-house, city-hall, Tacoma hotel, the offices of the Northern Pacific Railroad, Tacoma theater, Union Club, Carnegie Library, and the Chamber of Commerce.

*Churches, Schools, and Charities.*—The church organizations are divided denominationally as follows: 15 Methodist Episcopal, 8 Presbyterian, 8 Lutheran, 7 Protestant Episcopal, 6 Congregational, 6 Baptist, 5 Roman Catholic, 2 Christian, 2 Christian Science, 2 Salvation Army, and 1 each Adventist, German Evangelical, United Presbyterian, Scandinavian Free Evangelical, Spiritualist, Jewish, and Universalist, besides the First Free Church of Universal Religion. The aggregate membership of the churches is about 10,000. The public schools embrace a high school, with a manual-training department, and grammar and primary schools, occupying twenty buildings (cost, with their sites, nearly $1,000,000); daily attendance of pupils, about 8,000; teachers employed, 145; annual cost of maintenance, over $245,000. There are 16 private schools, academies, and business colleges, the most prominent institutions being the Annie Wright Seminary (Episcopal) for girls, Whitworth College (Presbyterian), the Pacific University (Lutheran), the Puget Sound University (Methodist), Vashon College (non-sectarian), and the Roman Catholic parochial schools. The city and other public libraries, Carnegie Library, in course of erection (donation, $75,000), the Ferry Museum of Art, and kindred organizations add to the educational advantages. The charitable organizations and institutions are the Associated Charities, City and County Hospital, Fanny Paddock Memorial Hospital, St. Joseph's Hospital, Grand Army Relief, Children's Home, Seaman's Friend Society, and numerous charities connected with the churches and secret societies. The Washington State Asylum for the Insane is 8 miles S.

*Finance and Banking.*—The assessed valuation in 1900 was $22,549,000, and the bonded indebtedness Jan., 1900, $3,750,000. There are 7 banks—2 national, 3 State, 1 savings, 1 foreign branch (London) banks. A clearing-house was organized in 1889.

*Business Interests.*—In 1881 a cargo of wheat valued at $51,000 was shipped from Tacoma to Liverpool in an American bottom. Since then there has grown an ocean commerce which in 1900 aggregated $15,545,497 in exports to foreign countries, composed of wheat, flour, coal, lumber, canned salmon, and miscellaneous merchandise; and the imports—mostly from China and Japan—amounted to more than $12,000,000. The coastwise shipping to and from this harbor is extensive. About $12,000,000 is invested in manufacturing industries. The plants include car-shops (cost $1,500,000), in which about 800 men are regularly employed, and several sawmills with a capacity of 1,150,000 feet per day, employing about 2,000 men. Over 3,000 persons are employed in other works, such as box-factories, breweries, rolling-mills, foundries, machine-shops, shipyards, smelters, packing-houses, match-factories, furniture-factories, planing-mills, brickyards, wheat elevators, warehouses, flour-mills, and shingle-factories. The value of the wholesale and jobbing trade is about $18,000,000 per annum. Having a transpacific steamship line to the Orient, stopping at Yokohama and Hongkong, a clipper-ship line to South Africa, steamship connection with Alaska and Pacific coast ports, a steamship line to Manila and London viâ Suez Canal, also one to Vladivostock, and railway connections with all parts of the U. S., Tacoma is one of the most important shipping and distributing points on the Pacific coast.

*History.*—Tacoma City, now the first ward and popularly called Old Town, was laid out in 1868 by Gen. M. M. McCarver. On July 14, 1873, the Northern Pacific Railroad Company established its Pacific terminus on Commencement Bay, naming it New Tacoma; in 1880 the town became the county-seat; and in 1883 the two towns were consolidated as Tacoma. Pop. (1880) 720; (1890) 36,000; (1900) 37,714.

Revised by A. E. GRAFTON.

**Tacoma**, MOUNT: See RAINIER, MOUNT.

**Tacon'ic**, or **Taghkanic**: a range of mountains extending nearly N. and S. along the eastern boundary of New York, and uniting the Green Mountains of Western Massachusetts with the Highlands of the Hudson. Its highest peaks are Equinox Mountain in Vermont, 3,847 feet, and Greylock in Massachusetts, 3,305 feet.

**Taconic System**: in geology, a group of strata in Western Massachusetts and Vermont and Eastern New York, representing the Cambrian period. The system was named by Prof. Ebenezer Emmons in 1842, and further described and defined in subsequent papers. It was asserted by some of his contemporaries that these rocks are not pre-Potsdam, as claimed by him, but are the metamorphosed equivalents of formations of the New York system. The discussion of this question, known as the Taconic controversy, was animated and bitter, and its literature is voluminous. In later years it has been claimed by some geologists that Taconic should be substituted for Cambrian as the name of the first Paleozoic period, and this contention has been warmly sustained, though having little influence on usage. The question turns partly on the facts of history, and partly on the extent to which and manner in which the law of priority should be applied in questions of stratigraphic nomenclature. See CAMBRIAN PERIOD and GEOLOGY, and consult E. Emmons, *Geology of New York*, part ii. (1842); *The Taconic System* (1844); *American Geology* (1855); J. D. Dana, *A Brief History of Taconic Ideas* (*Am. Jour. Sci.*, 3d series, vol. xxxvi., 1888); *List of Papers on the Taconic System* (*Am. Jour. Sci.*, 3d series, vol. xix., 1880); J. Marcou, *On the Use of the Name Taconic* (*Proc. Boston Soc. Nat. Hist.*, vol. xxiii., 1887); N. H. Winchell, *Some Objections to the Term Taconic Considered* (*Am. Geol.*, vol. i., 1888); C. D. Walcott, *Taconic System of Emmons* (*Am. Jour. Sci.*, 3d series, vol. xxxv., 1888).

G. K. GILBERT.



**Tactics** [plur. of *tactic*, from Gr. *τακτικός*, pertaining to arrangement, especially to military arrangement, deriv. of *τακτός*, drawn up, deriv. of *τάσσειν*, arrange, draw up (troops). Cf. Gr. *ἡ τακτική* (sc. *τέχνη*, art), and *τὰ τακτικά*, tactics]: the art of drawing up military or naval forces in order of battle and of performing military or naval evolutions. It may be treated conveniently under two heads:

MILITARY TACTICS.—This is the art of so handling bodies of troops, large or small, as to utilize to the fullest extent the fighting, manœuvering, and resisting capacity of every individual, weapon, and resource of all arms of the service. When applied to the combined action of larger masses made up of different arms, on the field of battle, it is called grand tactics. When restricted to actions of small bodies or single arms it is called minor tactics. The two divisions run imperceptibly into each other.

*Minor tactics* include as one of their branches drill-regulations, or drill, formerly called in the U. S. by the general name of tactics. The object of drill is (1) to enable the commanding officer to place each and every soldier on the spot he is to occupy, in any desired formation, in the most rapid manner consistent with complete control of the men at all stages of the movement; (2) to enable the soldier to use his weapon in the most effective way in action, and to carry it with the least fatigue when marching; (3) to execute properly formations and movements of ceremony, such as parades, reviews, etc., which are necessary to preserve the pride of the soldier in his own appearance and that of his command. The accomplishment of these objects requires that drill-regulations should be devised with a view to simplicity and ease in learning, and fitness for handling troops, not only with full ranks, but also when their smallest subdivisions have been cut up and made of different sizes by the casualties of action. The field of minor tactics has been so extended as to embrace the subjects of information and security, including outposts, reconnoissance, and the handling of advance and rear guards; marches, instruction of the three arms in all that refers to the use of their weapons, and their employment upon the field of battle. In the latter respect sometimes it encroaches upon that of grand tactics.

The minor tactics of the different arms must conform to the changes and improvements in weapons. These require corresponding changes in formations, etc. The prime factor in these changes has been the weapon of the infantry; the vast improvements which have been made in cannon have also had their effect, but since these improvements are more in greater accuracy at the longer ranges than in destructiveness at close quarters, their influence upon tactical manœuvers has been of the same kind and concurrent with that produced by the increased range of the infantry weapon.

The most marked changes which result from the increased range and accuracy are forcing the enemy to deploy and open fire at much greater distance than formerly, enlarging very much the area covered by the effective fire of a battery, thus necessitating fewer changes in its position and giving a larger latitude in its selection. They also allow the artillery to open the combat at a distance from the enemy which can be traversed by him only with such losses and in such time that the artillery may safely march at the head of a column, open fire, and receive support before it is endangered by the approach of the enemy; and this advantage is gained without the loss of its effective fire at short range, which it may use in assisting the infantry in close action as formerly.

The correct tactical use of artillery requires the concentration of its fire upon properly selected targets, and the modern improvements have added largely to its efficiency by facilitating this; while the great distance at which a destructive fire can be poured upon a body of cavalry, by both artillery and infantry, has almost entirely changed the tactical use of mounted troops on the field of battle, narrowly limiting the opportunities for a successful charge upon infantry or artillery in position.

The changes made since the time of the Romans in the arms and equipments of the cavalryman, as distinguished from the dragoon or mounted infantryman, have reduced themselves almost entirely to the addition of the revolver and the abolition of body-armor. The first adds somewhat to his aggressive value, while the second is the direct result of the improvement in the infantry weapon. This alteration in equipment has, however, introduced no material change in the tactics of combat of bodies of men fighting mounted, the detailed regulations and instructions for which in the most modern treatises correspond in every respect with the methods used by the cavalry of the Romans. The most marked change in the organization and the tactics of modern cavalry is the conversion of all mounted troops into dragoons, armed with a rifle or carbine, and trained to fight on foot or mounted as necessity determines; or even in some cases into mounted infantry who use their horses for transportation only and fight altogether on foot. In recent operations cavalry has been used as a veil or screen, to cover the advance of the rest of the army, to a much greater extent than it was formerly, although cavalry has frequently been used in this way in times past; a notable instance being Napoleon's use of Murat in his advance upon Ulm in 1805. Scouting, reconnoissances, and map-making have become a most important part of the duties of cavalry, and instruction in the methods used in the field form an important part of the tactical instruction of the trooper and his officers.

The modern minor tactics of infantry, in order to fulfill the requirements laid down in the definition above given, are designed with a view to beginning an action with a dispersed skirmishing line, in which the front of each battalion or company is covered by its own men, who are re-enforced and strengthened by their own comrades and commanded by their own officers, thus avoiding the disorganization resulting from mingling different commands on the front line of battle. In attempting to accomplish this, great prominence is necessarily given to the advance of successive lines in open order, which, by short rushes and by taking advantage of all possible cover, may diminish as much as possible the losses caused by modern small-arms and machine-guns, and at the same time collect for the final charge a strong line of companies and battalions. It is not to be expected that any single method will be approved by all military men, but each of the great nations has a system which, under the constant supervision and study of its officers, is modified as new developments are made in weapons and new lessons learned from experience in war.

*Grand tactics* includes planning battles, perfecting the preliminary arrangements, conducting them during their progress, and securing the results of victory or avoiding the consequences of defeat. It is concerned generally with the action of the several arms in combination on or in the immediate vicinity of the battle-field; but it reaches out on the one hand into the domain of logistics and strategy in the movement of troops and the character of battle sought, and on the other into that of minor tactics in the handling and placing of the different arms upon the field. It is essentially the province of generals, and one in which they should have full and unrestricted command, as success or failure almost invariably results from the character of the position selected, the manner in which the troops are placed, and the instant at which the different bodies are brought into action. These questions can be decided only by the commander present on the field and as they arise.

Battles are usually preceded and followed by minor actions, classed as combats, skirmishes, etc., which are generally not intended to be decisive, but arise between detached parts of the main army, and which may cease without marked effect or may be continued and finally merge into the general battle. Battles are classed as offensive, defensive, and defensive-offensive, the latter name being applied to those actions in which the attack having exhausted its strength, the defense takes the offensive to gain the victory. In great battles the fighting is not carried on in the same manner at all points of the line. False attacks and demonstrations of the class known as "containing movements" are made at some parts of the line, while the strength of the attack is concentrated at another, thus "making one's self stronger than the enemy at the time and place of actual conflict," which is the guiding principle in all the operations of the art of war, and is the very soul of success in battles.

It is this principle which, by overshadowing all others, has led to the statement that "the rules of tactics are invariable and are the same now as they were in the time of Alexander." This is true only of grand tactics.

In open battle it is evident that the application of the above-given principle is most easily made by the offensive, which also generally develops the enthusiasm of the men and, in case of success, will usually render the result decisive. History shows that success has generally attended the aggressive leader when other things were equal; but when an army is weak in men, in training, or in morale, its leader can only seek to give it superior strength in actual conflict by fighting a defensive battle in a well-selected position made strong by fortifications, against which the enemy may exhaust his superior strength.

Much has been written, with very little profit, upon the orders of battle, with their relative advantages. These so-called orders result, as a rule, from the natural features of the ground in the first position and from the development of the strong attack when the battle opens. Necessarily, if the lines remain in contact when one assumes a "convex order," the other must take up a "concave order," and *vice versa*; while the great and manifest advantages which result from an oblique attack upon one wing, by which it is rolled back and beaten in detail, are obtained either by overlapping it or by throwing against it a preponderating force. Any attempt to take up a geometrical "oblique order" would, as a rule, be at once seen by the enemy, who would take measures to meet it. The same is true of the other orders. The use of the terms, however, when properly understood, may be convenient in the description of battles, if too much weight be not given to them.

The works upon tactics are very numerous; see especially Home's *Précis of Modern Tactics* (London, 1878); Boguslawski, *Tactical Deductions from the War of 1870–71* (London, 1872); Clery, *Minor Tactics* (London, 1883); Shaw, *Modern Tactics* (London, 1884); Mayne, *Fire Tactics* (London, 1888); Meckel, *Éléments de la Tactique* (Paris, 1887); Clausewitz, *On War* (London, 1873); Jomini, *Art of War* (Philadelphia, 1877); Mercur, *Elements of the Art of War* (New York, 1894); Derrecagaix, *Modern War* (Washington, 1888). See also FORTIFICATION, STRATEGY, and WAR.

JAMES MERCUR.

NAVAL TACTICS.—The subject may be divided into grand tactics, or the tactics of battles, and elementary tactics, or the tactics of instruction. The history of naval tactics can very properly be separated into three grand divisions. The first, which may be called the oar period, begins where tradition merges into authentic history, and ends about the time of the battle of Lepanto (1571), covering a period of about 2,000 years. The second, or sail period, may be said to be embraced between Lepanto and the battle of Lissa (1866), lasting only 295 years, since which time there has been only the steam period, which is yet in its infancy. The sail period having completely passed away, and the tactics under oars being based upon the same general principles as steam tactics, the latter alone will be described.

The key to any system of naval tactics is the line of battle. If, in the line of battle, the vessels are all in line—or, as it was called in the tactics under sail, "line abreast" and heading toward the enemy—we have the line of battle of the oar period, when war-galleys were armed at the bow with a spur (rostrum), and depended for success in battle on ramming and sinking the galleys of the enemy or grappling and boarding him. This formation gives us also the line of battle of modern fighting ships when their principal offensive power lies in their rams. If, however, the power of the ship lies in her broadside (artillery placed on the side of the ship), it is obvious that such ship must present her broadside to the enemy, in which case the line of battle must be the "line ahead," or, as it is now properly called, in "column." In addition to the above, there are certain "orders" in which it is convenient for a fleet or squadron to navigate the sea, to go in and out of port, to anchor and to get under way. To change from one of these orders to another, or to change from any given order of steaming to the order of battle, constitutes elementary tactics. The disposition of the fleet for actual contact with the enemy under various conditions constitutes grand tactics. It was in the tactics of battle that Nelson's genius was most conspicuous. The following definitions have been adopted with a view to securing uniformity of movement in tactical evolutions: The coefficient of speed is the ratio between the number of revolutions per minute of the engines of a given ship and those of the flag-ship, when the speed of both is the same; the coefficients of helm are the ratios between the angles of a given ship's helm and those of the flag-ship's helm when describing the same circle.

*Fleet Tactics under Steam.*—An assembly of twelve or more line-of-battle ships, or vessels of equal military value, is called a *fleet*, and is separated into three divisions of one,

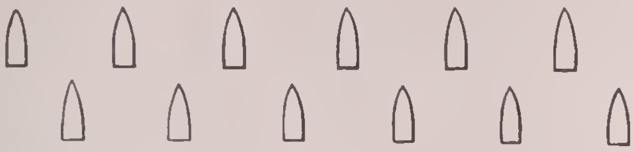


Fig. 1.

two, or three squadrons each, each squadron comprising not less than four vessels. The commander-in-chief commands the entire fleet; the second in command, the van division (or right when in line); the third, the rear division (or left when in line); and the fourth, the center.

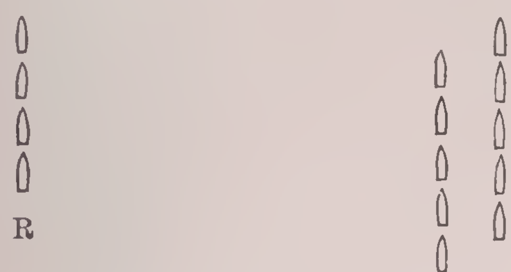



Fig. 2.

The line, the order of battle for line-of-battle ships, rams, and torpedo-vessels, is formed as in Fig. 1.

The column is the order of battle for vessels whose principal power is in their broadside batteries. (Fig. 2.)

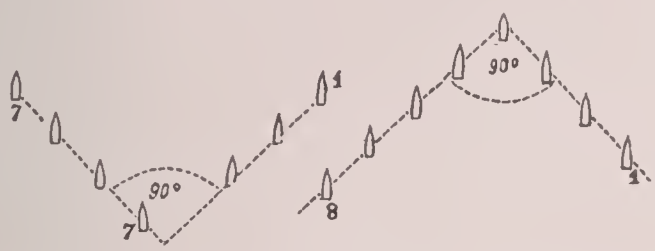



Fig. 3.

Double échelon orders are offensive (salient angle) and defensive (re-entrant angle) for vessels for all descriptions. (Fig. 3.)

Vessels are said to be in direct single échelon when, steering the same course, each bears from its next astern at an angle of 45° (four points) from the course; consequently the wings of a fleet in double échelon form a right angle. One vessel should always be designated by signal to act as guide, by which the movements of the other vessels are to be governed, and should wear a guide-flag at the main. When manœuvering, the vessel upon which a formation is made

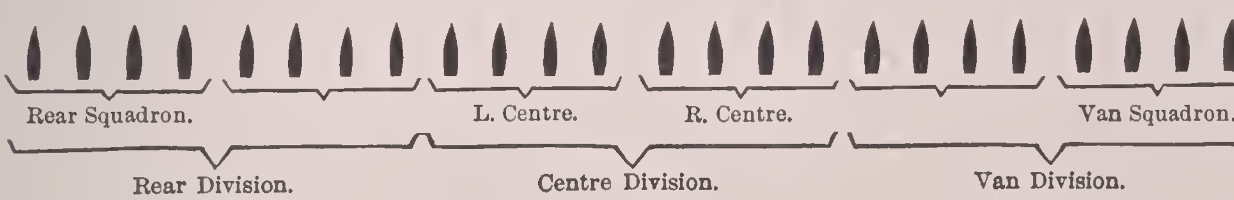



Fig. 4.

must necessarily be the guide. When the fleet is in line in natural order, the van squadron is on the right. (Fig. 4.) This was the line of battle formed by Callicratidas, the Spartan, at the battle of Arginusæ, his fleet being composed of 300 galleys. The fleet in column is in the natural order when the van squadron is leading.

Fig. 5 exhibits the fleet in column of squadrons, or of

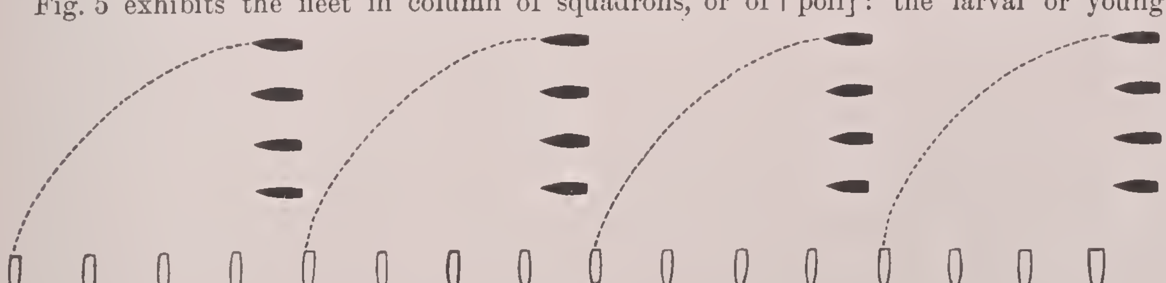


Fig. 5.

fours. Should Signal No. 319, By fours, left wheel, be made, each squadron on coming into line must find its place in the line without crowding or confusion. It was this evolution that was performed by Cnemus, commander of the Lacedæmonian fleet, in the battle in the Crisean Bay, when he engaged the force under Phormio, the skillful Athenian tactician, then guarding Naupactus, the modern Lepanto. These two illustrations show how closely the fleet tactics of the oar period resemble those of the steam period. The single line, as in Fig. 4, is easily shattered or doubled up. It should therefore be re-enforced as in Fig. 1.

Fig. 6.

As the single column may be broken and the rear ships cut off, it, too, should be re-enforced as in Fig. 2. In any case, there should be a reserve (R, Fig. 2), ready to succor any portion of the fleet that may need it.

A strong order of battle is the French *peloton* formation, for facility of manœuvering, affording mutual support, etc.

Fig. 7.

Three vessels act as a unit, and these *pelotons* may be formed in line (Fig. 6), in column (Fig. 7), or in échelon.

The simple orders are the line, column, and échelon; compound orders are those wherein the squadrons or divisions, considered as units, are ranged on one of the simple orders. See *Naval Tactics* (New York, 1859), by J. H. Ward, U. S. navy; *Fleet Tactics under Steam* (1863), by Com. F. A. Parker, U. S. navy; *Naval Warfare with Steam* (1832), by Sir Howard Douglas; *Tactique Navale*, and *Fleet Drill-book*, U. S. navy. S. B. Luce.

**Tacubaya**, tăă-kōō-baa'yăă: a town of the Federal District, Mexico, 3 miles S. W. of Mexico city (see map of Mexico, ref. 7–G). It is a fashionable suburb of the capital, and is associated with many episodes of the later history of the republic. The castle, military school, and observatory of Chapultepec (*q. v.*) are included in it. Pop. (1889) estimated, 12,000. H. H. S.

**Tacunga**: See Latacunga.

**Tadmor**, or **Thadmor**: See Palmyra.

**Tadousac'**: a summer resort in the united Chicoutimi and Saguenay Counties, Quebec, Canada; near the confluence of the Saguenay with the St. Lawrence, on a semicircular raised beach of sand (see map of Quebec, etc., ref. 2–E). Tadousac is the oldest village in Canada, having been a center of the fur-trade in early days. The Jesuits had a religious establishment here, of which only the traces of the foundation remain, and for a time it was the home of Father Marquette, the explorer of the Mississippi. It contains the oldest church edifice erected in Canada. From Tadousac to the Gulf the salmon and sea-trout fishing is unsurpassed. Pop. of district, 2,400. J. M. Harper.

**Tadpole** [Mod. Eng. *taddepol*; *tadde*, toad + *polle*, head, poll]: the larval or young stage of the frogs (*Ranidæ*), which is distinguished by the large head, compressed tapering tail, and (in the youngest stage) want of legs. The name is also applied to the corresponding stage in other amphibians and even to the larvæ of many ascidians, having a superficial resemblance to the tadpoles of frogs. See Batrachia, Frog, and Tunicata.

**Tael**, tāl [Portug., from Hindi *tola*, through Malay *tahil*, weight]: the name, in common use among foreigners in China and Hongkong, for the Chinese *liang* or ounce of fine silver, the monetary unit of reckoning there. It equals in weight $1\frac{1}{3}$ oz. avoirdupois. The haikwan tael is the standard recognized by the customs authorities. See China.

**Tænia**: See TAPEWORM.

**Tænioglos'sa** [from Gr. ταινία, ribbon + γλῶσσα, tongue]: a large group of molluscs. See MONOTOCARDIA.

**Taft**, ALPHONSO, LL. D.: jurist; b. at Townshend, Vt., Nov. 5, 1810; graduated at Yale, 1833, where he was afterward tutor and law student; was admitted to the bar 1838, and moved to Cincinnati, O., in 1840; judge of superior court of Cincinnati 1865–71; resigned and resumed practice of law; U. S. Secretary of War Mar. 8 to May 22, 1876; Attorney-General U. S. 1876–77; appointed envoy extraordinary and minister plenipotentiary of U. S. to Austria Apr. 26, 1882, and to Russia in 1884; resigned in Aug., 1885. D. at San Diego, Cal., May 21, 1891.

**Taft**, WILLIAM H.: See the Appendix.

**Taganrog'**: town; in the government of Ekaterinoslav, Russia; on the N. shore of the Sea of Azov, opposite and 18 miles W. of the mouth of the Don (see map of Russia, ref. 10–E). It was founded by Peter the Great, and was a favorite residence of Alexander I., who died here Dec. 1, 1825. Though its harbor is so shallow that ships must load half a mile from the shore, it carries on a large export trade in timber, hemp, copper, tar, wheat, and meat. Pop. (1897) 51,748. E. A. G.

**Taghkanic**: See TACONIC.

**Taglioni**, taa̤l-yo'nee: the name of a celebrated family of dancers and ballet-masters, of Italian origin, but principally connected with the royal theater of Berlin. The most illustrious member was MARIA TAGLIONI, b. in Stockholm, Apr. 23, 1804. She made her *début* in Vienna in 1822, danced subsequently in all the capitals of Europe, and created great enthusiasm, especially by her performance of the title-rôle in her father's ballet *La Sylphide*. She retired in 1847, and lived in Venice and at Lake Como. D. in Marseilles, Apr. 23, 1884.—Her brother, PAUL TAGLIONI, b. in Vienna, Jan. 12, 1808, was ballet-master in the royal theater of Berlin, and composed the ballets *Sardanapal*, *Satanella*, *Flick und Flock*, and others. D. in Berlin, Jan. 7, 1884.

**Ta'gus**: one of the principal rivers of Spain. It rises in the Sierra Albarracin, in lat. 40° 38′ N., lon. 1° 35′ W., flows mostly W. and S. W. through Spain and Portugal, and empties into the Atlantic at Lisbon, after a course of 566 miles. It is navigable 115 miles from its mouth.

**Tahiti**, taa̤-hee'tee, or **Otahei'te**: the largest of the SOCIETY ISLANDS (*q. v.*); in the Pacific Ocean, in lat. 17° 29′ S., lon. 149° 29′ W. It is high, reaching 7,336 feet at its highest point, but traversed by beautiful and fertile valleys, in which all tropical plants grow luxuriantly. It is 120 miles in circumference, with an area of 401 sq. miles, and had, in 1889, 9,603 inhabitants, who have been converted to Christianity. It is the principal island of the French establishments in Oceania, and contains Papiti, the capital of the colony. See Dora Hort, *Tahiti, the Garden of the Pacific* (1891). Revised by M. W. HARRINGTON.

**Tahlequah'**: town (founded in 1840); capital of the Cherokee Nation, Indian Territory; in the valley of the Illinois river; 26 miles E. of the Mo., Kan. and Tex. Railway, and 65 miles N. W. of Fort Smith, Ark. (for location, see map of Indian Territory, ref. 2–G). It is in an agricultural region, and contains national Cherokee schools, Female Seminary (building cost $100,000), Male Seminary (building cost $80,000), Capitol (cost $20,000), Baptist and Presbyterian mission schools, 2 school libraries, a private bank, and 4 weekly newspapers (2 printed in English and 2 in both English and Cherokee). Pop. (1900) 1,482.

EDITOR OF "TELEPHONE."

**Tahoe', Lake**: a lake partly in Nevada and partly in California, at an elevation of 6,225 feet in the Sierra Nevada. Its maximum length from N. to S. is 22½ miles and its greatest width 13 miles; area, 195 sq. miles; hydrographic basin, 500 sq. miles. Soundings by Prof. John Le Conte gave a depth of 1,506 feet, but it is thought that a more detailed survey will show a greater depth. Its waters are wonderfully clear, and are inhabited by excellent trout and other fishes. It is the source of Truckee river, which empties into Pyramid and Winnemucca Lakes. Surveys have been made with the view of drawing off its waters through a tunnel, for irrigation purposes. See *Physical Studies of Lake Tahoe*, by Prof. John Le Conte, in *Overland Monthly*, 1883 and 1884. ISRAEL C. RUSSELL.

**Tahpanhes** (Jer. xliii. 7–9), or **Tahpenes** (the *Tehaphnehes* of Ezek. xxx. 18, the Δάφναι of Herodotus, ii., 30, 107, and the Τάφνη, Τάφναι of the Septuagint): an Egyptian stronghold erected by Psammetichus I. as an eastern walled garrison for his Greek mercenaries, on the site of an earlier Ramesside town. It was to the E. what NAUCRATIS (*q. v.*) was to the W. of the Delta, and guarded the road to Asia. It was on the Roman road, 16 miles from Pelusium toward Memphis (*Itinerarium Antonini*, Wess. 162), on the Pelusiac branch of the Nile, at the present Tell Defenneh (30° 52′ N. lat., 32° 8′ E. of Greenwich). The main portion of the mound is known as the Palace of the Jew's Daughter (cf. Jer. xliii. 6–9), and its foundation deposits show that it was the work of PSAMMETICHUS I. (*q. v.*). A large elevated place before the fort has been identified with the "brick-work" in which Jeremiah hid large stones (Jer. xliii. 9) at the command of God. The site has furnished many Greek remains, but little that is Egyptian. In style the pottery of Tahpanhes was quite distinct from that of Naucratis, and shows attempts to imitate Egyptian bronze vases. This difference of style points to manufacture on the spot, not to importation from Greece. The date of the city is shown further by numerous impressions of the cartouch of Psammetichus I. on the seals of wine-jars. The overthrow of Hophra (Apries) by Amasis and the reduction of his eastern stronghold mark the existence of the place as from 665 to 564 B. C.

CHARLES R. GILLETT.

**Taillandier**, taa̤'yaan'di-ā', RENÉ GASPARD ERNEST, generally known under the name SAINT-RENÉ TAILLANDIER: educator and author; b. in Paris, Dec. 16, 1817; studied philosophy and literature in Paris and Heidelberg; was appointed Professor of Foreign Literatures at Strassburg in 1841, at Montpellier in 1843, at the Sorbonne in 1863, and became in 1870 secretary in the department of public education. He was elected to the Academy in 1873. Besides poems, he wrote *Scot Érigène* (1843); *Histoire de la jeune Allemagne* (1849); *Études sur la Révolution en Allemagne* (2 vols., 1853); *Michel Lermontoff* (1856); *Maurice de Saxe* (2 vols., 1865); *Tchèques et Magyars, Bohème et Hongrie* (1869); *La Serbie* (1871); *Dix ans de l'Histoire d'Allemagne* (1875); *Le roi Léopold et la reine Victoria* (2 vols., 1878). D. in Paris, Feb. 24, 1879. Revised by A. G. CANFIELD.

**Tailor**: the BLUEFISH (*q. v.*), *Pomatomus saltatrix*. The name is also applied (usually in the form tailor-herring) to the fall herring, *Clupea* (or *Pomolobus*) *mediocris*. It is probably applied to the bluefish on account of its sharp cutting teeth, but its applicability to the herring is not apparent.

**Tailor-bird** [so called from its habit of sewing together the tips of two or three leaves to make a nesting-place]: a small bird (*Sutoria sutoria*), a representative of the family *Lusciniidæ*; found in India and other eastern countries. It is about 5 inches long, with a slender and slightly decurved bill, short and rounded wings, and very long tail composed of narrow feathers; olive green above and white beneath, and brick-red on top of the head. For its nest, generally two leaves at the end of a bough are brought in contact, and sewed together by the bill, vegetable fibers being used as the threads; sometimes a large leaf is rolled together and sewed at its margins. Within the cavity thus formed are deposited soft downy or cotton-like vegetable substances, and the nest is then completed for the reception of the eggs, of which six to eight are laid. Revised by F. A. LUCAS.

**Tainan**, tī'naan': the name given to the treaty-port of Taiwan-foo in Formosa when, in 1885, it ceased to be the capital of the department and of the province of Taiwan. In 1896 it again became the capital. Pop. about 135,000. Tainan imports cotton and woolen goods, opium, metals, medicines, kerosene oil, ginseng, cuttlefish, rice, flour, gunny-bags, silk piece-goods, and matches; and exports sugar, camphor, hemp, lung-ngan pulp, and turmeric. In 1893 the net foreign imports amounted to 1,596,166 haikwan or custom-house taels (= $1,675,974), of which 92 per cent. came from Hongkong, while the net native imports amounted to 127,852 taels. The total exports amounted to 1,648,220 taels (= $1.730,631), including 480,529 piculs of sugar, valued at 1,272,757 taels, and 5,934 piculs of camphor. In the same year 70 steamers and 14 sailing vessels (aggregating 53,686 tons) entered port, and 69 steamers and 12 sailing vessels (aggregating 52,443 tons) cleared. R. L.

**Taine**, HIPPOLYTE ADOLPHE: philosopher and historian; b. at Vouziers, Ardennes, France, Apr. 21, 1828; was educated at the Collège Bourbon and the École Normale of Paris, and became a teacher, but soon gave it up because of the hostility of the authorities in consequence of his ideas. His *Essai sur Tite-Live* (1854) and *Les Philosophes français* *du XIX^e siècle* (1856) attracted much attention by their brilliancy and their sharp criticism of the current philosophy of Cousin's school. Strongly influenced by the study of the natural sciences, he sought to apply rigidly to the whole range of human achievements the laws of heredity and environment. He regarded all products of human activity as determined by three factors, environment (*milieu*), race, and moment. His works include *Voyage aux eaux des Pyrénées* (1855); *Essais de critique et d'histoire* (1857); *La Fontaine et ses fables* (1860); *Histoire de la littérature anglaise* (4 vols., 1864); *Nouveaux essais de critique et d'histoire* (1865); *Philosophie de l'art* (1865); *Philosophie de l'art en Italie* (1866); *Voyage en Italie* (2 vols., 1866); *Vie et opinions de Thomas Graindorge* (1867); *Philosophie de l'art dans les Pays-Bas* (1868); *De l'Intelligence* (2 vols., 1870); *Notes sur l'Angleterre* (1872); *Origines de la France contemporaine* (unfinished, 5 vols., 1876–90). In 1864 he became Professor of Æsthetics at the School of Fine Arts, Paris, and in 1878 a member of the Academy. D. in Paris, Mar. 5, 1893. See A. de Margerie, *H. Taine* (Paris, 1894); G. Monod, *Les Maîtres de l'histoire* (Paris, 1894). A. G. CANFIELD.

**Taiping** (or **Taeping**) **Rebellion**: a formidable insurrection which broke out in 1850 in South China, and had for its object the overthrow of the Manchu dynasty, which had ruled since 1643, and the establishment of a new purely native dynasty, to be styled the dynasty of "Great Peace." Hence the name Taipings applied by foreigners to the rebels, who, however, were by the Chinese called *Ch'ang-mao-tseh* or "long-haired rebels," from the fact that they had discarded the queue or outward expression of allegiance to the Manchus. (See CHINA.) The leader of the movement, a Hakka schoolmaster named Hung-Siu-Chuen, born in 1813, also included in his plans the establishment of a corrupt kind of Christianity elaborated by himself partly from a vision he had had in 1837 during a period of illness, and partly from an imperfect study of some Christian tracts and books he had obtained some years before. In this vision he thought he was taken to heaven, where, having been "washed" by an old woman, some venerable sages opened his body with a knife, took out his heart and other parts, and put new parts in their place, and a venerable man with a golden beard addressed him, saying: "All human beings in the world are produced and sustained by me; they eat my food and wear my clothing, but not one among them has a heart to venerate and remember me; they take my gifts and therewith worship demons; they rebel against me and arouse my anger," and giving Hung a sword he commanded him to "exterminate the demons." In his vision he also saw a man of middle age, whom he called his Elder Brother, and who instructed him how to act. After rereading the Christian tracts and books in Chinese which he had obtained, he concluded that the old man was God, the "Heavenly Father," that the middle-aged man was Christ, the "Heavenly Elder Brother," and that the demons were idols, and he became convinced that he had been appointed to restore the world to the worship of the true God. He at once began preaching his new doctrines, and thousands were converted. A "Church of God" was established, and so zealous were its members in demolishing temples and idols that they were soon brought into conflict both with their neighbors and with the authorities, and many fights ensued. In 1850 they broke out into open rebellion, Hung taking the name of the "Heavenly King." Early in 1852 they moved into Hunan, advanced down the Siang to the Yang-tse, down which they sailed, capturing every important city on its banks; made Nanking their capital, threatened Peking, and carried destruction and death over fifteen of the eighteen provinces of China. It has been estimated that 20,000,000 lives were sacrificed in this struggle. It was not till 1864, when Nanking was recaptured on July 19 by the Ever-Victorious army under "Chinese" Gordon, that the movement began to weaken; Hung himself had already taken poison, and his principal generals had fled. The remnant under Tsze Wang made a last stand at Chang-chow-fu in Fuh-kien, but were pressed so hard by the imperialists that they had to withdraw and disband. The imperial operations were directed by Tsŭng-kwoh-fan and Li Hung-Chang, but without the assistance rendered by the British and French at Shanghai and elsewhere, and by the native army drilled and officered by foreigners and led successively by Ward, Burgevine, Holland, Cooke, and Gordon, it is questionable if they would have succeeded in crushing the movement. See Wells Williams's *Middle Kingdom* (2 vols., New York, 1883). R. L.

**Taira**, tī'rää: a Japanese family descended from the Emperor Kwammu, and all-powerful in Japan during the eleventh century. This was a period of great corruption at court, and of misrule and insurrection in the provinces. The family was the first that rose to a leading place in the state by military prowess. Its chief representative was Kiyomori, who, after triumphing over the rival Minamoto party in 1159, was able to make and unmake emperors at will. When he died in 1181 only some infants of the rival clan had been spared, one of whom, however, YORITOMO (*q. v.*), was destined to restore the fortunes of his family and ruin the Taira dynasty. The incidents of these troublous times furnish to native art an inexhaustible store of themes for treatment. J. M. DIXON.

**Tait**, ARCHIBALD CAMPBELL, D. D., LL. D.: archbishop; b. in Edinburgh, Scotland, Dec. 22, 1811; educated at the University of Glasgow, and at Baliol College, Oxford; was one of the leading opponents of the Tractarians or Puseyites; took orders in the Church of England; was head master of Rugby School from 1842 to Apr., 1850, when he accepted the deanery of Carlisle; became Bishop of London Aug., 1856; originated in 1863 the successful scheme of raising a fund of £1,000,000 for supplying the deficiencies of church accommodation in London; became Archbishop of Canterbury in 1868. He was the author of *The Dangers and Safeguards of Modern Theology* (1861) and *The Word of God and the Ground of Faith* (1863), besides addresses, sermons, etc. D. in London, Dec. 3, 1882. See the *Life* by Davidson and Benham (2 vols., 1891).

**Tait**, ARTHUR FITZWILLIAM: See the Appendix.

**Tait**, JOHN ROBINSON: See the Appendix.

**Tait**, LAWSON, M. D., LL. D.: gynæcologist; b. in Edinburgh, Scotland, in 1845; studied arts and medicine in the University of Edinburgh 1859–66; settled in Birmingham, England, in 1870; passed examinations for licentiate in 1866, and in 1870 was made honorary fellow of the Royal College of Surgeons, Edinburgh; passed examinations for member in 1870, and for fellow in 1871, of the Royal College of Surgeons, England. He was one of the foremost surgeons in abdominal operations in Great Britain. His *Diseases of Women* has passed through several editions. D. June 13, 1899.

**Tait**, Sir MELBOURNE: See the Appendix.

**Tait**, PETER GUTHRIE: physicist and mathematician; b. at Dalkeith, Scotland, Apr. 28, 1831; educated at Edinburgh University and at St. Peter's College, Cambridge, where he graduated as senior wrangler in 1852; became Professor of Mathematics in Queen's College, Belfast, in 1854, and Professor of Natural Philosophy in Edinburgh University in 1860. He wrote a number of memoirs on the kinematical theory of gases, thermo-electricity, thermal conductivity, mirage, etc., and in pure mathematics on knots and quaternions. He was the author of *Dynamics of a Particle* (1856), written in conjunction with Steele, a work which has run through many editions; *Elementary Treatise on Quaternions* (1867); *Thermodynamics* (1868); *Recent Advances in Physical Science* (1876); and *Paradoxical Philosophy* (1878); and several text-books on physics. In conjunction with Lord Kelvin he wrote the *Treatise on Natural Philosophy*, and with Balfour Stewart *The Unseen Universe*. D. July 4, 1901. R. A. R.

**Taiwan**, tī'wään' (literally, terraced bay): the Chinese name of the large island lying off the coast of Fuh-kien, China, which is by foreigners called FORMOSA (*q. v.*). Until 1886, when it was made a separate province, it was a department of Fuh-kien, with a tao-tai or intendant of circuit at its head, and was divided into four *hien*, or districts, and five seaboard divisions called *ting*. Beginning at the S. and proceeding N., the hien are: *Fŭng-shan-hien*, *Taiwan-hien*, *Kia-yi-hien*, and *Changhwa-hien*. The ting are: *Taifang-ting*, comprising the seaboard of Fŭng-shan hien and Taiwan-hien; *Loo-kiang-ting*, the seaboard of the two remaining hien; *Tan-shui-* (or *Tamsui*) *ting*, the whole of the northernmost portion on the west side of the island; *Komalan-ting*, the whole eastern part of the island; and the *Pŭng-hoo-ting*, comprising the group of islands lying off the west coast, and known as the Pescadores. Twa-tu-tia, a few miles from Kilung, was the capital from 1885 to 1896. By the treaty concluded at Shimonoseki, Japan, early in 1895, China ceded Taiwan to Japan, and the Japanese took possession of it early in June, 1895, though opposed by the so-called republic which had been proclaimed there by the Chinese soldiers and residents some weeks earlier, with Tang, the ex-governor, as president. R. L.

**Taiwan-foo**: a walled city of Formosa and a treaty-port; situated on the west coast of the island, in about lat. 23° N. and lon. 129° E. (see map of China, ref. 8–K). Until 1885 it was the capital of the island. Since 1886 it has been called TAINAN (*q. v.*). In 1896 the Japanese again made it the capital of the island. It stands on a level plain of considerable extent, about 3 miles from the sea, from which canals run right up to the west gate, so that merchandise can be landed from ships in the roadstead alongside the godowns or storehouses in the western suburb, where most of the business is carried on. Kok-si-kon, the port of Taiwan-foo, 3 miles distant, is an open roadstead, in which ships anchor about 3 miles from shore. It is fairly well protected for vessels in the northeastern monsoon, but unsafe during the southwestern monsoon. For trade statistics, see TAINAN. Between this western suburb and the sea is the village of Anping, near which are found the ruins of the famous stronghold called Zelandia, built by the Dutch in 1624–30, when they established themselves on the island. It consisted of a single keep on a small hill, in the form of a bastioned fort, with another wall on the northern side at a distance of 100 yards. The walls were of great thickness and were built of small bricks, brought from Batavia for this special purpose. R. L.

**Tai-yuen**: a walled city of China, capital of the province of Shansi, but of no commercial importance (see map of China, ref. 4–I). It lies between two hills near the head of a fertile plain of considerable extent, about 3,000 feet above the level of the sea, and consists, like Peking, of an inner and an outer city, but has no extra-mural population. The outer city is surrounded by mud walls, pierced for three gates, but only two are opened. The inner city, or city proper, which is $2\frac{2}{3}$ miles long by $1\frac{2}{3}$ wide, has walls of moderate height pierced with eight gates surmounted by fine towers. The streets are 50 to 75 feet wide, and the people are well-behaved. Tai-yuen has a powder-mill and an arms-factory, and was anciently noted for its sword-blades and knives. Pop. about 200,000. R. L.

**Takashi'ma**: an island of Japan; about 8 miles from the entrance to Nagasaki harbor. It is only 250 acres in extent, and was, until a comparatively recent date, uninhabited. Coal-mining operations on a primitive scale were begun before the middle of the eighteenth century; in 1867 Scottish miners were employed, and now (1895) several thousand workmen turn out the largest output of any coal mine in Asia. At one time it was feared that the supply was near exhaustion, but later new veins were discovered and the output is undiminished. The mines extend for a considerable distance under the sea. J. M. DIXON.

**Takata**, taa-kaa'taa: a town in the province of Echigo, Western Japan; about 4 miles from the seacoast and 74 miles S. W. of Niigata (see map of Japan, ref. 5–D). Its port, Naoetsu, is the western terminus of the railway from Tokio to the west coast. It was formerly the castle-town of a daimio, Sakakibara, one of the four families entitled to supply a regent during the minority of a shogun. Cotton-weaving is extensively carried on, as also are leather-working and furriery. The Presbyterians of the U. S. have a mission here. Pop. 28,000. J. M. D.

**Takil'man Indians**: a stock of North American Indians, represented, so far as is known, by only one tribe, the Takĕlma. Their habitat was on the upper part of the Rogue river, Oregon (whence they are called Rogue River Indians), and their villages, numbering seventeen, extended along the south side of the river from the valley of Illinois creek to "Deep Rock," probably Rock Point, E. of Woodville, in Jackson County. It is probable that they were once the occupants of a territory larger than that just described, and that later there was an invasion by the Athapascan Indians, who established villages on all sides of them and imposed Athapascan names on Takilman villages, though they never succeeded in forcing the Takĕlma to abandon their own language. The present representatives of the tribe number about twenty-five, and are on the Siletz Reservation, Tillamook co., Ore. Apparently the Takilman Indians differed in no essential respect from their neighbors, except in their language. J. OWEN DORSEY.

**Takow**, taa'kow': a town on the west coast of Formosa; lat. 22° 38' N., lon. 130° 16' 30" E.; about 20 miles S. of Taiwan-foo (see map of China, ref. 8–K). It was thrown open to foreign residence and trade in 1864, but its trade has never been great. The custom-house returns are included in those of Taiwan-foo, now called TAINAN (*q. v.*).

**Taku**, taa'koo': a Chinese village, at the mouth of the Pei-ho, on the south bank; about 70 miles by water from Tientsin, but only 35 by land (see map of China, ref. 3–J). Here are the famous Taku forts, which, though deemed impregnable by the Chinese, were taken three times by the Anglo-French fleets in the campaigns of 1858–60, and again on June 17, 1900, by the fleets of the allied powers. (See CHINA.) See Oliphant's *Narrative of Lord Elgin's Visit to China in 1857–58–59*, and Swinhoe's *North China Campaign of 1860*.

**Talavera de la Reina**, taa-laa-vā'raa-dā-laa-rā-ee'naa: an old but well-built town in the province of Toledo, Spain; on the Tagus, 75 miles by rail S. W. of Madrid; in an exceedingly fertile plain, covered with vineyards and olive-groves (see map of Spain, ref. 16–E). It has manufactures of silk and earthenware. Here was fought a severe battle on July 28, 1809, between the French under Jourdan and Victor, and the allied Spaniards and British under Sir Arthur Wellesley (afterward Duke of Wellington), in which the latter were victorious. It was the birthplace (1536) of the historian Mariana. Pop. about 10,500.

**Talbot**, RICHARD: See TYRCONNEL.

**Talbot**, SILAS: naval officer; b. at Dighton, Bristol co., Mass., in 1751; at the beginning of the war of the Revolution was made captain in a Rhode Island regiment, and was present at the siege of Boston; in 1776 accompanied the army to New York, where he planned an attack by fire-ship on the British shipping, for which he received a commission as major and the thanks of Congress; was severely wounded in 1777 during an engagement with British vessels in Delaware river, and in 1778 he captured the British blockading schooner the Pigot, and was appointed captain in the navy Sept., 1779; fitted out the Pigot and captured several prizes, but in 1780 was made prisoner and sent to England; was exchanged in Dec., 1781; settled in New York, and in 1793–94 was in Congress; when the navy was reorganized in 1794 he superintended the construction of the frigate Constitution, which was his flag-ship during a cruise in the West Indies in 1799. D. in New York, June 30, 1813. See the *Life* by Henry T. Tuckerman (1850).

**Talbot**, WILLIAM HENRY FOX, LL. D.: photographer and antiquary; b. at Lacock Abbey, near Chippenham, England, Feb. 11, 1800; graduated at Cambridge 1821; sat for Chippenham as a Liberal in the first reformed Parliament 1832–34; pursued for some years from 1833 a series of experiments which resulted in Sept., 1840, in the discovery of the essential principle of the art of photography, and in 1841 of the calotype process; received in 1842 a medal from the Royal Society, and in later years devoted himself to antiquarian pursuits and philological studies, being one of the few scholars who have successfully deciphered the Assyrian cuneiform inscriptions. Among his works are *Hermes, or Classical and Antiquarian Researches* (vol. i., 1828; vol. ii., 1839); *Legendary Tales in Verse and Prose* (1830); *The Antiquity of the Book of Genesis illustrated by some New Arguments* (1839); *The Pencil of Nature, a Collection of Genuine Specimens of the New Art of Photography* (6 parts, 1844–46). D. at Lacock Abbey, Sept. 17, 1877.

**Talbotype**: same as calotype. See PHOTOGRAPHY.

**Talc** [from Fr. *talc*, from Arab. *'talaq*]: a magnesium silicate, usually somewhat hydrated, which sometimes makes up the mass of geological formations. Talc, when crystallized, is right rhombic. It belongs to the softest minerals, ranking with graphite in this respect, and is used as the lowest member, No. 1, of the scale of hardness. It is seldom found well crystallized, but usually in compact or in foliated masses, the foliation arising sometimes from the cleavage of the mineral, which is micaceous in its character. Its usual color is a light green, due to ferrous oxide associated with the magnesian base; but this color and this constituent are not essential, and it is found perfectly white, sometimes with a silvery luster. The massive varieties are called soapstone. (See STEATITE.) The average composition of the commoner varieties of talc is stated as $O_{16}Si_5Mg_6.2H_2O$; but there is an anhydrous talc, not separated from this species by Dana and other authorities, which, according to analyses of Genth, Senft, Lychnell, and Kersten, computes distinctly to the formula $O_{16}Si_6Mg_4$. Dana suggests that quartz may have been present as an impurity in these; but this would not account for the entire absence of water from many of the analyses; and, moreover, the density would be diminished by quartz, whereas one of Lychnell's anhydrous talcs gave the maximum density of all, 2·795.

The other extreme of the range of authoritative densities is a hydrous talc, a *rensselaerite* from Charleston Lake, Canada, for which Sterry Hunt gives the figure 2·644.

**Tal'ca**: a province of Chili; cut by the thirty-sixth parallel of south latitude; extending from the Pacific to the Argentine frontier. Area, 3,678 sq. miles. The Andes, including the quiescent volcanoes of Descabezado and Cerro Azul, occupy the eastern part; these and the lower Coast Range have forests resembling those of the southern provinces. The intermediate space consists of plains and rolling lands of great natural fertility, and improved by irrigation. The river Maule forms the southern boundary. The principal industries are wheat-raising and grazing. Pop. (census of 1895) 128,961. Talca, the capital, is in a fertile valley, watered by a branch of the Maule, on the railway from Chillan to Santiago, with a branch to the port of Constitucion (see map of South America, ref. 8-C). It is well built, has a seminary, hospital, etc., and is the center of a thriving trade. The climate is disagreeable, owing to the unusual extremes, for Chili, of heat and cold. Pop. (1885) 23,432; in 1895, 33,232. HERBERT H. SMITH.

**Talcott**, ANDREW: civil engineer and mathematician; b. at Glastonbury, Conn., Apr. 20, 1797; graduated at the U. S. Military Academy July 24, 1818, when appointed brevet second lieutenant in the Corps of Engineers. After a year's service on construction duty, he accompanied Gen. Henry Atkinson, as engineer, on the expedition to locate military posts on the upper Missouri and Yellowstone rivers, and on his return was assigned to the construction of the defenses of Hampton Roads, Va., Fort Delaware, etc., until 1835; from 1832 to 1836 was also engaged as astronomer for determining the boundary-line between Ohio and Michigan, and was in charge of the improvement of the Hudson river 1834-36; resigned from the army Sept. 21, 1836, to become division engineer on the Erie Railroad; in 1837 returned to duty in a civil capacity under the Government as superintendent of the improvement of the delta of the Mississippi river 1837-39; member of commission for exploration and survey of the northeastern boundary of the U. S. 1840-43; of joint army and navy board to visit the Portsmouth and Pensacola navy-yards and prepare plans for dry docks and other important works 1844-45; from 1848 to 1855 was chief engineer of the Richmond and Danville Railroad; of the Ohio and Mississippi Railroad 1856-57; of the railway from Vera Cruz, viâ the city of Mexico, to the Pacific Ocean, nearly completing the road from Vera Cruz to Mexico. He devised what is known as Talcott's method for determining territorial latitudes by the observation of stars near the zenith. D. at Richmond, Va., Apr. 22, 1883.

**Talent** [viâ O. Fr. from Lat. *talen'tum*, from Gr. *τάλαντον*, a certain weight, a certain weight of silver or gold, talent of money, liter., a balance. Cf. *τλῆναι*, bear, endure, Lat. *tollere*, lift, Sanskr. *tulā*, balance]: an ancient Greek weight containing 60 minæ, about 82 lb. avoirdupois. There was a Babylonian and an Æginetan talent, which were to the Attic as 5 to 3; the Eubœan talent was to the Attic nearly as 4 to 3; the Tyrian was equal to the Attic; the Cilician was half the Attic, etc. There was also a gold or Sicilian talent of about three-fourths of an ounce avoirdupois, called also the little talent. A talent in money was originally a talent's weight of silver or of gold, but the talent finally became a money of account. It was among all the Greeks the monetary unit. Its value varied with the kind of talent used and with the purchasing power of gold and silver. The Attic silver talent was smaller than the commercial talent, weighing 57 lb. of silver.

**Talfourd**, tal'ferd, Sir THOMAS NOON: statesman and author; b. at Doxey, near Stafford, England, Jan. 26, 1795; was the son of a wealthy brewer; studied at the Reading dissenting grammar school, under Dr. Valpy; was entered at the Middle Temple; studied law with Chitty, the celebrated pleader, and was called to the bar in 1821; practiced on the western circuit, acting at the same time as law reporter for the London *Times*; in 1835-41, and again in 1847-49, was a member of Parliament for Reading, and in 1849 was made a judge of the common pleas. In Parliament he was especially distinguished for his advocacy of the Custody of Infants Act and of the Copyright Act of 1842. He published many speeches and essays, some of which have been collected under the title *Critical and Miscellaneous Essays of Thomas Noon Talfourd* (1842). Among his works are *Poems on Various Subjects* (1811); *An Attempt to Estimate the Poetical Talent of the Present Age* (1815), one of the earliest public tributes to the genius of Wordsworth; *History of Greek Literature*, *History of Greece*, and *History of the Roman Republic*; several distinct volumes relating to his intimate friend Charles Lamb, subsequently put forth as one work, *Memoirs and Correspondence of Charles Lamb* (1837); *Final Memorials of Charles Lamb* (1848); four tragedies—*Ion* (1835), *The Athenian Captive* (1838), *Glencoe* (1840), and *The Castilian* (1854), the first two of which had a stage success; *Recollections of a First Visit to the Alps* (1842); *Vacation Rambles* (1844); and *Supplement to Vacation Rambles* (1846). D. at Stafford, Mar. 13, 1854.
Revised by H. A. BEERS.

**Taliesin**, tăl'i-sin: a Welsh bard, said to have flourished during the twelfth century, whose name has been handed down, together with that of the two Merlins, as the three principal Christian bards, Taliesin being styled *Pen Beirdd*, the chief of the bards. Many compositions ascribed to him are preserved in the *Archæology of Wales*.

**Talipes**: See CLUB-FOOT and ORTHOPÆDIC SURGERY.

**Tal'ipot** [from Hind. *tālpāt* < Sanskr. *tālapattra*, palm-leaf; *tāla*, palm-tree + *pattra-*, leaf]: a palm-tree, *Corypha umbraculifera*. It affords great leaves, which are used for covering houses, making umbrellas, and for making a substitute for writing-paper that is used extensively in the East, as well as for many other purposes. The pith affords a kind of sago. The tree grows in Malabar and Ceylon.

**Tallade'ga**: city; capital of Talladega co., Ala.; on the Birm. and Atl., the Louisv. and Nashv., and the South. railways; 23 miles E. of Birmingham, 30 miles S. W. of Anniston (for location, see map of Alabama, ref. 4-D). It is in an agricultural and mining region, and is noted for its educational and public institutions, which include the Talladega College for Negroes (Congregational, chartered in 1869), Isbell Female College for whites, Talladega Military Academy for whites, Alabama Institution for the Deaf (whites), Alabama Academy for the Blind (whites), Alabama Institution for the Colored Deaf, Dumb, and Blind, several public schools, and an Orphans' Home. The city has Baptist, Congregational, Methodist Episcopal, Presbyterian, and Protestant Episcopal churches, 2 national banks with combined capital of $100,000, cotton-factory, tannery, and 3 weekly newspapers. On the site of Talladega Gen. Jackson gained a victory over the Creek Indians in 1813. Pop. (1880) 1,233; (1890) 2,063; (1900) 2,661.
EDITOR OF "OUR MOUNTAIN HOME."

**Tallahas'see**: city; capital of the State of Florida and of Leon County; on the Carrabelle, Tall. and Ga. and the Fla. Cent. and Pen. railways; 21 miles N. of the Gulf of Mexico, 165 miles W. of Jacksonville (for location, see map of Florida, ref. 2-F). It is in an agricultural and fruit-growing region; contains 4 churches for white people and 6 for colored, separate public schools for white and colored children, West Florida Seminary, Normal College for Colored Teachers, 2 libraries (State, founded 1845; University, founded 1884), U. S. Government building, a national bank with capital of $50,000, a State bank with capital of $25,000, two private banks; a weekly and a daily newspaper; and has railway car-shops and machine and novelty wood works. Pop. (1880) 2,494; (1890) 2,934; (1895) 3,931.
EDITOR OF "TALLAHASSEEAN."

**Tallahatch'ie River**: a river which rises in Tippah co., Miss. After a devious course of more than 250 miles, in a generally S. S. W. direction, it unites with the Yallobusha to form the Yazoo. Throughout more than half its extent it is navigated by steamboats at all stages of water.

**Tallapoo'sa**: city; Haralson co., Ga.; on the Southern Railway; 3¼ miles from the Tallapoosa river, 63 miles W. of Atlanta; elevation, 1,200 feet above sea-level (for location, see map of Georgia, ref. 2-F). It is in an iron, timber, agricultural, and fruit-growing region, and contains six churches, free graded schools for white and colored pupils, a State bank with capital of $57,300, and a weekly newspaper. Adjacent to the city are about 3,000 acres devoted to grape-culture. The prosperity of the city dates from 1887, and is due to Northern capitalists. Pop. (1890) 1,699; (1900) 2,128. EDITOR OF "JOURNAL."

**Tallapoosa River**: a river which rises in Paulding co., Ga., and joins the Coosa to form the Alabama river. It is 250 miles long, and is navigable by steamboats some 40 miles.

**Talleyrand-Périgord**, Fr. pron. tăă'lă'raăn'pă'rēē'gōr', CHARLES MAURICE, Duc de, Prince of Benevento; statesman; b. in Paris, Feb. 13, 1754; was compelled by his family to renounce his right of primogeniture on account of his being lame, and was educated for the Church. He studied at St.-Sulpice, the Sorbonne, and at Rheims, and attracted much attention by his wit and other brilliant gifts. In 1775 he was ordained priest in spite of the notorious licentiousness of his life, in 1780 was chosen agent-general for the clergy, and in 1789 the king made him Bishop of Autun. Elected a deputy to the States-General, he was one of the first of the clergy who joined, and prompted his colleagues to join, the *tiers état*, and in intimate harmony with Mirabeau and Sieyès he took a prominent part in the debates of the Assembly. On Oct. 10, 1789, he proposed the confiscation of all Church property; July 14, 1790, he officiated at the grand national festival in the Champ de Mars, and consecrated the new colors of the national guard; Dec. 28, 1790, he took the oath to obey the constitution, and when the pope excommunicated him (May 1, 1791) he resigned his episcopal see. In the Representative Assembly his speeches on financial, educational, and other reforms exercised great influence. Nevertheless, a rumor was circulated that he was conspiring with the Duke of Orleans, and his friends saved him by procuring for him a diplomatic mission to London. While there his name was placed on the list of *émigrés*. He lived for some time in London and afterward in the U. S., but returned to Paris in 1796, and became Minister of Foreign Affairs in July, 1797, which office he held to Aug., 1807, with one short interruption. Recognizing the force of Napoleon's character, he gave him his support loyally in his struggle for power. He negotiated all the various treaties of peace of this epoch—the concordat with the pope, who relieved him from excommunication and secularized him; the confederacy of the Rhine, after which he was made Prince of Benevento, etc.; but he disapproved Napoleon's policy toward Great Britain, opposed his plans with respect to Spain, and when, after the Peace of Tilsit, an alliance was formed between France and Russia, he resigned his office and retired to his estates at Valençay. Before the Russian disaster he predicted the downfall of Napoleon, and entered into communication with the Bourbons; and during the last three years of Napoleon's career he was one of his most active and most dangerous enemies. He negotiated the first Peace of Paris, and represented France at the Congress of Vienna. Here he succeeded in dissolving the general feeling of concord with which the powers met, and produced a confusion of jealousy, mistrust, rivalry, and hatred which he understood how to use to the advantage of France. After the second restoration, however, he fell into disgrace, and during the reigns of Louis XVIII. and Charles X. took very little part in public life. In Sept., 1830, Louis Philippe sent him as ambassador to London, and he succeeded in establishing cordial and intimate relations between the courts of St. James and the Tuileries, and concluded the quadruple alliance between Great Britain, France, Spain, and Portugal Apr. 22, 1834. He returned to France shortly after. D. at Valençay, May 17, 1838. His *Mémoires* were intended by him to be published thirty years after his death, but in 1868 the publication was postponed for twenty-two years on the proposition of Napoleon III. They were published in 5 volumes 1889–91. For an account of his course at the Congress of Vienna, see *Correspondence between Talleyrand and Louis XVIII.* (1881); for estimates of his character, Lamartine, *Mémoires Politiques*; Blanc, *Histoire de Dix Ans*; Guizot's *Mémoires*; and Bastide, *Vie Religieuse et Politique de Talleyrand.* Revised by F. M. Colby.

**Tallien**, tăă'li-ăń', Jean Lambert: revolutionist; b. in Paris in 1769; became noted in 1792 as the editor of a Jacobin journal, *L'Ami du Citoyen*; was elected a member of the Convention; advocated the condemnation and immediate execution of Louis XVI., and attacked the Girondins with senseless fury. In 1793 he was sent to Bordeaux to exterminate the moderate party, but here he became acquainted with Madame de Fontenay, one of the most attractive women of that time, and this acquaintance suddenly changed him from an extreme radical to a decided moderate. He was immediately recalled, his name was erased from the lists of the Jacobin Club, Madame de Fontenay was thrown into prison, and his own life was endangered; but in this emergency he rallied the partisans of Danton and Hébert, and by his energy and coolness at the decisive moment the overthrow of Robespierre and the Terrorists was accomplished July 27, 1794. He then became one of the most conspicuous figures in the republic, and married Madame de Fontenay. He became a member of the Council of Five Hundred, but, trusted by neither monarchists nor republicans, was forced to withdraw. He went with Bonaparte to Egypt as a *savant*, but quarreled with Gen. Menou and was sent back to France in 1800. He was captured by a British cruiser and taken to London, where he was feasted and flattered by the Whig party as a hero. He returned to France in 1802, and died in Paris, Nov. 16, 1820. F. M. Colby.

**Tallis**, Thomas: organist; b. about 1520; was perhaps organist to Henry VIII., and certainly gentleman of the chapel to Edward VI., Mary, and Elizabeth, and organist to the last named; and has been styled the father of English cathedral music. In conjunction with his pupil, William Byrd, he issued *Cantiones quæ Sacræ vocantur*, etc. (1575), which are masterpieces, and were protected for twenty-one years by Elizabeth, this being the first patent of the kind granted by her. There are also extant his *Order of Daily Service* (ed. by Bishop, 1843, and by Rimbault, 1847), *Full Cathedral Service* (ed. by Rimbault, 1847), and *Order for Morning Prayer, with the Litany Noted* (new ed. 1854). It is said that for portions of his *Service* he was indebted to Peter Marbeck, organist of Windsor. D. Nov. 23, 1585. A complete list of his works is in Grove's *Dictionary of Music.*

**Tallmadge**, Benjamin, M. A.: soldier; b. at Setauket, N. Y., Feb. 25, 1754; graduated at Yale in 1773; principal of a high school at Wethersfield, Conn.; entered a Connecticut regiment at the outbreak of the war of the Revolution; rose to the rank of major; performed a brilliant exploit in crossing Long Island Sound, surprising and capturing 500 Tories at Lloyd's Neck, L. I., Sept. 5, 1779; planned and executed the capture of Fort George at Oyster Bay and the destruction of British forces on Long Island, May, 1780; was engaged in several prominent battles; was intrusted with the custody of Maj. André, and superintended his execution; was a member of Congress 1801–17. D. at Litchfield, Conn., Mar. 7, 1835. His *Memoirs* were published in 1859 by his son, Frederick A. Tallmadge.

**Tallmadge**, Frederick Augustus: lawyer; son of Benjamin Tallmadge; b. at Litchfield, Conn., Aug. 29, 1792; graduated at Yale College 1811; studied law under Judge Tapping Reeve at Litchfield, where he was admitted to the bar; began practice in New York 1814; soon became one of the most successful advocates, and filled many public posts, including those of member (1837–40) and president of the State Senate, judge of the Supreme Court of Errors, recorder of New York 1841–46 and 1848–51, member of Congress 1847–49, superintendent of the metropolitan police 1857, and clerk of the court of appeals 1862–65. He became best known for the energy he displayed while recorder in suppressing the Astor Place riot of May, 1849. D. in New York, Sept., 1869.

**Tallmadge**, James, LL. D.: lawyer; b. at Stamford, N. Y., Jan. 28, 1778; son of Col. James Tallmadge (1744–1821), an officer of the Revolution; graduated at Brown University 1798; studied law, which he practiced several years, but gave his chief attention to agriculture; was for some time private secretary to Gov. George Clinton; held a military command in New York during the war of 1812–15; was member of Congress 1817–19; introduced an amendment to the bill admitting Missouri excluding slavery from the region W. of the Mississippi; took a prominent part in the New York constitutional conventions of 1821 and 1846; sat in the Assembly 1824; was Lieutenant-Governor 1825–26. In 1836 introduced into Russia several American mechanical inventions, especially cotton-spinning machinery; was one of the founders of the University of the City of New York. D. in New York, Sept. 29, 1853.

**Tallow** [M. Eng. *taluh*: Low Germ. (hence Germ.) *talg*]: the hard fat of animals, more properly called suet. The term also includes those fats of a less degree of hardness, e. g. lard and grease, as distinguished from oils. The fats obtained from the rendering of animal fats of all kinds are technically known as tallow, and are chiefly used by the tallow-chandler for the production of soap and candles. The animal fats are hard in proportion as they contain more stearin and palmitin and less of olein. The quality of animal fats is much influenced by the mode of feeding and the quality of the food. The quality of tallow is also very dependent on its being rendered at a low temperature by steam, and the cleanliness of the operation, the character of the animals treated, etc.

Vegetable tallow is found in the seed of many plants. Chinese vegetable tallow is from the husk about the berries of *Stillingia sebifera*; the berries contain a liquid fat. The solid commercial product is white, sp. gr. 0·818, and melts at 99° F.; it is rich in palmitin. Bayberry tallow, from *Myrica cerifera*, also called myrtle-wax, is a pale-green, brittle, solid fat from the berries of the plant. It moulds in the fingers like wax when warm. It contains myristic acid in a free state, and also combined with glycerin, and a large quantity of palmitic acid, but no oleic or volatile acids (*Moore*). Other hard vegetable fats are found in nutmeg, palm oil, Japan wax, cocoa-butter, cocculus grains, and various species of *Bassia*, for a description of which see Gmelin, *Handbook*, xvi., 385–400. See also FATS and OILS. Revised by IRA REMSEN.

**Tallow-tree**: (1) of the southern parts of the U. S. and of China. see STILLINGIA; (2) the *Pentadesma butyracea* of West Africa, a guttiferous tree whose fruit yields a kind of yellowish tallow; (3) the piny dammar-tree of India, *Vateria indica*, a huge dipterocarpaceous tree, whose seeds on boiling yield an excellent white tallow.

**Talma**, taal'maa', FRANÇOIS JOSEPH: tragedian; b. in Paris, Jan. 15, 1763, the son of a dentist; was educated partly in London, partly in Paris in his father's profession, but was irresistibly drawn to the stage, and made his *début* in 1787 at the Comédie Française as Séïde in Voltaire's *Mahomet*. His *début* was successful, but he produced the first great impression by his performance of the title-rôle in Marie-Joseph Chenier's tragedy, *Charles IX.*, Nov. 4, 1789, from which date he rapidly rose in the estimation of the public until in the first decade of the nineteenth century he stood acknowledged by the whole world as the greatest tragedian of his time. He was a favorite with Napoleon, who liked to converse with him, and whom he accompanied to Erfurt in 1808, and to Dresden in 1813. The Bourbons also showed him great favor, and in his art he continued unrivaled and improving until his death Oct. 19, 1826, some of his last *rôles*, Sylla, Oreste, etc., being among his greatest creations. Before his time the tragic heroes, Brutus, Cæsar, Catiline, Nero, etc., always appeared on the stage in a sort of fancy costume, not very different from the costume of the age, and with high powdered peruke on the head. Talma was the first to discard the peruke and adopt a correct costume. He wrote *Réflexions sur Lekain et sur l'Art théâtral* (1815), and left an *Autobiography*, which was edited by Alexander Dumas in 4 vols. (1849–50).
Revised by B. B. VALLENTINE.

**Talmage**, THOMAS DE WITT, D. D.: clergyman; b. near Bound Brook, N. J., Jan. 7, 1832; educated, without graduating, in the class of 1853, University of the City of New York, and at New Brunswick Theological Seminary; pastor of Reformed churches at Belleville, N. J., 1856–59; Syracuse, N. Y., 1859–62; Second, Philadelphia, Pa., 1862–69; Central Presbyterian (later known as the "Tabernacle"), Brooklyn, N. Y., 1869–94; began a popular Sunday afternoon service at the Academy of Music, New York, in 1895. During his pastorate in Brooklyn, the Schermerhorn Street church was opened as a Tabernacle lay college for training Christian workers, with Dr. Talmage as president; the Tabernacle was built in 1870, burned 1872; rebuilt 1874, burned 1889; rebuilt 1891, burned 1894; the membership last reported being 4,447. Dr. Talmage was co-pastor of the First Presbyterian church in Washington, D. C., 1895–99. Dr. Talmage edited *The Christian at Work*, New York, 1873–76; *The Advance*, Chicago, 1877–78; *Frank Leslie's Sunday Magazine*; and since 1890 *The Christian Herald*. His sermons appear every week in many hundred secular and religious papers, and are translated into many foreign languages. Besides frequent contributions to periodicals, he has published *The Almond Tree in Blossom* (Philadelphia, 1870); *Shots at Targets*; *Crumbs Swept Up* (1870); *Sermons* (4 vols., New York, 1872–75); *Abominations of Modern Society* (New York, 1872; 2d ed. 1876); *The Battle for Bread*; *One Thousand Gems: or Brilliant Passages and Anecdotes* (1873); *Old Wells Dug Out* (1874); *Around the Tea-table* (Philadelphia, 1874); *Orange Blossoms Frosted*: *Sports that Kill* (New York, 1875); *Every-day Religion* (1875); *Night Sides of City Life* (1878); *Mask Torn Off* (1879); *The Brooklyn Tabernacle: 104 Sermons* (1884); *The Marriage Ring* (1886); *Social Dynamite* (Chicago, 1887); *The Pathway of Life*; *From the Pyramids to the Acropolis* (Philadelphia, 1892); *Ready! Ay Ready!* (1892); and *From Manger to Throne* (New York, 1894). C. K. HOYT.

**Tal'mud** [from Neo-Heb. *talmūd*, instruction, deriv. of *lāmad*, learn; cf. Heb. *limmad*, teach, *talmīd*, disciple, scholar]: a work whose authority was long esteemed second only to that of the Bible, and according to whose precepts the whole Jewish people, with the exception of the Karaites and the Reformed Jews of the nineteenth century, have endeavored to order their religious life. In reality it is composed of two distinct works, which were compiled at different epochs—the Mishna and the Gemara. In the oldest terminology of the schools "Talmud" signified "a deducing," and designated the process of seeking in the sacred writings support for laws not expressly provided therein. On this account the Mishna which embodied these deductions was also known as Talmud. Later on, when learned disputations on the Mishna became more frequent, the name Talmud was employed to denote these more recent discussions in contradistinction to the Mishna proper. In later times they were called *Gemara* (the Aramaic equivalent of Talmud). It was only at a still later period, when the Mishna and the Gemara were no longer transcribed separately, that the name Talmud was applied to the whole great work consisting of both Mishna and Gemara.

(A) *Mishna*.—The name Mishna signifies simply repetition, teaching, doctrine. It was used to designate, first, each individual ordinance; secondly, a group of interconnected ordinances; lastly, and especially, the great compilation of ordinances now known by that name, the authorship of which is referred to Rabbi Jehudah Hannasi. In the Talmud of Palestine, however, each individual Mishna is called *Halāchā*.

(*a*) *The Structure and Arrangement of the Mishna*.—It consists of six divisions (*Sedhārīm*): 1. *Zerāīm*, laws relating to seeds and products of the fields; 2. *Mōēdh*, laws relating to the festival celebrations; 3. *Nāshīm*, laws relating to women; 4. *Nezīkīn*, civil and criminal laws; 5. *Kodāshīm*, laws relating to offerings and vows; 6. *Tehārōth*, laws relating to ritual cleanliness and uncleanliness. Each division is subdivided into *Massechtōth* (tracts), of which there are 63 (11, 12, 7, 10, 11, 12). The whole number of tracts is occasionally given as 61, the first three tracts of the fourth division being counted as one; or as 60 (*Shir Hashirim Rabba*, 6, 9), Makkoth being counted as the last part of Sanhedrin. Each tract is again subdivided into *Perākīm* (chapters), of which the total number is 523 (74, 88, 71, 73, 91, 126), and each chapter into paragraphs. The order and sequence of the Sedarim are fixed and undisputed. The same unanimity, however, does not exist in the sequence of tracts and chapters, a slight divergence having been noted between the Mishna, the Palestinian, and the Babylonian Talmuds.*

(*b*) *The Origin, Development, and Close of the Mishna*.—During the sojourn of the Jews in Babylon the assured hope of restoration to the promised land had led to a deeper study of the Law and to a firm resolve to put it into practice whenever that restoration should be accomplished. At the head of this restoration stood Ezra, "a ready scribe in the law of Moses" (Ezra vii. 6). Not only the forms of temple-worship, the many dietary laws, the laws of Levitical purity, but even the agricultural regulations and the whole judiciary code had to be included in the work of reconstruction. Jewish tradition ascribes the continuation of Ezra's work to the *Sōpherīm* (scribes) or the men of the Great Synagogue.† After these the Sanhedrin of Jerusalem became the chief tribunal. From its decisions there was and could be no appeal. Thus, in the course of several centuries, a vast stock of laws and usages had accumulated which the Tōrāh (five books of Moses) did not directly authorize, but which were transmitted orally from generation to generation, and which Jewish orthodoxy refers back to the time of Moses (Oral Law). Academies arose for the propagation of this stock of tradition, and efforts began to be made to found the traditional enactments upon a biblical basis and support. This tendency received its chief impetus at the time that Sadducean opinions began to manifest themselves, and the Pharisean doctors found it imperative to emphasize their belief in the necessary development of the Law to suit the changed conditions.

* Long after the close of the Talmud a number of smaller tracts, composed in the form of the Mishna, made their appearance. They are appended to the 4th Seder under the general title of Minor Tracts. Besides these, seven lesser tracts were edited by R. Kirchheim from an ancient manuscript (*Septem libri Talmudici parvi*, Frankfort-on-the-Main, 1851). These are all of Palestinian origin, of obscure authorship, and have never been regarded as authorities.

† Doubt has been cast upon the existence of this body. See A. Kuenen, *Over de Mannen der Groote Synogoge* (Amsterdam, 1876).

The suppression of the Sadducean Sanhedrin at the death of Alexander Jannai and the triumph of Pharisees at the recall of Simon ben Shetach must have given the first immediate impulse to a classification of the Oral Law. Such classification, with its anti-Sadducean tendency, was introduced in the exegesis of the Law (*Midrash*)—e. g. the method of procedure of the Sanhedrin in the exegesis of Deuteronomy. Hillel the Elder (B. C. 32) carried on this work. Installed as patriarch in Palestine, he became the head of a numerous and learned school. To him is attributed the general arrangement of the Oral Law in six divisions. It is very probable that every great teacher had his own compilation which he handed down orally to his immediate disciples. We hear especially of a Mishna of Rabbi Akiba (about 100 A. D.), the celebrated Talmudist and martyr; and the compilation of R. Meir (about 150 A. D.)—to whom are ascribed the majority of the anonymous canons in our Mishna—became the foundation of the Mishna as it now exists.*

R. Jehudah Hannasi, simply called "Rabbi" (about 160 A. D.), was the one who gave final form to the Mishna. He examined anew the vast accumulation of ordinances, abridged and amplified it where necessary, but preserved the teachings of the Fathers—in so far as they met with his approval—in exactly the form in which he had received them. Here and there a few additions were made by later teachers, but these are unimportant, and are generally to be found at the end of the tracts. Whether the division of the Sedarim into tracts was the work of Rabbi or of his predecessors it is impossible to decide. The tracts, however, were known to the doctors of the Gemara, and Frankel has conclusively shown (*Hodogetica*, p. 264) that the Babylonian Gemara was already familiar with the division of the tracts into chapters. The arrangement of the chapters, however, in their present order is said to have been the work of the later Saboræans. The period of time which includes the men who are mentioned as authors of canons in the Mishna extends over five centuries and a half—namely, from the last of the scribes to the death of Rabbi. In the post-Mishnic epoch the name *Tannāīm* (teachers) was applied to those who had advanced opinions of their own in the disputations of the academies.

(*c*) *Language of the Mishna.*—This, though essentially Hebrew, differs from the more ancient Hebrew in important particulars. The natural development is shown in new and modified meanings which have sprung up side by side with the old; in the invention of new terms; in formal changes by means of which biblical words have been adapted to express new modes of thought. The influence of the Aramaic, which in the second century B. C. had become the ordinary language of the people, shows itself in the many Aramaic words received bodily into the language of the Mishna, as well as in many grammatical forms and syntactical constructions. Besides this, the spread of Grecian culture in Palestine favored the introduction of many Greek terms, and also, indirectly, of some Latin ones. Many of them, however, passed through Syrian channels on their way to Palestine, and are thus more or less modified in form.

(*d*) *The Composition of the Mishna.*—That the Mishna was not cast in a single mould must be plain to every one who is acquainted with its contents, form, and language. In many places the Mishna simply lays down the Law, omitting to mention the conflict of opinion that existed in regard to it. Elsewhere even the slightest diversity of opinion is noted. Certain ordinances are twice and three times repeated. One and the same ordinance is sometimes supported by totally different arguments in the different places in which it occurs. All this points to the conclusion that a considerable number of minor compilations already existed in the days of Rabbi Jehudah which he adopted, arranged, and enlarged, and in this way the general arrangement can be yet recognized. The oldest layer of Mishnas, dating back to the time of Alexander Jannai (see above), busied itself with the temple service and the court of justice. The tone is a general one, and a certain rhythm is perceptible. Their tendency was anti-Sadducean. The second layer busied itself with more minute and individual affairs. As nothing was reduced to writing, the material was arranged (1) as far as possible in the same order as the laws occur in the Pentateuch, (2) according to the outward agreement in the form of expression or in subject-matter. There are also indications by means of which the author of some of the individual parts of the work of R. Jehudah can be discovered.

(*e*) *Reduction of the Mishna to Writing.*—It was a general principle with the men of the Talmud that the traditional law ought not to be committed to writing. Unity of development was threatened if each teacher were to fix in writing his own collection. There is, however, sufficient evidence to show that at an early time both Haggada (exegesis) and Halacha (law) were committed to writing. But concerning the exact time at which the Mishna was written down, great diversity of opinion prevails. Some hold that Rabbi Jehudah arranged the Mishna in his own mind and transmitted it by word of mouth to his disciples; that it was thus preserved with verbal accuracy down to the time when the academies sank in importance, and it was found necessary to fix the traditions in writing.

Some hold, with a greater show of reason, that Rabbi Jehudah himself wrote out the greater part of the Mishna in full.

(*f*) *Authenticity of the Mishna Text.*—The text of the Mishna has suffered much, as it has passed through the hands of many copyists and compositors. It exists at present in three recensions: one in the manuscripts and editions of the Mishna, another embodied in the Talmud of Babylon, and a third in the Talmud of Palestine. All these differ greatly, and the text which was before the ancient commentators differs from that of any of the three recensions mentioned. Frankel has shown (*Mebo*, p. 20) that even during the lifetime of R. Jehudah and soon after his death the great authorities of Palestine did not scruple to subject his work to revision. For this reason criticism of the Mishna text plays so important a part in the Gemara of Babylon and of Palestine.

(*g*) *Commentaries on the Mishna.*—Maimonides (twelfth century) heads the list with his commentary, written in Arabic, of which only parts have been printed (Edward Pocock, *Porta Mosis* (Oxford, 1655); J. Barth, *Maimonides Commentar zum Tractat Makkoth* (Leipzig, 1881); J. Derenbourg, *Commentaries de Maimonide*, etc. (Berlin, 1886–91); E. Weill, *Der Commentar des Maimonides zum Tractat Berachoth* (Berlin, 1891); J. Zivi, *Der Comment. des Maimonides zum Tractat Demai.* (Berlin, 1891); S. Bamberger, *Commentar zum Tractat Kilajim* (Frankfort, 1891). A Hebrew translation may be found in many editions of the Mishna and the Talmud. He was followed by R. Tanchum, of Jerusalem, who wrote a lexicon of the Mishna in Arabic (Neubauer, catalogue of Hebrew MS. cols., 534, 535). Of the many commentaries which have appeared since then, it is only necessary to mention those of Asher ben Yechiel (1327), Obadya of Bertinoro (end of fifteenth century), Yomtov Lipmann Heller (1579–1654), Jacob ben Samuel Chagis (seventeenth century), which are to be found in the different editions of the Mishna.

(*h*) *Translations of the Mishna.*—About the middle of the seventeenth century the desire to become acquainted with the contents of the Mishna was manifested also by Christian scholars. Translations of all or single portions of the Mishna began to appear in Latin, Spanish, Italian, French, English, and German. The most important are Guilielmus Surenhusius, *Mishna sive totius Hebræorum juris Systema* (Amsterdam, 1698–1703); *Mishnayott*, edited by J. M. Jost (vocalized text with German transl. in Hebrew letters), Berlin, 1832–34; J. J. Rabe, *Mischnah oder der Text des Talmuds* (Ansbach, 1760–63); E. Baneth, *Mischnaiott . . . nebst Deut. Uebersetz.* (Frankfort-on-the-Main, 1888); A. Sammter, *Mischnayott . . . mit . . . Deut. Uebers.* (Berlin, 1886); D. A. de Sola and M. J. Raphal, *Eighteen Treatises from the Mishna* (London, 1843); J. Barclay, *The Talmud* (London, 1878); *Yoma, or the Day of Atonement*, Palestine Exploration Fund, Quarterly Statement (1885); *Middoth, or the Measurements of the Temple, ibid* (1887). For an account of the numerous editions of the Mishna, see Fürst, *Bibliotheca Judaica*, ii., p. 40, i.; Benjacob, *Oṣar Hassepharim* (1880), pp. 399 ff.

(B) *The Gemara.*—The term *Gemara* is of Aramaic origin, and its signification is the same as that of Talmud—teaching. It is also used to designate the method of deduction current in the schools as well as *tradition* itself. Ordinarily it denotes the whole body of controversies and teachings which arose in the academies after the close of the Mishna, and which, being collected in writing, now form the second and major part of the Talmud. There are two Gemaras, the one elaborated in the academies of Babylon, the other having Palestine for its birthplace. The customary name

* Dr. Lewy, *Ueber einige Fragmente aus der Mischna des Abba Saul*, has endeavored to show that Abba Saul (about 100 A. D.) collected a Mishna which was used in the final redaction.

given to the latter, Gemara of Jerusalem, is erroneous, as no academy existed in Jerusalem after the destruction of the temple.

(*a*) *The Gemara in its Relation to the Mishna.*—The Gemara is in general a commentary to the Mishna, to the words of which it attaches its discussions, explaining terms and things wherever necessary, harmonizing discrepant statements, and endeavoring to refer anonymous decisions to their proper authors. Nor does the Gemara ever lose sight of extra-Mishnic compilations, but discusses to what extent these may be brought into agreement with the Mishna. Furthermore, it formulates new ordinances, and reports in full the controversies that took place in the academies in respect to all these and kindred subjects. For this reason the authorities who lived after the close of the Mishna are called *Amoraim* (expounders), in contradiction to the Mishnic authorities who are known as *Tannaim* (teachers). But the Gemara has also gathered the utterances which have dropped from the lips of great masters and the traditions which had been preserved of their life and actions. Thus it contains *legal enactments, homiletical exegesis of scripture, gnomes, maxims, proverbs, parables, tales*, and also *medical, mathematical*, and *astronomical* data.

The Talmud divides its component elements into two distinct classes. The one class includes the ritual and ceremonial, the civil and criminal laws, and also the chief heads of ethics (*Halacha*, way, custom, law; cf. *Acts* 9, 2, etc.). Everything not legal is embraced under the term *Haggada* (non-Halachic interpretation of Scripture). Haggadic utterances are considered as individual and without binding authority, though some have become so hallowed by tradition that even the Halacha employs them as the basis of some of its enactments. The Mishna is exclusively occupied with Halacha. A few Haggadic elements are found chiefly at the end of tracts, but they are undoubtedly later additions. A single Mishnic tract is devoted to Haggada (*Aboth*, Sayings of the Fathers), but its distinct anti-Sadducean tendency was the cause of its early redaction.

(*b*) *Ancient Elements in the Gemara.*—Shortly before and after the close of the Mishna various collections of ordinances and disputations were made, where Halacha was interspersed with more or less Haggada. A few of these (so-called Halachic Midrash) are still preserved, though expanded by later writers and corrupted in the course of time. They are the Tosephta, composed after the manner of the Mishna, but with discussions and explanations; the *Mechilta, Siphra*, and *Siphri*—all three arranged in the form of a running commentary on Exodus, Leviticus, and Deuteronomy. These, and perhaps others now lost, bore the general titles *Mathnitha* (collection of teachings), rarely *Bārāitōth* ("productions extraneous" to the Mishna). These *Bārāitōth* are often quoted in the Talmud for the purpose of throwing light upon obscure passages in the Mishna or with a view to determining their own value. But certainly they are in a state of sad confusion, as can be seen from many *Bārāitōth* which are quoted in Tosephta, Mechilta, etc., compared with their citation in the Gemara.

(*c*) *Scope of the Two Gemaras.*—The Gemara of Babylon does not cover more than 37 Mishnic tracts. (There are wanting in *Zeraim* 10, *Moed* 1, *Nezikin* 2, *Kodashim* 2, *Teharoth* 11.*) It will be seen that the tracts omitted deal mostly with matters which pertained specially to the land of Israel. The tracts of the fifth division, however, have received a commentary, because of the firm hope that a sacrifice would at some future day be introduced, and because the study of sacrificial laws was deemed equally meritorious with the performance of the sacrifice itself. It must not, however, be supposed that the omitted tracts were entirely neglected by the Amoraim of Babylon. They are frequently mentioned, and are often the subject of elaborate disputation.

The Gemara of Palestine extends over 39 tracts—i. e. over the first four books and over a part of the sixth. It is true that the text of the Palestinian Gemara is full of gaps, in view of which some scholars have thought that there was at one time a Palestinian Gemara to the whole Mishna. But the evidence is insufficient, and only makes it probable that a Gemara to the whole of Nidda in the sixth book (see *Tosaphot to Nidda*, 66 a) did exist at one time.

(*d*) *The Language of the Two Gemaras.*—Aramaic, which, as has been said, had become the language of the people, had branched off into Eastern and Western Aramaic. The Jews in Babylon had introduced into the Eastern Aramaic a number of Hebrew words and expressions, as the Jews in the Middle Ages have done in their Judæo-German dialect. In this Hebræo-Aramæan the Babylonian Talmud is written, but the want of good MSS. and the ignorance of copyists make it difficult to study its linguistic phenomena. The Palestinian Gemara is composed in the current Eastern Aramaic, of which there are other representatives in the Christian Palestinian dialect and in the Samaritan. The Palestinian Gemara has preserved more closely than the Babylonian the actual pronunciation of its day, in which letters belonging to the same order of speech interchange readily. It contains also a much larger quantity of Greek words than does the Babylonian.

(*e*) *The Form of Discussion in the Two Gemaras.*—In style and form both Gemaras exhibit the common attribute of pregnant brevity and succinctness. This is especially true in the terminology of the schools, where a single word often indicates whole sentences. As there are neither vowel-sounds nor interpunctuation, and as question and answer are stylistically closely interwoven, it needs the practiced eye of the scholar to discern where the one ends and the other begins. The Palestinian Gemara is still more economical. In *material* and *method* of discussion a difference is seen between the more ancient and the younger Amoraim of Babylon. The former aim at condensation, and restrict themselves to plain and simple exegesis and deduction. The younger Amoraim, particularly since the days of Abaya and Rabba (fourth century), argue rather for the sake of mental exercise. They raise artificial difficulties only for the purpose of unraveling them again; and this method obtained the ascendency in the schools against the older form and in practical cases of conflicting authority. The Gemara of Palestine refrained altogether from such attempts at unbridled dialectics. In its treatment of the Haggada, too, it is simpler and more rational; while the Babylonian Haggada is full of gross exaggerations; of demonology and of witchcraft, borrowed from the Zoroastrianism that surrounded it on all sides, though it is not wanting in noble moral principles and in deep sentiments.

(*f*) *The Teachers of the Two Gemaras.*—From the time of the older Amoraim (end of third century) to the middle of the fifth century seven generations of scholars are mentioned in the Babylonian and six in the Palestinian Talmud up to the first half of the fourth century. Until the disorders of war made it impossible, an unbroken bond of reciprocity had connected the schools of both countries. Young students from Babylon sought the Palestinian academies, and after years returned home with fresh materials. The reverse was sometimes the case. Thus at times we find Palestinian authorities cited in the Babylonian Gemara, and *vice versa*; but numerous inaccuracies and contradictions occur, the same ordinance being at times attributed to different Amoraim in the two Gemaras. This is often due to the corruption of the text and the similarity of names.

(*g*) *The Compilers of the Gemara and the Date of their Compilation.*—The rapid growth of the material on the one hand and the religious persecutions under the Sassanide kings Yesdigerd II. and Phiruz on the other necessitated the collecting and ordering of the discussions of the Amoraim in Babylon. Tradition and research places this toward the close of the fifth century, and ascribe its editing to R. Ashi (head of the school in Sura from 375–427 A. D.). But R. Ashi was by no means the first, last, or only one engaged in the work. Some of the tracts differ strikingly from others, and repetitions are very numerous. At an early date attempts were made by means of mnemotechnic signs to give assistance to the memory, and it is very possible that many of the tracts, or parts of them, had been previously arranged by earlier Amoraim. R. Ashi rearranged, corrected, and perhaps completed them. Nor was the redaction finished by R. Ashi; tradition expressly mentions R. Abhina, ii. (473–499 A. D.) as coeditor; and authorities are quoted in the Gemara who lived toward the end of the fifth century. The final redaction was made under the Saboraim (the followers of the Amoraim in the sixth century. But the work was never formally closed. It was never intended that there should be a canon of the Gemara. The assertion of Graetz that "further additions and extensions could no more be admitted" is a simple fiction. Not only have marginal notes crept into the text, but long passages of Halachic tendency and numberless Haggadas have been interpolated into the

* Schiller (*Encycl. Brit.*, xxiii., 36) says that the Gemara to *Shekahim* and the five smaller tracts are wrongly added to the Babylonian Gemara.

Gemara. Even passages from the famous commentary of R. Yitschaki have been incorporated in the text. Indeed, in the Middle Ages it was a mooted point whether R. Ashi himself wrote down any of the Gemara. It seems impossible to believe that R. Ashi could have orally arranged so voluminous a work (ten or eleven times as large as the Mishna); and there exists an authentic tradition that R. Ashi revised the Gemara in a second edition.

Of the authorship and date of completion of the Palestinian Gemara still less is known. By an ancient tradition its authorship is ascribed to R. Jochanan (end of second century). But that is impossible, as everywhere one meets with the names of Amoraim who flourished centuries after R. Jochanan. Perhaps the tradition merely indicates that R. Jochanan was the author of the Mishna recension found in the Palestinian Gemara. J. H. Weiss has endeavored to prove that R. Jose ii. (about the middle of the fourth century) laid the foundation upon which the Palestinian Talmud was built. In regard to the date of composition the same uncertainty exists. Isaac Alfassi asserts that the authors of the Babylonian Gemara were acquainted with that of Palestine. During the Middle Ages all deferred to his authority. Jost declares that it was edited hardly 100 years after the close of the Mishna. Rappoport and Chayoth (*Mebo*, p. 28 b) agree with Alfassi. Frankel refutes their arguments; but concedes that the close of the Palestinian preceded that of the Babylonian by several centuries. Wiesner assigns to its completion so late a period as that between 760–900. Steinschneider is correct in saying that it was not edited before the last third of the fourth century (as Diocletian, Ursicinus, and Julian are mentioned); and it probably received its final form at the time of the abolition of the patriarchate of Tiberias, in the last quarter of the fifth century.

(*h*) *Condition of the Text of the Gemaras.*—It is hardly to be expected that the text of the Babylonian Gemara, which has passed through the hands of so many copyists and compositors, should be very correct; but the disfigurement of the text as it stands is greater than in the case of any other work which has been handed down to us from ancient times. Three causes have occurred to bring about this result: (1) Unfortunately, the text of the Talmud was not treated with that care accorded to the biblical text. Incompetent men have inserted marginal notes in the text, have omitted whole sentences, and have confused names and things in general. Would-be critics have made uncalled-for changes in the text to suit their pleasures—an abuse already complained of by Hai Gaon. (2) Pious censors, who continued to pursue the literature of the Jews with a fanatical hatred almost to the present day, found a peculiar pleasure in venting their spite upon the Talmud. Ignorant and overzealous as most of them were, they not only expunged the few passages that refer to the founder of Christianity, but many others which they wrongly construed to be disguised attacks upon Christianity. Jewish editors themselves, in sheer self-defense, undertook to erase what a mournful experience had taught them was liable to give offense. (3) Good MSS. became very scarce, owing to the bigotry of mediæval popes. Acting upon the order of Louis IX., cartloads of the Talmud were burned in Paris 1242. Clement IV. (1265–68) sent to the Bishop of Tarragona a bull ordering that all copies of the Talmud should be handed over to the Franciscans and Dominicans, who were to burn whatever was anti-Christian. Gregory IX. in 1239 ordered the archbishops in France, Spain, and Portugal to confiscate all possible copies of the Talmud. Fortunately the passages which have been expunged or disfigured have been published separately.

Since the invention of printing not less than fifty complete editions of the Talmud have been published (see Rabbinovicz, *Dikduke Soferim*, p. 42), besides hundreds of single tracts. None of these, however, can be said to contain a philologically correct text. It is true that from the sixteenth century on attempts have been made to justify the text of the Gemara, notably by such scholars as Solomon Luria (1582), Samuel Kaidonover (1697), Isaac Berlin (1800), Elia of Wilna (1797), and Akiba Eger (1837). R. Rabbinovicz, in his *Variæ Lectiones*, 15 vols., Munich, 1868–86, has collected a large number of variants, especially from the celebrated Munich MS. But the first systematic attempt to formulate the requirements for such an edition was made by F. Lebrecht. In 1886 the Semitic section of the Seventh Oriental Congress publicly expressed its desire in this direction. M. Friedmann has accordingly attempted such a critical edition of *Sukkoth*, but hardly with success.

A trustworthy scientific text can be gotten only by (1) a comparison of all available MSS., (2) a comparison of parallel passages in both Gemaras, (3) a collection of all the citations in the older compendia,* in the commentaries,† and in the lexicon of R. Nathan ben Yechiel. A good beginning has been made in this direction by Max L. Margolis in his *Commentarius Isaacidis quatenus ad textum Talmudis investigandum adhiberi possit* (New York, 1891); *The Columbia College MS. of Meghilla* (New York, 1892).

The Palestinian Gemara has fared still worse. The corruption of its text is visible on every page. It has not suffered so much as the Babylonian from censorial interference and from the mistakes of copyists, for during a long period it remained unknown in the schools, and even after it had become known it was barely noticed, much less critically studied by scholars. But it has suffered from want of attention and pure ignorance of the Aramaic dialect in which it is written. Its unguarded condition has caused it to be largely interpolated, especially in its Haggadic portions. Wiesner has endeavored to show that such interpolations, evidently aimed against the reputation of the great bearers of Talmudic tradition, were at times the work of the Karaites, whose chief seat was in Palestine. Though this has been denied by Geiger, S. Adler has brought additional proof of this view in his *Kobeṣ al Yadh*. Only one complete MS. of the Palestinian Gemara exists in Leyden and one fragment in Oxford.

(*i*) *The Literature of the Talmud.*—For eighteen centuries Jewish thought has almost wholly moved within a sphere of which the Talmud was the center. The more the Jews were oppressed the more fruitful did their literary activity become. It kept the soul alive while the body was almost dead. An immense literature has grown out of and around the Talmud. A bare list of such would fill a bulky volume. (For the older literature, see Steinschneider, *Jew. Lit.*, London, 1857, and *Catal. Libr. Hebræor. in Bibl. Bodleiana*, Berlin, 1860. For the newer literature, Ben Jacob, *Oṣar Hassepharim*, Wilna, 1880, and the ordinary bibliographies.) They may be roughly referred to the following categories: (1) Epitomes (Halachoth). (2) Commentaries, primary and secondary. (3) Novellæ (extended disputations on Talmudic topics). (4) Digests, and commentaries on them. (5) Collections of commandments (containing the Talmudic ordinances in peculiar arrangement. (6) Ritual and legal questions and answers. (7) Religious discourses. (8) Polemic and apologetic works. (9) Lexica and works of reference. (10) Collection of Proverbs. (11) Historical and bibliographical works. (12) In modern times monographs and larger treatises of a scientific character. This great literature is written mainly in rabbinical Hebrew, but a number of works have appeared in Arabic, and latterly in almost every European language.

(*j*) *Some Auxiliaries to the Study of the Talmud.*—Very little has been done toward the grammatical treatment of the Talmudic texts; but see S. D. Luzzato, *Elementi Grammaticali del Caldeo Biblico e del Dialetto Talm. Babyl.*, Padua, 1865 (Germ. transl. by Krüger, Breslau, 1873; Eng. by J. S. Goldammer, New York, 1876); and the monographs G. Rülf, *Zur Lautlehre der Aram. Talmud. Dialekte* (Breslau, 1879); I. Rosenberg, *Das Aramäische Verbum im Babyl. Talmud.* (Marburg, 1888); M. G. Landau, *Geist und Sprache der Hebräer* (Prague, 1822); G. Dalman, *Gramm. d. galiläischen Aramäische* (Leipzig, 1894).

As to lexicons, the situation is more favorable. *The Aruch*, by Rabbi Nathan, of Rome, after having been enlarged by Benjamin Musaphia and M. J. Landau, has been re-edited according to the editio princeps and some MSS. in the monumental work of A. Kohut, *Plenus Aruch* (or *Aruch completum*; 8 vols., Vienna, 1878–92). Buxtorf's *Lex. Talmudicum* has been re-edited and enlarged (though not successfully) by B. Fischer (Leipzig, 1875). See also S. M. Bondi, *Or Esther* (Dessau, 1812); A Stein, *Talmudische Terminologie* (Prague, 1869). In modern languages should be mentioned J. Levi, *Chald. Wörterb. über die Targumim* (Leipzig, 1867); *Neuhebr. und Chald. Wörterb.* (Leipzig, 1876–89); M. Lattes, *Saggio di giunte e correzione al Lessico Talm.* (Turin, 1879); *Nuovo Saggio* (Rome, 1881); *Miscellanea Postuma*, fasc. i., ii. (Milan, 1884–85); M. Jastron, *A Dict. of the Targumim, the Talmud*, etc. (London and New York, 1886, *seq.*); J. Fürst, *Glossarium Græco-Hebræum*

* Such as the *Halakhot Gedholoth*, the *Sheeltoth of R. Achai Gaon*; the compendium of *Alfasi*; Jacob ibn Chahib's compendium of the Haggada *En Jacob*.

† Gershon ben Jehudah, Chananel, Nissim, Solomon ben Isaac (Rashi), the compilers of the Tosaphot or additions, Moses ben Maimon.

(Strassburg, 1891); Arsène Darmesteter, *Le Talmud* (in *Rev. Étud. Juives*, xix., p. ccclxxxi). As a general work of reference, J. Hamburger, *Real-encyclopädie für Bibel und Talmud* (Strelitz, 1883–86) may be consulted. See also a paper by T. Theodores, *The Talmud*, in *Owens College Magazine*, pp. 329–378; S. Schecter, *On the Study of the Talmud*, *Westminster Review* (1885); and especially the learned treatise of H. S. Strack, *Einleitung in den Thalmud* (Leipzig, 1887; 2d ed. 1894).

Much less has been done for the Palestinian Talmud; but see Zach. Frankel, *Introductio in Talmud Hierosolymitanum* (Breslau, 1870); M. Schlesinger, *Das Aram. Verbum im Jerusal. Talmud* (Berlin, 1889).

(*k*) *Translations of the Talmud.*—No work is so difficult to translate into a modern language as is the Talmud. Its condensed and peculiar style makes it unintelligible to one who can not make use of it in the original. The following attempts have been made, but they are all to be used with great caution: G. E. Edzard, *Tractatus Talmudici Avoda Sara* (Hamburg, 1705); B. Ugolini, *Thesaurus* (*Zebachim Menachoth, Tamid Sanhedrin*) (vol. xix., 1756; vol. xxv., 1762); Chiarini, *Berachoth* (Leipzig, 1831); Joh. J. Rabe, *Der Talmudische Tractat Berachoth* (Halle, 1777); E. M. Pinner, *Talmud Babli, Tractat Berachoth* (Berlin, 1842); F. C. Ewald, *Abodah Sarah* (Nuremberg, 1856); A. Sammter, *Tractat Baba Meşia* (Berlin, 1876); M. Rawicz, *Der Traktat Megilla* (Frankfort-on-the-Main, 1883); D. O. Straschun, *Der Traktat Taanit* (Halle, 1883); M. Rawicz, *Der Traktat Rosch ha-Schanah* (Frankfort-on-the-Main, 1886); Aug. Wuensche, *Der Babyl. Talmud in seinen Haggadischen Bestandtheilen* (2 vols., Leipzig, 1886–87); A. W. Streane, *A Translation of the Treatise Chagigah* (Cambridge, 1891); M. Rawicz, *Der Traktat Sanhedrin* (Frankfort, 1892); *Talmud in Maráthi*, transl. by Rámchandra Náráyan Neue (Bombay, 1884, *seq.*).

Of the Palestinian Talmud there is translation of seventeen tracts in B. Ugolini's *Thesaurus antiquitatum Sacrarum* (vols. xvii,–xxx., Venice, 1755–65); Moïse Schwab, *Le Talmud de Jérusalem traduit* (Paris, 1871, *seq.*; Eng. transl. of vol. i., London, 1885); M. Schwab, *Traité des Berakhoth* (Paris, 1871); J. J. Rabe, *Der Talm. Tractat Peah . . . aus der Hierasol. Gemara übersetzt* (Ansbach, 1781); Aug. Wuensche, *Der Jerus. Talmud in seinen Haggad. Bestandtheilen* (Zurich, 1880).

(*l*) *General Character and Importance of the Talmud.*—It is almost impossible to give in one paragraph an idea of what the Talmud is in its entire scope. From early times it has been customary to speak of the Ocean of the Talmud. The metaphor is well chosen to characterize a work so gigantic in proportions, so unique in the world's literature. It is a sea into which during many centuries have flowed the waters of Jewish life and Jewish thought. It swarms with a thousand varied forms of life. The Talmud is no dry handbook. It is an open encyclopædia of rabbinical Judaism, containing not only a digest of laws, enactments of ceremonial, moral, religious, and social character, but a record of the discussions themselves on each and all of these subjects; the history of the men who appear on its pages, their sayings and doings, and the record of the events which took place in the political life of the people during so eventful a period.

The Talmud has suffered much both from its worshipers and detractors. For the great mass of Jews it has been the one regulator of their every action, and has been held in as high esteem as the Bible. By its detractors it has been branded as "the product of a subtlety run mad." But a just and intelligent estimate of the great work finds hidden in its depths innumerable pearls and many priceless treasures, though at the same time much that is useless and the product of an over-developed casuistry, which the world and a large proportion of the Jews have now outlived. The Talmud is the mirror of its age, and the men of the Talmud, however exalted they may have been in intellect and character, were none the less the children of their age. The early Fathers of the Christian Church and the scholastics of the Middle Ages were imbued with the same spirit of casuistry; but neither class is regarded as authoritative in matters of belief and action, but as marking an epoch in the history of the Christian Church. Modern scientific inquiry will treat the Fathers and Scholastics of the Talmud as the Jewish representatives of a system matured in the past. It will find in the Talmud a source for the history of a great part of the Jewish mind, and will thus secure for the Talmud a place among the literary monuments of the world.

(*m*) *Science.*—The religion of Judaism, as represented in its Talmudic form, was a religion of life. It accompanied its adherent from the cradle to the grave. The Talmud, therefore, whose object it was to develop religion, to that extent had often to treat of questions of general science. The Haggada, too, offers scientific material in abundance. For the history of the different sciences there is much material buried in the discussions of the Talmud. The following branches are represented:

1. *Mathematics.*—Apart from scattered allusions, entire chapters of several tracts are devoted to mathematics for the purpose of fixing various religious observances. See the literature in Steinschneider, *Hammaskir* (1875); Mahler, *Ueber den Talmud als Quelle für das Studium der Geschichte der Mathem.* (*Jüd. Litt. Blatt*, xii. 1883).

2. *Medicine* is treated of in numerous places in the Talmud. No complete collection of all the passages has been made, but see S. Cohn, *De Medicina Talm.* (Breslau, 1846); J. Wunderbar, *Biblisch-Talmudische Medicin* (Riga and Leipzig, 1850); Alois Brecher, *Der Aderlass im Talmud* (in *Prager Medicin. Wochenschr.*, 1873); Joseph Bergel, *Die Medicin der Talmudisten* (Leipzig, 1885).

3. *Botany* is represented in the Talmud in the discussions on the agricultural laws, etc. The whole material has been definitely collected in the excellent work of Im. Low, *Aramäische Pflanzennamen* (Leipzig, 1881).

4. *Zoölogy.*—See L. Lewysohn, *Zoologie des Talmud* (Frankfort-on-the-Main, 1858); J. Bergel, *Studien über die Naturwissenschaftlichen Kentnisse der Talmudisten* (Leipzig, 1880).

5. *Astronomy.*—In addition to scattered notices on the subject, astronomy is especially discussed in the treatise *Rosh Hashanah* in regard to the fixing of the new moon. See S. Gobermann, *Sheerith Yaakob* (Vilna, 1884).

6. *Law.*—In this direction the Talmud offers vast material, which has given rise to numerous monographs, of which the principal are Frankel, *Der Gerichtl. Beweis nach mosaisch-talmudischem Rechte* (Berlin, 1846), *Zur Kenntniss des mosaisch-talmudischen Criminal- und Civilrechts* (Berlin, 1860), and *Grundlinien des mosaisch-talmudischen Eherechts* (Breslau, 1860); Mayer, *Die Rechte der Israeliten, Athener und Römer* (Leipzig); J. Wiesner, *Der Bann* (Leipzig, 1864), *Das mosaisch-talmudische Polizeirecht* (Leipzig, 1879); M. Mielziner, *The Jewish Law of Marriage and Divorce* (Cincinnati, 1884); J. J. M. Rabbinowitz, *Législation criminelle du Talmud* (Paris, 1876), *Législation civile du Thalmud* (5 vols., Paris, 1877–80); M. Bloch, *Das mosaisch-talmudische Erbrecht* (Leipzig, 1890).

7. *History.*—As the Talmud contains the product of the Jewish mind for 1,000 years, it is almost the only guide for the understanding of the development of Judaism from the close of the Bible to the close of the Babylonian Gemara. It also offers much archæological material which still awaits research. For a proper insight into the origin and beginnings of Christianity, the Talmud is an invaluable source. Much that is in the New Testament, its mode of exegesis, its allusions, and the conflict between the different sects of the time can be understood only in connection with the social and scholastic life (of which it was a part) as portrayed in the Talmuds. See Aug. Wuensche, *Neue Beiträge zur Erläuterung der Evangelien aus Talmud und Midrash* (Göttingen, 1878); M. H. Bennet, *The Mishna as Illustrating the Gospels* (Cambridge, 1884); Ferd. Weber, *Die Lehren des Talmuds* (Leipzig, 1888); E. Schürer, *A History of the Jewish People in the Time of Christ* (New York, 1891).*

8. *Geography.*—As may be expected, much geographical information, especially in regard to Palestine, Syria, and Babylonia, is contained in the Talmud. Zunz was the first to call attention to this. See *Gesammelte Schriften* (i., pp. 151–154); Berliner, *Beiträge zur Geographie und Ethnographie Babyloniens* (Berlin, 1883); A. Kohut, *Lakes of the Holy Land* (in *Jew. Quart. Rev.*, iv., p. 690, *seq.*).

9. *Pedagogics.*—Even before the destruction of the temple elementary and higher schools existed all over Palestine. The material on this subject has been collected by S. Marcus, *Zur Schulpädagogik des Talmud* (Berlin, 1866); J. Weisen, *Geschichte und Methodik d. Schulwesens im Talmud* (Strassburg, 1892).

10. *Ethics.*—From the description of the Talmud as given here, it will be seen how difficult it is to speak of the ethics of the Talmud as a whole. As there is no system of phi-

* For the influence of the Talmud on Mohammed, see Geiger, *Was hat Mohammed, etc.* (Bonn, 1833); Hirschfeld, *Beiträge zur Erklärung des Koran* (Leipzig, 1886).

losophy or of psychology, so there is no real system of ethics contained in the Talmud. We find there the individual opinions of different teachers, living at different times and under different circumstances. It is as wrong to make the whole Talmudic Judaism responsible for certain views as it is to foist upon the official Halacha the beautiful flights of individual teachers. The terrible accusations of Wagenseil, Eisenmenger, and Rohling (where they are not directly falsified), have magnified the one, while the panegyrics of Emanuel Deutsch and S. R. Hirsch have contributed little toward arriving at a just estimate; but, on the whole, it may be truthfully said that the general ethical level of both Halacha and Haggada is a high one, reaching in many of the leading spirits of the day to the full height of moral excellency of their time, and that where it does recede from this height it is due to political and social oppression, or to an excessive use of casuistical argumentation.

Non-Jewish scholars who were acquainted with its contents, such as Reuchlin, Buxtorf, Herder, F. Delitsch, and H. Strack, have even become its strenuous defenders; and it may indeed be said that it is due to the Talmud that the long centuries of heartrending persecutions which the Jews have had to suffer have been unable to break down their spirit or degrade their intellectual, moral, and emotional life. See Ad. Lowy, *Die Tugend und Sittenlehre des Talmud* (Vienna, 1890); S. Schaffer, *Das Recht und seine Stellung zur Moral* (Frankfort, 1889); Leopold Dukes, *Rabbinische Blumenlese* (Leipzig, 1844); and cf. A. Keunen, *Volksreligion und Weltreligion* (Berlin, 1883), p. 188. See BIBLE.
Revised by RICHARD GOTTHEIL.

**Tal'pidæ** [Mod. Lat., named from *Tal'pa*, the typical genus, from Lat. *tal'pa*, mole]: a family of insectivorous mammals embracing the moles and the desmans. The ears are rudimentary, and the eyes very small; the skull is nearly smooth, and the posterior ridges are obsolete; the foramen magnum is oblong, and inclined far forward below; there are no distinct postglenoid processes; the tympanic elements form auditory bullæ; the zygomatic arches are slender rods: the teeth are in number M. $\frac{3}{3}$, P. M. $\frac{3-5}{3-5}$, C. $\frac{1}{1}$, I. $\frac{2-3}{1-3} \times 2$, and also differ in development; in the upper jaw the true molars mostly (i. e. M. 1 and M. 2) have each four primary external and two primary and more elevated internal cusps, and an internal ledge bearing a cusp along its inner wall, but no secondary lower ledge behind the principal internal one; in the lower jaw the true molars have each two primary external cusps and three primary internal ones, connecting, and by their union circumscribing, triangular areas; the other teeth vary much in the several groups; the vertebræ are characteristic in that the cervicals have no hypapophyses, and the dorsal and lumbar no hyperapophyses; the sternum has a broad and keeled manubrium; the fore limbs are generally developed more than the posterior; the carpi are more or less enlarged, and have at least each an additional ossicle developed as an os intermedium: the scapulæ are long and narrow. (1) The *Talpinæ* include the moles, and have the body large and subcylindrical, the neck short, and the fore limbs short and very wide, and eminently adapted for digging; the skull is inflated at the pterygoid regions, and has no distinct pterygoid fossæ; the lower jaw is contracted under the ascending rami: the incisor teeth are in good number ($\frac{3}{3-2}$); the sternum has a very elongated manubrium; the clavicles are short and broad, the humeri broad, and enlarged at their angles; and the carpi have each an enlarged, sickle-shaped bone. (2) The *Myogalinæ* are in external appearance considerably like the shrews or long-snouted mice; the skull is not inflated at the pterygoid regions, and has distinct pterygoid fossæ; the lower jaw is extended below under the ascending rami; the incisor teeth are in reduced number ($\frac{2}{3}$ or $\frac{2}{1}$); the sternum has a manubrium of moderate size; the clavicles are elongated; the humeri subcylindrical; and the carpi have no sickle-shaped bones. The family is entirely confined to the northern hemisphere, and each great region is characterized by peculiar forms. Of the moles, the typical species (forming the group *Talpæ*, distinguishable by dental characters) are represented by the genera *Talpa* and *Scaptonyx* in Europe and Eastern Asia, and aberrant groups (*Condyluræ* and *Scalopes*) are exemplified by four genera in North America—viz., *Condylura*, *Scalops*, *Parascalops*, and *Scapanus*. Of the *Myogalinæ*, one genus (*Desman* or *Myogale*) is represented by species in certain parts of Europe (e. g. Pyrenees) and Asia; another (*Uropsilus*) is peculiar to Southern China or Tibet; a third (*Urotrichus*) has species in Japan; and a fourth (*Neurotrichus*) in America W. of the Rocky Mountains. See DESMAN and MOLE.
Revised by F. A. LUCAS.

**Taluses**: See PHYSIOGRAPHY.

**Talvi**: pseudonym for THERESE ALBERTINE LUISE ROBINSON (*q. v.*).

**Tama**: city; Tama co., Ia.; on the Chi. and N. W. and the Chi., Mil. and St. P. railways; 2 miles S. of Toledo, the county-seat, and 51 W. of Cedar Rapids (for location, see map of Iowa, ref. 5–I). It is in an agricultural region, and has a public park, 6 churches, public and parochial schools, water-works, electric-light and street-railway plants, a national bank with capital of $50,000, a private bank, and 2 weekly papers. The city has excellent water-power, and flour, saw, and paper mills, egg-case, cigar, and broom factories, and 3 machine-shops and factories. The reservation of the Sac and Fox Indians is in the township. Pop. (1880) 1,289; (1890) 1,741; (1900) 2,649.
EDITOR OF "HERALD."

**Tamagawa**: a river of Japan, flowing eastward into the Bay of Tokio, which it enters a few miles S. of that city. For over two centuries Tokio has received a supply of pure water from a canal cut from this river to the Yedogawa; and the water-works, with modern plant, obtain their supply from the same source. Cormorant-fishing is practiced at the Sekido ferry on this river. The finest cherry-blossoms found in the vicinity of Tokio occur at Koganei, on its banks. Hachioji, a silk-manufacturing center, is near the Tamagawa and about 25 miles from its mouth. J. M. D.

**Taman'dua** [= Portug., from the native name; said to be Tupi *taa*, ant + *munden*, trap]: a species of ant-eater (family *Myrmecophagidæ*), found in Brazil and other parts of northeastern South America, and distinguished by its arboreal habits and long prehensile tail. The hair is short; the color of the head, shoulders, fore limbs, hind limbs outside, and tail along the middle is white; a stripe from each side of the neck over the shoulder and remaining part black. The native name has been accepted as a generic term, and the species is now known as *Tamandua tetradactyla*.
Revised by F. A. LUCAS.

**Tama'qua**: borough (settled in 1799, incorporated in 1832); Schuylkill co., Pa.; on the Tamaqua or Little Schuylkill river, and the Cent. of N. J. and the Phila. and Read. railways: 17 miles E. N. E. of Pottsville, the county-seat, and 40 miles N. of Reading (for location, see map of Pennsylvania, ref. 5–H). It is in a coal-mining region, and contains a public high school, 24 graded public schools, 12 churches, gravity water-works, gas and electric lights, a national bank with capital of $100,000, a State bank with capital of $47,130, 3 foundries and machine-shops, 2 planing-mills, flour-mill, powder-mill, screen-works, and a semi-weekly and a weekly newspaper. Pop. (1880) 5,730; (1890) 6,054; (1900) 7,267.
EDITOR OF "COURIER."

**Tamarack**: See HACKMATACK.

**Tamarind** [from Arab. *tamarhindī*, liter., Indian date; *tamar*, date (cf. Heb. *tāmār*, palm-tree) + *Hindī*, Indian, deriv. of *Hind*, India]: a beautiful leguminous tree, the *Tamarindus indica*, from Southern Asia and Africa, now naturalized in most warm regions. The pods are filled with a pleasant sour pulp, which is preserved with sugar, and is used for making a drink for fever patients, etc. Tamarind-pulp contains citric, tartaric, and malic acids, potash, sugar, vegetable jelly, etc. As a salt of copper is a common adulteration, a piece of polished iron (as a knife) should be left in the pulp for about an hour, when, if copper be present, it will be deposited on the iron. Tamarind-pulp is refrigerant and gently laxative, and is employed in the diseases of children. The tree is sparingly grown in Southern Florida and along the north shore of the Gulf of Mexico. The wood is very hard and handsome.
Revised by L. H. BAILEY.


Tamarind (*Tamarindus indica*).

**Tamarisk Family** [*tamarisk* is from Lat. *tamaris'cus, ta'marix*; cf. Sanskr. *tamālaka*, a kind of tree]: the *Tamariscaceæ*, a small group of about forty-five species of dicotyledonous shrubs or trees, mostly of the temperate and warmer regions of the northern hemisphere, with regular, hermaphrodite flowers, having five sepals, five petals, five to many stamens, and a superior one-celled, many-ovuled, three to five carpellary ovary. The leaves are alternate and small, often scale-like. The most important genus is *Tamarix*, which includes about twenty species, several of which are cultivated for their pretty pink flowers and beautiful foliage—e. g. *T. articulata*, *T. dioica*, *T. parviflora*, *T. tetrandra*, and *T. gallica*, the common tamarisk, which has run into many varieties. An interesting relationship has been shown to exist between this family and the WILLOW FAMILY (*q. v.*), in which the flowers are simplified from the tamarisk type. CHARLES E. BESSEY.

Common tamarisk (*Tamarix gallica*).

**Tamatave**, taa-maa-taav': town and port on the east coast of Madagascar; lat. 18° 10' S., lon. 49° 28' E., 140 miles E. N. E. of Tananarivo, with which it is connected by telegraph (see map of Africa, ref. 8–H). It is on a sandbar between the port and the ocean, and is considered insalubrious. The port has deep water, but is ill protected and dangerous of access. Extensive improvements have been authorized by the Hova government. The trade is large, and the exports consist of cattle, swine, skins, rice, tobacco, copal, raw silks, mats, baskets, woods, especially the violet ebony wood. There are several important business houses. Pop. about 7,000, of which 3,000 are foreigners, including French, British, Hindus, natives of the U. S., and natives of the Mascarene islands. M. W. H.

**Tamaulipas**, taa-mow'lee-paas: a northeastern state of Mexico; bordering on Texas, the Gulf of Mexico, Vera Cruz, San Luis Potosí, Nuevo Leon, and Coahuila. Area, 29,339 sq. miles. Nearly all the surface consists of plains and low rolling lands with occasional hills, resembling the coast-belt of Southern Texas, and, like it, bordered by extensive lagoons and salt-marshes. The southwestern part alone is included in the Mexican plateau, which here rises to about 4,000 feet; this is bordered by low mountains of the eastern Sierra Madre, and their well-watered slopes are the finest and most thickly inhabited portions of the state. The climate of the plains is essentially tropical, and the coast region is hot and often insalubrious during the summer months; much of the land is too dry for tillage without irrigation. The mountain region has a temperate and healthful climate with abundant rains; portions of forest remain, principally on the higher slopes. Besides the Rio Grande, which forms the northern boundary, and the Pánuco on the S., the state has several considerable rivers. Agriculture and grazing are almost the only industries; but sugar, cotton, and hides are exported, and coffee-raising has come into prominence. There are no mines of importance, though silver, coal, petroleum, etc., are reported. Pop. (1893) estimated, 173,200. Capital, Ciudad Victoria. The principal ports are Tampico and Bagdad, the port of Matamoros. A strip, nominally 20 km. wide, along the northern frontier constitutes the *Zona Libre*, or Free Zone; this was established by the state in 1858, and has been extended by the general Government to the entire northern frontier of Mexico. Imports for use in the zone (except cattle) pay only 10 per cent. of the ordinary duties. The Mexican authorities claim that this arrangement is necessitated by the retail trade across the frontier; the U. S. customs officers, on the contrary, have frequently complained that it encourages smuggling. HERBERT H. SMITH.

**Tamboff'**: government of European Russia, in the southeastern part of the empire, on the Oka. Area, 25,710 sq. miles. Pop. (1897) 2,715,265. Here are large forests yielding fine timber and excellent pasturage. The grain crops are large, especially in the southern portions. Woolen fabrics, tallow, and spirits are largely manufactured.

**Tamboff**: capital of the government of Tamboff, European Russia; on the Zna; founded in 1636 (see map of Russia, ref. 8–E). It is well built, with low wooden houses that are surrounded by gardens. It has a college, an ecclesiastical seminary, a high school for ladies, a military academy, and several other educational institutions, and has an active trade in the products of the district. Pop. (1897) 48,134.
Revised by M. W. HARRINGTON.

**Tambora**: See SUMBAWA.

**Tambourine** [from Fr. *tambourin*, dimin. of *tambour*, drum (in O. Fr. *tabour*) from Arab. and Pers. *tambūr*, kind of lute or guitar, and Pers. *tabir*, drum]: a musical instrument resembling a drum, consisting of a wooden or metallic hoop over which a parchment is stretched, and furnished with a set of bells. It is held in one hand, and beaten with the knuckles or fingers of the other hand, or sometimes also with the elbow. It has been in use from time immemorial in the Basque provinces of Spain and in the retired regions of Italy, especially in the Abruzzi, and is well known from its employment by gypsies and wandering musicians, being a favorite instrument for accompanying their dances. It also figures prominently in the music of the Salvation Army.

**Tamerlane**: See TIMUR.

**Tamil Language**: See DRÁVIDIAN LANGUAGES.

**Tam'many Society**: a political society in New York, founded by an upholsterer named Mooney, May 12, 1789. It derived its name from a Delaware chieftain who for his reputed virtues was in the latter years of the Revolution facetiously chosen patron saint of the new republic. Organized ostensibly for charitable purposes, it nevertheless had a definite political character from the first, representing the dread of an aristocracy and the distrust of Hamilton's policy felt by the thoroughgoing Democrats of the time. Secret societies under the auspices of St. Tammany were organized in Philadelphia and other cities; but the institution soon fell into oblivion except in New York, where it was soon turned to account as a political lever, and it ultimately became the principal instrument of the managers of the Democratic party in New York, exerting a considerable influence also upon State politics, and to a less extent on national politics. The society was much discredited by the participation in its honors of WILLIAM M. TWEED (*q. v.*) and his accomplices in fraud, but it was reorganized, and to some extent reformed, after the Tweed prosecutions.

**Tammuz** [Heb., from Babylonian *Dumuzu*, *Duzu*]: a god of Babylonian origin, whose death the Israelitish women are said to have bewailed (Ezek. viii. 14). A similar lamentation has been found in the cuneiform literature. Tammuz represents the spring vegetation which comes to an end in the fourth month. For this reason the Babylonians named that month after the god; and with the other names of the months, the Jews took this one from the Babylonians. There is, no doubt, some connection between the cult of Tammuz and that of the Greek Adonis (*Ādhōn* = lord), which the old writers expressly connect with the Orient. The real home of the Adonis worship seems to have been Syria and Southern Asia Minor, though it appears as early as the seventh century B. C. in purely Greek countries. Whatever its origin may be, its later forms were undoubtedly influenced by the East. That sexual excesses were connected with the worship of Tammuz is evident from the phallus which still plays a part in the modern Persian festival of Husein, which Eerdman has shown to contain remnants of the old Tammuz worship. RICHARD GOTTHEIL.

**Tampa**: city; port of entry; capital of Hillsboro co., Fla.; at the head of Tampa Bay at mouth of the Hillsboro river; on the Fla. Cent. and Pen., the Savannah, Fla. and W., and the Silver Spr., Ocala and Gulf railways; 30 miles from the Gulf of Mexico (for location, see map of Florida, ref. 6–I). It has an excellent harbor, with 23 feet of water at the outer bar, mean tide, and has steamship connection with New York, New Orleans, Mobile, Havana, Puerto Cortez (Honduras), Key West, and other ports. There are 17 churches, 7 public and 8 private schools, 2 national banks with combined capital of $150,000, 3 daily and 6 weekly newspapers, electric-light and street-railway plants, and a spring-water supply with daily capacity of 3,000,000 gal.

The principal industry is the manufacture of cigars, which has 120 establishments, employs 4,000 persons, and turns out goods of an annual value of $6,000,000. In 1894 the internal revenue collections aggregated $185,000, and the custom-house collections $600,000. During the year 35,000 tons of phosphate were shipped to domestic ports and 105,-000 tons to foreign. The city has hotel property valued at $3,000,000. Tampa was made a port of entry in 1886, and has grown rapidly since. Pop. (1880) 720; (1890) 5,532; (1900) 15,839. EDITOR OF "TRIBUNE."

**Tampa Bay**: a body of water on the west coast of Florida, chiefly in Hillsboro County. Its upper portion is divided into two parts, called Old Tampa Bay and Hillsboro Bay. It is some 35 miles long and from 6 to 15 miles wide. A line of keys fences its entrance from storms, so that it constitutes a safe, spacious, accessible, and excellent harbor. The bay contains many small islands, and abounds in fish and turtle. On Egmont Key, at the entrance, is a brick lighthouse 86 feet high, lat. 27° 36′ N., lon. 82° 45′ 15″ W.

**Tampico**, taăm-pee'kō: town and port of the state of Tamaulipas, Mexico; a short distance above the mouth of the Pánuco river, which divides Tamaulipas from Vera Cruz; terminus of railways to Monterey and San Luis Potosí (see map of Mexico, ref. 6–H). The harbor, formed by the river, has been made good and safe by extensive improvements, including a breakwater and jetty, so that vessels drawing 24 feet of water may enter the harbor. The town is built on flat land surrounded by swamps; in the summer it is hot and unhealthful, but less so than Vera Cruz. The Pánuco and its branch, the Tamesí, are navigated for some distance by small steamers, and there is a canal to afford inland communication between Tampico and Tuxpan, Vera Cruz, through the lagoon of Tamiahua. Tampico was opened as a port in 1823, when the fort in Vera Cruz was still held by the Spaniards. During the frequent blockades of Vera Cruz it has been the most important gulf port of Mexico, and its trade is increasing. Pop. (1889) 11,680. HERBERT H. SMITH.

**Tamsui**, taam'sōō'ēē [literally, fresh water (town)]: a treaty-port of Formosa, on the north end of the island, in the hien or district called Changhwa; lat. 25° 10′ N., lon. 101° 26′ E. (see map of China, ref. 7–K). It lies between a double-peaked hill of about 1,700 feet, on the S. W., and the Tamsui range of mountains (2,800 feet), which extend far into the interior, and is distant about 13 miles from the large trading-town of Bangka. The anchorage is poor, and has at its mouth a bar covered with 10 feet of water at low tide. The water-supply of the town is remarkable for its excellence, being obtained from a mountain stream 8 miles inland from Bangka, and conducted to the city by a tunnel cut in the solid rock, and a wooden aqueduct 8 feet wide and 5 feet deep, supported on crutches 30 feet above the surface of the water of an affluent which it has to cross in its course. The village of Kien-pai and the towns of Bangka and Twa-tu-tia are supplied from the same sources. Tamsui (which includes Kilung, 29 miles to the E.) imports cotton and woolen goods, opium, metals, matches, kerosene oil, rice, beans, native cloth, joss-sticks, etc.; and exports, among other things, camphor, tea, and coal. In 1893 the foreign imports amounted to 2,137,805 haikwan or custom-house taels (= $2,244,695), and the native 947,417 taels; while the exports were valued at 5,197,652 taels. Pop. 100,000. R. LILLEY.

**Tan**: See FRECKLES.

**Tana**: See DEMBEA.

**Tanagers** [from Mod. Lat. *Tan'agra*, from Braz. *tangara*, a bird of the tanager kind]: the *Tanagridæ*, a family of passerine birds, having, as a rule, a thick, conical, triangular bill with the cutting edges not much inflected, and generally notched or toothed behind the tip; the angle of chin is not far forward; the nostrils are placed very high; the wings are moderate, angulated, have nine primaries, and the inner secondaries are not produced. They are closely related to the *Fringillidæ*, with which they should probably be united. The colors are in almost all the species quite brilliant. The group is peculiar to the New World, and is chiefly developed in the tropical regions. Over 300 species have been described, arranged under forty-three genera. One genus (*Piranga*) is represented in the U. S. by five species, the most conspicuous of which are the scarlet tanager (*Piranga erythromelas*) and summer redbird (*Piranga rubra*). The species feed upon grains as well as insects, etc. Revised by F. A. LUCAS.

**Tan'agra Figurines**: statuettes and groups of terra-cotta found since 1873 among the ruins of Tanagra in the modern province of Bœotia, Greece. The name is used loosely for statuettes and groups, fragments of which are found at other places, in Sicily, Southern Italy, Northern Egypt, as well as in Greece proper. In all the countries colonized or influenced by the ancient Greeks these figures were once as common as the painted vases which are so valuable to modern students, and Tanagra was only one, though an important one, of the many towns where keramic work was carried on. Thus outside the walls of Smyrna in Asia Minor are rubbish heaps from which have been brought hundreds of delicately finished heads in terra-cotta, the bodies being often left behind as unimportant. Many earthenware figures are found in tombs, but it does not follow that they were made, like the thin gold jewelry found in similar tombs, for interment with the body. It is far more likely that they were buried as the favorite works of art of the deceased, or in some cases as portraits of friends. It is the theory of some archæologists that the veiled female figures represent goddesses of the dead, as Persephone. Many of the statuettes are colored in an elaborate fashion, but this coloring is rarely fired so as to form true keramic painting; it is therefore very perishable. These painted statuettes generally bring the highest prices when offered for sale. As the laws of the Turkish empire and of Greece against the exportation of works of art have not long been enforced, and as these figures are small and easily concealed, thousands of them have been sold in Europe; and the greater number of these have passed into private hands. The museums of Europe and the U. S. have also fine examples.

The greater number of the figures discovered are standing, draped female figures from 6 to 9 inches high. These have been generally made in moulds, with the head alone showing signs of being finished by hand and much more carefully. The back of the figure, the drapery, etc., is generally much less carefully modeled than the front. Moulds have been found exactly corresponding to some of them. Groups of two or three figures are not uncommon, and some of these are curiously made like *appliques*, that is, with the back absolutely flat and blank, the whole group having one face only, as if a bas-relief of which the background had been cut away and removed.

Very few instances of the copying of important Greek statues are known among these terra-cottas, but these figures have given to the modern world a very important instance of what might be called *genre* sculpture among the ancients, fanciful, graceful, sometimes humorous, sometimes pathetic, and of a domestic sort. The theory cited above, that many of the pieces are religious in character, is not contrary to the evidently decorative and fanciful character of others. Many modern copies exist, sometimes made in the ancient moulds, and it has become difficult to distinguish the genuine ancient specimens. For treatises upon the subject, see A. S. Murray's *Handbook of Grecian Archæology*; the *Monuments Grecs*, a kind of periodical published in Paris; Rayet's *Art Antique*, which has splendid photographic plates; Kekulé's *Griechische Thonfiguren aus Tanagra* (Stuttgart, 1878); and many papers in the *Gazette des Beaux-Arts* and in other artistic and archæological periodicals. RUSSELL STURGIS.

**Tananarivo**: capital of Madagascar. See ANTANANARIVO.

**Tan'cred**: one of the most celebrated heroes of the first crusade; b. in Sicily in 1078, a son of Odo, a Norman baron, and Emma, the sister of Robert Guiscard; in 1096 raised an army in Apulia and Calabria, crossed over to Epirus, joined his cousin, Bohemund of Taranto, and distinguished himself greatly by his valor, sagacity, piety, and chivalric forbearance toward a defeated enemy during the campaigns in Asia Minor and Syria, but still more at the conquest of Jerusalem in 1099, and afterward in the battle of Askalon. He was made Prince of Tiberias, and governed with great wisdom not only his own principality but also that of Bohemund, who had been captured by the Saracens; but most of his time had been taken up in petty warfare, partly with Baldwin and the other Christian princes, partly with the Saracens. D. in Antioch, in 1112. His exploits have been narrated in prose and verse by Raoul de Caen in his *Les Gestes de Tancrède*. He also plays a conspicuous part in Tasso's *Gerusalemme Liberata*. See Delabarre, *Histoire de*

*Tancrède* (Paris, 1822), and Kugler, *Boemund und Tankred, Fürsten von Antiochien* (Tübingen, 1862).

**Tandy**, JAMES NAPPER: Irish agitator; b. in Dublin in 1740. He was the first secretary of the United Irishmen, a society said to have been formed to support HENRY GRATTAN (*q. v.*) in his effort to secure self-government for Ireland, but opposed by Grattan because of its rebellious schemes under the leadership of THEOBALD WOLFE TONE (*q. v.*). Tandy was active in local politics, being one of the Protestant leaders, and prominently engaged in the free-trade agitation. In 1792 he was ordered to be imprisoned for challenging the solicitor-general on the floor of the Irish House of Commons. Having been proclaimed, he brought an action against the viceroy and his privy councilors, but his suit was dismissed. In the spring of 1793, when he was about to be tried on a charge of distributing a seditious pamphlet, a far more serious charge of conspiracy was made against him, and he fled to the U. S., lived there five years, and then went to France, where he is said to have become a general of division. During the invasion of Ireland in 1798 Tandy landed at Rutland, Ireland, but failed and fled to Norway, and thence to Hamburg, where he was arrested and delivered to English authorities. He was tried and acquitted in Dublin on Feb. 12, 1800, but was held and tried in Lifford, County Donegal, for his treasonable landing, convicted, and sentenced to death. Again he escaped to France. He died in Bordeaux in 1803.

**Taney**, taw'nee, ROGER BROOKE, LL. D.: jurist; b. in Calvert co., Md., Mar. 17, 1777; graduated at Dickinson College in 1795; studied law, and was admitted to the bar in 1799, beginning practice in Calvert County, from which he was chosen a delegate to the General Assembly of Maryland; removed to Frederick, Md., in 1801, and in 1816 was elected to the State Senate. He originally belonged to the Federal party, and stoutly supported the policy of the Government in the war with Great Britain. In 1819, in his defense of a Methodist minister who had condemned slavery, he declared that slavery was a blot on the national character. In 1822 he removed to Baltimore, and in 1824 he became a supporter of Gen. Jackson, by whom in 1831 he was appointed U. S. Attorney-General, and in 1833 was nominated as Secretary of the Treasury in place of Mr. Duane, who had been dismissed in consequence of his disagreement with the President in the matter of the removal of the public deposits from the U. S. Bank; but the Senate, by a vote of 28 to 18, refused to confirm the nomination, although he had for nearly nine months exercised the functions of Secretary and had ordered the removal of the deposits. He was nominated by the President as the successor of Chief Justice Marshall, who died in 1835, and the administration having secured a majority in the Senate, the nomination was confirmed in Mar., 1836, he taking his seat upon the bench in the following January, and occupying it until his death. In the administration of this office he supported the supremacy of the U. S. Constitution, but far less broadly than Chief Justice Marshall had before him. Chief Justice Taney and a majority of the court decided, in the case of the city of New York against Miln, that an act of the Legislature of New York which required masters of vessels to report their passengers on arrival was a police measure merely, and did not interfere with the regulation of foreign commerce by Congress. In the case of Briscoe against the Bank of the Commonwealth of Kentucky the decision of the former Chief Justice Marshall was reversed, the new decision affirming the constitutionality of the act under which the bank was established. His judgment in a case connected with the Charles river bridge declared the right of legislatures to authorize bridges, railroads, and similar improvements regardless of contracts implied in former grants. Justice Joseph Story threatened to resign because of these decisions, and Chancellor James Kent declared that they destroyed his confidence in the Supreme Court as a guardian of the Constitution. In the case of disputed boundaries between Massachusetts and Rhode Island, in dissenting from the judgment of the court, Chief Justice Taney held that the Federal Supreme Court had no power to decide questions of political jurisdiction between States. His most noted act was his decision in the DRED SCOTT CASE (*q. v.*) in 1857. Another of his opinions which occasioned much public feeling was that rendered in 1861, in the case of John Merryman, who had been arrested in Baltimore by order of a Federal general for alleged treason. The chief justice issued a writ of *habeas corpus* to bring the prisoner before him; the officer in charge of Merryman refused to obey, on the ground that he had been empowered by President Lincoln to suspend the execution of the writ of *habeas corpus*; whereupon the chief justice wrote out a formal opinion to the effect that the President had no constitutional authority to suspend the writ, and that this could be done only by the legislative authority. D. in Washington, Oct. 12, 1864. A notice of his career is contained in Santvoord's *Sketches of the Lives and Judicial Services of the Chief-Justices of the United States* (1853), and a memoir, embodying an autobiography down to 1801, has been written by Prof. Samuel Tyler (1872). A bronze statue of him, ordered by the State of Maryland, was unveiled at Baltimore Dec. 10, 1872.

**Tanganyika**, taan-gaan-yee'kaa: a lake of Central Africa, S. of Lakes Albert and Victoria, between lat. 3° and 9° S. and between lon. 29° and 32° E.; about 400 miles in length from N. W. to S. E. It was first discovered by Burton and Speke in 1858, and afterward explored by Livingstone and Cameron. It has an elevation of 2,700 feet above the level of the sea, deep and clear water, and a very irregular form, its width varying from 10 to 50 miles. Area, 12,170 sq. miles. Its shores are generally rich in beautiful scenery, especially those of the northern part, which are set with mountains and hills covered with a luxuriant vegetation. The surrounding country is in many places densely peopled. The most important town is Ujiji, on the eastern shore.

The study of the fauna of Lake Tanganyika by Mr. J. E. S. Moore in 1896–97 suggested a striking theory as to the physical history of this part of Central Africa, and in 1899 Mr. Moore led an expedition to the lake to sound and dredge it, examine the surrounding region, and collect all data that may assist in solving the question he has raised. The genera of molluscs that occur in the African fresh waters have been found to be very constant over an immense area. The whole series in Lake Nyassa, for example, has also been recorded from Victoria Nyanza. But in Tanganyika he found a distinct fauna superadded to the normal African lake fauna. This strangely isolated group of organisms includes, besides the medusa and molluscs, two prawns, deep-water crabs, etc., which appear to be of marine instead of lacustrine origin. None of these animals can be directly associated with any living oceanic species, and the peculiar fauna, wherever it came from, must be old. It is inconceivable that delicate organisms like the medusa should have found their way up the lake's effluent as it now exists. The molluscs are almost exclusively deep-water forms. An anatomical examination of them shows that they possess the characters of several modern marine types. The supposition, therefore, is that the Tanganyika region must at one time have been in connection, either on the east, west, or north, with a deep arm of the sea. C. C. ADAMS.

**Tangent** [from Lat. *tan'gens*, pres. partic. of *tan'gere*, *tac'tum*, touch, whence Eng. *tact*, *tactile*, etc.]: a line touching a curve at some point of its length; this point is called the *point of contact*. The tangent to a curve at a point may be regarded as the limit of a secant through that point; for, suppose a secant to be drawn through the point of contact and at any other point of the curve; then let the second point be moved along the curve toward the first; the secant will continually approach the tangent, and when the second point falls on the first, the secant will become a tangent; if the motion of the second point is continued, the line will become a secant on the other side. From this explanation we infer that only one tangent can be drawn to a curve at a given point. An exception, however, occurs when two or more branches of the curve pass through the point. According to the theory of the infinitesimal calculus, a curve is to be regarded as a broken line whose sides are infinitesimal; the consecutive vertices of this polygonal line are called *consecutive points*, and the prolongation of any side is a *tangent*; a tangent to a curve is therefore a line passing through two consecutive points of the curve. The first point in the order of generation is the point of contact. For the trigonometrical tangent of an angle, see TRIGONOMETRY.

**Tan'ghin** [from Malagasy]: an ordeal poison formerly used in Madagascar, consisting of the powdered seed of the *Tanghinia venenifera*, an apocynaceous tree of that island. It killed by paralysis of the heart and respiration. It contains an active principle, *tanghinin*. A small portion was administered to the suspected person, whose only hope was in the emetic action which the drug sometimes exerted.

Revised by H. A. HARE.

**Tangier**, taan-jeer′ (Arab. *Tanja*, anc. *Tingis*): fortified port of Morocco, on the Straits of Gibraltar, 5 miles E. of Cape Spartel, on a shallow, semicircular bay open to the N. and N. E. (see map of Africa, ref. 1–B). Its trade is large and increasing. In 1892 935 vessels entered and 927 cleared; the value of the imports was $2,624,000 and the exports less than half as much. The chief imports are cotton goods and sugar; exports, beans, barley, and wool. Tangier is also of considerable political importance as the only place of residence permanently open for foreigners, whether representatives or private, and it is a favorite place of refuge for fugitives from justice. The winter climate is exceptionally fine, and is largely resorted to by those who are unable to stand the severer climate of Europe. Pop. about 30,000, one-third Jews, who transact most of the business. MARK W. HARRINGTON.

**Tangle**, or **Sea-tangle**: any one of several kinds of seaweeds, but especially *Laminaria digitata*. The young shoots are sometimes used as food and forage, and the plants are employed in the production of iodine. The stalks of the European sea-tangle are used in making uterine tents for surgeons' use, but those growing on the North American coast have been found unfit for this purpose.

**Tanhäuser**, taan′hoi-zer: minnesinger; probably a member of the noble family Tanhausen, in Bavaria. He was born in the early part of the thirteenth century; lived chiefly at the court of Vienna; participated in one of the crusades; probably joined King Konrad IV. (d. 1254), and disappears with the death of King Konradin (1268). He is one of the foremost representatives of the later minnesong, a poet of great talent, of delightful humor, and of a remarkable mastery of the metrical form. He led for a time a very gay life, and the sensuous character of many of his poems, as well as a penitential song which he composed later, may have been the cause of his becoming the hero of the Tanhäuser legend. According to this legend, Tanhäuser lived for some time with Venus in the Venusberg, but finally was smitten by conscience and begged Venus to allow him to depart. She refused, but owing to the help of the Holy Virgin Tanhäuser made his escape and went to Pope Urban (IV.) to obtain remission of his sins. The pope, however, answered that Tanhäuser's sins could as little be forgiven as the wand which he held in his hand could become green again. Tanhäuser, in his despair, went back to Venusberg and was received with great rejoicing. Three days after the pope's wand suddenly began to sprout, and messengers were sent to inform Tanhäuser of this divine miracle, but on account of his return to the Venusberg he was obliged to remain there till doomsday.

The Tanhäuser legend is doubtless one of the stories treating of the fatal union between a mortal youth and an elf which frequently occur in German, Danish, and English folk-songs, and which are founded on popular conceptions having their origin in old Germanic mythology. The reason why Venus, in this legend, takes the place of the elf may be found in the fact that the minnesinger Tanhäuser frequently addresses in his poems Minne (love) as Frau Venus. In the mentioning of Pope Urban may perhaps be seen a reminiscence of the historical fact that it was Pope Urban IV. (1261–64) who caused the final downfall and utter destruction of the glorious dynasty of the Hohenstaufen, with which Tanhäuser seems to have been closely allied. The story of the wand which began to sprout in spite of the words of the pope seems to express the popular view concerning the papal abuses in granting the remission of sins.

The best account of the Tanhäuser legend is contained in the famous *Tanhäuserlied*, one of the most popular folksongs of the sixteenth century, printed in Uhland's *Volkslieder*, No. 297. See also I. G. Th. Grässe, *Der Tannhäuser und Ewige Jude* (1861). In modern times the legend has been treated poetically by L. Tieck, H. Heine, Fr. von Sallet, E. Geibel, and by Richard Wagner in his famous opera. JULIUS GOEBEL.

**Tani**, KANJO, Count: soldier and statesman; b. in the province of Tosa, island of Shikoku, Japan, in 1837. He served on the imperialist side in the troubles of the restoration, and when the Satsuma rebellion broke out in 1877 was a major-general, in command of the garrison at Kumamoto. His brilliant defense of this stronghold against a powerful attacking force established his reputation. In 1883 he became Minister of Agriculture and Commerce, and soon after made a European tour. On his return he advocated various reforms in the administration, but as these were not adopted he resigned, and has since become leader of the opposition in the new house of peers. J. M. DIXON.

**Ta′nis** (Gr. Τάνις, Egypt. *Tā′* or *Tān*, Heb. *Zo′an*, Arabic *Ṣân*): an ancient Egyptian city in the Delta region, on the old Tanitic branch of the Nile (31° N. lat., 31° 55′ E. of Greenwich). It was the capital of the fourteenth nome of Lower Egypt, and a very populous and important city in certain periods of Egyptian history. In the Hebrew Scriptures it is said to have been founded seven years after Hebron in Palestine (Num. xiii. 22), and the miracles of Moses were said to have been performed in the "field of Zoan" (Ps. lxxviii. 12, 43). This designation corresponds with the native designation of the region, sekhet Tān, "the field of Tān." In the time of Isaiah and Ezekiel it was an important place. The site was explored by Napoleon's *savants*, by Mariette, and again by Flinders Petrie under the auspices of the Egypt Exploration Fund in 1883–84, The earliest monument found was a statue of Merira Pepi. of the seventh dynasty, but as it was the sole memorial of that ancient time it is supposed to have been transported thither at a later date. A red-granite colossal statue of Amenemha I., the first king of the twelfth dynasty, and others in black granite representing Usertasen I. and Amenemha II., of the same dynasty, are believed to be monuments of the earliest founders of the temple which constituted the central portion of the city. The last-named colossus shows a peculiarity, in that it is sculptured without the usual supporting pilaster in the rear. From the same dynasty came two sphinxes, one of which is in the Louvre. There were found also other pre-Hyksos sphinxes and statues dating from the thirteenth dynasty. From the following period, during which the place was beautified and fortified so that it became one of the Hyksos strongholds, the distinctive "Tanis sphinxes" were long supposed to have come. (See SPHINX.) They are cut from dark-gray granite, adorned with manes, short, thick beards, and shaggy breasts. They have been usurped by later native kings, who caused their own names to be inscribed over erasures, rendering an exact determination of their age impossible. In some cases the name of the Hyksos king Apepi still is visible on the right shoulder of the sphinxes. From the eighteenth dynasty there are no monuments at Tanis, but with Seti I. and Ramses II. of the nineteenth dynasty its real glory dates. The latter built the huge temple, utterly obliterating the plan of the buildings of the twelfth dynasty Pharaohs. This building was massive and extensive, and was approached by an avenue adorned with obelisks (fourteen have been found in broken condition), sphinxes, and huge statues. In a space of 150 feet were found eight obelisks, and between them were the statues mentioned above, while towering above them all was the colossal statue of Ramses II., which Petrie, judging according to the law of proportion when applied to the fragments that were found, declares must have been about 75 feet high, or, with the base and diadem, 92 feet, and must have weighed complete about 900 tons, "the largest statue ever executed." The ruins of the temple cover a space about 1,000 feet long and occupy a depression surrounded by ridges about 60 feet above the Nile. Tanis retained its importance under the native kings down to the thirtieth dynasty and under the Greeks and Romans. It appears also to have been an important seaport, and to have lost its pre-eminence to Alexandria through the silting up of the Tanitic branch of the Nile (now represented by the Mu'izz Canal) and also of Lake Menzaleh. In the Coptic period it had lost its importance completely and was scarcely known. At present Sañ is a squalid fishing-village, half a mile from the canal and at a considerable distance from Lake Menzaleh. See Petrie, *Tanis* (2 vols., London, 1885, 1888), and second and fifth *Memoirs* of the Egypt Exploration Fund. CHARLES R. GILLETT.

**Tanjore**, tăn-jōr′: city of Madras, British India: capital of a district of the same name, and railway junction; on the right bank of the south branch of the Cavery; lat. 10° 47′ N., lon. 79° 10′ E. (see map of S. India, ref 7–E). It is one of the great religious and literary centers of Tamil India, and is renowned for its artistic industries (silk rugs, jewelry, and copper *repoussé*) and for its great pagoda. The palace of the rajahs contains a very valuable collection of 18,000 Sanskrit manuscripts. Pop. (1901) 57,605. M. W. H.

**Tank-worm**: See GUINEA-WORM.

**Tan′nahill**, ROBERT: poet; b. at Paisley, Scotland, June 3, 1774; bred as a weaver, he worked at the loom all his life;

wrote occasionally for periodicals, and in 1807 published *The Soldier's Return, with other Poems and Songs, chiefly in the Scottish Dialect*, which rendered the poet famous. Several of these became popular favorites, and have remained so. When his publisher hesitated to issue a new and enlarged edition, he fell into a fit of despondency, burned all the new poems which he had written, and drowned himself in a pool near Paisley, May 17, 1810. A statue of the poet was erected in Paisley in 1883. Tannahill possessed much tenderness of sentiment and a delicate feeling for the effects of nature. An edition of his poems by D. Semple (1876) contains an exhaustive account of the poet's life and writings.

**Tanner**, THOMAS, D. D.: antiquary; b. at Market Lavington, Wiltshire, England, Jan. 25, 1674; was educated at Oxford, and was made fellow of All Souls in 1696; entered holy orders; became successively chaplain to the Bishop of Norwich, whose daughter was his wife, chancellor of Norwich, prebendary of Ely, rector of Thorpe, near Norwich, Archdeacon of Norwich (1710), canon of Christ church, Oxford (1723), and in 1732 Bishop of St. Asaph. His principal works, published posthumously, are *Notitia Monastica*, an account of the religious houses, colleges, hospitals, etc., founded in England and Wales before 1540 (1744), and *Bibliotheca Britannico-Hibernica*, an account of the writers who flourished in England, Scotland, and Ireland up to the beginning of the seventeenth century (1748). He edited Anthony Wood's *Athenæ Oxonienses* (2 vols. fol., 1721). He bequeathed his large collection of MSS. to the Bodleian Library. D. at Oxford, Dec. 14, 1735.

Revised by S. M. JACKSON.

**Tannhäuser**: same as TANHÄUSER (*q. v.*).

**Tannic Acid**, or **Tannin** [*tannic* is deriv. of *tan*, tanbark, deriv. of *tan* (verb) < O. Eng. *tannian*; cf. O. H. Germ. *tanna*, fir, oak > Mod. Germ. *tanne*, fir; *tannin* = Fr., deriv. of *tan*, tan]: any one of several astringent principles that are widely disseminated in the vegetable kingdom. The chief sources of these compounds are the barks of varieties of the oak and pine, sumach, gall and valonia nuts, kino, dividivi, and catechu; the bark and berries of many forest and fruit trees, such as the elm, the willow, the horse-chestnut, the plum, the pear. All of the forms of tannic acid were formerly supposed to be identical with the tannin contained in the gall-nut, the differences in chemical composition presented by them being accounted for by the presence of accidental impurities; but there is no doubt of the existence of several distinct acids with many properties in common.

The term "pathological tannins" has been applied to those obtained from diseased vegetable excrescences, such as the gall-nut; those which are contained in barks, etc., being designated as "physiological tannins. The latter only are adapted to the manufacture of leather. The most important and best-investigated form of tannin is that known as gallotannic acid. Other modifications are caffetannic, catechutannic, morintannic, quercitannic, and quinotannic acids, which, although very similar in many properties, possess different compositions.

Gallotannic acid occurs in the gall-nut, an excrescence produced by the puncture of a small hymenopterous insect upon the leaves and stalks of the species of oak *Quercus infectoria*, sometimes in a proportion as high as 60 per cent. of the mass. The tannin of the sumach, once considered identical with gallotannic acid, appears to be a distinct compound. Pure gallotannic acid, $C_{14}H_{10}O_9$, is an amorphous buff-colored solid, easily soluble in water; it also dissolves in aqueous alcohol, but only with great difficulty in pure ether. It has an intensely astringent taste, imparts a strong red color to litmus, enters into double decomposition with bases, and liberates carbonic acid from the carbonates. Of the gallotannates, the ferric salt is especially characteristic and important. It is obtained, upon adding a solution of the acid to a solution of a ferric salt, in the form of a violet-black precipitate. This reaction is exceedingly delicate. The basis of much of the ordinary writing-ink is ferric gallotannate. In common with most forms of tannin, gallotannic acid forms with gelatin an insoluble compound. The affinity of the acid for gelatin is so great that when a skin is immersed in its aqueous solution all the tannin is ultimately removed. This property of gallotannic acid is often utilized in its quantitative estimation in nut-galls, etc., a standardized solution of gelatin, with a small quantity of alum or ammonic chloride, being employed for this purpose. See LEATHER. Revised by IRA REMSEN.

**Tanning**: See LEATHER.

**Tañoan** (tăn'yō-ăn) or **Tanoan Indians**: a family of North American Pueblo Indians. In the middle of the sixteenth century they were widely scattered and divided into distinct geographic groups, and they were variously named by their Spanish discoverers and conquerors. For a long time they were regarded as representative, linguistically and otherwise, of four diverse stocks, but since 1878 they have all been designated as *Tanoan*.

*Tribes and Pueblos.*—As with other Pueblo Indians, they are chiefly named according to their pueblos or towns. In alphabetical order these are Hano (of the Tusayan group in Arizona), Isleta (New Mexico), Isleta (Texas, below El Paso), Jemez, Nambe, Pecos (a mere remnant, living since 1840 with their kinspeople at Jemez), Picuris, Pojoaque, Sandia, San Ildefonso, San Juan (de los Caballeros), Santa Clara, Senecú (in Northeastern Chihuahua, Mexico, below El Paso), Tangewiñge (a remnant sub-tribe sharing with the Keresans the pueblo of Santo Domingo), Taos, and Tesuque.

*Habitat.*—Notwithstanding the intrusion of the Keresan Cochitme and Kiwami tribes (which was comparatively recent at the time of the discovery), the Tanoans were the people *par excellence* of the Rio Grande del Norte, originally occupying, with but slight interruptions, its entire valley and some of its outlying tributaries from within 40 miles of the northern boundary of New Mexico to within 120 miles of Mexico itself, a stretch of country not less than 230 miles long by a varying width of from a few to nearly 100 miles at its several widest points. Throughout this region their pueblos were, in the sixteenth century, distributed from north southward in five groups—Taos, Tewa, Jemez, Tanos, and Piros—this geographic distribution agreeing almost wholly with that of the ethnic subdivisions of the family.

Of the Taos group were Taos (Te-wat-ha, the "Braba" of Castañeda and the "Tayberon" of later Spanish writers), situated about 45 miles due N. N. E. of Santa Fé, on an eastern tributary of the Rio Grande, and Picuris (Ping-'ul-tha or U-la-na, the Picuries of Oñate, 1584–85), 2 miles S. W. of Taos. Both occupy nearly the same positions as when discovered.

Of the Tewa group, San Juan (Jyu-o-tyu te-oj-ke) was situated on the western side of the Rio Grande, about 30 miles S. W. of Picuris. It was, with a companion town on the opposite side of the river, at Chamito, now in ruins, the Tunque Yunge of Castañeda, and from it probably the majority of the Tewas now of Hano in Tusayan fled in the latter part of the seventeenth century. The still inhabited Santa Clara (Ka-po), and San Ildefonso (Pho-ju-o-ge), on the east side of the river, respectively about 2 and 5 miles lower down than San Juan, belonged also to the Tewas. Their remaining towns are (as they were) Pojuaque (Pho-ju-añ-ge), Nambe (Na-im-be), and Tesuque or Tezuque (Te-tzo-ge), all quite near to each other and from 6 to 9 miles E. of the main Rio Grande valley, the last-named being only 9 miles N. of Santa Fé.

The Jemez (or Teguala tribe) now occupy but one pueblo, Jemez (Wa-la to-hu-a), 30 miles W. of the Rio Grande, on the Rio Jemez, but in the sixteenth century they existed in two branches. The western was distributed in twelve or thirteen towns, of which the main group was near the famous Hot Springs of San Diego. Here were the large ruins of Gwin-se-wa or old Jemez (at the Hot Springs themselves), and of A-mox-yum Kwa, Asht-ya-la-kwa, and four others on the heights lower down. Below these still were seven or eight goodly towns (the ruins of which can be still distinctly traced), from about where the modern Jemez stands to near the Keresan towns of Cia. The Pecos (Pa-e-kwi wa-la), or eastern branch of the Tequala, speaking the same dialect, were separated by a distance of 80 miles from their western kinsmen, with whom their few survivors now dwell. They occupied the famous ruin of Pecos (Tshi-kwit-ye, the Cicuiye of Coronado), on the Rio Pecos, some 40 miles E. of the Rio Grande and S. E. of Santa Fé. This pueblo was, at the time of the discovery, the largest and most populous in New Mexico. It is probable also that the ruins of Ku-wang wa-la (pueblo de las Ruedas) and Se-yu-pa we-la, near Fulton in the same section, were occupied by sub-tribes of these Pecos, who were the most eastern representatives (as the Taos are the most northern) of all the Pueblo peoples.

Properly, there were three groups of the Tano pueblos—the northern, or Galisteo; the southern, or Rio Grande; and the eastern, or Manzano. The northern Tanos (Tañ-ge-was) originally had two pueblos on the site of the present capital of New Mexico, and others in the same neighborhood; but when discovered their most northern town was Tzi-gu-ma, at Ciénega, 12 miles S. of Santa Fé, and a few miles S. E. of this was another important town at San Marcos, called Kwa-ka. About 12 miles farther S. (at Galisteo) was their principal pueblo of Tan-ge-wiñ-ge, and within a radius of 10 miles around the Galisteo basin the lesser pueblos of I-pe-re (at San Lázaro), Yam-p'ham-ba (San Cristóbal), and Hi-shi, or Pueblo Largo. Of these six towns the inhabitants were almost totally destroyed by the Comanches and Apaches soon after the sixteenth century, a few fugitives seeking shelter with the Santo Domingo Keres, where their descendants remain, keeping up, as do their Tewa kinsmen in the far away Hano of Tusayan, their original language and organization. On the northern spurs of the Sandia and Manzano Mountains were other pueblos of this tribe. In addition to these, but belonging more properly to the Rio Grande division of the Tanos, were six or seven pueblos W. and S. W. of the Salines, linking the northern or Tañ-ge-was to the more southern or Isleta series of Tano towns. Of the latter there were twelve or thirteen, situated along the Rio Grande from Bernalillo to below Isleta, including Na-f'hi-ap, near Bernalillo, and a town at Los Corrales (the ancestral homes, probably, of the present Sandias); and Pu-a-ray, the principal pueblo of the series, Hy-en tu-ay, and Bejui tu-way, near Las Lunas, which were the ancestral abodes of the modern Isletas. These eighteen or more populous pueblos constituted the famous province of Tiguex of Coronado.

Following the Isleta pueblos, there were at least ten or twelve settlements of the Piros distributed along both sides of the Rio Grande as far S. as San Marcial. The northernmost of these (abandoned for El Paso in 1680) was at Alamillo; another, called Pil-a-bo, and perhaps a third, occupied the site of Socorro. At San Antonio was the New Mexican Se-ne-kú, or Senecú, which was destroyed by Apaches in 1675. Fugitives from it fled to Socorro and to Chihuahua, near El Paso, where they established themselves with fugitives from other devastated towns in the pueblo of the same name there, still inhabited by their descendants. The last of the series, and the most southern example of the compact, many-celled pueblos, still occupied at the time of the discovery was Tre-na-quel, at San Marcial. S. of the Salines and some 40 miles E. of the Rio Grande series were, in the valley of Abo, the Piro towns of Abo and Ten Abo (El Pueblo de Los Siete Arroyos), and near the Mesa de los Jumanos, Tabira, or the famous Gran Quivira. All of these Piro towns, including three or four others in the immediate vicinity, were destroyed by Apaches between 1670 and 1680, those of the inhabitants who escaped fleeing to the lower Senecú and Isleta pueblos.

*General Characteristics.*—The Tanoans were everywhere the frontiersmen of the Pueblo country and peoples. On the N. and E. they were contiguous to the Great Plains, and thus to the Utes, Pawnees, Comanches, dog-using Apaches, and other buffalo-hunting or roving tribes. With these they were constantly either at war or on terms of very doubtful amity during frequent but brief trading-truces. Thus they became hardier and more warlike, and greater travelers, traders, and hunters, than any others of the Pueblo peoples. Their training as mountaineers, and their intermarriage for generations with wilder neighbors, especially with the Shoshonean Utes and Comanches, have had a marked influence on their physical development and appearance.

The typical Tanoans (of the north especially) are tall, broad-shouldered, lithe, but strong-limbed, resembling the plains Indians in these and many other respects, even more than they do the Pueblo Indians of other stocks. They are alert in movement and wit, their expression being keen, their features spare, clear-cut, and prominent. The women are shorter than the men, but taller than the average Pueblo woman, and less rotund as a rule. Their costume is much the same. Their dresses, although more ornate, are much shorter of skirt, both modifications being due largely to their greater stature, and to the more active life led by the Tanoan women. The men wear their hair as do the northern plains Indian, long, and plaited at the sides (with fur or bright-colored stuffs interbraided), instead of doing it up at the back in a club or queue, as do the Keresans. They also wear long leggings of buckskin in place of the short, wide trousers or long knitted stockings of the other Pueblos, and for a long time catskin and buffalo robes largely supplied the place of the striped or figured and woven serapes so characteristic of all the other Pueblos.

The wide distribution of the Tanoans was the result of their wandering proclivities; their permanent segregation in small but numerous communities and the compact many-storied and steeply terraced style of their pueblos being due to their constant warfare and defensive necessities. In supplying all pueblos with products of the buffalo-hunt the Tanoans formed small trading-parties, which sometimes penetrated as far S. and W. as the Pima country of Arizona and Northern Mexico. Even now their descendants are the greatest travelers and cleverest traders among existing Pueblos. Able to secure in this way all the products of the finer Pueblo arts, they depended more than the townspeople on both barter and the hunt, tilled the soil less extensively, and seldom resorted to irrigation.

Their tendency to sever themselves (in bands more or less numerous) from their own communities and to join those of other stocks is strongly characteristic, the Hano Tewas of Tusayan being the last of a series of such migrant settlements. While thus so much affected externally by natural and sociologic environment, the Tanoans have been remarkably tenacious of their language, organization, and customs, even the few survivors of the Galisteo towns adhering to these, after a residence with alien people for more than two centuries. This adhesion to native institutions was in part due to the similarity of culture everywhere traceable among the Pueblos; but with the Tanoans the division of each tribe into two main bodies—the clan-groups of winter and summer—was more distinct than with the other Pueblos, resulting sometimes in double (that is, northern and southern) divisions of their towns, as at Taos, and in the possession of at least two kivas in every pueblo. Within these groups, however, occurred the usual septenary subdivisions (see *Habitations* under PUEBLO INDIANS) and the clan-system, together with the totems of their tribes, was no less analogous to those of other Pueblos. The cult-lore of the Tanoans, while pueblo in principle, is very composite in make-up, their folk-tales being derived from, or modified by, that of all the numerous wilder peoples with whom they held intercourse. Naturally they had not advanced beyond simple animism and a resultantly extensive fetish worship, which included a kind of mortuary fetishism not characteristic originally of the other pueblos (exclusively, it may be, of the Tusayan Indians). Their dance-worship is more obviously animal dramaturgy than is that of the Zuñi Pueblos, and their sacred or sociologic games are more athletic than those of the farther pueblos. Their tendency to war kept them on only a slender footing of peace even with the other pueblos, but made them pre-eminent, and secured them leadership, in case of any general confederation or uprising of the Pueblos. The Rio Grande or Isleta (Tiguex) Tanoans were the first to oppose the Spaniards, murdering the earliest Franciscan missionaries to New Mexico. Moreover, it was a wizard chief of the Tanoans, the celebrated Popé, who incited, planned, and largely led the terrible Pueblo rebellion of 1680–96, which well-nigh resulted in the downfall of Spanish power N. of Mexico. Yet the position of the Tanoans on the frontiers, as heretofore defined, led to the speedy extermination of whole groups of their pueblos by the wilder tribes soon after the introduction of Spanish horses and firearms, which, by changing the nature of Indian warfare, rendered the Pueblo defensive method no longer adequate.

*History.*—There is evidence that the ancestral Tanoans were derived from the northwest—ruins of their pueblos being abundant in Colorado and Utah, and thence traceable southwardly into the cañon and mountain country W. N. W. of the present Taos ranges in the north of New Mexico. It seems probable that the Lower Taños and Jemez branches were the first to migrate, peopling the basin and tributary valleys of the great river below Santa Fé, from the north and west, while the Taos and Tewa branches of the same family descended directly from the west, and then spread gradually eastward and downward along the upper section of the same river to about their present stations thereon and on the higher tributaries.

Whatever the original language of the Tanoans may have been, it is now true that considerable numbers of words in their various dialects show Shoshonean association. Their long intercourse and constant intermarriages with Ute and Comanche branches of this great stock during centuries may account for this. If, nevertheless, the Tanoans should yet be proven to have been Shoshonean at an earlier stage of development, then the conversion to the pueblo mode of life and the aridian status of culture of the Shoshonean-Moqui or Tusayan Indians is, by comparison with theirs, a modern event. It is worth noting that the Jemez Tanoans are now largely Navajo, and that formerly they and their eastern kinsmen, the Pecos, were once so intermixed also with the Zuñis that much in their dialect—especially in the names of their pueblos and ruins—shows unmistakable relation to the Zuñi. this, however, more in a derivative than in an inherited way. The wide rangings of the Tanoans made them no less townspeople in the Pueblo sense, but far less sedentary than any of the other Pueblo peoples, and hence less conservative, more subject to admixture with and prone to adopt terms, etc., from outsiders.

*Population.*—The total population of the Tanoan Indians was in the sixteenth century much greater than at present. There are now only between 3,250 and 3,300 of them. Isleta, of New Mexico, is the most populous pueblo, its inhabitants numbering 1,059.

AUTHORITIES.—Ad. F. Bandelier, in *Papers* and *Reports* of the Archæological Institute of America (i., Boston and Cambridge, 1883–91); H. H. Bancroft, *Arizona and New Mexico* and *Native Races*; and W. W. H. Davis, *Spanish Conquest of New Mexico.* See also INDIANS OF NORTH AMERICA, PUEBLO INDIANS, KERESAN INDIANS, SHOSHONEAN INDIANS, and ZUÑIAN INDIANS. FRANK HAMILTON CUSHING.

**Tanrec**, or **Tenrec** [= Fr., from native (Malagasy) name]: any insectivorous mammal of the family *Centetidæ.* The species are confined to Madagascar, and some have a superficial resemblance to hedgehogs. The tailless *Centetes ecaudatus* attains a length of 6 inches, and has dorsal spines, lost in the adult. The species of *Orzoryctes* are mole-like, and burrow in the rice-fields, doing much damage.

**Tansil'lo**, LUIGI: poet; b. at Venosa, Italy, in 1510. He passed his life in Naples, where he long enjoyed the favor of the viceroy, Don Pedro de Toledo, after whose death, however, he lived poorly by a small office in the customs. D. at Teano, Dec. 1, 1568. His earlier poems are the *Due Pellegrini*, a pastoral; the *Vendemmiatore* (1532), in *ottava rima*, a work so licentious that it was placed upon the Index; and some amorous *Rime*, probably addressed to Maria of Aragon. To his later period belong certain spirited *Capitoli*, or epistles sent to influential friends; the *Balia*, exhorting mothers to nurse their own children; the *Podere* (1560), an idyl on the charms of country-life; and the *Lagrime di San Pietro*, a religious work written by way of atonement for the *Vendemmiatore.* See *Opere di Luigi Tansillo* (Venice, 1738); *Poesie di Luigi Tansillo* (London, 1782); *Capitoli giocosi e satirici*, ed. by S. Volpicella (Naples, 1870); *Poesie liriche edite ed inedite*, ed. by F. Fiorentino (Naples, 1882, with biography); *Il podere*, in *Poeti minori italiani* (Venice, 1786); *The Nurse, a Poem translated from the Italian of Luigi Tansillo*, by William Roscoe (3d ed. Dublin, 1800, with Italian text); *X. Sonetti inediti*, in *Aneddoti tansilliani e danteschi*, ed. by Francesco and Imbriani (Naples, 1883); Franc. Flamini, *Sulle poesie del Tansillo di genere vario* (Pisa, 1888). J. D. M. FORD.

**Tansy** [M. Eng. *tansaye*, from O. Fr. *tanaisie* < Late Lat. *athana'sia*, tansy, from Gr. ἀθανασία, immortality, deriv. of ἀθάνατος, immortal; ἀ-, un-, without + θάνατος, death; cf. *live-forever*, name of a plant]: the *Tanacetum vulgare*, a perennial plant of the family *Compositæ*, bearing doubly pinnatifid leaves and yellow flowers, blossoming from July to September. It was originally introduced into the U. S. from Europe, where it is indigenous. It is cultivated in gardens, but also grows in fields and along roadsides. It possesses a very strong, not unpleasant odor, and an acrid and aromatic taste, properties which are exhibited by its aqueous and alcoholic infusions. The leaves contain a peculiar volatile oil and an acid termed *tanacetic acid*, which is crystalline, forms salts with potassium and sodium, and precipitates solutions of calcium, zinc, silver, and mercury salts. The volatile oil of tansy has a specific gravity of 0·92; when distilled with potassium chromate and sulphuric acid, it yields a volatile crystalline substance isomeric with ordinary camphor; it possesses poisonous properties. Its seeds and leaves are employed, to a slight extent, as medicinal agents. Revised by L. H. BAILEY.

**Tan'talum** [Mod. Lat., named from the mythical *Tantalus* (see TANTALUS), because of the perplexity and difficulty encountered by its discoverer in isolating it]: one of the rarer elements, a metal discovered in 1802 by the Swedish chemist Ekeberg in two Swedish minerals, one of which was *tantalite*, composed mainly of tantalic oxide, $Ta_2O_5$, and ferrous oxide. For many years it was confounded with the COLUMBIUM (*q. v.*) of Hatchett. Tantalum is found also as tantalate of yttrium in the mineral *yttro-tantalite*; in the American, Bavarian, and Greenland *columbites*, with columbic acid; in Nordenskjöld's *hjelmite*; in *euxinite*, *æschynite*, etc. H. Rose obtained metallic tantalum as a black powder, of density 10·78. Its equivalent weight is accepted as 182 from determinations of Marignac. *Tantalic pentoxide* ($Ta_2O_5$), which forms tantalic acid by reacting with water, and tantalates by combining with bases, is an infusible white powder. Revised by IRA REMSEN.

**Tan'talus** (Gr. Τάνταλος): in Greek mythology, a very wealthy King of Phrygia, though some of the mythographers wrongly assign him to Argos, Corinth, or Paphlagonia. He was a son of Zeus and a nymph called Pluto (wealth)—though his lineage is variously given—and father of Pelops and Niobe. He was a favorite of the gods, who often invited him to their banquets, but their favor changed to hatred when Tantalus stole nectar and ambrosia from their table. In order to test the omniscience of the gods he slew his son Pelops, and served him up at a banquet to which he invited the Olympians. As a punishment for this crime he was cast down to Tartarus, where, tortured by hunger and thirst, he was made to stand in a lake, whose water receded whenever he tried to drink; rich fruit hung in clusters from trees above his head, but was withdrawn whenever he tried to pluck it. According to others his punishment consisted in eternal fear caused by a huge rock that was suspended over his head and threatened to fall and crush him. The myth is based on facts. The capital city of Tantalus was in the neighborhood of Smyrna, and its acropolis and what is called the tomb of Tantalus still exist. See Perrot and Chipiez, *History of Art in Phrygia*, etc. (London, 1892). J. R. S. STERRETT.

**Tantum Ergo** [Lat. (these words occurring in the hymn) *tantum* (*sacramentum*), so great (a sacrament) + *ergo*, therefore]: a popular eucharistic hymn, the fifth and sixth stanzas of the *Pange Lingua* (Proclaim, O Tongue!), a famous hymn by Thomas Aquinas. It is sung in Roman Catholic churches during eucharistic services, at the benediction.

**Taoism**, tow'izm [Chinese *tao*, road, way, or path; word, doctrine, reason, etc. + *ism*]: a philosophy and a religion found in China. Both are supposed to be based on the teachings of LAO-TSE (*q. v.*), a scholar and official of the sixth century B. C., who, disgusted with the general decay of manners and social order which characterized his times, became a recluse, and embodied his ideas of things in a little book entitled *T'ao-teh-king*, the "Classic of the Way and of Virtue"; but it is probable that he merely gave expression to ideas which had already found currency in his own and earlier times, while the religion called Taoism, if it ever had any connection with philosophic Taoism, has lost all trace of it. Just what philosophic Taoism is depends largely on the meaning of the word *tao.* Scholars are not agreed, and there is no word in English which can be used in all cases as a satisfactory equivalent. Moreover, Lao-tse's work is obscure in style and abounds in paradoxes, and the writings of Lieh-tse (about 500 B. C.), Chwang-tse (fourth century B. C.), and other later Taoists throw little light on the subject. Some Western scholars call it the "Doctrine of the Way," that is, of the ideal or eternal way of right conduct. Others describe it as "Rationalism," or the doctrine of Reason; while still others speak of it as "Naturalism."

Lao-tse's system seems to have been leveled more particularly against the artificial enactments, by which it was sought to remedy the licentiousness and the turbulence and unrest of his time. He wished people to cultivate "naturalness" or the simplicity and innocence of former days. It is only when *tao* (or nature) is missed that arbitrary standards are set up, that men become ambitious and violent, and squabble in their eagerness for gain and advantage. He who does not act contrary to his nature continues long. Lao-tse inculcated unselfishness under the figure of "emptiness" and humility under the simile of water, which, though good at benefiting all things, always seeks the lowest place—the place which all men dislike. Lastly, he taught that unkindness should be requited with kindness. CHU-HI (*q. v.*), the famous Chinese philosopher of the twelfth century, sums up Taoism as the doctrine of surrender to others. "Its leading doctrines," says Giles, "teach man, by a course of non-resistance and inaction, to bring his moral and physical natures into perfect harmony with their environment, the result being a complete victory over all obstacles to human happiness and even over death itself."

Taoism as a religion dates from the advent of Buddhism in China in the first Christian century, when the superstitions and fanciful notions about immortality (in the flesh) and genii, and alchemy, with its quest after the elixir of life and the herb of immortality, and geomancy, etc., became consolidated into one system and adopted Buddhist forms. It has its temples, monasteries, and idols; its "three pure ones" (in imitation of the Hindu Trimūrti and the Buddhist Triratna), of whom Lao-tse is one, its hell and its purgatory, and a hereditary pope, who enjoys large estates granted him by the government, whose recognition and patronage it now shares with Buddhism. Its moral system is embodied in such tracts as the *Kan Ying Pien*, or Book of Rewards and Punishments (translated by Dr. Legge in his *Texts of Taoism*).

For a fuller account of Taoism in both its forms, see Julien's translation of the *Tao-teh-king* (1822), and the translations in German by Plänckner and von Strauss (1824); Chalmers's *Speculations of the Old Philosopher Lau-tsze* (1868); Legge's *Religions of China* (London and New York, 1881) and his *Texts of Taoism*, in the Sacred Books of the East (2 vols., Oxford, 1891); Balfour's *Works of Chuang-tsze* (1881) and his *Taoist Texts, Ethical, Political and Speculative* (1884); also Giles's *Chuang Tzu, Mystic, Moralist, and Social Reformer* (London, 1890). R. LILLEY.

**Taos**: See TAÑOAN INDIANS.

**Tapajós**, tăă-pāă-zhōs': a river of Brazil; one of the principal southern tributaries of the Amazon; formed by the junction, in lat. 10° 24' 30" S., of two nearly equal branches, the Arinos and Juruena. Both of these rise on the plateau of Matto Grosso, near lat. 14° 30' S., and about 225 miles apart. The sources of the Arinos are close to those of the Paraguay, and it is said that both receive water from the same tracts of flooded land. The Arinos, Juruena and Tapajós are obstructed at intervals by rapids and low falls as far as lat. 4° 30' S.; below this the lower Tapajós is navigable, broadening into a lake-like expanse 12 miles across, but suddenly narrowing to less than a mile at its mouth in the Amazon. Length of the Tapajós and Arinos, nearly 1,100 miles. HERBERT H. SMITH.

**Tapestry** [from O. Fr. *tapisserie*, deriv. of *tapisser*, furnish with tapestry, deriv. of *tapis*, tapestry, carpet < Late Lat. *tape'tium* = Gr. ταπήτιον, dimin. of τάπης, τάπητος, tapestry, rug, carpet]: a fabric made by weaving or tying threads of worsted, silk, or other material into a warp of strong twine, which warp is not seen in the finished stuff. Tapestry is made entirely by hand and without those repetitions of the pattern which are characteristic of mechanical weaving. It also differs from all weaving in the usual sense in the fact that there is no shuttle thrown from side to side of the web. It has been rightly described as a mosaic of threads held in place only by the warp. In some modern languages the word for tapestry means also common worsted-work on canvas, and this is not inaccurate, for tapestry differs from worsted-work chiefly in its much greater solidity and in the immensely superior character of the designs executed in it. Both differ from embroidery, in that there is no background, as of cloth or leather, upon which the work is done, the whole fabric being made together.

Tapestry was anciently made on a frame which held the twine of the warp horizontal. As the work was always done from the wrong side, the workman could not see the right side, which was held downward and out of reach. An invention, perhaps of the Middle Ages, consisted in using a vertical frame. With this the workman can easily walk to the right side or face of his tapestry, judge of its progress, and compare it minutely with the cartoon or pattern made for him to follow. These two processes are called low warp (*de basse lisse*) and high warp (*de haute lisse*). The important tapestries since the fifteenth century are all high warp.

During the fifteenth and following centuries tapestry was made in Flanders, France, and Italy, and probably in other European countries. The most famous center of the industry was the town of Arras, France, and the name "arras" was often applied to tapestry of any make, as in Shakspeare's *Henry IV.*, Act II., Scene IV. Tapestry was the favorite decoration for walls of rooms and even for the lower part of the interiors of churches and chapels. It was hung from hooks and generally left free at the lower edge, so that a certain space might be left between it and the wall, in which a person might be concealed. The decoration of interior doorways and windows was made of but little account by the tapestry, which turned all corners and was arranged to meet across the door or to conceal the window at pleasure. This loose hanging of the tapestry is important to its best effect; those pieces which in modern times have been stretched tight and framed, as in the Gallery of Apollo in the Louvre, lose their charm and are mere imitations of paintings in an unfit material.

The famous factory of the Gobelins in Paris was established in 1630, the royal factory of Aubusson in 1665, and the royal factory of Beauvais is of the same epoch. These three factories have generally been maintained by the state; they are still so maintained, and their most important productions are not commonly sold.

The BAYEUX TAPESTRY (*q. v.*), so called, is a long and narrow piece of embroidery in worsted on linen, and is therefore not tapestry in any sense. It represents the preparations of William of Normandy for the invasion of England, and is undoubtedly a work of the epoch; it is on exhibition at the Public Library of Bayeux in Normandy, but is said to be decaying. For tapestry Brussels, see CARPETS.

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RUSSELL STURGIS.

**Tapeworm**: any one of the *Cestodes*, a group of parasitic flatworms (Plathelminthes), the most striking feature of which is the complete absence of an alimentary canal. This is compensated for by the mode of life, as these animals live in the adult state fastened to the inner wall of the digestive tract of some animal, and being thus surrounded by partially digested food, absorb their nourishment through the body walls. In all there is an anterior end or head in which is the chief nervous center or brain, and which serves usually by means of suckers or hooks as the organ of fixation. Behind the head is the flat, elongate body, which is largely occupied by the organs of reproduction. In the simpler tapeworms, which occur in some of the lower animals, the body is undivided and there is but a pair, male and female, of reproductive openings. In the other forms the head, followed by an unsegmented portion or neck, is called a scolex and behind this occurs a series of joints or proglottids, each of which contains its own set of reproductive organs. These proglottids arise by division of the posterior part of the scolex, each new proglottid pushing the others backward, so that the one farthest removed from the head is necessarily the oldest. As the proglottids grow older they increase in size, and as they mature the sexual products they become free from the rest and are carried to the external world with the rejecta. New ones are continually formed from the scolex, and this is the reason why the head of the worm must be removed in order to stop the troubles caused by these parasites.

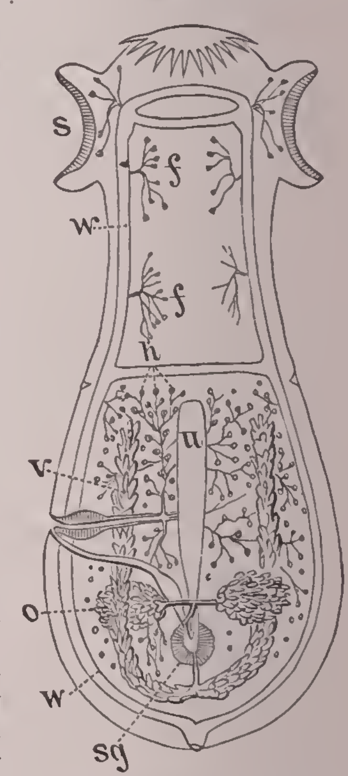


FIG. 1.—Diagram showing the structure of a tapeworm, with two joints or body segments, in the posterior of which the reproductive organs are developed. At the anterior end is a circle of hooks, behind which, at *s*, are two of the four suckers: *f*, flame cells; *h*, testis; *u*, uterus; *v*, vitellarium; *w*, excretory (water-vascular) tubes; *o*, ovary; *sg*, shell gland.

In many tapeworms the history is simple. The proglottids or their contained eggs are eaten by some animal, and in its intestine they develop directly into the parent form. In the case of those species which affect man the development is more complicated, and can best be followed by tracing the history of different forms.

The largest tapeworm occurring in man is known as

*Bothriocephalus latus*; it may consist of over 2,000 proglottids and have a length of 40 feet. The head is elongate and has two narrow pits or suckers on the side. Hooks are lacking. The genital openings are on the flat surface of the proglottids. The history is not completely known. From the eggs hatches an embryo which swims freely in the water, and apparently must enter some host not yet discovered. When this host is eaten by some fish (in Europe by the pike or burbot), the scolex is developed and bores through the intestinal walls, and entering the muscles secretes a thin wall (cyst) about itself. If this fish be eaten in an imperfectly cooked condition by man the scolex fastens itself to the intestinal wall and develops into the mature worm. *Bothriocephalus latus* is common as a human parasite in Switzerland, Northern Russia, and Sweden, but is rare in other parts of Europe. In America it is found only in natives of these countries.

Fig. 2.—Cysticercus stage of tapeworm.

Several species of *Tænia* infest man. These agree in having a spherical or pear-shaped head bearing four suckers and usually a circle of hooks to aid in fixation. The sexual openings are on the edges of the proglottids. These worms, like the last, have two hosts in the life-cycle, but differ from *Bothriocephalus* in the character of the larval stages and in that the intermediate host is usually a mammal. The larvæ have separate names. The cysticercoid is a scolex, the head of which has been inverted into the body as the finger of a glove can be turned into the hand. The cysticercus, or bladder-worm, differs in that the body into which the head is inverted becomes enormously swollen by fluids within. The cœnurus is a cysticercus with several invaginated heads, while the echinococcus has secondary *cœnuri* turned in from the wall of the original sac. In the future development of cysticerci or echinococci each head gives rise to a distinct worm.

*Tænia solium* is the most common tapeworm of man. The tip of the head is surrounded by a double circle of hooks, and the body, sometimes 10 feet in length, may consist of 800 to 900 proglottids. The ripe proglottids and eggs, cast out from the body, are eaten by pigs, and the embryos, hatching in the intestine, bore through into the muscles, where they develop into the cysticercoid stage. If pork infested with these bladder-worms ("measly pork") be eaten in an uncooked condition, the cysticerci are set free and, fastening themselves to the intestinal wall, develop into the adult worm. Sometimes man, by eating lettuce, etc., which has been watered by liquid manure, becomes the host of the bladder-worm stage.

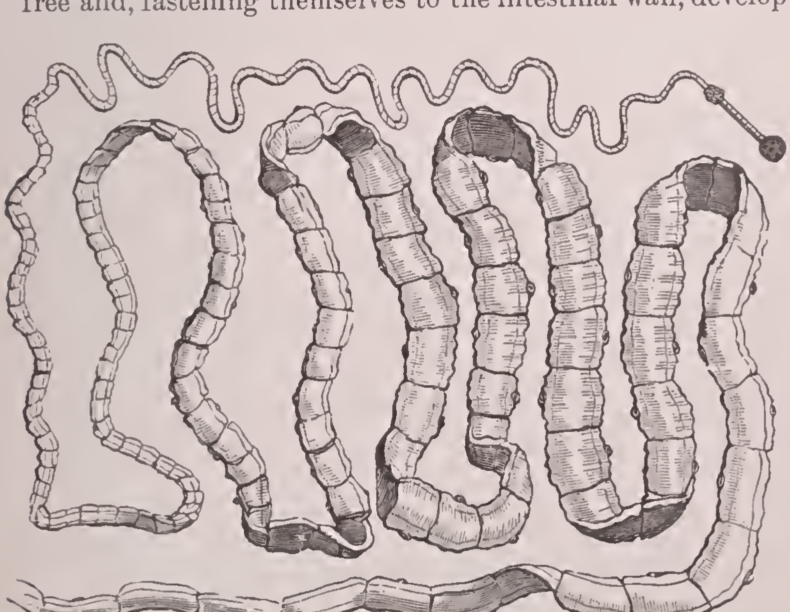

Fig. 3.—The common tapeworm of man (*Tænia solium*).

*Tænia saginata*, which is less common than *T. solium*, lacks the circle of hooks and reaches a length of 25 feet. Its history is much the same as that of *T. solium*, except that cattle instead of swine serve as the intermediate hosts. Other tapeworms are occasionally found in man, as *T. cucumerina* and the echinococcus stage of *T. echinococcus*, the adult of which lives in the intestine of the dog. Domestic and other animals are commonly infested with tapeworms, and the histories of many have been followed. The alternating hosts of a few may be of interest:

| Adult. | Encysted Form. |
|---|---|
| *Tænia serrata* of dog. | Cysticercus in rabbit. |
| *T. crassicollis* of cat. | Cysticercus in mouse. |
| *T. marginata* of dog. | Cysticercus in pigs and cows. |
| *T. cœnurus* of dog. | Cœnurus in sheep. |
| *T. echinococcus* of dog. | Echinococcus of man and domestic animals. |
| *T. cucumerina* of dog. | Cysticercoid in dog-louse. |

The presence of tapeworms in the human being is usually followed by uncomfortable symptoms, and a physician should be called. In domestic animals these parasites sometimes cause death. As infection in man almost always occurs by eating raw or improperly cooked meat, all danger may be avoided by partaking only of that which has been cooked through. The literature relating to the tapeworm is enormous. The most useful works are Cobbold's *Entozoa* (London, 1864) and Leuckart's *Die Parasiten des Menschen* (2d ed. Leipzig, 1879–89). J. S. Kingsley.

**Tapioca** [= Portug., from Braz. *tipioca*, manioc juice]: the starch of the manioc *Manihot utilissima* (*Janipha* or *Jatropha manihot*). It is prepared by pressing the washed and dried roots under water, when it is obtained in a mealy form, which is converted into a granular condition by drying over hot plates. Upon drying and pressing the pulp remaining in the water, cassava-bread is obtained. This, when pulverized, is known as manjok-flour. Tapioca is largely consumed as food. Revised by L. H. Bailey.

**Tapir** [from Braz. (Tupi) *tapy'ra*, tapir]: any one of the *Tapiridæ*, a family of perissodactyl mammals, related to the rhinoceroses and horses. The hind quarters project notably backward, the snout is produced into a short flexible proboscis with the nostrils at the end; the ears are erect and moderately developed; the neck abbreviated; the tail very short; the anterior feet have each four toes, the posterior three. The teeth are in almost full number—viz., M. $\frac{3}{3}$, P. M. $\frac{4}{3}$, C. $\frac{1}{1}$, I. $\frac{3}{3} \times 2 = 42$; all the molars, as well as premolars, 2, 3, 4, are nearly similar, squarish, and each with the anterior crest marginal, but with an anterior cingulum terminating in a cusp at the antero-exterior angle of the tooth; the hindermost molars (M. 3) have no posterior lobes; the outer incisors of the upper jaw are enlarged, and like canines; the true canines very small; the incisors of the under jaw uniform; the canines large. The skull has the nasal aperture very large, and encroaching far behind into the frontals and on each side of the nasal bones; the nasal bones, when fully developed, form together a somewhat heart-shaped figure, broad behind and tapering forward. The lower jaw has moderately deep rami, whose angles are convex and project considerably backward. The family is represented by five species, viz., (1) *Tapirus terrestris*, a species widely spread over South America in the lowlands, and extending from the Isthmus of Panama to Paraguay; (2) *Tapirus pinchaque*, confined to the Andes of South America, especially Ecuador and New Granada; (3) *Tapirus indicus*, an inhabitant of the Malaccan Peninsula, Sumatra, and Borneo; (4) *Elasmognathus bairdii*, a native of the Isthmus of Panama, and extending northward into Southern Mexico; and (5) *Elasmognathus dowii*, found in Nicaragua. In *Tapirus* the margins of the upper jaw are rolled inward, but in *Elasmognathus* they are spread out so as to firmly embrace the mesethmoid. All the species are denizens of deep forests, but near where water abounds, to which they frequently resort. They vary in size from that of a small ass to that of a moderate horse, the *Tapirus pinchaque* being the smallest, and the *Tapirus indicus* the largest. This animal is remarkable for its coloration, the fore parts and hind legs being black, the upper hinder portion of the body dirty white. The American species are dark brown. *Elasmognathus bairdii* is the largest American species. All the species (except possibly *E. dowii*) are striped or spotted in early youth, but soon assume the uniform or bicolored livery of full age. Although represented at present by species so singularly isolated as are the American and Malaccan species, in the Tertiary epoch the family was widely diffused, and animals belonging to it roamed over Europe and America far to the northward. The species, too, are the nearest relations of the Eocene *Lophiodontidæ*, which are among the oldest of known placental mammals. Revised by F. A. Lucas.

**Tappan**, ARTHUR: philanthropist; b. at Northampton, Mass., May 22, 1786; son of Benjamin Tappan (1748–1831), a Revolutionary patriot and merchant; became a merchant at Portland, Me., and at Montreal, Canada; established himself in New York as an importer of British dry-goods 1814; was one of the founders of the American Tract Society; endowed Lane Seminary at Cincinnati, a professorship at Auburn Theological Seminary, and erected Tappan Hall of Oberlin College, of which he was a founder; joined his brother Lewis in founding the New York *Journal of Commerce* (1828); was the first president of the American Anti-slavery Society, formed in Philadelphia Dec. 4, 1833, but withdrew from it in 1840 on account of the aggressive spirit manifested by many members toward the churches and the Union; was obliged to suspend payments in the great crisis of 1837, but ultimately met all his engagements; was nevertheless forced to go into bankruptcy in 1842, when he caused the whole of his personal property to be sold. D. at New Haven, Conn., July 23, 1865. See his *Life*, by Lewis Tappan (New York, 1871).

**Tappan**, HENRY PHILIP, D. D., LL. D.: educator and author; b. at Rhinebeck, N. Y., Apr. 23, 1805; graduated at Union College in 1825; studied theology at Princeton, and after having been a year associate pastor of a Dutch Reformed church in Schenectady became in 1828 pastor of a Congregational church in Pittsfield, Mass.; in 1832 became Professor of Moral Philosophy in the University of the City of New York; resigned in 1838, and opened a private school; in 1852 was elected chancellor of the University of Michigan; resigned in 1863. D. at Vevay, Switzerland, Nov. 15, 1881. He published *Review of Edwards's Inquiry into the Freedom of the Will* (1839); *The Doctrine of the Will determined by an Appeal to Consciousness* (1840); *The Doctrine of the Will applied to Moral Agency and Responsibility* (1841); *Elements of Logic* (1844; revised and enlarged 1858); *Treatise on University Education* (1851); and *A Step from the New World to the Old, and Back Again* (1852). Revised by G. P. FISHER.

**Tapping**, or **Paracentesis**: in surgery, the piercing of the walls of a cavity so as to draw off a dropsical or other collection of fluid. The abdomen, chest, scrotum, and even the head are tapped for the removal of such effusions. The trocar and canula answer for the performance of the operation in many simple cases. In some others the contained fluid has to be removed by an instrument acting as a pump or syringe. Tapping often affords great relief, and occasionally is of great service toward recovery, especially in pyothorax and hydrothorax. Revised by W. PEPPER.

**Tap′ti**: river of Bombay, British India; rising in the Satpura Mountains and flowing W. to the Gulf of Cambay, near Surat. It is paralleled by a railway and is not properly navigable, nor is it used to any extent for irrigation. Length, 457 miles; area of basin, 30,000 sq. miles. It is subject to occasional but severe floods. It curiously parallels the more important and more sacred Nerbudda river.

**Tar**: a word associated with pitch and used in a very indefinite manner, usually with a prefix. Tar is a name properly applied to a black, exceedingly viscous fluid distilled in a rude way in forests from the wood of various species of pine and spruce. The wood is placed in a pit and covered with turf in a manner resembling a charcoal pit. A part of the wood is burned to furnish heat to distill the remainder, and the tar is received into barrels. It is mainly used in preparing the hemp ropes used in the rigging of ships and in calking the sides and decks of ships. A different kind of tar is obtained as a residuum when the wood of deciduous trees is distilled for pyroligneous acid; this is called wood-tar. A similar material, known as coal-tar (also called gas-tar), is obtained as a residuum when bituminous coal is distilled for illuminating gas. A similar, but not identical, liquid called blast-furnace tar is obtained by condensing the vapors that escape from blast furnaces and coke-ovens. A material called bone-tar is obtained as a residuum from the distillation of bone oil or Dippel's oil. Candle-tar is a residuum from the stearin manufacture. The word pitch appears to have been applied at a very remote period to asphaltum and maltha or mineral tar. When different tars are distilled, as well as petroleums, various kinds of pitch are obtained. The pitch from the paraffin petroleums is called coke-pitch; that from wood-tar is the black pitch of commerce. Burgundy pitch is more properly a resin; it is obtained from the European fir, *Abies excelsa*. In Persia and Afghanistan goat and sheep dung are distilled, furnishing a material of a tarry or pitchy consistence that is applied to the goats or sheep to ward off disease. The oily distillate of tar is called oil of tar. See BITUMEN and COAL-TAR.

S. F. PECKHAM.

**Tara**: See TARO.

**Tarantass′** (Russian, *tarantasŭ*): a long Russian vehicle, drawn usually by three horses abreast. It has four wheels, and its boat-shaped body rests on two parallel wooden bars instead of on springs. The tarantass has a hood or cover, but generally no seats.

**Tar′antism**: an epidemic dancing mania, formerly prevalent in Apulia, and especially at Taranto, whence its name. It was popularly believed to be caused by the bite of the tarantula, and doubtless the fright attending the bite may have aggravated the nervous symptoms of the patient. The disease was essentially a form of emotional or hysterical excitation. (See DANCING MANIA and CHOREA.) Not only dancing, but catalepsy, was one of the symptoms. It was believed that the patients possessed an ardent passion for music and the dance and for bright and beautiful objects. The most successful cure was from hearing and dancing the music of the tarantella, the Sicilian national dance.

Revised by W. PEPPER.

**Taran′to** (Lat. *Taren′tum*; Gr. Τάρας, Τάραντος): town; in the province of Lecce, Italy; in lat. 40° 26′ N., lon. 17° 16′ E.; at the northern extremity of the large Gulf of Taranto, on an island connected with the mainland by two stone bridges (see map of Italy, ref. 7–H). Two low islands (anc. *Chœrades*), San Pietro and San Paolo, lie as a protection across the harbor, which is one of the finest in Italy. The main entrance is between Cape S. Vito and the island of S. Pietro, and admits shipping of the heaviest tonnage. The most important buildings are the Cathedral of San Cataldo, the church of the archbishop, and a castle erected by Charles V. The almost tropical vegetation is hardly less luxuriant now than when Horace wrote his *Ode*, 6, b. ii. Even the date-palm bears fruit here, though not in its perfection. The honey, the oil, and the fruits of the neighborhood have as great a reputation as ever, and the waters of the Gulf of Taranto are noted for their shell-fish, such as oysters and mussels, the gathering of which affords considerable employment to the people. The remains of the ancient town, the largest of all the cities of Magna Græcia (founded 708 B. C.), and once boasting of an army of 30,000 foot and 5,000 horse, besides a strong navy, are insignificant. Taranto is mentioned in mediæval history, and is especially remembered as the fief of Bohemond the Norman crusader. Pop. 25,246. Revised by M. W. HARRINGTON.

**Taran′tula** [= Mod. Lat., from Ital. *tarantola*, dimin. from *Taranto*, Tarentum]: a large lycosid spider (*Tarantula apuliæ*) of the warmer portions of Europe, fabled to cause by its bite the peculiar madness called tarantism. In America the term is given to any of the large mygalid spiders of the tropics.

**Tarapacá**: a northern province of Chile, between Antofagasta on the S. and Tacna on the N., extending from the Pacific to the Andes of Bolivia. Area, 19,300 sq. miles. A barren and desolate range of mountains runs parallel to the coast, rising to 6,000 feet in parts. Between this and the base of the Andes is a rainless desert, called Pampa de Tamarugal, 30 miles wide and 3,000 feet above sea-level. A few watercourses cross this waste in deep ravines, but generally do not reach the sea; they form the only habitable portions. The province owes its importance to its immense beds of Chile saltpeter; these extend also into Antofagasta, but always in the interior desert, and at least 20 miles from the coast. To reach them railways extend inland from Iquique, the capital and principal port, and from Pisagua; reducing-works have been built at various points. The exports of saltpeter and subsidiary products from Iquique and Pisagua exceed 30,000,000 pesos in annual value. There are some silver mines near Iquique. Tarapacá, formerly a coast department of Peru, was seized by Chile in 1880, and was definitely ceded to that country by the treaty of peace ratified in 1884. Pop. (1893) estimated, 48,638, nearly all engaged in the saltpeter-trade. HERBERT H. SMITH.

**Tarascon**, tāā′rāās′kōn′: town; in the department of Bouches-du-Rhône, France; on the left bank of the Rhône, 8 miles N. of Arles (see map of France, ref. 8–H). It has manufactures of woolen and silk fabrics, and the Arles sausages are made here. The Gothic church of St. Martha, built in 1187–97 and rebuilt in 1379–1449, and the castle finished in the fifteenth century by King René of Anjou are its most important buildings. The town celebrates the fête of La Tarasque, a monster subdued by St. Martha and described by Daudet in his works devoted to Tartarin. Pop. (1896) 9,023. Revised by M. W. HARRINGTON.

**Taraxacum**: See DANDELION.

**Tarbagatai'**: military frontier district of the Chinese empire and chain of mountains separating the former from the Russian province of Semipalatinsk. The district is a part of the ancient Sungaria, and is between Semipalatinsk and Kansuh. Area about 25,500 sq. miles, but the district is ill defined. Pop. about 64,000, consisting of Kalmucks, Kirghiz, and others, mostly nomadic. M. W. H.

**Tar'boro**: town; capital of Edgecombe co., N. C.; on the Tar river, and the Atlantic Coast Line railway system; 41 miles N. W. of Washington, 48 miles E. by N. of Raleigh, the State capital (for location, see map of North Carolina, ref. 2–I). It is in a cotton, corn, and peanut growing region, and contains 7 churches, a graded and 4 other schools, a State bank, with capital of $33,960, a weekly newspaper, and cotton and knitting factories and agricultural-implement works. Pop. (1880) 1,600; (1890) 1,924; (1900) 2,499.

EDITOR OF "SOUTHERNER."

**Tardigra'da** [Mod. Lat.; Lat. *tar'dus*, slow + *gra'di*, to step, walk]: a group of minute soft-bodied animals found in fresh water, damp moss, or sand. Popularly they are known as water-bears. Their four pairs of legs are short, thick, and armed each with a double claw. Through their transparent bodies the internal organization is readily studied under the microscope. The alimentary canal consists of a muscular pharynx near the mouth, a large sac-like stomach, and a short intestine or cloaca. Into this last division open the reproductive organs and a pair of small short tubes supposed to be comparable to the Malpighian tubules of insects. The nervous system consists of a supra-œsophageal and a sub-œsophageal ganglion connected by a circumoral commissure, and a chain of four ganglia, one for each pair of legs. The muscular system consists entirely of smooth muscle-fibers. The blood circulates freely through the body and is aërated through the skin, there being no special circulatory or respiratory organs. Where the animals belong in a system of nature is a matter of uncertainty. The presence of four pairs of legs has caused them to be considered as possibly primitive or degenerate *Arachnida*, but the absence of striated muscle-fibers and other peculiarities of structure seem to exclude them from the *Arthropoda* altogether. F. C. KENYON.

**Tarentum**: See TARANTO.

**Tarentum**: borough; Allegheny co., Pa.; on the Allegheny river, and the Alleg. Val. and the Penn. railways; 21 miles N. E. of Pittsburg (for location, see map of Pennsylvania, ref. 4–B). It is in an agricultural region, and has glass, paper, and other manufactories, a national bank with capital of $50,000, and two weekly newspapers. Pop. (1880) 1,245; (1890) 4,627; (1900) 5,472.

**Tares**: various leguminous plants, especially of the genus *Vicia*. Some of them are common weeds in the cultivated grounds of the U. S. and Europe. *V. sativa* is cultivated as a forage-plant and as a green manure. (See VETCH.) Its herbage is very nutritious. It is probable that the plant called tare in the English New Testament is either DARNEL or CHESS (*qq. v.*).

**Tar'gūm** [= Aram.-Heb., translation; cf. Assyrian *ragāmu*, to speak]: a name given by the Jews to the Aramæan translations and paraphrases of the Old Testament which became necessary when Hebrew was superseded by Aramæan as the spoken language of Palestine. The word occurs for the first time in Ezra iv. 7; but it is impossible to say when these translations were first made—unofficial ones probably at an early date. We hear of a Targūm to Job as early as the time of Gamaliel the elder, the teacher of Paul. But they were not committed to writing until a later date. Linguistically they belong to the Western Aramaic, and were made in Palestine, though they received their final form in Babylon. There seems to have been a disinclination to committing the Targūm to the Tōrāh and the Prophets to writing. In the official reading in the synagogue, the Tōrāh was translated verse by verse, as we find it in the best MSS. In the prophetical lessons, three verses could be read at a time. During the Middle Ages, the Targūm was cultivated especially by the Jews of Yemen, who have also translated into Aramæan certain portions of the prayer-book (*Mntschr. f. Wissen. d. Judenth.*, 39, p. 175).

The following Targūmīm are distinguished: A. To the Tōrāh: (*i.*) The first Jerusalem Targūm, which is fragmentary, and though probably the oldest, was not put into its present shape before the seventh century. (*ii.*) The second Jerusalem Targūm (or Pseudo-Jonathan), which is complete. (*iii.*) The Targūm Onkelos, which is supposed to mean "similar in character to the Greek translation of Aquila," but which Jewish tradition refers to one Onkelos the proselyte. It was called by the Babylonians "our Targūm," and is evidently a result of official pruning. It follows the Hebrew text very closely, and agrees with the LXX. in its philosophical and religious exegesis. By some its composition is placed in the second century A. D. (school of R. Akiba), by others in the first (Hausdorff, in *Mntschr. f. Wissen. d. Judenth.*, 38, p. 203). A Māsōrāh to this Targūm has been edited by A. Berliner (Leipzig, 1877). To parts of the Tōrāh there were also other Targūmīm (*Mntschr.*, 39, p. 97, *seq.*). B. To the Prophets there exist: (*i.*) Remnants of an old Jerusalem Targūm, which is, however, very largely intermixed with Midrash. (*ii.*) The official Targūm, which is said to be the work of Jonathan ben Uzziel, a pupil of Hillel; but it seems to have received its final form in Babylon under R. Joseph bar Chiyyāh (333 A. D.). Luzzatto supposes that the name "Jonathan" bears the same relation to the Greek translation of Theodotion as Onkelos does to Aguila. This translation is free and paraphrastic. For other Targūms to the Prophets, see Gottheil, *Journ. Amer. Orient. Soc.*, xiv., p. xlii. C. The Targūmīm to the Hagiographa were never official: some are literal translations, others largely interspersed with Midrash. There is no Targūm to Daniel, Ezra, Nehemiah; that to Proverbs shows a very decided connection with the Peshitta; that to the Psalms is later than the ninth century. There are three Targūmīm to Esther. There is also a Samaritan Targūm to the Tōrāh, but the date of its composition is unknown (ed. Petermann and Vollers, Berlin, 1876–85; cf. Nöldeke, *Deutsch. Zeit. d. Morgenl. Gesell.*, xxx., 343).

The text of the Targūmīm will be found in the Polyglotts. Onkelos has been re-edited by Berliner (Berlin, 1884); the Targūm to the Prophets and Hagiographa by Lagarde (*Prophetæ Chaldaice*, Leipzig, 1872; *Hagiographa Chaldaice*, Leipzig, 1873); cf. also Merx, *Chrestom. Targumica* (Berlin, 1888); Buhl, *Kanon und Text des Alten Testamentes* (Leipzig, 1891, §§ 59–67; Eng. ed., New York, 1893), where the full literature is given. RICHARD GOTTHEIL.

**Tarifa**, tāā-ree'fāā: town; in the province of Cadiz, Spain; on the Strait of Gibraltar. It is the southernmost town on the continent of Europe (see map of Spain, ref. 20–D). It is surrounded by old Moorish walls within which is an alcazar. There is a modern fort and a lighthouse 135 feet high. Its fisheries for tunnies and anchovies are very important, and its oranges are noted for their sweetness. Pop. (1887) 13,206.

**Tariffs** [viâ Fr. from Span. *tarifa*, price-list, rate-book, from Arab. *ta'rīf*, notification, information, inventory, deriv. of *'arafa*, know, inform, explain]: tables or lists of dues or duties, specifically of customs duties leviable on articles of import or export; by colloquial extension such duties themselves. Custom duties are as old as international trade, being a natural source of revenue as soon as commodities pass from country to country. In European countries they go back to the Middle Ages. Almost from the first they were instruments of industrial policy as well as means of securing revenue. How soon they began to be consciously used for the purpose of influencing industrial development is a matter of some dispute; but it is certain that duties having a distinctly protective purpose appear as early as the sixteenth century. In the mercantile system the use of import duties as one means of fostering certain kinds of industries, especially manufactures, reached perhaps its highest development. The most effective application of that system, and of high tariffs as part of it, was made by Colbert, in France, in the second half of the seventeenth century, more particularly in the tariffs of 1664 and 1667. Other countries adopted a similar policy, and in the eighteenth century every European country had an elaborate system of duties on imports and exports, prohibitions, bounties, premiums, designed to turn industry into particular channels. The other weapons of the mercantile policy—prohibitions, bounties, and so on—have in the main disappeared, but tariffs or import duties have continued to play an important part.

The first break in the general use of protective duties came late in the eighteenth century, by the commercial treaty of 1786 between Great Britain and France. These countries had carried on for a century and more a commercial warfare, which played a large part in causing the frequent military struggles. The treaty of 1786 provided for the reciprocal admission of goods at greatly reduced duties, and was due largely to the gradual permeation of the influence of Adam Smith and of the French physiocrats. It lasted, however, but a short time, being ended by the wars of the French Revolution. With the close of the Napoleonic wars in 1815 the tariff history of all European countries enters on a new stage. In Great Britain the influence of Adam Smith and his followers, all strong advocates of the principle of free trade, served to loosen the hold of the protective system. At the same time the industrial position of Great Britain, the need of plentiful and cheap raw materials for her growing manufactures and of food for her growing population, made it clearly to her interest to adopt a policy of freedom as to them. The first important steps were taken under the leadership of Huskisson in 1824, and consisted in a lowering of duties on manufactures and a lowering or abolition of them on raw materials. After Huskisson's death in 1829 there was a temporary lull, though some changes were made by Lord Althorp after 1832. In the decade 1830–40 the agitation against the corn-laws (duties on grain) became active, under the leadership of Cobden. The corn-laws had developed during the eighteenth century, and had been made more severe after the close of the Napoleonic wars. The Corn-law League attacked them, but at first without success. In 1842, when Peel resumed the task of moderating the protective system in general, the corn-laws were retained, though in modified form; but in 1846 they were finally abolished, under the pressure of a bad harvest and high price of food, combined with the potato famine in Ireland. With the downfall of the corn-laws the last prop of protection in Great Britain was gone. In the year of their repeal duties were further reduced; in 1853 still more; finally in 1860, at the time of the treaty with France (see below), the last vestige of protection disappeared. Since 1860 duties have been levied on a very few articles, like tea, coffee, cocoa, tobacco, spirits, wines; and where these articles are produced within the country (e. g. spirits), an internal tax is levied practically equal in amount to the duty on the imported articles.

France returned to the system of prohibitions during the revolutionary and Napoleonic wars. Largely as a measure of warfare against Great Britain, absolute prohibition of import was established in regard to most manufactured articles. The Revolution, however, had one important influence in the direction of freedom; for the intricate duties on the passage of goods from one province of France to another, which had previously existed, were swept away early in its course. When peace came in 1815 a system of prohibition even more rigid than that of the preceding century was maintained on imports of manufactures from abroad. The successive governments made some attempts at relaxation, but did not feel strong enough to alienate the manufacturing interest. Finally, in 1860, Napoleon III., influenced largely by a desire to gain the good will of England, abruptly put an end to the prohibitory *régime* by the famous commercial treaty with that country. The treaty, negotiated by the economists Cobden and Chevalier, provided for the admission of British goods into France at moderate duties, not usually exceeding 10 per cent. It had important consequences in all European countries, for similar treaties were concluded by France shortly after with the other leading countries, and by these with each other, with the result that a network of treaties was spread over the Continent, bringing everywhere a marked moderation of the duties. The treaty system, however, was never thoroughly popular in France, and did not endure. It had never been applied to agricultural articles, and the growing competition of the U. S. and other new countries caused a gradually increasing application of protection to them, by duties on grains and meat-products. The original treaty with Great Britain was terminated in 1881, and treaties with other countries in 1891–92. In 1892 the treaty system was finally abandoned, and a new tariff of distinctly protective duties was adopted, with a provision only for certain minimum duties to be granted to countries which should give reciprocal favors to France.

In Germany the seventeenth and eighteenth centuries had seen the application of highly complicated protective tariffs, similar to those of Great Britain and France. The most rigorous system was that of the Prussian kings, especially of Frederick the Great. After the close of the Napoleonic wars the liberal statesmen who had guided Prussia through the critical period of conflict reformed the tariff in 1818, substituting moderate and simple duties for the previous system of high and complicated rates. Other German states maintained for a while their own tariffs, but the number of petty states and their involved boundaries made the separate tariffs intolerable, especially as the French rule had for a while abolished them for large parts of Germany. Some smaller states joined in a customs union with Prussia; other states formed unions between themselves. Finally, by separate treaties, a general customs union, the Zollverein, was formed in 1834. The Zollverein treaties provided for complete free trade within Germany, and for moderate duties (those of the Prussian tariff of 1818) on foreign imports. The Zollverein treaties were renewed from term to term. In 1853 a treaty was made with Austria, not admitting that country to the Zollverein, but providing for reciprocal reductions of duty. In 1861 occurred a crisis in the Zollverein's history, Prussia being desirous of lower duties, while the southern states, influenced largely by political sympathy with Austria, wished a retention or increase of the existing rates. Prussia won the victory by boldly concluding an independent treaty with France in 1862, which was later adopted for the Zollverein, and provided for a marked moderation of the previous duties. After the formation of the German empire in 1870–71 the history of the Zollverein becomes the tariff history of Germany. In 1879 a distinct return to protection took place in the form of higher duties on manufactures and new duties on agricultural products. This change in policy was due partly to changed political conditions (Prince Bismarck having broken with the old liberal party), and partly to the agricultural depression resulting from the competition of the U. S. The duties on grain were further raised after 1879. In 1892 a change in policy was again made by commercial treaties with Austria-Hungary, Italy, and other countries, providing for reciprocal reductions of duties, and among others for lower duties on Hungarian grain and Italian wines. In 1894, after prolonged negotiations, a treaty on similar lines was concluded with Russia, admitting Russian barley and wheat into Germany at lower rates.

*Tariffs in the United States.* — The history of U. S. tariffs divides itself into four periods: the first running from the year 1789 to about 1816; the second, the period of the early protective movement, from 1816 to 1840; the third from 1840 to 1860; and the fourth and last covering the period since the civil war.

I. The first period is marked in general by the fact that tariff legislation occupied a subordinate place in public attention, and that the protective controversy can not be said to have fairly begun. It is true that one of the first acts passed by the first Congress in 1789 was the Tariff Act of that year; but the prompt attention given to the subject is easily explained from the imperative need of revenue for the new commonwealth. The act of 1789 was based partly upon the impost scheme which it had been attempted to adopt for the confederation in the years immediately preceding 1789, and partly on the existing legislation of some of the individual States. The impost scheme of the confederation had proposed a duty of 5 per cent. on imports in general, and other moderate revenue duties on tea, coffee, sugar, spirits, and similar articles. This scheme had never been carried out, because it had proved impossible to secure the necessary consent of every individual State. As to the tariff policy of the individual States, some, notably Massachusetts and Pennsylvania, had tariffs of a distinctly protectionist character, and some of the provisions in them were transferred bodily into the Tariff Act of 1789. Accordingly, that act contained two distinct sets of duties: First, duties for revenue only. These included *ad valorem* duties, varying from 5 to 15 per cent. (the 5-per-cent. rate being fixed on all commodities not otherwise specified, the higher rates put on some articles of luxury) and moderate specific duties on tea, coffee, sugar, and spirits. Second, there were certain specific duties on manufactures which were meant to give protection. It has sometimes been said that this act of 1789 marks the beginning of the protective policy in the U. S., while, on the other hand, the moderation of the duties has been emphasized as indicating that no such thing as protection was then contemplated. The fact is that the act had some undeniably protective features, but that these attracted little public attention.

These general remarks apply to the whole period from 1789 to 1816. After 1789 duties were raised from time to time, in each case for the purpose of securing more revenue. Thus the act of 1792 raised duties to provide means for increasing the army, after St. Clair's defeat in the Indian war. The act of 1797 was needed to provide for the payment of certain installments of the foreign debt then coming due. In 1800 duties were increased to pay interest on a loan authorized in view of a possible war with France. In 1804 an addition of 2½ per cent. to all duties, yielding the "Mediterranean fund" for carrying on the war with the Barbary powers, was made. In 1812 all duties were doubled, a futile attempt to secure an increase of revenue for carrying on the war of 1812. The main cause for all these changes was the need for revenue; but a few provisions were inserted which indicate a protective purpose. Thus in the act of 1804 specific duties were added on cordage, iron, and glassware, which were undoubtedly intended to be protective. It remains true, however, that throughout these years the protective system occupied a very small share of public attention.

II. In the second period (1816–42) of tariff history in the U. S. the protective principle was definitely applied. In 1807 came the embargo, followed by interruptions in foreign trade which lasted almost continuously till 1815. These interruptions, culminating in the war of 1812, checked and at times almost destroyed a profitable foreign commerce, and caused a sudden and rapid development of manufacturing industry within the U. S. The development of national feeling and patriotic pride which the war of 1812 brought about served to stimulate the desire to aid domestic industries. When the war of 1812 came to a close, and Congress proceeded in 1816 to remodel the tariff, a new spirit was felt. The Tariff Act of 1816 consequently raised duties generally. Specific duties were imposed upon crude iron, as well as upon manufactures of iron; the duties on cotton goods and woolen goods were made 25 per cent. While the act of 1816 was more distinctly protective in character than the acts of the earlier period, it was marked, like them, by a great degree of indifference on the part of the public. Not long after its passage, however, public feeling took a very different turn. In the latter part of 1818 a commercial crisis set in, partly in consequence of the collapse of excessive bank issues and partly in consequence of deeper causes. Imports and exports both fell sharply, and the shrinkage of foreign trade and the collapse of prices contributed to a sudden growth of strong desire for protection. For ten or fifteen years the feeling throughout the Northern States was unmistakably in favor of distinctly protective legislation. This feeling led in 1824 to the passage of the first Tariff Act for protection only. The act of 1824 was marked by an advance in duties on certain materials like hemp, wool, and iron, as well as by an advance on manufactures, such as cottons, woolens, cordage, and glassware. The increase of duties on raw materials caused this act to be resisted in Massachusetts; but in 1828, when a second protective act was passed, in which manufactures received a larger share of attention, Massachusetts and the New England States generally came into line among the advocates of protection. This act, the product of political intrigues, is known as the "act of abominations" from the fact that its authors, thinking to get rid of the tariff issue, loaded the measure with certain "abominations" to prevent the New England men from voting for it. The latter, however, accepted it with all its faults. In the act of 1832 the "abominations" of 1828 were removed, and the protective system was put in a more reasonable form. Hardly, however, had the protective movement reached its high-water mark in the act of 1832 than its disintegration began. The opposition of the South to the protective duties culminated in the nullification movement in South Carolina in the fall of 1832. By the so-called Compromise Act of 1833 concessions were made to the South providing for the gradual reduction of duties until finally on July 1, 1842, they should reach the 20-per-cent. level. As to the effects of the tariff legislation during this period, they are mingled with those of the many forces determining national prosperity. It may be fairly said, however, that there was at least some opportunity of securing advantage from the protective legislation of those days. The period was one of transition; the U. S., which had been almost exclusively an agricultural country in the earlier period, was developing into a country having a large manufacturing element. That development, which was certain to take place in any event sooner or later, may have been brought about more quickly and more easily in consequence of this protective legislation.

III. In the third period (1842–60) the tariff issue at first was a party question and had a good share of public attention; but it was soon crowded out of sight by the slavery question. In 1842 the Whigs, having come into power, proceeded to pass the Tariff Act of that year. It went into effect on Sept. 1; consequently the 20-per-cent. rate which the Compromise Act of 1833 had aimed at remained in force only two months, from July 1 to Sept. 1, 1842. The act of 1842 was a protectionist measure, passed by the Whigs after a long and bitter wrangle with President Tyler. It provided for high duties upon iron, cotton goods, woolen goods, paper, and glass, and on manufactures in general. It remained in effect only four years, being superseded in 1846 by the Democratic Tariff Act passed in that year. The act of 1846 was framed largely by Robert J. Walker, then Secretary of the Treasury. It arranged commodities in nine schedules, indicated by the letters A, B, C, D, E, F, G, H, I. The duties were respectively 100, 40, 30, 25, 20, 15, 10, and 5 per cent.; schedule I contained the articles admitted free of duty. Most articles with which the protective controversy is concerned—iron and metals in general, wool and woolens, manufactures of paper, glass, and wood—were put in schedule C, paying 30 per cent. duty. Cotton goods were in schedule D, and paid 25 per cent. The duty of 30 per cent. which was levied on most manufactures was really a moderate protective duty; and the fact that this act not what it is often said to be, a tariff for revenue only, is further indicated by the exemption from duty of tea and coffee. The act of 1846 remained in force for eleven years, and the system it established was continued to the time of the civil war. The changes made by the act of 1857 were of no importance in principle. In 1857 the revenue was redundant, and all parties were agreed upon effecting a reduction of duties. The rate in schedule A was lowered to 40 per cent., that in schedule B to 30 per cent., that in schedule C to 24 per cent., and so on. As to the effects of the legislation of this period, it is clear that the act of 1842 was not in force sufficiently long to give any indication as to its permanent effects upon the community. The whole period from 1842 to 1860 was one of prosperity, especially the latter part of it, the decade from 1850 to 1860. The commercial crisis of 1857, a simple result of over-speculation and over-investment, checked the advancing tide of prosperity for but a short time. This general prosperity has often been ascribed to the moderate tariff legislation of 1846, but it is difficult to trace any direct connection. Such events as the discoveries of gold in California, the opening up of the Mississippi valley by railways, the improvement of ocean transportation, and the general advance in the arts, were the chief causes affecting material prosperity, which probably would have continued at much the same rate whether tariff legislation had been more or less protective than it was. It is certain that notwithstanding the moderate duties of 1846–60 there was a growth of manufacturing industry nearly in proportion to the general growth of population and of wealth. The manufacture of cotton goods advanced steadily in the decade between 1850 and 1860, very nearly doubling its consumption of raw cotton. So far as woolen goods are concerned, there are no accurate figures, but most branches of the industry grew, especially after the Tariff Act of 1857 admitted wool practically free of duty. In iron the growth was less striking, but the production of pig iron increased from an average of about 600,000 tons at the beginning of the decade to one of about 750,000 tons at the close of the decade. In miscellaneous manufactures there was a steady advance. Whether or no manufacturing industries would have developed more quickly under the stimulus of higher duties, they did not cease to exist or cease to grow under a *régime* of moderate duties.

IV. The fourth period (from 1861 on) is ushered in by the Morrill Tariff Act of 1861. The crisis of 1857 had been followed by a decline in imports, and this, with the reduction of duties made by the act of 1857, had brought the revenue to a point dangerously low. At the same time the Republican party had secured, for the first time, control of the House of Representatives, and was desirous of increasing its hold in the manufacturing States, especially in Pennsylvania, by imposing protective duties. Accordingly, in the session of 1859–60, the Morrill Tariff Act was passed by the House. In the succeeding session of 1860–61 it was passed in the Senate, and became a law. It raised duties appreciably. The duty on pig iron was made $6 a ton; that on wool of the ordinary grade 3 cents a pound; cotton goods from 1 cent a yard upward; and so on with specific duties. The Morrill act of 1861 remained in effect a very short time. The war began in the spring of 1861. In every year of the war several acts for increasing duties were passed. The most important were the general Tariff Acts of 1862 and 1864. The Tariff Act of June 30, 1864, proved the most important of all, becoming the basis of a permanent tariff system. It was accompanied by a heavy internal tax act, and by an act giving wide authority to borrow, the three measures touching high-water mark in the revenue legislation of the war. The Tariff Act increased both revenue and protective duties. The need of revenue and the desire to offset the heavy taxes imposed on manufactures by the internal revenue acts were the main causes of its enactment. When the war closed the country consequently found itself with a tariff of very high duties. After that there was a twofold tendency. On the one hand, the revenue duties were steadily reduced; on the other hand, the protective duties in the main were retained, and in many cases were increased. Gradually and unexpectedly the high protective duties produced during the war became the permanent industrial policy of the country. The decade immediately after the war (1865–75) was one of uncertainty in regard to tariff legislation, as it was in regard to currency legislation. Some considerable advances in protective duties were made. The most important of these latter was the Wool and Woolens Act of 1867, making a considerable increase in duties on those articles. The duty upon wool of the kind chiefly used was raised from 6 to about 11 cents a pound. On woolen goods an elaborate system of compound duties, begun as early as 1861, was greatly enlarged and developed. A specific duty was imposed on woolen goods, the object of which was to compensate the U. S. manufacturer for the duty he had to pay on his raw wool. This specific duty was made 50 cents a pound by the act of 1867; over and above this a duty of 35 per cent. *ad valorem* was fixed. Another significant act was the Copper Act, passed in 1869 over President Johnson's veto. It raised the duties on copper considerably, on the copper ore as well as on pig copper, and so shut out a considerable importation of copper ore for smelting and refining in the U. S. The act was passed to aid the great copper mines of Lake Superior district, and helped them in securing control of the whole market. On the other hand, during this decade attempts were made to bring about a reduction of duties, in some cases with success. In 1870 an act was passed reducing considerably the revenue duties, and making some reductions in the protective duties. That on pig iron, for example, went down from $9 to $7 a ton. Some other duties, however, were increased by this same act, the most important of these being the duty on steel rails, which was changed from an *ad valorem* rate of 45 per cent. to a specific duty of $28 a ton. In 1872 a temporary reduction of 10 per cent. of the protective duties was made, but they were restored to the old rates in 1875. The complete repeal of the tea and coffee duties at the same time (1872) was of decisive importance. It settled for a long time the policy of using protection duties as the main sources of customs revenue. The next important step was the act of 1883, which made the first general revision after the civil war. In 1882 President Arthur appointed a tariff commission which framed a bill which became the basis of the tariff legislation of 1883. The bill prepared by the commission, however, was much changed in the course of its passage through the House and Senate, and the final result was a compromise and somewhat of a makeshift. Some protective duties were reduced. Thus the duty on pig iron went down from $7 to $6.72 a ton; on steel rails, from $28 to $17 a ton; on wool, from 11¼ to 10 cents a pound; on silk manufactures, from 60 to 50 per cent. In other directions, however, duties were increased. While the duties on the cheaper grades of woolen goods, of which importation had entirely ceased, were reduced, the duties on the finer grades were increased. Similarly on cotton goods, while the duties on cheap goods (never imported into the U. S.) were reduced, those on finer cottons, of which the importation was large, were raised. The next step came seven years later, in the Tariff Act of 1890, familiarly known as the McKinley Tariff Act. That act was the direct but unexpected result of the attack made on the protective system in President Cleveland's message to Congress in Dec., 1887. It is almost certain that if President Cleveland had not forced the tariff question to the front, the Republicans who passed the act of 1890 as a party measure would have been content to leave the tariff as it was settled in 1883. The important changes made by the Tariff Act of 1890 were the following: The duty on sugar was swept away, all raw sugar being admitted free. The sugar duty had been practically a revenue duty, nine-tenths of the sugar being imported and only one-tenth being made at home. The domestic sugar-producers, producing the one-tenth, were placated by being given, instead of the duty, a bounty of 2 cents a pound, the rate of the previous duty. This change was substantially similar to the remission of the duties on tea and coffee in 1872, and still further emphasized the policy of relying for customs revenue upon protective duties only. The duty upon raw wool was slightly increased, the rise on the important class being from 10 cents to 11 cents a pound. The change, slight in amount, served chiefly to emphasize the policy of making no concessions in the way of free admission of raw materials. On woolen goods there was a considerable advance. The compensating system was still retained, the specific duty continuing on all woolen goods. The *ad valorem* duty upon them was raised to 50 per cent. On cotton goods of the finer grades, on hosiery and stockings, on velvets and plushes of all sorts, particularly high duties were imposed. Among metals the duty upon pig iron was left unchanged; that upon steel rails was slightly reduced. The most important change was an increase in the duty upon tin plate. This article had never been produced in the U. S., while very large amounts were imported from England. The duty was raised to $2\frac{2}{10}$ cents per pound, equivalent to about 70 per cent. upon the value. This change perhaps more squarely presented the issue whether a new and distinct expansion of the protective system should be made; for the question here was not whether an industry already existing should be supported, but whether an entirely new industry should be established under the shelter of protective duties. The next stage in tariff legislation came with the Tariff Act of 1894, which reversed in part the policy of the act of 1890. As the Republicans had used the first opportunity to carry out their tariff policy after the election of 1888, so the Democrats used the first opportunity after their victory of 1892. The bill as passed by the House had provided for a considerable reduction of duties, and had made free use of *ad valorem* duties. The Senate, however, raised the duties somewhat, and restored many specific duties. After a long struggle between the two houses, the bill as amended in the Senate was passed, and became the Tariff Act of 1894. The most important change made by it was the free admission of raw wool, which marked a radical change in policy, toward the free admission of raw materials. With the free admission of wool came a complete change in the duties on woolen goods. The former system of compound duties was given up, and simple *ad valorem* duties of between 35 and 45 per cent. were imposed on woolens. Some other materials besides wool were admitted free, notably lumber, flax, hemp, and copper. Coal and iron ore were left subject to duties, though to reduced duties. On manufactures there was a general but not considerable lowering of the rates. Cottons, linens, and silks were subjected to less change. The rate on chinaware was lowered appreciably. On iron and steel manufactures most of the changes were of minor importance. A significant reduction was that on tin plate, to about half the rate imposed in 1890—1½ cents instead of $2\frac{2}{10}$ cents a pound. Sugar was again subjected to a duty, fixed at 40 per cent., mainly for revenue purposes, but largely in order to secure for the Tariff Act the votes of the Senators from the sugar-producing State of Louisiana. At the same time an additional duty was imposed on refined sugar, for the protection of the domestic refiners. The refining industry was monopolized by the so-called Sugar Trust; this was a direct contribution to monopoly profits, virtually the same as had been given by the act of 1890. On the whole, the tariff of 1894 made but one really important change—the free admission of wool. Beyond that it brought about mainly a slight moderation of the protective duties.

Considering now the effects of the protective system of this fourth period since the civil war, one is confronted by the same difficulties which presented themselves in considering the period of moderate duties that preceded the war. A dozen factors influenced the prosperity of the community, and among them it is impossible to disentangle the separate effects of the tariff. The community, upon the whole, prospered wonderfully. The arts advanced, however, at a rapid pace in the U. S. and abroad; new lands were taken into cultivation; new and rich mineral resources were discovered; the restless activity of the business man fairly transformed the industrial world. These factors counted for very much more than any tariff system, high or low, could have counted. So far as particular manufactures are concerned, there was in some directions very great growth, in other directions a less rapid growth. The iron industry has developed to an extraordinary extent. The total production of pig iron quadrupled between the close of the civil war and the year 1890; but the greatest part of this increase was due to the opening of new mines of iron ore and coal in the heart of the country, to the growth of population, and the great improvements in internal transportation. The cotton-manufacture advanced rapidly; but here again it is probable, that a great advance would have taken place without high duties. The woolen industry grew less fast, and it is questionable whether the duties on raw wool did not hamper it quite as much as those on woolen goods promoted it. The silk-manufacture was virtually created by the duties levied during the civil war and maintained thereafter, and in this instance there seems to have been, in part at least, a successful application of protection to young industries. In general, the effect of the protective duties in maintaining manufactures has been as much exaggerated as their effect on the prosperity of the community as a whole. The general trend of industrial development in the U. S., the high average of mechanical skill and inventiveness, the thickening of population, the possession of great stores of minerals—all would make the country a manufacturing one under any tariff conditions. The effect of duties may have been to make the growth of manufactures more rapid and somewhat more diversified than it would otherwise have been, but the main lines of development have not been greatly changed. See PROTECTION, FREE TRADE, and FINANCE.

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F. W. TAUSSIG.

**Tarija**, taă-rec'khaă: the southeasternmost department of Bolivia; bounded W. and N. by Chuquisaca, E. by Brazil (separated by the river Paraguay), and S. by the Paraguayan Chaco and the Argentine Republic. The limits with Chuquisaca and Paraguay are arbitrary and unsettled; hence the area is unknown, but it is not less than 40,000 sq. miles. About one-third, in the western part, consists of mountainous lands and plateaus, on the eastern side of the Cordillera; the remainder is a plain, continuous with the Gran Chaco, and, like it, consisting of open lands and forests, interspersed with immense areas in the eastern part which are covered with water during several months of the year; this plain is crossed by the river Pilcomayo, and, except near the mountains, its only inhabitants are roving Indians. The civilized population is gathered in the mountain region, where much of the land is very fertile. Almost the only occupations are agriculture and grazing, the department being especially suitable for the latter. Pop. (1889) about 63,000, exclusive of wild Indians. Tarija, or San Bernardo de Tarija, the capital, is situated on a plain by a branch of the upper Vermejo. It has a considerable trade with the Argentine Republic, and resembles an Argentine rather than a Bolivian town. The climate is pleasant. Goiter is very prevalent in the vicinity. Pop. about 9,000.

HERBERT H. SMITH.

**Tar'kio**: village (founded in 1880); Atchison co., Mo.; on the Tarkio river, and a branch of the Kan. City, St. J. and Council B. Railway; 60 miles N. by W. of St. Joseph (for location, see map of Missouri, ref. 1–C). It is in an agricultural and stock-raising region; contains 7 churches, large public-school building, 3 hotels, water-works, electric lights, several manufactories, a national bank with capital of $50,000, a State bank, and a monthly and 2 weekly periodicals; and is the seat of Tarkio College (United Presbyterian, opened in 1884). Pop. (1890) 1,156; (1900) 1,901.

EDITOR OF "AVALANCHE."

**Tarleton**, taărl'tŭn, Sir BANASTRE: soldier; b. in Liverpool, England, Aug. 21, 1754, son of the mayor of the city; served under Howe and Clinton in the campaigns of 1777–78. He became lieutenant-colonel and commanded the British Legion, with which he served under Clinton and Cornwallis in the Carolinas, achieving a reputation for cruelty, so that "Tarleton's quarter" became a synonym for wholesale butchery. He took part in the battles of Camden and Guilford Court-house, and at the battle of the Cowpens, Jan. 17, 1781, was defeated by Col. Morgan. He served with Cornwallis during the remainder of the war, and was among those surrendered at Yorktown. Returning to England, he was promoted to the rank of colonel, and in 1790 was returned to Parliament for Liverpool, serving till 1806 and again in 1807–12. He was promoted to be lieutenant-general in 1817, having previously been appointed governor of Berwick and Holy Island, and was created a baronet and a G. C. B. in 1818. He published a *History of the Campaigns of 1780–81 in the Southern Provinces of North America* (London, 1787). D. in England, Jan. 23, 1833.

**Tar'ma**: a town of the department of Junin, Peru; in a beautiful valley formed by a sub-branch of the river Ucayali; 56 miles S. S. E. of Cerro de Pasco, and 9,800 feet above the sea. It was originally the Indian town of Tarama, was occupied by the Spaniards soon after the Conquest, and during the colonial period was noted for its rich silver mines; it was the capital of the *intendencia* of Tarma, now the department of Junin. It is the center of a fertile agricultural district; alfalfa is extensively cultivated. Owing to its salubrious climate the residents of the higher and exposed mining regions resort to it for rest and recuperation; with railway communication it would become one of the principal cities of Peru. In the vicinity are interesting ruins, some supposed to be pre-Incarial. Pop. about 9,000. H. H. S.

**Tarn**: department of Southwestern France; on both sides of the Tarn, an affluent of the Garonne. Area, 2,217 sq. miles. The ground is elevated, and the surface is mostly an undulating plain, except in the southeastern part, which is covered with spurs of the Cévennes. Forests of oak and beech are numerous, and large crops of wheat, wine, and hemp are raised. Coal and iron abound and are extensively worked. Many cattle and sheep are raised. Pop. (1896) 339,-827. Capital, Albi. Revised by M. W. HARRINGTON.

**Tarn-et-Garonne**, ā-gaă'rōn': department of Southwestern France; between the rivers Tarn and Garonne. Area, 1,436 sq. miles. The surface is an elevated and undulating plateau, traversed by several deep valleys along the rivers. The soil is very fertile, and the climate temperate and healthful. Agriculture is the chief occupation, and wheat and wine the principal products; manufactures include silk, paper, and soap, but are rather insignificant. Pop. (1896) 309,191. Capital, Montauban.

Revised by M. W. HARRINGTON.

**Tarno'pol**: town of Galicia, Austria-Hungary; on the Sered; 80 miles by rail E. S. E. of Lemberg (see map of Austria-Hungary, ref. 4–M). Formerly it was a fortress, and received valuable privileges from the kings of Poland. It is celebrated for its horses and horse-markets, which are the most frequented in the country. Pop. (1890) 26,217.

**Tarnow**, taar'nov: town of Galicia, Austria-Hungary; on the Dunajec; 50 miles by rail E. of Cracow (see map of Austria-Hungary, ref. 3–I). It has a fine cathedral and many good educational institutions. Pop. (1890) 27,574.

**Taro**, or **Tara** [= Polynesian]; an araceous plant; the root of *Alocasia macrorhiza*, of which many varieties are grown in the Pacific islands. The tops are used as a pot-herb, and the starchy root is one of the most important articles of food in Polynesia. In New Zealand the name is applied to *Pteris esculenta*, a fern whose roots afford an edible starch.

**Tarpeia**: See TARPEIAN ROCK.

**Tarpei'an Rock**: the southeastern portion of the Capitoline Hill at Rome. According to tradition, it took its name from Tarpeia, a vestal virgin, who during the reign of Romulus betrayed the Capitoline citadel to the attacking Sabines, having obtained from them the promise that they would give her what they wore upon their left arms, meaning certain gold ornaments. They kept their promise by crushing her beneath their shields. In later times it was customary to hurl condemned criminals from the Tarpeian Rock.

Revised by CHARLES H. HASKINS.

**Tarpon**: a large fish, *Megalops thrissoides*, of the family *Elopidæ*; closely related to the herrings, with which it is sometimes placed. The eye is large, whence the generic name, and so is the obliquely placed mouth. The dorsal fin is high, with a long filament behind, the tail deeply forked, the body covered with scales, some more than 2 inches wide.

The color is silvery below and on the sides, blue above. The tarpon reaches a length of 6 feet and a weight of 150 lb. It is found in the warm parts of the Atlantic and is common on parts of the Florida coast, where it has come much into vogue among anglers, since, in spite of its vast size, it can be taken with rod and line. furnishing rare sport from its vigorous leaps and fine fighting qualities. The tackle used is a 7½-foot to 8-foot heavy rod, multiplying reel, and 200 to 250 yards of linen line. F. A. LUCAS.

**Tarquin'ius**: the name of a Roman family of Greek origin, which, according to legend, played a very important part in the early history of the city of Rome, and two of whose members became kings. Demaratus emigrated from Corinth and settled at Tarquinii, a town of Etruria. His son, Lucumo, married Tanaquil, an ambitious and cunning woman, daughter of one of the most prominent Etruscan families, and she induced him to emigrate to Rome, where he soon acquired the rights of citizenship and assumed the name of (1) LUCIUS TARQUINIUS PRISCUS. His wealth and his wisdom made him one of the most prominent citizens. The king, Ancus Marcius, appointed him guardian of his children, and after the death of Ancus Marcius, in 616 B. C., the senate and people unanimously elected him king. He waged successful wars against the Sabines, Latins, and Etruscans, and extended the power of Rome. He built the Cloaca Maxima, laid out the Circus Maximus and the Forum, and began the Capitoline temple and the stone wall around the city. He instituted the Roman games and added 100 new members to the senate. He was murdered in 578 B. C., and succeeded by his son-in-law, Servius Tullius.—(2) His son, LUCIUS TARQUINIUS SUPERBUS, assassinated Servius Tullius in 534 B. C., and seized the crown. He abolished the reforms which Servius Tullius had introduced, and ruled arbitrarily and oppressively, whence his surname Superbus. The vacant places in the senate were not filled, the advice of this body was seldom asked, and he slighted the higher classes and sorely oppressed the lower by heavy taxes and forced labor. Finally, the rape of LUCRETIA (*q. v.*) became the occasion of a general outbreak. Tarquinius was deposed and the monarchical government abolished in Rome. He made three attempts to reconquer his power by the aid of the people of Tarquinii, Porsena, and the Latins, but in vain, and died in wretchedness at Cumæ in 495 B. C. For the elements of truth contained in these legends of the Tarquins, see ROME. Revised by CHARLES H. HASKINS.

**Tarr**, RALPH STOCKMAN: See the Appendix.

**Tar'ragon** [from Span. *taragona*, from Arab. *tarkhūn*]: an aromatic perennial composite herb (*Artemisia dracunculus*), a native of Northern Asia, but acclimated in European gardens, where, especially in France, it is cultivated for the sake of the young shoots, which are used in the dressing of salads and for the flavoring of vinegar with an infusion of its leaves, which have a taste resembling anise. Tarragon vinegar thus prepared is an article of commerce.

**Tarrago'na** (anc. *Tarraco*): capital of the province of Tarragona, Spain; at the mouth of the Francolí, in the Mediterranean, 60 miles W. of Barcelona (see map of Spain, ref. 14–J). It consists of an upper town, surrounded by walls, and a lower and modern town defended by two castles. Its harbor is accessible only for small vessels, yet it carries on a considerable trade in grain, wine, and oil; large quantities of fruits are annually exported. The imports and exports reach over 30,000,0000 pesetas annually. There are schools of design and navigation and an ecclesiastical seminary. The Gothic cathedral dates from 1120. The city was founded by the Phœnicians, and rose under the Romans to great importance. Pop. (1887) 27,225.

**Tar River**: a river which rises in Granville co., N. C., and after an indirect E. S. E. course falls into Pamlico Sound. Its wide estuary for some 40 miles is called Pamlico river. The Tar has a rapid current, is 180 miles long, and is navigable for steamboats 85 miles, to Tarboro.

**Tar'rytown**: village; Westchester co., N. Y.; on an expansion of the Hudson river known as the Tappan Sea, and on the N. Y. Cent. and Hud. River Railroad; 25 miles N. of New York (for location, see map of New York, ref. 8–J). It is one of the most attractive places for suburban residence on the Hudson; was the scene of the capture of Maj. André by Paulding, Williams, and Van Wart; and contains the Sunnyside home and the burial-place of Washington Irving, Sleepy Hollow, the Philipse manor house (erected in 1683), a Dutch church (erected prior to 1699), a monument to the Revolutionary soldiers of the manor (dedicated in 1894), 3 libraries, a national bank with capital of $100,000, a savings-bank with deposits of over $1,500,000, and 2 weekly papers. Pop. (1880) 3,025; (1890) 3,562; (1900) 4,770, including North Tarrytown, 9,011. EDITOR OF "ARGUS."

**Tar'shish** [from Heb. *Tar'shīsh*]: one of the most western trading-posts of the Phœnicians, probably Tartessus in Spain (on the Bætis, Guadalquivir), mentioned frequently in the Old Testament. It was probably founded by Tyrians (Is. xxiii. 1, 6, 10; Jer. x. 9). From this place the Phœnician merchantmen were generally called Tarshish ships, a name to which de Lacouperie (*Bab. and Orient. Record*, vii., 129) sees a reference in the Chinese *Tat'sin* traders. The author of 2 Chron. ix. 21; xx. 36, 37 identifies these ships with ships of Tarsus in Asia Minor, which W. F. Ainsworth, *A Personal Narrative of the Euphrates Expedition*, i., 138, considers to be right. Halévy (*Rev. des Études Juives*, xiii., 14) supposes that the island of Sardinia is meant; Le Page Renouf (*Proc. Soc. Bibl. Arch.*, xvi., 138), the mainland of Phœnicia; but both without sufficient reason. See Meyer, *Gesch. d. Alterth.*, i., § 281; Pietschmann, *Gesch. der Phönizier* (Berlin, 1889, p. 286). RICHARD GOTTHEIL.

**Tarsi'idæ** [from *Tarsius*—so named from the length of the tarsi—the representative genus]: a family of mammals of the order *Primates* and sub-order *Lemuroidea* or *Prosimiæ*, distinguished by the length of the tarsi and the dentition. The teeth are in number 34—viz., M. $\frac{3}{3}$, P. M. $\frac{3}{3}$, C. $\frac{1}{1}$, I. $\frac{2}{1} \times 2$; the true molars have numerous pointed cusps; the premolars are conical, and successively increase in size from the first to last; the canines are normally developed; the median upper incisors are longest. The skull has the orbits slightly closed behind; the fibulæ are partially ankylosed with the tibiæ; the hind feet have their second and third toes armed with claws, and the rest provided with flattened pointed nails. The bones of the tarsus are much elongated, whence the name of the group. Only one species is known, *Tarsius spectrum*, an inhabitant of the forests of Sumatra, Borneo, Celebes, and Banca, sometimes called malmang, specter lemur, and (adopted from the French) tarsier. Its size is about that of the common rat. It has very large eyes, and ears, long hind legs and tail, is nocturnal in habits, and feeds chiefly on insects and lizards. E. A. BIRGE.

**Tarsiped'idæ** [Mod. Lat., named from *Tar'sipes*, *Tarsipedis*, the typical genus; *tar'sus*, ankle + Lat. *pes*, *pe'dis*, foot]: a family of marsupial mammals. The general form and size of the animal are similar to those of a mouse; the snout is elongated; the tongue is very long, slender, and exsertile; the fore and hind limbs differ but little in length; the feet have each five toes; those of the front are rather small, slightly enlarged toward their tips, and provided with minute scale-like nails, "impressed, as it were, into the flesh, on the upper surface of the toe"; the inner hind toe is thumb-like, slender, and destitute of a nail, the second and third very short (joined together as usual in the sub-order), and armed with small nails which are directed upward almost at right angles to the toes, and the fourth and fifth larger (free), and furnished with scale-like nails; the tail is long and slender, scaly, like that of a rat, and sparsely hairy. The teeth are very small and simple, variable in number, and similar in shape. The stomach is small and simple, and has very thin walls; the intestine has no cæcum. The skull is very thin and almost papery; the lower jaw has very slender and almost straight rami, without distinct coronoid or angular processes, and with elongated foramina in their posterior halves. This type is one of the most extraordinary and exceptional of mammals. Only one species—the *Tarsipes rostratus*—is known, an inhabitant of Western Australia, and generally found from Swan river to King George's Sound, but is very rarely obtained. It is nocturnal in its habits, and in the night is very active. It will dart at passing flies and kindred insects with great celerity; having caught one, it holds the fly between its front paws, and proceeds leisurely to eat it. It is also very fond of honey, which it extracts from flowers by means of its long tongue. Revised by F. A. LUCAS.

**Tarsus**: See FOOT.

**Tarsus**: town; in Asia Minor, in the vilayet of Adana, on the Cydnus (*Tarsus Chaï*); the ancient metropolis of the Cilician confederation; then the capital of the Roman province of Cilicia, and for several centuries before and after Christ the most important city of Asia Minor as a seat of learning and center of commerce (see map of Turkey, ref.

6–G). Cleopatra, accompanied by Mark Antony, ascended the Cydnus to Tarsus in a gilded galley with purple sails and silver oars. Tarsus was the birthplace of Paul the apostle, and the burial-place of Julian the Apostate. The city has greatly declined. The greater part of its former site is covered with *débris*; but it possesses one colossal ruin, an enigma to antiquarians, as it resembles no known edifice, and as its object has never been determined. This consists of two solid masses of concrete masonry; the larger 115 feet long, 49 feet wide, and 23½ feet high; the smaller 56 feet long, 39 feet wide, and 23½ feet high; the two inclosed in a rectangular space, 380 feet long and 153 feet wide, by a solid wall 21 feet thick, and 23½ feet high. Tarsus is on the railway from Adana to Mersin, and at the junction of several highways. It carries on a considerable trade in cotton, sesame, wheat, maize, yellow wax, skins, carpets, tobacco, and raw materials. Pop. 30,000, which is reduced in summer to 7,000, the inhabitants being forced to leave on account of the poisonous exhalations of the Cydnus.

E. A. GROSVENOR.

**Tartar** [*tartar* (readapted to Lat.) is from O. Fr. *tartre* < Late Lat. *tar'tarum*; cf. Lat. *Tar'tarus* = Gr. Τάρταρος, the nether world, Tartarus, but the connection is not obvious]: any salt of tartaric acid, more especially the acid potassium tartrate or hydrogen-potassium tartrate. See ARGOL.

**Tartar, Cream of**: See CREAM OF TARTAR.

**Tartar Emetic** (*Antimonii et Potassii Tartras*): a double tartrate of potassium and basic antimony; its formula is $2K.(SbO).C_4H_4O_6.H_2O$. It is made by boiling acid potassium tartrate (cream of tartar) with antimony oxide in water. It forms in transparent crystals, which become white and opaque by exposure to the air, but in the shops it is generally kept in the form of powder. It dissolves in 20 parts of cold water, and in between 2 and 3 of boiling, but all aqueous solutions spontaneously decompose on keeping. It is insoluble in alcohol, but soluble in proof spirit or wine. If pure, a solution of tartar emetic yields no precipitate with barium chloride, nor, when diluted, with silver nitrate, nor does it turn blue with potassium ferrocyanide.

Tartar emetic has rather a nauseous, harsh metallic taste, and upon the animal system is a local irritant and a powerful constitutional poison. Applied to the skin, as in ointment, it causes burning pain, redness, and finally the eruption of a crop of painful pustules. Taken internally, small doses, as a small fraction of a grain, tend to reduce the force and frequency of the pulse and promote perspiration. Somewhat larger quantities cause nausea and vomiting, with relaxation of the bowels and of the muscular system, reduced action of the heart, and a general feeling of depression and weakness. Still larger doses cause an intensification of the above symptoms, with burning pain in the stomach, the induction of a choleraic state characterized by violent and prolonged nausea, vomiting, and serous purging, colic, cramps, great enfeeblement of the heart and general strength, and finally collapse and death. After death decided inflammation of the stomach and bowels is generally found. Sometimes, however, both this lesion and the irritative symptoms dependent upon it are absent even in fatal poisoning. Death does not often occur until several days after the poisoning. In cases of tartar-emetic poisoning, tannic or gallic acid, or some vegetable infusion containing the same, such as green tea, decoction of oak-bark, of cinchona, etc., should be administered, and free vomiting promoted. The inflammation and great cardiac and constitutional depression which the poison occasions must be treated on general medical principles. In medicine, tartar emetic has been much employed in minute doses to reduce the pulse and promote sweating in acute fevers. It is often made an ingredient of mixtures to relax the inflamed mucous membrane and promote free secretion in the early stages of bronchitis, and may also be employed as an emetic. Locally, it is sometimes used in ointment to produce pustulation for the purpose of persistent counter-irritation, but here, as in its other uses, less violent means are usually found sufficient.

Revised by H. A. HARE.

**Tartar'ic Acid** [*tartaric* is deriv. of TARTAR (*q. v.*)]: an acid ($H_2.C_4H_4O_6$) found in the free state in various plants and berries, or, by extension, any one of several isomeric acids. It forms salts called tartrates.

Of ordinary tartaric acid (dextrotartaric acid), the chief source is the grape, in which it occurs as the hydrogen-potassium tartrate (cream of tartar, $KHC_4H_4O_6$). It is prepared by dissolving crude tartar in boiling water, and slowly adding pulverized chalk as long as the mixture effervesces. Usually, 1 part of chalk is sufficient to decompose 4 parts of tartar. Insoluble calcium tartrate and soluble potassium tartrate are formed by this operation. Upon filtering, and adding the equivalent quantity of calcium chloride, all the tartaric acid is obtained as a precipitate of calcium tartrate. The two precipitates are then united, washed, and decomposed into insoluble calcium sulphate and free tartaric acid by 3 parts of sulphuric acid diluted with 7 of water for every 5 of the salt taken. The filtrate is evaporated in leaden pans, and allowed to crystallize. This acid can also be artificially produced by the oxidation of milk-sugar, glucose, starch, gum, etc., with nitric acid. It forms colorless transparent rhombic prisms, which become strongly electrical when gently heated. It is easily soluble in water and in alcohol; the aqueous solution becomes mouldy on standing, and is gradually converted into acetic acid. Dextrotartaric acid is distinguished from its isomers by the fact that in aqueous solution it exerts a strong right-handed rotation on polarized light. In its crystalline structure it bears an interesting relation to the isomeric lævotartaric acid. The crystals of the two acids resemble one another perfectly in form, excepting that ordinary tartaric acid presents hemihedral faces on the right of the crystal, which in lævotartaric acid are situated on the left or opposite side; so that the reflection of a crystal of the dextro-acid represents one of the lævo-acid. The dextrotartrates and lævotartrates exhibit the same difference in their crystalline form. In pyro-electrical relations also, crystals of dextrotartaric acid present properties opposite to those of the lævo-acid. Dextrotartaric acid precipitates solutions of the caustic alkaline earths; also solutions of lead, silver, and potassium salts. The precipitate with potassium compounds (cream of tartar) serves for the detection of the acid in the presence of other organic acids. Boiling tartaric acid reduces silver, gold, and platinum salts, and prevents the precipitation of the salts of copper and iron by the alkalies, the latter property being frequently utilized in chemical analysis. Dextrotartaric acid melts at 338° F.; at a higher temperature it is converted into several isomeric acids. By increased heat, pyruvic (or pyroracemic, $H_2.C_6H_6O_6$) and pyrotartaric, $H_2.C_5H_6O_4$, acids are produced. When heated with the alkalies it loses water, and the oxalate and acetate of the base are formed. By oxidation dextrotartaric acid is decomposed into carbonic and formic acids; when treated with reducing agents, either one or two atoms of hydrogen are eliminated, and malic or succinic acid is obtained. Tartaric acid forms acid, neutral, and double salts. Three varieties of the latter are well defined—those containing monatomic metals, such as Rochelle salts, $KNaC_4H_4O_6.4H_2O$, which is analogous to cream of tartar; those formed from monatomic and diatomic metals, in which the oxide of the latter is combined with the same proportion of acid as the monatomic element, such as potassium-ferrous tartrate, $K.FeO.C_4H_4O_6$; and those analogous to tartar emetic, such as silver-antimony tartrate, $Ag.SbO.C_4H_4O_6$. The only quadribasic tartrates as yet prepared are those of lead and zinc. When strongly heated, all tartrates are carbonized and emit the odor of burned sugar.

The isomeric *lævotartaric acid* is obtained upon neutralizing equal parts of racemic acid, one with soda, the other with ammonia, mixing the fluids, and allowing the double salt to crystallize; half of the crystals formed possess the hemihedral faces common to dextrotartrates, the remainder showing those characteristic of the lævo-salts. Upon mechanically separating the two varieties, dissolving them in water, adding plumbic nitrate, and decomposing the precipitates with sulphuric acid, solutions of the dextro-acids and lævo-acids are obtained. When equal amounts of the dextrotartaric and lævotartaric acids are mixed and evaporated, RACEMIC ACID (*q. v.*) is produced; in the same manner racemates are obtained from mixtures of dextrotartrates and lævotartrates. For the chemical theory, see STEREO-CHEMISTRY.

Tartaric acid is extensively used in dyeing and in preparing effervescing drinks and baking-powders. Some of the tartrates, such as tartar emetic, Rochelle salt, and the potassium-ferrous tartrate (*tartarus chalybeatus*), possess valuable medicinal properties.

Revised by IRA REMSEN.

**Tartars**, properly **Tatars** [from Pers. *Tātār*: cf. Chin. *Tah-tar*]: an ethnological name, used by some in a wider, by others in a narrower, and always in a somewhat vague, sense. The word *Tah-tar* was first applied to those Mongolian tribes who on their swift horses descended from the Altai plateaus into the Chinese lowlands, robbing and plun-

dering. When adopted by the Europeans, the word was changed into *Tar-tar*, with an allusion to the classical Tartarus, and was applied to all those tribes and races which Genghis Khan had brought under his sway and led into Europe, including not only Mongolian, but also Tungusian and Turkish races. The name is used in a restricted sense, especially by Russian writers, to designate certain populations speaking the Turkish language, and mostly of Turkish race, living in Siberia, the Caucasus, and Central and Eastern Russia. See Howorth's *History of the Mongols* (1876–80).
Revised by M. W. Harrington.

**Tar'tarus** (in Gr. Τάρταρος): a name used synonymously with *Hades* by the later Greek and Latin writers, but with Homer it means a separate place, as far below Hades as the heavens are above earth, into which Zeus had thrown the worst offenders against his authority. Later writers, however, sometimes make a distinction between Tartarus and the Elysian Fields as two divisions of Hades, the former occupied by the criminals, the latter simply inhabited by the dead. As a personification, Tartarus is represented as the son of Æther and Gæa (air and earth), and by his mother he was father to the Gigantes, Typhoeus and Echidna.
Revised by J. R. S. Sterrett.

**Tar'tary**: a geographical name of vague and variable application. In the Middle Ages the name denoted the whole central part of Eastern Europe and Asia, from the Dnieper to the Sea of Japan. Later, a division into European and Asiatic Tartary took place, and the name of European Tartary was soon confined to the territory now called Crimea, while that of Asiatic Tartary first signified the whole empire of Genghis Khan and his successors, then Turkestan alone, with the exclusion of Turfan, Mongolia, and Manchuria, and now only that part of Turkestan which does not belong either to Russia or to China.
Revised by M. W. Harrington.

**Tartrates**: See Tartaric Acid, Cream of Tartar, Tartar Emetic, Rochelle Salt, etc.

**Tarudant'**: southernmost city of Morocco and center of caravan trade; near the southern slope of the Atlas Mountains, 2 miles from the river Sus and 44 miles from the Atlantic. It is surrounded by walls, has several fine mosques and a citadel, but is otherwise poorly built. Its dye-works and manufactures of leather and copperware are important. Pop. probably 8,000 or 10,000, and decreasing.
Revised by M. W. Harrington.

**Taschereau**, taäsh'rō', Elzéar Alexandre: cardinal; b. at Ste. Marie de la Beauce, province of Quebec, Canada, Feb. 17, 1820; educated at the Seminary of Quebec and in Rome; was ordained a priest in 1842, and soon afterward appointed to the chair of Moral Philosophy in the Seminary of Quebec, which he filled for twelve years. In 1854 he was sent to Rome by the second provincial council of Quebec to present its decrees to the pope for ratification; in 1856 received the degree of canon law from the Roman seminary, and was appointed Professor of Canon Law in Laval University; in 1859 became a member of the council of public instruction in Lower Canada, and in 1860 superior of seminary and rector of Laval University. He was appointed vicar-general of the diocese of Quebec in 1862; administrator of the diocese in 1870; the same year attended the Œcumenical Council at Rome; was consecrated Archbishop of Quebec in 1871, and cardinal in 1886. Cardinal Taschereau was an earnest advocate of temperance. D. in Quebec, Apr. 12, 1898.

**Taschereau**, Henri Elzéar, LL. D.: jurist; b. at Ste. Marie de la Beauce, P. Q., Canada, Oct. 7, 1836; educated at the Seminary of Quebec, and admitted to the bar in 1857. He represented Beauce in the Canadian Assembly 1861–67; was appointed puisne judge of the Supreme Court of the Province of Quebec Jan. 12, 1871, and puisne judge of the Supreme Court of the Dominion Oct., 1878. In 1895 he became dean of the law faculty of Ottawa University. Author of *The Criminal Law for the Dominion of Canada* (2 vols.) and of *Code de Procédure civile du Bas Canada*.

**Taschereau**, Jules Antoine: journalist and author; b. at Tours, France, Dec. 19, 1801; became very early a frequent contributor to the Parisian press, and was one of the founders of the *National*; entered the civil service of the Government shortly after the Revolution of July, 1830, but soon returned to his journalistic activity; was one of the editors of *Historiettes de Tallemant des Réaux* (6 vols., 1833–34; 2d ed. 9 vols., 1854–60), and founded the *Revue rétrospective* (20 vols., 1833–37); received an appointment at the National Library in 1852, and became its director-general in 1858. D. in Paris, Nov. 11, 1874. He published editions of the works of Molière (1823–24), Boufflers (1827), the *Correspondance littéraire* of Grimm and Diderot (1829–31), etc.; superintended the publication of many volumes of the catalogue of the National Library (1855, *et seq.*); and wrote *Histoire de la Vie et des Écrits de Molière* (1825) and *Histoire de la Vie et des Ouvrages de Corneille* (1829), both several times reprinted.
Revised by A. G. Canfield.

**Tashkend'**: capital of Russian Turkestan and chief town of Syr-Darya; the most populous city in Central Asia; in a gently sloping, well-watered, fertile plain, covered with numerous fruit-trees, at the foot of the Alatau and Chatkal Mountains (see map of Asia, ref. 4–E). The city was formerly inclosed by a wall 7 miles long and pierced by nine gates, but this is now in a ruinous condition, and rich gardens irrigated by canals surround the city, which forms an oval whose greater axis lies in the direction W. to E., and which is bent inward to the S. In the hollow thus formed the Russian town, the so-called European town, is built. S. W. of the European and S. of the Asiatic city is the Russian citadel, with barracks and military stores, surrounded by a bastioned wall. A great caravanserai forms the center of the wholesale business district. The Asiatic city has narrow, crooked, and ill-paved streets. Tashkend is one of the oldest and largest cities of Central Asia, from old times the seat of an important agriculture and a brisk trade. Here the roads from Kashgar meet with those which lead S. from Samarkand, N. from Orenburg and Siberia, into Central Asia. The value of foreign goods exchanged in the city amounts to about $20,000,000 annually; the principal exports and imports are cotton fabrics, metal ware, and silk. The Arab geographers of the Middle Ages called the city *Shash*; from the sixteenth century to the eighteenth it was the capital of the Kirghiz Kosaks; in 1810 it was taken by the Khan of Khokan, and in 1867 it was occupied by the Russians. Pop. (1885) 121,410, of whom 75,000 are Sarts, and 20,000 Russians (in 1892), the remainder being Uzbegs, Kirghiz, Jews, and other Asiatics.
Revised by M. W. Harrington.

**Tashkurgan**: See Khulum.

**Tasman**, Abel Janszoon: explorer; b. at Hoorn, province of North Holland, about 1602; made voyages in the western Pacific and Indian Oceans in 1639–42, under authority of the governor-general of the Dutch East India Company, Van Diemen, who then sent him to circumnavigate the Australian continent; left Batavia Aug. 14, 1642; discovered Nov. 24 the island which he called Van Diemen's Land, but which is now called Tasmania; Dec. 13, the southern island of New Zealand; Jan. 21, the Friendly islands; Feb. 6, the Fiji islands; and returned to Batavia June 15, 1643. Of this voyage he published an account which was reprinted at Amsterdam in 1722 (new ed. by Swart, 1860). Jan. 29, 1644, he set out on a voyage along the coasts of New Guinea, and made important discoveries on the north and northwestern coasts of Australia. D. at Batavia in Oct., 1659.
Revised by M. W. Harrington.

**Tasma'nia**, formerly **Van Diemen's Land**: an island and British colony of Australasia; 150 miles S. of the colony of Victoria, Australia, from which it is separated by Bass Straits (see map of Australia). It is the smallest and most healthful for Europeans of the seven Australasian colonies; between the parallels 40° 33′ S. and 43° 39′ S. and meridians 144° 39′ E. and 148° 33′ E.; area, 26,216 sq. miles, about that of Greece and only a quarter of that of New Zealand. The discoverer, Abel Janszoon Tasman, named it after the governor of the Dutch Indies of the time—Van Diemen—but when the importation of convicts ceased, in 1853, it was renamed after the discoverer. The colony includes, with the island of Tasmania and the adjacent small islands, the Furneaux Archipelago, N. of the northeast angle and consisting of Flinders island (area, 800 sq. miles), Cape Barren island, and others smaller; also King's island, N. of the northwest point and about half way to Australia (area, 425 sq. miles). The main island is well watered, picturesque, and varied, with high mountains and fine valleys, rocky and often precipitous coasts, and numerous rivers, cascades, and fresh-water lakes. In contradistinction to Australia, it is sometimes called the Green Isle.

The coast is indented by many large and small bays, deep estuaries, and well-protected ports. The west coast is the boldest, and offers least protection to commerce.

The surface is rough and mountainous, and consists essentially of a central plateau, about 4,000 feet above sea-level, extending in places to the coast, especially at the W., which is rugged. Cradle Mountain in the west is 5,069 feet high; Frenchman's Cap, 4,760; Hugel Mountain, 4,700; and the celebrated Mt. Bischoff, 2,500. In the east the highest peak is Ben Lomond (5,020 feet); in the south Mt. Wellington (4,170 feet) dominates Hobart. The streams are numerous. The longest river is the Tamar (150 miles), which rises near the eastern coast—as the South Esk or Macquarie—and flows into Bass Straits through Port Dalrymple, near the middle of the north coast. The name Tamar is applied only to the estuary, which extends from the mouth southward about 60 miles to Launceston (the second port in point of importance in the colony), with about 20 feet of water. The next longest river is the Derwent (140 miles long), which rises in Lake St. Clair, at the foot of Mt. Hugel, and empties into Storm Bay on the south coast through a large estuary, on which is situated Hobart (formerly Hobart Town), the capital and principal port of the island. One of its branches rises in Great Lake in the center of the island—the largest of the lakes, having an area of 70 sq. miles—3,820 feet above sea-level. Nearly opposite the mouth of the Derwent are the strangely formed North and South Bruni islands, connected by a narrow isthmus, a characteristic form reproduced in several peninsulas and islands on the southeast coast.

*Climate.*—The latitude and insular character give Tasmania a temperate and genial climate. In the settled parts the extreme winter temperatures range only between 20° F. to 44° F., and in summer between 78° and 96°. The autumn is the pleasantest season, with a mean temperature of about 57°. The mean annual temperature for Hobart for fifty years is 55°. The hot winds of Australia are much tempered by the passage of Bass Straits, and are felt only in the northern parts of this colony. Land and sea breezes prevail in the warmest months. The rainfall is chiefly in winter, like Southern Chile and Oregon, and, also like them, the western coast is wet and the rainfall decreases rapidly eastward. A hundred inches or more may fall on the west coast, while more than a third of the area has an annual fall of only from 10 to 20 inches. At Hobart the average for a long series of years is 23 inches, with 143 rainy days a year. Zymotic diseases are relatively rare.

*Minerals.*—The strata generally are very much contorted and tangled, and the density of the scrub vegetation has greatly impeded their investigation. Metamorphic rocks are abundant, and quartz is so common a feature of the western cliffs as to reflect a white light on passing ships. The evidences of repeated volcanic action are numerous and unmistakable, but no volcanic cones are found. Palæozoic rocks abound, and are often thrown up into irregular ranges up to 5,000 feet or more in height. The Carboniferous strata are common, except on the western half. Tertiary rocks are not extensive, and the Pleistocene was marked by very great denuding forces. Raised beaches and moraines are not rare.

The character of the mineral products is indicated in the accompanying table. Gold was discovered in 1852, and is generally distributed in the river sands and in the quartz rock, but Tasmania has an unimportant position among the

| MINERALS. | TOTAL PRODUCT TO 1893. | | PRODUCT IN 1892. | |
|---|---|---|---|---|
| | Value. | Per cent. of Australasian product. | Value. | Per cent. of Australasian product. |
| Tin | £5,557,438 | 34·4 | £256,083 | 46·6 |
| Gold | 2,562,569 | 0·7 | 174,070 | 2·6 |
| Coal | 268,752 | 0·8 | 18,022 | 0·9 |
| Silver | 137,155 | 0·9 | 45,502 | 1·8 |
| Copper | 617 | .... | ........ | .... |
| Totals | £8,526,531 | 1·9 | £493,677 | 4·0 |

Australasian colonies as a producer of gold. The value of the export in 1899 was £205,936. As a producer of tin, however, she leads her sister colonies. It has hitherto been obtained almost exclusively from alluvial deposits, and is always in the form of cassiterite or tin oxide. The most celebrated mines are those of Mt. Bischoff in the northwest, near the head waters of the Arthur river, and these mines, with those of the Ringarooma district in the northeast, have yielded more than three-fourths of the tin product of the colony. Considerable areas of stream-tin are worked out, and attention is turning to the lodes, of which many well-known ones have remained untouched, as at Mt. Bischoff, Mt. Humskirk (on the coast S. W. of the preceding), and Ben Lomond in the northeast. The export in 1899 was valued at £281,947. Anthracite and bituminous coal are found, the latter in abundance; about 50,000 tons are produced annually. The silver-mining industry is developing rapidly, chiefly in the Mt. Zeehan and Mt. Dundas districts, which give almost the entire product. Silver of the value of £208,869 was exported in 1899, as against £79,353 in 1892. Copper is met with at Mt. Maurice and elsewhere, but not in paying quantities. Arsenic, bismuth, antimony, zinc, manganese, graphite, galena, and asbestos exist. Iron is present in large quantities and in all varieties of ore. Hobart free-stone is largely exported to the other colonies. A peculiar inflammable resinous mineral has been found in the Mersey district and named tasmanite.

*Fauna and Flora.*—The fauna is similar to that of Australia, but the TASMANIAN WOLF and TASMANIAN DEVIL (*qq. v.*) are peculiar to Tasmania. Several European food-fishes have been introduced. A less favorable immigrant is the rabbit, which has become a pest here as in Australia. The flora is similar to that of Victoria, but has many peculiar species. The celebrated blue gum, or *Eucalyptus globulus*, which has become a favorite immigrant in pestilential localities in America and Europe, flourishes best in the southern districts of Tasmania. Forests are abundant, and afford some woods of great value. The scrub is very thick and tangled. The evergreen forests are aromatic. There is a large timber-trade with the other colonies.

*Agriculture.*—The soil is generally good, and some of the lower plains and valleys are marvelously fertile. The higher plateau is especially suited to stock-raising. Only a little more than 1 per cent. of the area is under cultivation, and this percentage has increased very little for a generation. Of the cultivated land, 33 per cent. is in wheat, yielding 18 bush. to the acre, but the product is not sufficient for local consumption; 26 per cent. is in hay, yielding 1·2 tons per acre; 13 per cent. in oats (27 bush. to the acre); 9 per cent. in potatoes; 2 per cent. in barley; and 6 per cent. in orchards. For the last the climate and soil are especially suited. No maize is raised. Oats, potatoes, and hay are exported.

In 1900 the colony possessed 1,672,068 sheep, 160,204 horned cattle, 31,189 horses, and 74,451 swine. It is singularly well adapted to sheep-rearing, and its stud flocks are annually drawn on to improve the breed of sheep in the other colonies, but the industry is slowly decreasing. The wool clip was valued at £219,291. The dairy products are excellent, and are largely exported. The number of cattle and horses is increasing.

*Population.*—The aborigines were nearly allied to the native Australians, and in 1803 numbered about 5,000. Soon after arose the "Black war," in which they were nearly exterminated. In 1835 they were transported to Flinders island, where they died out rapidly. The last representative of pure blood died in 1876. In 1891 there remained 139 half-castes. In 1893 the population of the colony was 154,424, with a considerable surplus of males. The annual increase for thirty years was 1·63 per cent.—the least in the seven colonies. The conditions for longevity are favorable, and the percentage of those over 65 years of age is 5·55, which is very high. The density per square mile was nearly 6, and was 3·44 in 1861. In 1893 there were 848 marriages, 5,216 births (4 per cent. of them illegitimate), and 2,071 deaths, giving rates of 5·51, 33·92, and 13·47 respectively. Seventy-four per cent. of the inhabitants were born in the colony, and the surplus of immigration over emigration is small. The Chinese numbered 1,056 in 1891, and the number of other aliens was very small.

No state aid is given to religion. Half of the population are professed members of the Church of England, 18 per cent. are Roman Catholics, 12 per cent. Wesleyan and Methodist, 7 per cent. Presbyterians, 3 per cent. Congregationalist, 2 per cent. Baptists, and 84 persons were professed Hebrews. The percentage of Methodists and Baptists is increasing, that of the other sects decreasing.

The statutory school age is from 7 to 14, and school attendance is compulsory. In 1899 there were 309 public schools, with a total enrollment of 23,293, and 241 private schools, with 8,781 pupils. In 1891 over 20 per cent. of the population could not read or write, but this number is decreasing rapidly. In 1892 there were 357 insane and 732 paupers in asylums. Of the total population, 17,925 were engaged in agriculture and 987 in purely pastoral pursuits;

15.854 in industrial and 4,004 in mining pursuits. The public libraries numbered 40, with 65,787 volumes.

*Commerce.*—The first state railway was begun in 1868, and at the end of 1899 there were 547¼ miles of railways, of which 84 were in private hands. The principal line is 130 miles long, crossing the island N. and S. and connecting Hobart and Launceston. The state roads cost on the average £8,338 per mile, and in 1892 they gave a net profit of 3·76 per cent. on the cost. A cable joins Tasmania to Victoria, and within the colony there are (1899) 2,004½ miles of telegraph line, with 3,680 miles of wire, besides 815 miles of telephone wire. The total imports in 1899 were valued at £1,769,324; the exports for the same year amounted to £2,577,475. The chief imports were textiles, art and mechanical products, and foods and drinks. The trade is almost entirely with Great Britain or the other Australasian colonies. The registered shipping in 1899 was 44 steamers and 156 sailing vessels. In 1899 797 vessels entered and 755 cleared from Tasmanian ports.

*Administration.*—The constitution became operative in 1886. The Parliament consists of a Legislative Council of 18 elective members, holding office for six years, and of a House of Assembly of 36 members, elected for three years. All members of Parliament receive £50 per year, and have free passes on railways and franks in the post-office and on the telegraph lines. The governor is appointed by the British crown, and has a cabinet of advisers of six responsible ministers with salaries of £600 per annum. The public revenue is derived from taxation (58 per cent.), mostly customs: from railway, postal, telegraph, and other public services (32 per cent.); and from the rental and sale of public lands. In 1899 it was £943,970. The expenditure was £871,-453, devoted to special public works (35 per cent.), to interest due (36 per cent.), to hospitals and charities (6 per cent.), to law and protection (10 per cent.), to education (5 per cent.), and to general purposes (8 per cent.) The public debt at the end of 1899 was £8,395,639, chiefly at 4 per cent. The defense force consists of 1,854 volunteers. The Derwent and Tamar are fortified below the chief ports. The capital is Hobart: pop. (1891) 33,450; (1894) 35,073. The next largest town is Launceston; pop. (1894) 22,351. In 1891 there were no other towns with over 5,000 inhabitants.

*History.*—Tasmania was discovered by Tasman Nov. 24, 1642, and first circumnavigated by Bass and Flinders in 1798. The first settlement was made from Sydney in 1803, and in the following year a penal colony was established at Hobart. The first newspaper was printed in 1810. There were several conflicts with the natives, and by 1825 the prosperity of the colony was seriously endangered from the number of escaped convicts who had taken to the bush and become brigands. Up to this time the colony had been subject to New South Wales, but it was then made independent. A protest was made against the continuance of the importation of convicts, but this had to be repeated for nearly a generation before it was effective. Freedom of the press, trial by jury, and popular government were also gained only after long struggles. Although large numbers of criminals were transported to the colony from the beginning till 1853, the convict taint upon it was never so deep as on New South Wales.

REFERENCES.—*The Annual Official Record*; Fenton, *History of Tasmania* (1884); Roth, *The Aborigines of Tasmania* (1890); and Coghlan, *A Statistical Account of the Seven Colonies of Australasia* (official, 1894).

MARK W. HARRINGTON.

**Tasmanian Devil** (so called from its fierce, untamable disposition): the *Dasyurus ursinus*, a carnivorous marsupial peculiar to Tasmania. It is about 20 inches long, exclusive of the tail, and dull black, with a white mark on the breast. The form is thickset, head large, teeth powerful. Before these animals were reduced in numbers they were very destructive to poultry and even to sheep. F. A. L.

**Tasmanian Wolf, Zebra Wolf**, or **Thylacine**: the *Thylacinus cynocephalus*, a marsupial of dog-like appearance, restricted to Tasmania. It is the largest of carnivorous marsupials, reaching a length of 4 feet. It has no marsupial bones, their place being taken by tendons. The color is grayish brown washed with yellowish, and there are about a dozen blackish cross-bars on the hind part of the back. It was abundant, but has been nearly exterminated, owing to the havoc it wrought among sheep. F. A. L.

**Tasse**, taas, JOSEPH: author; b. in Montreal, Canada, Oct. 23, 1848; educated at Bourget's College, Rigaud, P. Q. He edited *Le Canada*, Ottawa, 1867–68, *Minerve*, Montreal, 1869–72, and was a director of *La Revue Canadienne*, a monthly to which he contributed essays on literature, history, and political economy; since 1880 he has been the leading writer of that periodical. In 1873 he visited Europe and published an account of his tour. He represented Ottawa in Parliament 1878–87, and became a member of the Senate Feb. 9, 1891. He is author of *La Vallée de l'Outaouais* (1872); *Les Canadiens de l'Ouest* (2 vols., 1878); *Parallel of the Life of Sir John Macdonald and Lord Beaconsfield* (1879): *Political Recollections* (1891); and *Life and Speeches of Sir George E. Cartier* (1892). NEIL MACDONALD.

**Tassisudan'**: the summer capital of BHUTAN (*q. v.*); 15 miles W. of Punakha, the capital proper; on the Chin-Chu or Raidak, an affluent of the Brahmaputra (see map of N. India, ref. 6–J). It contains a palace for the two rajahs, of whom the dherma-rajah lives in a high tower, together with a beautiful idol, and the deb-rajah in a square edifice inclosing the tower. The palace is furthermore surrounded by rows of smithies, in which metallic idols are manufactured, and outside of these factories the town extends.

Revised by M. W. HARRINGTON.

**Tasso**, BERNARDO: poet; b. in Venice, of a noble family from Bergamo, in 1493; studied at Padua, then became secretary to Count Guido Rangone, in whose company he visited Paris (1528). He then entered the service of Renata, daughter of Louis XII. of France and wife of Prince Ercole d'Este. In 1532 he left Ferrara and entered the service of Ferrante Sanseverino, Prince of Salerno. In his company he visited Tunis (1535), Spain (1537 and 1539), France and Flanders (1544). As early as 1536 he married Porzia de' Rossi of Pistoja; and in 1544 he was allowed by his master to retire to Sorrento in order to give himself to literature. Here he labored on his long epic *L'Amadigi*, based on the *Amadis de Gaula*. In 1547, however, his master was ruined by participation in the uprising against the introduction of the Inquisition into Naples, and Tasso shared his fate. The latter's property was confiscated, and he came to actual want. His misery was increased by the loss of his wife in 1556. After living for a time at Rome (1554–56) the poet found refuge with Duke Guidobaldo of Urbino. In 1558, however, he went to Venice, where he was made chancellor of the Venetian Academy. Later he entered the service of Luigi d'Este, then that of Guglielmo Gonzaga, who made him *podesta* of Ostiglia. Here he died, Sept. 4, 1569. Besides the long epic *Amadigi*, we have from this poet the *Floridante*, a narrative poem finished by his son Torquato; and also shorter poems called *Amori*, *Egloghe pescatorie*, and *Odi*. In prose are the *Ragionamento della poesia*, and numerous highly interesting *Lettere*. The best edition of the *Amadigi* is that of Venice, 1581. See also Seghezzi, *Lettere di M. Bernardo Tasso* (2 vols., Comino, 1733); Serassi, *Delle Lettere di M. Bernardo Tasso*, vol. iii. (Padua, 1751); G. Campori, *Lettere inedite di B. Tasso* (with *Life*, Bologna, 1869); A. Portioli, *Lettere inedite di B. Tasso* (Mantua, 1871). A. R. MARSH.

**Tasso**, TORQUATO: poet; b. at Sorrento, Italy, Mar. 11, 1544; a son of Bernardo Tasso; educated first by the Jesuits at Naples, he continued his studies at Rome and Bergamo, then at the court of the Duke of Urbino in Pesaro, and at Venice, whither his father's fortunes had carried him; finally, in 1560, at his father's desire, he went to the University of Padua to study law. He felt himself more attracted, however, to literature and poetry. In 1562 he published a romantic epic, *Rinaldo*, in twelve cantos, and the applause with which it was received determined him to give up jurisprudence altogether and devote himself entirely to poetry. He repaired to Bologna, where he studied philosophy, frequented the select literary circles of the place, and took up again work on his great epic, *Gerusalemme Liberata*, which he had begun while still hardly more than a boy, moved by the advances of the Turks in Hungary and their frequent raids on parts of the coast of Italy, starting reminiscences of the great time of the crusades. In 1565 he entered the service of Cardinal Luigi d'Este, whom he accompanied to Paris and on other diplomatic missions, and who brought him into connection with his brother, Alfonso II., reigning Duke of Ferrara. In 1571, at which time he had finished the first eight songs of his epic, he left the cardinal, receiving in 1572 a kind of court appointment and a pension from Alfonso II., and settled at Ferrara, where he lived very happily for several years, enjoying the intimate friendship of the duke and his two sisters, Lucrezia and Eleonora. In the summer of 1573 he wrote for a court festivity his *Aminta*, a pastoral drama, the best of its kind (1st ed. Cremona, 1580); and in 1575 the *Gerusalemme Liberata* was completed. But in the meantime a peculiar melancholy had developed in his mind, and it sometimes burst into open lunacy. His relation to the ducal family had been disturbed, whether on account of a vehement passion for the Princess Eleonora or from some other cause is not known. He was greatly disturbed about his own spiritual condition, fearing that his opinions were unsound, and particularly that his poem was inconsistent with Christian faith and morals. He accordingly submitted the work to many supposed authorities, who treated it with pitiless pedantry, to the poet's great distress. The criticisms, rivalries, and intrigues which as a poet and a courtier he could not escape overwhelmed his imagination; he grew suspicious toward all, saw a secret enemy in everybody, and finally, after the duke had been compelled to restrain him in the effort to cure him, fled from the court in 1577. He sought refuge with his sister at Sorrento, and here his mind soon became calm and clear again. He now yearned for Ferrara, wrote to the duke, and, although the answer he received was very cool, he returned. But he had hardly arrived before the disease again seized his mind. Once more he fled, and once more he returned. His anxiety to re-establish the old relation to this family became more and more passionate as it became more and more evident to him that such a re-establishment was impossible. His manners, his denunciations, became finally so provoking that the duke confined him in a lunatic asylum in 1579. Here he remained seven years, while his great work was read not only in Italy, but all through Europe, and made his name one of the first of his age. At last, in 1586, at the request of Vincenzo Gonzaga, Prince of Mantua, the duke released him, and he now resided for a short time in Mantua, and then settled at Naples. He was poor, sick, and suffering, but his unquiet mind would not permit him to rest; for several years he moved restlessly from place to place, growing steadily worse both in mind and body. His fame, however, was growing continually greater. In 1594 Pope Clement VIII. invited him to come to Rome and be crowned on the capitol, but he died before the solemnity took place, Apr. 25, 1595, and lies buried in the Church of S. Onofrio in Rome. Besides the above-mentioned works he wrote *Torrismondo*, a tragedy, a number of beautiful lyrical poems, some dialogues and essays, some letters, etc. Mention must be made also of the second form of the *Gerusalemme Liberata*, the fruit of years of effort on Tasso's part to relieve the poem of the faults alleged by his self-chosen critics to exist in it. This was finished in 1593 and called *Gerusalemme Conquistata*. Compared with the first form it is a poor and heavy thing; and yet only the piratical printing of the *Liberata* by one Celio Malaspina (Venice, 1580) has preserved to the world one of the chief treasures of modern literature. A complete edition of the *Works* appeared in 33 volumes at Pisa (1821–32), but this is now superseded by the various partial editions of Guasti and Solerti: *Lettere*, ed. by C. Guasti (5 vols., Florence, 1852–55); *I Dialoghi*, ed. by Guasti (3 vols., Florence, 1858); *Prose diverse*, ed. by Guasti (2 vols., Florence, 1875); *Appendice alle Opere in prosa*, ed. by Solerti (Florence, 1892); *Opere minori in versi*, ed. by Solerti (7 vols., Bologna). Best edition of the *Gerus. Liber.* by S. Ferrari (Florence, 1890). See also G. J. Ferrazzi, *T. Tasso, studj biografici-critici-bibliografici* (Bassano, 1880); P. A. Serassi, *La Vita di T. Tasso* (3d ed., with notes by C. Guasti, 2 vols., Florence, 1858); A. Corradi, *Le infermità di T. Tasso* (in *Mem. dell' Istit. Lombardo*, vol. xiv., 1880); English translations of the *Gerusalemme Liberata*, by Edward Fairfax (London, 1600) and by J. K. James (2 vols., 1865). A. R. MARSH.

**Tasso'ni**, ALESSANDRO: poet and critic; b. at Modena, Italy, Sept. 28, 1565, of noble parents; spent some time at the Universities of Bologna and Ferrara, and was associated with the Accademia della Crusca from 1589. He was in Spain with Cardinal Ascanio Colonna in 1600; but after 1603 in Italy, in the service of Charles Emmanuel of Savoy and engaged upon diplomatic missions between Rome and Modena, Piedmont and Turin. D. at Modena, Apr. 25, 1635. His critical writings are the *Pensieri* (1608–20)—freely expressed views upon literary, scientific, and moral matters; the *Considerazioni sopra le Rime del Petrarca* (1602–09), directed against the literary abuses of the time, which were due to the Petrarchists and the Marinists; and the *Avvertimenti di Crescenzio Pepe* (1611). The political *Filippiche contro gli Spagnuoli* (1615) shows his hatred for the Spaniards. His best-known work is the *Secchia rapita* (1615–22), a mock-heroic poem which sings a war caused between the Modenese and the Bolognese, when the former carried off a bucket from the latter. It does not fall behind the *Lutrin* and the *Rape of the Lock*. Further may be mentioned the *Tenda Rossa*, several unedited political documents, the fragment of an epic, the *Oceano*, some satirical rhymes, and his *Letters*. See *La Secchia rapita, poema eroicomico, e Il primo canto dell' Oceano* (Turin, 1830); *Rime*, ed. by T. Casini (Bologna, 1880); *Life*, by A. Muratori, in the edition of the *Secchia Rapita* (Modena, 1744). Cf. G. Tiraboschi, *Biblioteca Modenese* (1784), v., 180 ff., and d'Ancona and Bacci, *Manuale della Letteratura Italiana*, iii., 356 ff. (Florence, 1893). J. D. M. FORD.

**Taste**: See SENSES and HISTOLOGY (*The Digestive Organs*).

**Tatar Bazardjik**: town; in Eastern Roumelia (Bulgaria); on the Maritza; 23 miles W. N. W. of Philippopolis (see map of Turkey, ref. 3–C); traversed by the railway which connects Vienna and Constantinople; maintains a large trade in wheat, lumber, coarse cloth (shaïak), ottar of rose, tobacco, tar, cheese, rice, butter, sheep, and skins. Pop. (1893) 16,343. E. A. G.

**Tatars**: See TARTARS.

**Tate**, NAHUM: poet; b. in Dublin, Ireland, in 1652; was educated at Trinity College; went to London, devoted himself to literature, and in 1692 succeeded Shadwell as poet-laureate; fell into pecuniary straits, and died in the precincts of the Mint, where debtors were privileged from arrest, Aug. 12, 1715. He assisted Dryden in the composition of *Absalom and Achitophel*, most of the second and poorer part being the work of Tate; perpetrated an alteration of Shakspeare's *King Lear*, which kept the stage for a long time in place of the original; as poet-laureate produced commonplace birthday odes and elegies; and put forth several works in prose and verse, among which are about half a score of dramatic pieces. He is chiefly known as a psalmodist, the versions of the Psalms executed by him and Nicholas Brady being long retained in the English *Book of Common Prayer*; these first appeared under the title *Essay of a New Version of the Psalms of David, consisting of the first Twenty, by N. Brady and N. Tate* (1695), which was followed by *The Book of Psalms, a New Version in Metre, fitted to the Tunes used in the Churches, by N. Tate and N. Brady* (1696), and *A Supplement of Church Hymns* (1700). Revised by H. A. BEERS.

**Tateno Gozo**: official and diplomatist; b. at Kokura, on the southern shore of the Straits of Shimonoseki, Japan, in 1841. Sent in 1869 to London in charge of students, he spent four years there, and acquired a thorough knowledge of the English language and of foreign life. From 1880 to 1890 he served with great acceptance as governor of Osaka, whence he was transferred to the legation at Washington, D. C., as minister plenipotentiary. He returned to Japan in the year 1894. J. M. DIXON.

**Tatham**, WILLIAM: soldier and author; b. at Hutton, England, in 1752; emigrated to Virginia in 1769, and entered a mercantile establishment on the James river; served as adjutant of militia against the Indians; during the Revolution was colonel in the Virginia cavalry, and in 1780, in connection with Col. John Todd, compiled the first trustworthy account of the Western territory. He studied law and was admitted in 1784; in 1786 established himself at Lumbarton, N. C., and in 1787 was elected to the Legislature of North Carolina. He twice visited England, and in 1801–1805 was superintendent of the London docks. Returning to Virginia in 1805, he was in his old age reduced to penury, and was appointed keeper of the military stores in the Richmond arsenal. He committed suicide at Richmond, Feb. 22, 1819. Among his publications are *Analysis of the State of Virginia* (Philadelphia, 1794); *Remarks on Inland Canals* (London, 1798); *Political Economy of Inland Navigation* (London, 1799); and *History and Practical Essays on the Culture and Commerce of Tobacco* (London, 1800).

**Tatia'nus**: Christian apologist; b. in Assyria about 110 A. D.; studied philosophy and rhetoric; went to Rome, and taught rhetoric there; enjoyed the friendship of Justin Martyr; was converted by him to Christianity about 152, and wrote in Greek one of the earliest apologies for Christianity against the pagan philosophers, *An Address to the Greeks* (ed. K. Otto, Jena, 1851; Eng. trans., *Ante-*

*Nicene Fathers*, ii., 65–82). After the death of Justin, about 167, Tatian returned to the East, and adopted very strange, heterodox ideas of the Gnostic variety, joining the Encratites. He died, perhaps at Edessa, about 180. His morality was asceticism. He forbade marriage, animal food, wine, etc., and used water in the celebration of the Eucharist. The *Diatessaron* of Tatian, in which the Gospels are so combined as to form a continuous narrative without repetitions, known from the fifth century as the form in which the Gospels were read in Syria, was probably made originally in Syriac. It was entirely unknown except in name and from quotations from it until a Latin translation of it, along with an Arabic version of it of Egyptian origin in the fourteenth century, was published by A. Ciasca in Rome, 1888. Eng. trans. from the Arabic by J. Hamlyn Hill, *Earliest Life of Christ* (Edinburgh, 1894). It proves the existence of four, and only four, Gospels about the middle of the second century. Revised by S. M. Jackson.

**Tatius**, Achilles: See Achilles Tatius.

**Tatnall**, Josiah: soldier; b. at Bonaventura, near Savannah, Ga., in 1762; went to England with his parents, who were loyalists, on the outbreak of the Revolutionary war, but ran away from home in 1780, and returning to Georgia in 1782 joined the army of Gen. Nathanael Greene; was made colonel of militia in 1793 and brigadier-general in 1800; took an active part in the military affairs of the State, and was elected to the Legislature; was U. S. Senator from Georgia 1796–99, and Governor of Georgia 1800. D. at Nassau, New Providence, June 6, 1803.

**Tatou-peba**: See Cachicama.

**Tatpurusha**: a technical term of the traditional Sanskrit grammar applying to substantive compounds, in which the prior member is an adjective, noun, or adverb modifying in meaning the second member, the whole being of the same part of speech as the latter member. They are also called determinative compounds. Such are *indradhanús-*, Indra's bow, *vedavíd*, Veda-knowing, *priyasakha-*, dear friend; or in English, *dining-room, weatherwise, wildcat*. Karmadhāraya (*q. v.*) applies to a subdivision of this class. See also Immutata. Benj. Ide Wheeler.

**Tattam**, Henry, LL. D., F. R. S.: Orientalist; b. in Ireland, Dec. 28, 1788; educated at Trinity College, Dublin, and at the Universities of Göttingen and Leyden; took orders in the Church of England; was archdeacon of Bedford 1844–66, and rector of Stanford Rivers, Essex, 1849–68, and was afterward a chaplain in ordinary to the Queen. D. at Stanford Rivers, Jan. 8, 1868. During his travels in the East, early in the century, he laid the foundation of an intimate knowledge of Oriental languages, concerning one of which, the Coptic, he became an authority. He discovered at the convent of Nitria, in the northwest desert of Egypt, and secured for the British Museum, a splendid collection of ancient Syriac MSS. Among these were the *Ecclesiastical History of John, Bishop of Ephesus* (Oxford, 1853), and the *Epistles of Ignatius* (1845), both edited in the Syriac text by Dr. William Cureton, and the former translated into English by Dr. R. Payne Smith (1860). He was the author of several works, including *Lexicon Ægyptiaco-Latinum ex veteribus Linguæ Ægyptiacæ Monumentis, etc.* (Oxford, 1835); *The Ancient Coptic Version of the Book of Job the Just, translated into English and edited* (1847); and *Prophetæ Majores in Dialecto Linguæ Ægyptiacæ* (Oxford, 2 vols., 1852). Revised by S. M. Jackson.

**Tattler**: a name applied without definite limits to numerous birds of the snipe family, usually to the larger species of sandpipers, such as the yellowlegs, *Totanus melanoleucus*.

**Tattooing** [deriv. of *tattoo*, from Fr. *tatouer*, tattoo, from Tahitian *tatu*, tattooing]: the practice of marking the skin with various indelible figures by means of slight punctures or incisions into which certain pigments are introduced. In the islands of the South Pacific the custom was originally almost universal, although now dying out through the influence of missionaries and civilization. Tattooing is also found among the Burmese, Laos, Japanese, and American Indians (see Indians of North America); in Japan, however, the practice has been forbidden by the Government, and is disappearing. With the races of darker color, such as Negroes, Malays, and the natives of Australia, a more prevalent method of ornamenting the skin is by means of simple scars. The tattooing of a few emblems on the arms or body is a common custom with white sailors and with the lower-class population of Europe. With the Polynesians and Japanese, however, the figures cover nearly the whole body, and largely take the place of clothing. A distinguishing peculiarity of the Maoris was the elaborate tattooing of the face; many of their heads are preserved in museums. The art of tattooing was brought to its highest and most artistic development in Japan; here the subjects chosen for representation include lions, dragons, birds, trees, flowers, historical incidents, beautiful women, etc. The best authorities on the subject are Lacassagne, *Les Tatouages* (Paris, 1881), and Joest, *Tättowiren, Narbenzeichnen, und Körperbemalen* (Berlin, 1887).

**Taubaté**, tow-bă̄a-tā': town of the state of São Paulo, Brazil; in the valley of the upper Parahyba, and on the railway from São Paulo to Rio de Janeiro; 81 miles E. N. E. of the former city (see map of South America, ref. 7–G). It is the center of one of the richest coffee-growing districts of Brazil. Pop. about 12,000; with the *municipio* (1889), 23,000.

**Tauchnitz**, towch'nits, Christian Bernhard, Baron von: publisher; nephew of Karl Christoph Tauchnitz; b. at Schleinitz, near Naumburg, Germany, Aug. 25, 1816; established a publishing-house at Leipzig in 1837, and became celebrated for his editions of Greek and Latin classics, Hebrew and Greek Bibles; best known to travelers and writers for his continental editions of British authors, which consists of 3,000 titles. He began this series in 1841, and adopted the principle of paying the authors for the republication of their works, although there was at that time no international copyright. He was made a baron 1860; became British consul-general in Saxony, 1872, and 1876 for the other Saxon principalities; called by the king to the house of peers of Saxony 1877. D. in Leipzig, Aug. 14, 1895.

**Tauchnitz**, Karl Christoph Traugott: publisher; b. at Grossbardau, near Grimma, Saxony, Oct. 29, 1761; learned printing at Leipzig; worked for some time in Unger's establishment in Berlin, and opened in 1796 a printing-house in Leipzig, to which were added in 1798 a bookstore, in 1800 a type-foundry, and in 1816 the first stereotype-foundry in Germany. From his establishment, which soon grew and became one of the largest of the kind in Germany, issued those celebrated editions of Greek and Latin authors which in correctness, convenience, and cheapness surpassed all other editions which had hitherto appeared. D. in Leipzig, Jan. 14, 1836.

**Tauism and Tauists**: See Taoism.

**Tauler**, tow'ler, Johannes, Doctor Illuminatus: mystic; b. at Strassburg about 1300; entered the order of the Dominicans about 1318, and came under the influence of Meister Eckart, theological professor of the monastic school. He further studied theology at the college of his order in Cologne 1327–31, and afterward in Paris. The scholastic method, however, of the theology of that time did not satisfy him; he felt himself drawn toward the mystical and speculative writers on religion and philosophy; and this tendency was still more strengthened within him, after his return from Strassburg, by his intercourse with Meister Eckart. Eckart's pantheism, however, as well as Suso's sentimentalism, remained foreign to him. His character was of a more practical turn, and it is the moral bearing of the religious ideas which forms the essence of all his writings. Banished with the Dominicans from Strassburg, in consequence of their determination to close their churches during the papal ban, he went to Basel (1339). There he was converted by the mysterious "Friend from Oberland," and his preaching became more spiritual. From 1346 he lived in Strassburg, and there died June 16, 1361. He enjoyed the reputation of being the greatest preacher of his time, and set a rare example of Christian courage, self-denial, and persistency during times of papal ban, of plague, and other hardships. His sermons were first collected in 1498 (Leipzig). A translation into new High German was given by Schlosser (Frankfort, 1826); better by J. Hamberger (Frankfort, 2d ed. 1872). See Karl Schmidt, *Johannes Tauler von Strassburg* (Hamburg, 1841); Miss Winkworth, *Life and Times of Tauler* (London, 1857), containing twenty-five of his sermons; American reprint, ed. by R. D. Hitchcock, New York, 1858. See also Denifle's *Das Buch von der geistlichen Armut* (Strassburg, 1877) and *Taulers Bekehrung* (1879); A. Jundt, *Les amis de Dieu au XIV$^e$ siècle* (Paris, 1879); F. Bevan, *Trois amis de Dieu* (1889). Revised by S. M. Jackson.

**Taunay**, tow-nā', Alfredo d'Escragnolle: author and politician; b. in Rio de Janeiro, Brazil, Feb. 22, 1843. His ancestors were French nobles, who fled to Portugal during the Revolution, and passed with the royal family to Brazil. After graduating with high honors at the Pedro II. College, he studied engineering in the Polytechnic and Military schools in Rio de Janeiro, having entered the army in 1861. In 1865–68 he was attached to the Engineer Corps of the Brazilian army which invaded Northern Paraguay from Matto Grosso. The history and sufferings of these campaigns were described by him in two works—*Scenas de viagem* (1868) and *La Retraite de Laguna* (1871; originally written in French); these at once placed him in the first rank among Brazilian authors. In 1869–70 he was attached to the army in Southern Paraguay, editing its records. After the war he took an active part (as a conservative) in politics, was elected to parliament, was president successively of Santa Catharina and Paraná, and in 1886 was chosen to the senate; in all these positions his efforts were especially directed to the promotion of immigration, and he urged his plans in an important series of publications. His other writings include essays, poems, comedies, criticism, etc., and a series of novels which are regarded as the best ever produced by a Brazilian author. Among these are *A mocidade de Trajano* and *Innocencia*, the latter translated into French and English. Taunay excels in descriptions and character-drawing, but is lacking in humor. Since the Revolution he has been a leader of the imperialist party, but has taken no part in the acts of rebellion. See Koseritz, *Alfredo d'Escragnolle Taunay* (Rio, 1886). HERBERT H. SMITH.

**Taunton**: town; in Somersetshire, England; on the Tone; 45 miles S. W. of Bristol (for location, see map of England, ref. 13–F). It is well built, and has manufactures of hosiery and silk, and trade in agricultural and dairy produce. Among its principal edifices are the Church of St. Mary Magdalen, St. James's church, the market-house, Taunton and Somerset Institution, the West of England College for Dissenters, and a castle built in the time of Henry I. Taunton returns one member to Parliament. Pop. (1891) 18,026.

**Taunton**: city; capital of Bristol co., Mass.; on the Taunton river, and the N. Y., N. H., and Hart. Railroad; 15 miles N. by E. of Fall River, 33 miles S. of Boston (for location, see map of Massachusetts, ref. 5–I). It was called Cohannet by the Indians; the first purchase of ground by the whites was in 1637; the town was incorporated in 1639, and had a city government in 1865. It is in an agricultural region, and is widely known for the extent and variety of its manufactures. In 1900 it had 313 manufacturing establishments, representing 67 industries. The invested capital aggregated $7,754,773. Over 6,000 persons were employed, to whom $3,104,023 was paid in wages. Materials valued at $4,771,096 were used in manufacturing, and goods were produced at an aggregate value of $9,834,584. The principal manufactures are cotton machinery, cotton cloth and yarn, cutlery, nails and tacks, copper, yellow metal, silver and britannia ware, oil-cloth, fire and building brick, stoves, printing-presses, shoe-buttons and eyelets, jewelry, and machinists' tools. The city has an extensive trade with the interior in coal and grain, and a considerable coasting trade. There are 22 churches; a high school, 64 graded and 17 ungraded public schools, and over 5,700 pupils; Bristol Academy (non-sectarian, chartered in 1792); a public library with 40,000 volumes; State Insane Hospital; Home for Aged Women; the Morton Memorial Hospital; exhibition grounds and buildings of the Bristol County Agricultural Society; headquarters of the Old Colony Historical Society; new court-house; 3 national banks with aggregate capital and surplus of $1,800,000, 3 co-operative banks with authorized capital of $1,000,000 each, 1 trust and loan company, and 2 savings-banks with aggregate deposits of over $7,000,000; and 3 daily, 2 weekly, and 3 monthly periodicals. The assessed valuation in 1900 was $20,000,000, and net city debt $419,482.97. Pop. (1880) 21,213; (1890) 25,448; (1900) 31,007.

**Taurida**, tow'rēe-dăă: government of Russia, bordering on the Dneiper, the Black Sea, and the Sea of Azof; area, 24,497 sq. miles. It consists of the peninsula of the CRIMEA (*q. v.*) and some extensive districts of the mainland. The northwestern part of the Crimea and the mainland are desert steppes interspersed with salt lakes; they are inhabited by Tartars, who feed large herds of cattle and sheep on the steppes and cultivate wheat and millet. Pop. of government (1897) 1,443,835. Revised by M. W. HARRINGTON.

**Taurus**, taw'rŭs [= Lat. = Gr., liter., bull, ox < Indo-Eur. **taruos* > O. Ir. *tarb*]: a brilliant constellation, which may be seen S. of the zenith during the evenings of December and January. It includes the remarkable groups of stars the Pleiades and Hyades, and the red star Aldebaran. Taurus is the second sign of the Zodiac. S. N.

**Taurus**: a range of mountains in Asia Minor, stretching E. to W. from the Euphrates to the Gulf of Adalia. By the Alma-Dagh it communicates with the Lebanon Mountains in Syria, and by one branch of the Anti-Taurus with the Caucasian Mountains. It rises in terraces from the Mediterranean to a height of 10,000 feet, and incloses between itself and Anti-Taurus an elevated plain, arid, dotted with salt lakes, and having the same character as the plateaus of Central Asia. Revised by M. W. HARRINGTON.

**Tausig**, tow'zich, CARL: pianist; b. near Warsaw, Poland, Nov. 4, 1841: pronounced by his teacher Liszt the best pianist the world ever heard. His octave playing was wonderful. After making many successful concert tours he settled in 1865 in Berlin, where he opened a school for piano instruction. D. in Leipzig, July 17, 1871. His compositions are all for the piano, and are masterpieces of execution. D. E. H.

**Taussig**, tow'sig, FRANK WILLIAM: political economist; b. in St. Louis, Mo., Dec. 28, 1859; A. B. 1879, Ph. D. 1883, LL. B. 1886, all from Harvard University; studied one year in Europe; has since been Professor of Political Economy in Harvard University; author of *Tariff History of the United States* (New York, 1888; 2d ed. 1892); *The Silver Situation in the United States* (1892); various contributions to scientific periodicals, chiefly to *The Quarterly Journal of Economics*. C. H. T.

**Tautog'** [from Amer. Ind. *tautauog* (given by Roger Williams, and said by him to mean sheep's heads), plur. of *taut*, the Indian name]: a fish (*Tautoga onitis*) of the family *Labridæ*, related to the wrasses of Europe, but the only member of its genus. It is a deep-bodied fish, with small smooth scales; the opercular bones scaleless; the teeth on the jaws conical and in two rows, and none behind developed as canines; dorsal spines numerous (seventeen), and only three anal spines; the adult is sometimes an almost uniform black, but generally more or less blotched, and in the young banded and otherwise decorated. It is common on the Atlantic coast of North America from Massachusetts to Carolina, and rarer farther northward and southward. Its average weight is about 2 lb., but it frequently weighs 10 lb. It makes its appearance in large numbers and in shallow waters on the New England and New York coasts between the months of April and November, and is most abundant in May and October. It spawns in May or June. When it first makes its appearance in shallow water, it refuses the hook, but soon takes it readily, and is one of the most frequently caught of the salt-water fishes. It prefers rocky places and slight currents. It keeps near the bottom, and preys upon crustaceans and molluscs. Revised by F. A. LUCAS.

**Tavernier**, tăă'vār'ni-ā', JEAN BAPTISTE, Baron d'Aubonne: traveler; b. in Paris in 1605; undertook while still very young extensive journeys in Europe, and made from 1631 to 1633 his first great journey to the East—from Constantinople to Persia, and thence by way of Aleppo to Rome. Subsequently, from 1638 to 1669, he made five more voyages to the East, through Asia Minor and Persia to Hindustan, and as far as Batavia. He possessed great skill in appraising precious stones, and by trading in jewelry he amassed a great fortune. He also promoted French commerce in the East Indies in various ways, and on his return from his last voyage Louis XIV., who bought many of his jewels, made him a baron. He lost a part of his fortune, however, and, being a Protestant, sought refuge in Switzerland after the revocation of the Edict of Nantes. On a seventh journey to the East he died in Moscow in July, 1689. A report of his first six voyages was edited by Chappuzeau (2 vols., 1676–77), and a third by La Chapelle (1679), under the title *Les Six Voyages de J.-B. Tavernier*. His descriptions are remarkable for their accuracy and for the light that they throw on the condition of Eastern commerce. An edition of his works was published in 1810 (7 vols.), and an abridged edition in 1882. See *Travels in India* (Eng. trans., 2 vols., 1890), and Joret, *Jean-Baptiste Tavernier*. F. M. COLBY.

**Tav'istock**: town; in Devonshire, England; on the Tavy; 11 miles N. of Plymouth (see map of England, ref. 14–D). There are only a few remains of a once splendid Benedictine abbey, founded in 961. Copper, lead, silver, and tin are found in the vicinity, and there is much trade in cattle and grain. Pop. (1891) 6,252.

**Tavoy′**: capital of Tavoy district, Tenasserim, Burma; in lat. 14° 7′ N., on the river Tavoy, 30 miles from its mouth (see map of S. India, ref. 5–M). It is a neat and handsome town, of a thoroughly Indian character, built of bamboo and on piles, half concealed by luxuriant orchards and fruit-gardens, and standing in the center of rich rice-fields. Salt and earthen pots are the chief manufactures. Pop. 13,370. M. W. H.

**Taysen**, tow′sen, HANS: Reformer; b. near Kjerteminde, island of Fünen, Denmark, 1494. In 1515 he entered a cloister, but the following year went abroad and studied at the University of Rostock, where he took the master's degree. After lecturing on theology at the University of Copenhagen for two years, he went abroad again, with the assistance of his cloister, and spent a year at Wittenberg, under the direct influence of Luther and Melanchthon. After a year he was suddenly called home, and returned filled with enthusiasm over the new teachings. In spite of entreaties, threats, and imprisonment, he continued to preach, even from his prison windows. In 1526 he was made chaplain to Frederick I., and permitted to preach in Viborg. Three years later he moved to Copenhagen, and became the leader of the Danish Reformation, *Omnium Lutheranorum in Dania antesignanus*. For some unknown reason he was not included in the first list of Danish Protestant bishops, but in 1542 he was appointed to the diocese of Ribe, where he remained till his death Nov. 11, 1561. Among his writings, which are inferior in form to those of Christiern Pedersen, are a translation of the Pentateuch (Magdeburg, 1535); *Postil* (Sermon, 1539), a collection of sermons for the whole year; and a translation of the whole Bible (before 1543). D. K. DODGE.

**Taw′as City**: incorporated village; capital of Iosco co., Mich.; on Tawas Bay, Lake Huron, at the mouth of the Tawas river, and on the Detroit and Mack. Railroad; 65 miles N. E. of Bay City (for location, see map of Michigan, ref. 5–J). It has a fine harbor, is in an agricultural region, and is principally engaged in the manufacture and shipment of lumber and salt. There are 6 churches, graded public school, a private bank, and 2 weekly newspapers. Pop. (1880) 712; (1890) 1,544; (1900) 1,228. EDITOR OF "HERALD."

**Tawing and Tanning**: See LEATHER.

**Taxa′ceæ** [Mod. Lat., from *Taxus*, the typical genus, from Lat. *taxus* = Gr. τάξος, yew-tree]: one of the two families of the order *Coniferæ*. See CONIFERS.

**Taxation** [viâ O. Fr. from Lat. *taxa′tio*, estimation, valuing, deriv. of *taxa′re*, handle, estimate, value, rate, deriv. of *tan′gere, tac′tum*, touch]: the system by which revenue is raised to meet the general expenses of a government, whether national or local. Taxes are to be distinguished (1) from forced contributions, which do not form part of a system, but which are an exceptional means of raising revenue in time of war or other emergency; (2) from fees like court charges or postage-stamps, which are contributions in connection with special services rendered in each case, and do not, properly speaking, form part of the general revenue.

An account of the principal taxes in use will be found in the article FINANCE. The object of the present article is to examine the grounds on which methods of taxation are criticised or justified.

In his *Wealth of Nations*, published in 1776, Adam Smith laid down four canons of taxation which are taken as the starting-point in this discussion. They were as follows: (1) The subjects of every state ought to contribute to the support of the government as nearly as possible in proportion to their respective abilities—that is, in proportion to the revenue which they respectively enjoy under the protection of the state. (2) The tax which each individual is bound to pay ought to be certain and not arbitrary. (3) Every tax ought to be levied at the time or in the manner in which it is most likely to be convenient for the contributor to pay it. (4) Every tax ought to be so contrived as both to take out and to keep out of the pockets of the people as little as possible over and above what it brings into the treasury of the state. As the French financier Colbert somewhat cynically puts it, taxation is the art of so plucking the goose as to secure the largest amount of feathers with the least amount of squealing.

Of these canons the second and third are obviously of minor importance, being rather of the nature of administrative directions as to the detail of collection than general criteria for judging a tax itself. The first and fourth are the important ones. Taxes must be equal and effective. Of course, if a tax meets both these requirements, it is a good one. But can both be applied side by side? In ancient times this was possible. There was one group of men who had considerable property and income which was in a form where it could be easily assessed. The property consisted chiefly of real estate. What little personal property there was consisted largely of visible and tangible objects, like plate or jewels, which the owners kept for display. A tax levied on these persons fell on those who could afford to pay it, and was one which could be collected at relatively little expense; a tax on any other body of persons was at once unjust and destructive. But even at the time when Smith wrote matters had begun to change from their ancient simplicity. The persons who had the most ability or revenue were not always in a position where the assessors could ascertain the exact measure of this ability. Personal property in invisible forms, like stocks and bonds, had begun to acquire increasing importance. The attempt to make everybody contribute equally by the old method resulted in burdening the honest and exempting the dishonest, and in making a tax system which was singularly ineffective—one whose burdens were out of proportion to the financial results. The tax legislator now has to decide the question whether he shall make equality *or* effectiveness his primary aim. This can be answered only by looking at the indirect effects of the taxes laid and studying what is known as the incidence of taxation. Suppose that a tax is laid which is equal, but not effective—for instance, one which taxes people on stocks and bonds in the same manner that it does on real estate—the result is that the honest people alone tell what they have, while the dishonest conceal it. This constitutes, first, a premium on dishonesty; second, a burden on the honest, for if half of the property of a given class escapes taxation, the other half has to pay double rates in order to yield a given amount of revenue; third, an increasing burden, because each year of successful evasion renders the public conscience more lax and reduces the honest to a smaller minority. No system of oaths has been devised which will meet this evil.

On the other hand, suppose a tax is laid which is effective but not equal—that is, which strikes a particular class of persons, but reaches all that it is aimed at. Assume, for instance, that houses were taxed at a different rate from other kinds of property. At first this would be an injustice to the owners of houses; but as time went on fewer houses would be built for rent, and the owners of those already existing could charge higher prices on account of the short supply, thus shifting part of the burden on to the occupiers. Then as rents were slightly raised the employers of labor would probably have to pay a little higher wages in order to induce workmen to live in the place in question—a thing which the employers would be enabled to do if the house tax had been sufficiently productive to diminish the amount of the total payments which business concerns would have to contribute to the municipal support. Each year as it passed would tend to shift the burden of this tax from the class which originally felt it to the shoulders of the community as a whole. The only cases where such shifting would not take place would be those where the class specially taxed was making such high profits that a diminution of these profits did not affect the supply of the goods or services which this class gave; and where profits were so large as this it would prove that such a class under previous systems of taxation had not been contributing a fair share to the expenses of the government. A tax law which aims to be equal, but which is ineffective, produces the worst kind of inequality, which tends to increase as time goes on. A tax law which aims to be effective, even in apparent disregard of equality, tends by a constant process of economic adjustment to be more and more equally distributed over the whole community. Effectiveness rather than equality should therefore be the primary object of the tax legislator. The other can be trusted to follow. Unfortunately this sequence is not well understood. In seeking to apply an illusory theory of equal treatment of all persons, law-makers really put double burdens on the honest. When the courts squarely face the fact that any tax is a discriminating tax, if a large part of those against whom it is directed can practically escape its burdens, we may hope for a real reform in these matters. A few rules can be given which tend to secure effectiveness of tax laws and to avoid discriminations against the honest.

(1) Taxes should be assessed on things rather than on persons—on the property itself rather than on its owners. (2) In conformity with this rule an income tax should be levied at the sources of the income rather than on the receivers of the income. Of course this complicates the possibility of levying compensatory or progressive income taxes, and may bear hard upon people with small incomes; but the evasions which result from a violation of this rule do far more harm than the hardships which result from conformity to it. (3) No deductions from the value of property should be made on account of debt. Mortgaged real estate, for instance, should be assessed at its full value. This at first sight seems very unjust, but is really the equitable arrangement. Under the present system, which allows deduction for debt, a large part of the money lent on real estate wholly escapes taxation. The present system puts burdens, first, on the holder of unmortgaged real estate, who has to pay a higher rate of tax because the valuation of the town where he lives is lower; second, on the widows and orphans, who pay a high tax rate on their investments, while other investors conceal the fact of their holdings. Its benefit to the holder of mortgaged real estate is largely illusory, because the existence of the present system keeps the rate of interest higher than would otherwise be the case. The only man who gets much benefit is the unscrupulous lender, who enjoys the high rate of interest and makes no tax return. (4) The same principle should be applied to corporations. The value of the corporate property is represented by the market value of its stock and debt. This debt can be reached by taxing the corporation either on its gross earnings, its net earnings, or its securities as a whole. It can not be reached by an attempt to tax it in the hands of the holders. (5) To secure an equitable land tax, real estate should be assessed on the basis of its price rather than of its productiveness; unimproved real estate should be assessed higher and improvements relatively lower than at present. The assessors to-day see that the man who holds unimproved real estate gets little income, and they let him off easily on account of his supposed inability to pay a high tax. The real effect of this is to take burdens off from the shoulders of a man who is waiting for the growth of the community to make him rich, and to put those burdens on the shoulders of those who are contributing to that growth. Whatever may be thought of Henry George's single-tax theory as a whole, there can be little question that a relatively higher assessment of ground rent, with corresponding relief for those who have made improvements, is a much-needed reform. (See SINGLE TAX.) (6) The objects of national, state, and local taxation should be separated as far as possible. If, as happens in so many of the U. S., the State taxes are partly made up of contributions from the towns on the basis of their grand lists, or assessed valuations, the local assessors are anxious to lessen the share of the State tax which their town must pay. This they can do by lowering the grand list and correspondingly raising the local tax rate. When once the assessors are interested in making an incorrect list, no board of equalization can overcome the evil.

There are certain important groups of taxes in which revenue is a subordinate consideration, and which therefore fall somewhat outside the scope of this article. High licenses constitute one group, protective tariffs another. The object of such taxes is to discourage certain forms of trade upon which they are levied, and they should obviously be judged on other grounds than those of equality or fiscal effectiveness.

There is no satisfactory general work on the economics of taxation. The leading American writers on the subject are David A. Wells, whose article on *Taxation* in *Lalor's Cyclopædia of Political Economy* goes into more detail than is compatible with the scope of this work, and includes a detailed bibliography, and E. R. A. Seligman, *Publications of the American Economic Association*, vol. vii., Nos. 2, 3, vol. ix., Nos. 1, 2, who has done excellent work, but not quite comprehensive enough for the general reader. Cossa, *Taxation, its Principles and Methods*, deals with European conditions rather than American. R. T. Ely's *Taxation in American States and Cities* contains some interesting matter, but must be used with caution. ARTHUR T. HADLEY.

**Tax'idermy** [from Gr. τάξις, arranging, arrangement (deriv. of τάσσειν, τάξαι, arrange) + δέρμα, a skin (deriv. of δέρειν, to skin)]: the art of preserving the skins of animals and replacing the flesh by some durable material, so as to represent life. In the matter of removing and replacing perishable parts it differs from embalming, which seeks to preserve the flesh itself. With the questionable exception of crustaceans, the art of the taxidermist is practically restricted to vertebrated animals, for invertebrates are usually dried or preserved in liquid, and while a large insect may be cleaned and mounted, such cleaning and mounting can hardly be called taxidermy.

Taxidermy is a comparatively modern art, for while it is said that Hanno brought back to Carthage skins, supposed to be those of gorillas, from the west coast of Africa, no attempt seems to have been made to mount them. The well-known quotation from *Romeo and Juliet*,

> And in his needy shop a tortoise hung,
> An alligator stuff'd, and other skins,
> Of ill-shaped fishes,

is one of the earliest references to stuffed animals. Still, from a work published in Paris in 1689, it is certain that as early as 1517 birds, including the cassowary, brought from Malaysia, were mounted in Amsterdam, and a stuffed rhinoceros is preserved in the Royal Museum of Vertebrates, Florence, which was prepared for the museum by Ulysses Aldrovandus in Bologna, sometime in the sixteenth century. It is very probable that taxidermy originated in the desire to preserve for exhibition the strange quadrupeds and brilliant-hued birds brought to Europe by the early navigators, and to this desire is due the genesis of the modern natural history museum. The establishment of museums naturally gave an impetus to taxidermy, but it was for a long time taxidermy of a decidedly inferior quality, and so far back as 1825 Waterton vigorously criticised the appearance of museum specimens. The demand for more art in taxidermy came mainly from private individuals desirous of preserving birds for their beauty, or mammals as trophies of the chase, and it was many years before the greater portion of museum work rose above the level of the positively bad. Perhaps the earliest institution to admit within its walls groups of animals mounted to show them with natural surroundings, or to illustrate their habits, was the University of Pisa, where, at the beginning of the nineteenth century, Prof. Paolo Savi mounted in a most artistic manner a number of groups of birds and mammals.

The British Museum was the first large institution formally to adopt groups of birds mounted with their natural surroundings as a part of its regular exhibition series, but in this it was only following in the lead of E. T. Booth, who had applied the idea to one entire museum, and had introduced into the Brighton Museum, England, a series of British birds thus mounted. At present the best work is demanded by public museums, and some noteworthy examples of taxidermy are to be found in the U. S. in the American Museum of Natural History, New York, and in the U. S. National Museum at Washington.

The general principles of taxidermy may be outlined as follows: The skin of the animal to be mounted must be carefully removed, cleaned, and poisoned, preferably with some preparation of arsenic, either in the shape of arsenical soap or in powder. In the case of most mammals the skin must be so tanned that the hair will not fall out, and that the skin may dry hard and stiff in order to retain the form given it. Wires or irons are placed in the legs to sustain the weight of the animal, and around these the original shape of the legs is carefully built up in tow, or tow and excelsior. On the care with which this is done depends much of the appearance of the finished work, and in the case of quadrupeds thinly clad with hair great pains are needed to bring out the muscles. The leg-irons are attached to a central wire, board, or body of excelsior, according to the size of the animal or method to be followed, and in birds and small mammals the neck and body are made together, and little remains to be done in the way of further filling. The easiest, but worst, method is after the skin has been drawn over the legs, and they have been attached to the body, to fill out the skin with tow or straw, working out the principal muscles from within. The best method, with quadrupeds of any size, is to build up over a wooden framework the entire shape of the body, including the neck, replacing the muscles by excelsior and tow, smearing this manikin over with clay to attain smoothness. The finer details about the eyes, lips, and nostrils are reproduced by placing a layer of clay beneath the skin, and working in the lines and other characters. Birds are preserved readily by the art of taxidermy; mammals are more difficult; the smooth, glossy skin of cetaceans defies the taxidermist, and can only be imitated by a carefully made cast, and the same is true of the large majority of reptiles and fishes, although with care many may be mounted. See Hornaday, *Taxidermy and Zoölogical Collecting* (New York, 1891), and Davie, *Methods in the Art of Taxidermy* (Columbus, 1894). F. A. LUCAS.

**Tax Laws**: See the Appendix.

**Taxonomy** [from Gr. τάξις, arrangement + νόμος, law]: that department of biological science which deals with the arrangement and classification of animals and plants.

**Tax Sales**: public official sales of land made in pursuance of law for the non-payment of taxes which have been laid upon them. Power to make such sales is entirely statutory, and is not derived from any rule of the common law, the right of a government to grant such power being a necessary attribute of its sovereignty. The power when granted is a naked power, and not one coupled with an interest, and the statutes giving it must be strictly construed.

In the U. S. tax sales are very common, and the laws governing them and the construction of those laws form a very important part of the jurisprudence of the various States. The statutes of the several States vary widely in their specific provisions as to the assessment of taxes, the manner of making tax sales and their effect, and the right of redemption accorded to interested parties. Certain general principles, however, have been established which apply to all, or nearly all, the statutes, and regulate the proceedings under them.

*Requisites to a Valid Sale.*—The land must be regularly listed and assessed, it must not be exempt, and the tax must remain undischarged at the time of the sale. Payment, or even tender by the owner, or by any other person whose interests would be prejudiced by the sale, destroys the right to sell. Such a sale is in a great measure an *ex parte* proceeding, and in order to render it valid every statutory requirement which regulates the prior proceedings, down to and including the sale, must be strictly complied with. This principle applies to all preliminary steps—the assessment and laying the tax, preparation of the assessment roll and its delivery to the proper officer for collection, etc.—as well as to the subsequent steps relating to default in payment of the tax and the proceedings thereupon preparatory to making the sale. This doctrine is fundamental in all the States, but in the methods and means by which this regularity shall be judicially determined there is considerable variation.

Due notice, usually by advertisement in a newspaper for a specified time, must be given of the property to be sold, and of the time and place of the sale, which must be held as advertised, must be public, and must be conducted by the officer authorized by statute in strict conformity with the provisions of the statutes.

The *amount of land* to be sold is variously regulated; in some States it is optional with the officer to sell the whole or a part, while in others the amount is limited to such as it is necessary to sell to realize enough to satisfy the taxes and charges, any violation of the provisions in this respect rendering the sale void. Each parcel of land which is separately assessed must be sold by itself, usually for cash to the person bidding the highest sum, which sum must not be less than the total amount of taxes and charges. After the sale, in most States, the officer is required to issue to the purchaser a certificate of sale which, upon the termination of the time limited by statute for redemption, entitles the purchaser to a deed of the land, executed by the proper officer on behalf of the State, and conveys or purports to convey the title to him; and the officer must make a return specifying the fact of notice, the time of sale, the property sold, the name of the purchaser, etc., and the making of this return is usually mandatory.

The *right of redemption* is usually allowed to the owner and parties interested during the period fixed by statute, during which time the possession of the owner is not disturbed. In most of the States it is provided that notice to redeem must be given to the owner, and that his right of redemption shall continue thereafter during the time required to elapse before the purchaser is entitled to a deed. The provisions as to who shall have the right to redeem are construed liberally, and usually any one possessing an interest in the land may exercise the right, but not a mere stranger. Payment or tender of the full amount required by statute by the owner, or other person entitled to redeem, constitutes an exercise of this right, and vests the title absolutely again in the owner or the redeemer, cutting off the right of the purchaser. The statutes regulating the right of redemption are liberally construed in favor of those having the right to redeem, but their provisions must be observed; and without statutory authority the courts can not entertain an action to redeem the land.

The *deed to the purchaser* upon the tax sale (to which he is entitled upon the expiration of the time of redemption, the land remaining unredeemed) must be substantially in the form required by statute; must recite enough of the previous proceedings to show at least authority to sell and to make the deed; must describe the property with sufficient certainty (if possible, following the description in the assessment roll); and its execution and delivery must be in accordance with such statutory provisions. There are some States in which every tax sale is required by statute to be founded upon an order of the court. At the common law a tax deed is not even *prima facie* evidence of the facts necessary to create valid title under the deed, but the burden of proof is upon the purchaser to show by independent proof compliance with all statutory requirements.

This rule has been variously modified by statute; in some States only to the extent of making the tax deed *prima facie* evidence that the proceedings on the sale itself were duly performed, still leaving the purchaser to prove compliance with the law as to all requisites thereto; in other States (the great majority) to the extent of making the deed *prima facie* of the regularity of all previous proceedings upon which the validity of the tax deed depends, making the production of the tax deed shift the burden of proof from the purchaser to the owner or redemptioner; in a few States, to the extent of making the deed conclusive evidence of the regularity of the sale and of certain proceedings prior thereto, such as the assessment of the tax, proper advertisement of the sale, etc., but not depriving the owner or redemptioner of the right to avoid the tax sale by proof of failure to comply with any vitally essential prerequisite. Adverse possession during the prescribed period, and under a claim of title by a tax deed valid on its face, is sufficient to vest the title by prescription where the title under the tax deed would be defective. This would not be so in a case of a claim of title under a certificate of sale. As to the case of possession under a claim of title by a tax deed void on its face the authorities are divided. In the case of a void or voidable tax title the purchaser at common law had no remedy; but relief is generally granted by statute, usually by providing that the purchaser may recover the purchase money, and subsequent taxes paid, with interest.

After execution and delivery of the tax deed the parties are remitted to the ordinary remedies open to them in cases of contested titles. Unless a purchaser under a tax sale can enter peaceably, he must bring an action in the nature of an ejectment in order to obtain possession. Generally the former owner may institute an action to set aside the sale and conveyance thereunder, for any material irregularity, illegality, or fraud; but the time limited for the beginning of such action is generally made much shorter than that prescribed by common law for contesting the title of land. This time begins to run in some States from the date of sale; in others, from the execution and delivery of the deed; and in still others, from the time when the purchaser takes possession. The nature of the estate acquired by the tax deed varies in the different States, in some being only the interest of the person to whom the land was assessed, or that of the real owner; in others, a new and original fee, unincumbered by previous liens, created in the purchaser, and going back no further than the tax sale. F. STURGES ALLEN.

**Tax Title**: See the Appendix.

**Tay**: a river of Scotland, flowing from Loch Tay, at an elevation of 355 feet above the level of the sea, to the German Ocean, which it enters through a large estuary, the Firth of Tay, from 1 to 3 miles broad. It is the largest river of Scotland, draining nearly the whole of Perthshire, and carrying to the German Ocean a greater mass of water than any other of the rivers of Great Britain. The Dochart, the principal feeder of Loch Tay, rises in Ben Lui, on the borders of Argyleshire and, flowing in a northeastern direction, is joined by the Lochy just before the united streams enter the lake. Loch Tay itself is a long and narrow sheet of water picturesquely situated in a basin scooped out of the bosom of the mountains, 355 feet above the level of the sea. After leaving it the Tay receives from the N. and the E. the Lyon, the Tummel, the Garry, and the Isla, and from the W. the Almond and the Earn. Its entire basin comprises an area of about 2,500 sq. miles. Its entire course is about 120 miles, and it is navigable for vessels of 500 tons burden up to Newburgh, 15 miles from its mouth. The tide flows up the river to about a mile above Perth, to which place it is navigable by vessels of 100 tons. The salmon-fisheries of the Tay and its tributaries are of considerable value. The Stormouthfield pounds for the propagation of salmon are 5 miles above Perth. On Dec. 28, 1879, the railway bridge across the Tay was blown down in a hurricane, but a new bridge, some distance to the W., was opened on June 20, 1887. See BRIDGES (*Failure of Bridges*).

Revised by M. W. HARRINGTON.

**Tayabas**, tāā-yaa'bāās: town of the Philippines, the capital of the district of Tayabas; on the southern shore of the island of Luzon, 60 miles S. E. of Manila (see map of East Indies, ref. 3–G); in an unhealthful region. It is a clean, well-built, and handsome town, carrying on a considerable trade. Pop. 20,000, most of whom are Chinese mestizoes.

**Taygetus**, tā-ij'i-tŭs: the loftiest mountain range of Peloponnesus, Greece, extending in an almost unbroken line for about 70 miles, from Leondari in Arcadia to Cape Matapan. Its height, ascertained by the French commission to be 7,902 feet, its unbroken length and majestic form, have been celebrated by both ancient and modern writers. It rises to its greatest height immediately above Sparta. Its principal summit was in ancient times called *Taletum*, now St. Elias. On the sides of Taygetus are forests of pine, which abounded formerly with wild animals. The districts around Taletum formed a celebrated hunting-ground. The southern part of Mt. Taygetus is rich in marble and iron. Near Croceæ there were quarries of green porphyry, which was extensively employed by the Romans. There was also another kind of marble, obtained from quarries more to the S., called by the Romans Tamorian marble.

**Tayler**, JOHN JAMES, D. D.: preacher, educator, and author; b. in Nottingham, England, in 1798; son of a Unitarian minister; educated at the dissenting college in York; graduated at the University of Glasgow 1818; studied theology; became minister of a Unitarian congregation in Manchester 1820; was secretary to the college in York from 1822 to 1840, when it was removed to Manchester; became at that time Professor of Ecclesiastical History, and subsequently of Doctrinal Theology; removed to London in 1853, along with the college, of which, under the name of Manchester New College, he became principal; was for some years pastor, together with Rev. James Martineau, of the Unitarian congregation in Little Portland Street. He was the author of *A Retrospect of the Religious Life of England* (1845); *Christian Aspects of Faith and Duty* (1851); *An Attempt to ascertain the Character of the Fourth Gospel* (1867); *A Catholic Christian Church the Want of our Time* (1867); *Christianity, What is it? and What has it done?* (1868); and other works on religious subjects, some of them posthumously published. D. at Hampstead, London, May 28, 1869. His *Life and Letters* (1872) were published by Rev. John Hamilton Thom. Revised by J. W. CHADWICK.

**Taylor**: town (founded in 1875); Williamson co., Tex.; on the International and Gt. N. and the Mo., Kan. and Tex. railways; 37 miles N. E. of Austin (for location, see map of Texas, ref. 6–E). It is in an agricultural, stock-raising, and fruit and vegetable growing region, and contains 12 churches, public-school buildings valued at $38,000, electric-light and street-railway plants, railway-shops, cotton-compress, 2 cottonseed-oil mills, 2 national banks with combined capital of $250,000, and 3 weekly newspapers. Pop. (1890) 2,584; (1900) 4,211. EDITOR OF "JOURNAL."

**Taylor**, ALFRED SWAINE, M. D., F. R. S.: physician and chemist; b. at Northfleet, Kent, England, in Dec., 1806; studied surgery; became Professor of Chemistry at Guy's Hospital, and first Professor of Medical Jurisprudence in the same institution. Author of *A Manual of Medical Jurisprudence* (1843); *Photogenic Drawing* (1840); *On Poisons in Relation to Medical Jurisprudence and Medicine* (1848); *On Poisoning by Strychnia* (1856); and (his most important work) *The Principles and Practice of Medical Jurisprudence* (1st ed. 1865); author with Dr. W. T. Brande of a standard *Manual of Chemistry*, and editor for many years of *The Medical Gazette*. D. May 27, 1880.

Revised by F. STURGES ALLEN.

**Taylor**, ANN and JANE: See TAYLOR, ISAAC.

**Taylor**, BAYARD: traveler and author; b. at Kennett Square, Pa., Jan. 11, 1825; in 1842 became apprentice to a printer; published his first volume, *Ximena and other Poems*, in 1844; in 1844–45 made a pedestrian tour in Europe, and after his return published *Views Afoot, or Europe seen with Knapsack and Staff* (1846); in 1847 became one of the editorial staff of *The New York Tribune*, with which he was connected while he lived, publishing in that journal originally the substance of most of his works of travel. In 1849 he visited California; in 1851 visited Egypt, Asia Minor, Syria, and Europe; in 1852–53 crossed India from Bombay to Calcutta, going thence to Hongkong and joining Perry's expedition to Japan, and made several other journeys. In 1862–63 he was secretary of legation, and for a while *chargé d'affaires* at St. Petersburg; in 1874 went to Egypt, and thence to the millennial celebration in Iceland. He resided at intervals several years in Germany, where he married, and from 1872 he was engaged upon a biography of Goethe and Schiller, which he left unfinished. Several of his works have been translated into German, French, and Russian. His books of travel are *El Dorado, or Adventures in the Path of Empire* (1850); *Journey to Central Africa* (1854); *The Lands of the Saracen* (1854); *Visit to India, China, and Japan* (1855); *Northern Travel—Summer and Winter Pictures of Sweden, Denmark, and Lapland* (1857); *Travels in Greece and Russia* (1859); *At Home and Abroad, a Sketch-book of Life, Scenery, and Men* (1859; 2d series, 1862); *Colorado, a Summer Trip* (1867); *Byways of Europe* (1869); and *Egypt and Iceland* (1874). He wrote four novels—*Hannah Thurston* (1863); *John Godfrey's Fortunes* (1864); *The Story of Kennett* (1866); and *Joseph and his Friend* (1870). He published the following volumes of poems: *Rhymes of Travel, Ballads, and other poems* (1848); *The American Legend*, delivered before the Phi Beta Kappa Society of Harvard University (1850); *Book of Romances, Lyrics, and Songs* (1851); *Poems and Ballads* (1854); *Poems of the Orient* (1855); *Poems of Home and Travel*, selected from his earlier productions (1855); *The Poet's Journal* (1862); *The Picture of St. John* (1866); *The Ballad of Abraham Lincoln* (1869); *The Masque of the Gods* (1872); *Lars, a Pastoral of Norway* (1873); *The Prophet, a Tragedy* (1874); *Home Pastorals and Lyrics* (1875); and a *Centennial Ode* (1876). He edited a *Hand-book of Literature and the Fine Arts*, in conjunction with George Ripley (1852); *Cyclopædia of Modern Travel* (1856); *Frithiof's Saga*, translated from the Swedish of Tegnér by W. L. Blackley (1867); Auerbach's *Villa on the Rhine* (1869); and the *Illustrated Library of Travel, Exploration, and Adventure* (1872, *seq.*); and translated into the original meters both parts of Goethe's *Faust* (1870–71), which is probably his most important literary work. Besides the foregoing he wrote largely in prose and verse for many periodicals; contributed notes on Loo-Choo and Japan to the *Narrative of Perry's Expedition*, and an introduction to R. H. Stoddard's *Life, Travels, and Books of Alexander von Humboldt*, and lectured extensively in nearly every part of the U. S. In 1876 he published *The Echo Club and other Literary Diversions*, and delivered the poem at the Centennial celebration of the anniversary of the Declaration of Independence, in Philadelphia, July 4. He was appointed U. S. minister to Germany in 1877; died in Berlin, Dec. 19, 1878. See his *Life and Letters* (2 vols., Boston, 1884). Revised by H. A. BEERS.

**Taylor**, BENJAMIN FRANKLIN: poet and journalist; b. at Lowville, N. Y., July 19, 1819; was educated at what is now Colgate University, Hamilton, N. Y., where his father, Stephen W. Taylor, was professor; became in 1840 literary editor of the Chicago *Evening Journal*, and during the civil war was its military correspondent with the armies in the West; afterward traveled and lectured. He published *January and June* (1853); *Pictures in Camp and Field* (1867); *The World on Wheels* (1873); *Old-time Pictures and Sheaves of Rhyme* (1874); *Songs of Yesterday* (1875); *The River of Time*; *Complete Poems* (1887); and other works. D. at Cleveland, O., Feb. 24, 1887. Revised by H. A. BEERS.

**Taylor**, BROOK: mathematician; b. at Edmonton, near London, Aug. 18, 1685; entered St. John's College, Cambridge, in 1701; distinguished himself in music, painting, and mathematics; in 1708 wrote a treatise on *The Center of Oscillation*, which was published in the *Philosophical transactions* for 1713; in 1712 was chosen a fellow of the Royal Society, of which he became secretary two years later; and in 1715 he had a controversial correspondence with Count Raymond de Montmort upon the philosophical theories of Malebranche. He published *Methodus Incrementorum*, etc. (1715), which contains the foundation of the calculus of finite differences and the first announcement of the famous "Taylor's theorem," the latter almost unnoticed by mathematicians until 1772, when Lagrange adopted it as the basis of the differential calculus. Among his other works were *New Principles of Linear Perspective* (1719), and *Contemplatio Philosophica*, with a memoir (1793). D. Dec. 29, 1731.

**Taylor**, Charles Fayette: See the Appendix.

**Taylor**, George: patriot; b. in Ireland in 1716; is said to have been the son of a clergyman and to have received a liberal education; emigrated to North America as a "redemptioner" in 1736; was bound to an iron manufacturer, by whom he was made a clerk, at Durham, Pa.; several years later married the widow of his employer and became proprietor of the works; established a large iron-mill on the Lehigh river, and acquired a considerable fortune. In 1764 he was elected to the colonial assembly, in 1770 became a judge of the county court, and in 1775 was elected to the provincial assembly, and was earnest in the advocacy of revolutionary measures. He was elected to fill a vacancy in the Continental Congress July 20, 1776, and so was not a member when the Declaration of Independence was passed, but was one of those who signed the document. He retired from Congress in Mar., 1777, and returned to his home in Pennsylvania. D. at Easton, Pa., Feb. 23, 1781.

**Taylor**, Sir Henry: dramatist; b. at Bishop Middleham, Durham, England, Oct. 18, 1800; entered in 1824 the Colonial Office in London, in which he continued until 1872, and was for many years one of the five senior clerks. He contributed to various periodicals, and published *Isaac Comnenus*, a drama (1827); *Philip van Artevelde*, a tragedy (1834); *The Statesman*, a series of essays (1836); *Edwin the Fair*, an historical drama (1842); *The Eve of Conquest, and other Poems* (1847); *Notes from Life*, a series of essays (1847); *Notes from Books*, containing essays on the poems of Wordsworth and Sir Aubrey de Vere (1849); *The Virgin Widow*, a comedy (1850); *St. Clement's Eve*, a play (1862); and *A Sicilian Summer, and other Poems* (1868). An edition of his plays and poems appeared in 3 vols. in 1863; another in 5 vols. in 1878; his *Autobiography* appeared in 1885 (2 vols.) and his *Correspondence* in 1888. His *Philip van Artevelde* is the best English historical tragedy since Otway's *Venice Preserved*. D. at Bournemouth, Mar. 28, 1886.

**Taylor**, Henry Clay: See the Appendix.

**Taylor**, Isaac (known as Taylor of Ongar): author; b. in London in 1759; was a successful engraver in London; removed to Lavenham, Suffolk, in 1786; was minister of an Independent congregation at Colchester 1796–1810, and of one at Ongar, Essex, from 1811 until his death. Besides sermons, he published, mainly for the young, a number of volumes including *Advice to the Teens*; *Beginnings of British Biography*; *Beginnings of European Biography*; *Biography of a Brown Loaf*; *Book of Martyrs for the Young*; *Bunyan explained to a Child*; *Character Essential to Success in Life*; *Child's Life of Christ*; *Mirabilia, or the Wonders of Nature and Art*; *Scenes in America, in Asia, in England, in Europe, in Foreign Lands*; *Scenes of Commerce*; *Scenes of British Wealth*; *Self-cultivation Recommended*, all separate works; and *Twelve Addresses to Youth, with Hymns*. Nearly all of his works have been frequently republished. He was the father of Ann Taylor (Mrs. Gilbert, of Nottingham, b. 1782, d. 1866; *Autobiography*, 1871), who with her sister, Jane (1783–1824; *Memoirs*, 1825), wrote *Hymns for Infant Minds* and *Original Poems*; of Jeffreys Taylor (1792–1853), author of a number of works, chiefly for the young; and of Isaac Taylor, LL. D. (*q. v.*). D. at Ongar, Dec. 11, 1829.—His elder brother, Charles Taylor (1756–1821), was the editor of *Calmet's Dictionary of the Holy Bible*. Revised by S. M. Jackson.

**Taylor**, Isaac, LL. D.: author; son of Isaac Taylor of Ongar; b. at Lavenham, Suffolk, England, Aug. 17, 1787; was educated as an artist, but began to study theology with the intention of becoming an Independent minister; became a member of the Established Church, turned his attention to the bar, and finally devoted himself to the study of mechanical inventions and to literary labor. Besides contributions to *The Eclectic Review* he published many books, including *Elements of Thought* (London, 1823); *History of the Transmission of Ancient Books to Modern Times* (1827); *The Process of Historical Proof Exemplified and Explained* (1828); *Natural History of Enthusiasm*, one of his best works (1829); *New Model of Christian Missions* (1829); *Saturday Evening* (1832); *Fanaticism*, a continuation of the *Natural History of Enthusiasm* (1834); *Spiritual Despotism* (1835); *Physical Theory of Another Life* (1836), which was the first work published under his own name and which greatly enhanced his reputation; *Ancient Christianity and the Doctrines of the Oxford Tracts for the Times* (1839; with supplement and indexes, 1844); *Loyola, and Jesuitism in its Rudiments* (1849); *Wesley and Methodism* (1851); *The Restoration of Belief* (1855); *The World of Mind* (1857); *Logic in Theology* (1859); *The Liturgy and the Dissenters* (1860); *The Spirit of Hebrew Poetry* (1861); and *Considerations on the Pentateuch*, a reply to the work of Bishop Colenso (1863). In 1836 he was a candidate for the chair of Logic and Metaphysics in the University of Edinburgh, but was unsuccessful. In 1862 a pension of £100 was bestowed upon him from the civil-service fund "in public acknowledgment of his eminent services to literature, especially in the departments of history and philosophy, during more than forty years." D. at Ongar, June 28, 1865. His LL. D. came from the University of the City of New York in 1862.—His son, Isaac Taylor, a clergyman of the Church of England, b. at Stanford Rivers, May 2, 1829, graduated B. A. at Cambridge 1853; became curate 1857; vicar of St. Matthias, Bethnal Green, London, 1865, of Holy Trinity, Twickenham, 1869; rector of Settrington, diocese of York, 1875; has been also a canon of York since 1885. He is honorary LL. D., Edinburgh, 1879, Litt. D., Cambridge, 1885, and is author of *Words and Places*, an explanation of the local names in Great Britain (London, 1865); *The Family Pen, Memorials, Biographical and Literary, of the Taylor Family of Ongar* (1867); *The Alphabet: an Account of the Origin and Development of Letters* (1883); *The Manx Runes* (1886); *The Origin of the Aryans* (1890); and other works. Revised by S. M. Jackson.

**Taylor**, Isidore Séverin Justin, Baron: traveler and author; b. in Brussels, Aug. 15, 1789; studied art at Paris; served for several years in the army; traveled extensively; was appointed in 1824 royal commissary of the Comédie Française, which he opened to the dramas of Victor Hugo and other romanticists; induced by his petitions the Legislative Assembly (1818–30) to vote the restoration of the mediæval monuments in France; was sent to Egypt to negotiate the transfer to France of the obelisk of Luxor, and was made a senator in 1869. He wrote *Voyages pittoresques et romantiques dans l'Ancienne France* (1820–54); *Voyages pittoresques en Espagne*, etc. (1826, *seq.*); *La Syrie, l'Égypte*, etc. (1837); *Voyages en Suisse, Italie, Angleterre*, etc. (1843). D. in Paris, Sept. 6, 1879. Revised by A. G. Canfield.

**Taylor**, James Hudson: clergyman, missionary; founder of the China Inland Mission; b. at Barnsley, Yorkshire, England, May 31, 1832; studied and practiced medicine and surgery in Hull; sent out by the Chinese Evangelization Society as its first representative 1853 and began duty in Shanghai; moved to Ningpo, and severed his relations with the society 1857; labored independently until 1860, when he returned to England in broken health; organized the China Inland Mission 1865, and returned to China himself 1866; has since been back and forth several times. He is the director of the China Inland Mission, which has had a remarkable career. Its missionaries come from different denominations and have no guaranteed salary, a number being of independent means. They adopt native dress and mode of life as far as practicable. The mission makes "no personal solicitation or collection of funds" and does not publish the names of its donors. See Miss M. Geraldine Guinness, *The Story of the China Inland Mission* (2 vols., 2d ed. London, 1893). Samuel Macauley Jackson.

**Taylor**, James Monroe, D. D., LL. D.: educator; b. in Brooklyn, N. Y., Aug. 5, 1848; educated at the University of Rochester and Rochester Theological Seminary; pastor in South Norwalk, Conn., 1873–82, Providence, R. I., 1882–86; elected president of Vassar College, Poughkeepsie, N. Y., 1886; author of a number of magazine articles and addresses, including *The Place of Preaching in the Plan of God* (1880); *The Catechumenate* (1875); *The Future of the Woman's College* (1890); *Neglect of the Student in Recent Educational Theory* (1893); and *Psychology* (1892).

**Taylor**, James Morford: See the Appendix.

**Taylor**, Jeremy, D. D.: theologian; b. in Aug., 1613, at Cambridge, England, where his father was a barber; in 1626 entered Caius College as a sizar; took his degree; gained the friendship of Bishop Laud, and in 1636 obtained a fellowship at Oxford, and in 1638 was presented to the rectory of Uppingham. In the civil wars he adhered to the cause of Charles I., who made him his chaplain, and in 1642 commanded that the degree of D. D. should be conferred upon him on account of his treatise, *Episcopacy asserted* *against the Acephali and Ærians New and Old*; but in that year his rectory was sequestered by Parliament and he was forced to take refuge in Wales, where he supported himself by teaching a school and wrote his noblest works; preached occasionally in London; was several times imprisoned for giving utterance to royalist sentiments; and in 1658 took up his residence in Ireland upon the invitation of the Earl of Conway. In 1660 he was one of the signers of the royalist declaration of Apr. 24 which paved the way for the restoration of Charles II. He had married for his second wife Joanna Bridges (who was said to be a natural daughter of Charles I.), and soon after the Restoration he was made Bishop of Down and Connor, to which the see of Dromore was added, and was also made vice-chancellor of the University of Dublin and a member of the Irish privy council. He labored earnestly, but with indifferent success, for the firm establishment of the English Church in Ireland. As a preacher and writer, he occupies a foremost rank in literature. Besides his *Sermons* his principal works are *Discourse on the Liberty of Prophesying*, setting forth the iniquity of persecution for differences in opinions, by some held to be the ablest of all his works (1647); *The Great Exemplar of Sanctity and Holy Life*, a life of Christ (1649); *The Rule and Exercise of Holy Living* (1650); *The Rule and Exercise of Holy Dying* (1651); *Ductor Dubitantium*, a work on casuistry. Many of his separate works have been frequently republished. His *Whole Works*, with a *Life* of the author and a critical examination of his writings by Bishop Heber, in 15 vols., appeared in 1820–22 (10 vols., rev. ed. 1807–54); his *Life* was also written by R. A. Willmott (1847). D. at Lisburn, Ireland, Aug. 13, 1667. See ENGLISH LITERATURE. Revised by S. M. JACKSON.

**Taylor**, JOHN: poet; b. in Gloucestershire, England, in Aug., 1580; was educated at a free school in Gloucester; went to London, where he was apprenticed to a waterman, and followed this occupation during the greater part of his life, whence he is styled "the water-poet." His productions in prose and verse, of which about 140 are known to collectors, have no literary value, but some interest in showing the manners and customs of the times. The following will serve to illustrate Taylor's eccentric titles: *Taylor's Revenge, or the Rimer, William Fennor, firkt, ferrited, and finely fetcht over the Coals* (1615); *The pennyles Pilgrimage, or the moneylesse Perambulation of John Taylor, alias the King's Majestie's Water-Poet, from London to Edenborough on Foot* (1618). In 1630 Taylor made a collection, in a single volume, of the sixty-three pieces which he had at that time put forth in brochures and broadsheets, which was in 1869 republished in facsimile by the Spencer Society. D. in London in 1654. Revised by H. A. BEERS.

**Taylor**, JOHN, LL. D.: Greek scholar; b. at Shrewsbury, 1703; was educated at Cambridge University; librarian to the university in 1732, advocate in Doctors' Commons in 1741, and chancellor of Lincoln in 1744. He subsequently entered holy orders; became rector of Lawford in 1751, archdeacon of Buckingham in 1753, and canon residentiary of St. Paul's in 1757. He published several orations and essays, but his principal works are an edition of the Greek text, with a Latin translation and notes, of *The Orations and Fragments of Lysias* (1739), his masterpiece, and some of the *Orations of Demosthenes, Æschines, Dinarchus, and Demades*. D. in 1766. See F. A. Wolf, *Analecta*, i., 550 ff. Revised by A. GUDEMAN.

**Taylor**, JOHN LOUIS: jurist; b. in London, Mar. 1, 1769; was taken to the U. S. by a brother in 1781; studied law, and settled at Fayetteville, N. C., from where he removed to Newbern, and later to Raleigh; was several times elected to the Legislature; became one of the judges of the superior court of the State in 1798, and was chief justice of the Supreme Court from 1810 until his death. He had much constructive ability, and in 1817 was made commissioner to revise the statutes of the State. A volume of his decisions, containing cases decided from 1799 to 1802, was published in 1802, and another volume, of cases from 1816 to 1818, appeared in 1818. He also published a *Charge to the Grand Jury of Edgecombe Superior Court, exhibiting a View of the Criminal Law of North Carolina* (1817). D. at Raleigh, Jan. 29, 1829. Revised by F. STURGES ALLEN.

**Taylor**, NATHANIEL WILLIAM, D. D.: theologian; b. at New Milford, Conn., June 23, 1786; graduated at Yale College in 1807; studied theology, and in 1812 became pastor of the First (Center) Congregational church in New Haven, where he rose to eminence as a preacher. In 1822 he was chosen Dwight Professor of Didactic Theology in Yale College, and occupied the chair until his death. In 1828 he delivered the *concio ad clerum* discourse at New Haven, which was the beginning of a theological controversy which spread through New England and beyond its limits. Dr. Taylor defended his modifications of Calvinism in the *Christian Spectator*. They were vehemently opposed by other divines in various discourses and periodicals. By his writings and through his pupils he produced a profound impression on theology in the Congregational and Presbyterian communions. After his death four volumes of his works, edited by Rev. Noah Porter, D. D., were published: *Practical Sermons*, preached while pastor of the Center church (1858); *Lectures on the Moral Government of God* (2 vols., 1859); and *Essays, Lectures, etc., upon Select Topics in Revealed Theology* (1859). D. in New Haven, Mar. 10, 1858. Revised by G. P. FISHER.

**Taylor**, PHILIP MEADOWS: soldier and author; b. in Liverpool, Sept. 25, 1808; went to Calcutta, where he held a mercantile post; in 1826 entered the army of the Nizam of Haiderabad, for whom he administered several large territories; about 1858 became administrator for the British Government of some districts in the Deccan; rose to the rank of colonel and was decorated with the order of the Star of India; was a learned archæologist; married a princess of Southern India. He was the author of *Confessions of a Thug* (3 vols., 1839; new ed. 1858); *Tippoo Sultaun, a Tale of the Mysore War* (3 vols., 1840); *Notices of Cromlechs, Cairns, and other Ancient Scytho-Druidical Remains in the Principality of Sorapur* (London, 1853); *Tara, a Mahratta Tale* (3 vols., 1863); *Ralph Darnell, a Tale* (3 vols., 1865); *The Student's Manual of the History of India, from the Earliest Period to the Present* (1870), and other works. D. in Menton, France, May 13, 1876. See his *Story of my Life* (1877; new ed. 1881).

**Taylor**, RICHARD: soldier; son of Zachary Taylor; b. in New Orleans, La., Jan. 27, 1826; graduated at Yale 1845; was a resident of Louisiana at the breaking out of the civil war, when he entered the Confederate army, and was made colonel of a Louisiana regiment, which fought under his command at the battle of Bull Run; was made brigadier-general in Oct., 1861; served under Stonewall Jackson in Virginia; became major-general; in 1863–64 commanded in the department W. of the Mississippi, especially against Gen. Banks in his unsuccessful Red river campaign; in Sept., 1864, was placed in command of the department of East Louisiana, with headquarters in Mobile; on May 8, 1865, surrendered to Gen. Canby, his force being the last which remained to the Confederacy. After the war he resided on his plantation in Louisiana. He published *Destruction and Reconstruction* (1879). D. in New York, Apr. 12, 1879.

**Taylor**, SAMUEL COLERIDGE: See the Appendix.

**Taylor**, THOMAS: author; styled the Platonist; b. in London, May 15, 1758; studied in St. Paul's School with the design of becoming a dissenting minister, but afterward entered a banking-house; devoted his spare moments to the study of Greek, mathematics, and chemistry; taught the languages and mathematics. His works comprise sixty-three volumes, of which twenty-three are large quartos: among them are treatises on arithmetic and geometry, on the Eleusinian and Bacchic mysteries; an edition, with large additions, of the *Greek Lexicon* of Hedericus; an essay on the *Rights of Brutes*, in ridicule of Paine's *Rights of Man*; a *History of the Restoration of the Platonic Theology*; and a volume of *Miscellanies in Prose and Verse*. His main labor was the translating of little-known Greek and Latin works. Besides the *Plato* and *Aristotle*, his translations include the remains of Apuleius, Celsus, Demophilus, Hierocles, Iamblichus, Julian, Maximus Tyrius, Ocellus Lucanus, Olympiodorus, Pausanius, Plotinus, Porphyry, Proclus, the *Orphic Hymns*, and the *Chaldæan Oracles*. His translation of Plato (1804) was printed at the cost of the Duke of Norfolk, who locked up nearly all copies in his house, where they remained until 1848. Of his translations of Aristotle (1806–12) only fifty complete copies were struck off, the expense being defrayed by W. Meredith, a retired tradesman, who gave Taylor an annuity of £100. D. in London, Nov. 1, 1835.

**Taylor**, Sir THOMAS WARDLAW: See the Appendix.

**Taylor**, TOM: dramatist; b. at Sunderland, Durham, in 1817; was educated at Glasgow University and Trinity College, Cambridge; appointed to the chair of English Literature in University College, London, which he held for two years; wrote for periodicals, especially for *Punch*, which he edited in 1874–80; studied law; was called to the bar in 1845; was made secretary to the board of health in 1854, and in 1858 secretary to the Local Government Act Office. He was art critic to the London *Times* and *Graphic*. He produced, either singly or in conjunction with others, more than 100 dramatic pieces, many of which have had a marked success; among them are *Still Waters Run Deep*; *The Unequal Match*; *The Overland Route*; *The Contested Election*; *Our American Cousin*; *The Ticket-of-Leave Man*; and *'Twixt Axe and Crown*. He also published *Life of B. R. Haydon* (1853); *Autobiographical Recollections of C. R. Leslie* (1860); translated from the French of Villemarque the *Ballads and Songs of Brittany* (1865); published *Life and Times of Sir Joshua Reynolds* (1865); and in conjunction with C. W. Franks prepared a *Catalogue of the Works of Sir Joshua Reynolds* (1869). D. at Wandsworth, July 12, 1880. Revised by H. A. BEERS.

**Taylor**, WILLIAM: author; b. in Norwich, England, in 1765. He was the first Englishman to introduce to English readers a knowledge of the literature of Germany, and is best known by his vigorous translation of Bürger's *Lenore*. He published a translation of Lessing's *Nathan the Wise* (1805); *English Synonyms Discriminated* (1813); and *Historic Survey of German Poetry*, with many translations (3 vols., 1828–30). His *Life and Writings*, containing correspondence with Robert Southey and original letters from Sir Walter Scott, was published by J. W. Robberds (2 vols., 8vo, 1843). D. at Norwich in Mar., 1836.

Revised by H. A. BEERS.

**Taylor**, WILLIAM, D. D.: bishop and author; b. in Rockbridge co., Va., May 2, 1821; educated at Lexington, Va.; entered the ministry of the Methodist Episcopal Church 1842; missionary to California in 1849; labored as an evangelist in all the English-speaking countries in the world; elected missionary bishop for Africa May, 1884; author of a number of works, including *Seven Years' Street Preaching in San Francisco*; *Address to Young America and a Word to the Old Folks*; *Pauline Methods of Missionary Work*; *Reconciliation, or How to be Saved*; *Infancy and Manhood of the Christian Life*; *Four Years' Campaign in India*; *Our South American Cousins*; *Ten Years' Self-supporting Missions in India*; *Letters to a Quaker Friend on Baptism*; and *The Election of Grace*. A. OSBORN.

**Taylor**, WILLIAM MACKERGO, D. D., LL. D.: clergyman and author; b. at Kilmarnock, Ayrshire, Scotland, Oct. 23, 1829: educated at Kilmarnock Academy; graduated M. A. at University of Glasgow 1849; studied theology at Divinity Hall of the United Presbyterian Church in Edinburgh; was licensed to preach by the presbytery of Kilmarnock Dec. 14, 1852; ordained pastor of the United Presbyterian congregation at Kilmaurs June 28, 1853; settled over the United Presbyterian church, Liverpool, England, Oct. 23, 1855; in 1871 was delegate from the United Presbyterian Church in Scotland to the General Assembly of the Presbyterian Church at Chicago; was called to the pastorate of the Broadway Tabernacle (Congregational) church in New York Nov. 22, 1871, and entered upon his labors there Mar. 10, 1872; retired in consequence of paralysis 1893. D. in New York, Feb. 8, 1895. In addition to many articles in *The Scottish Review* and many separate sermons, he published *Life Truths* (1862); *The Miracles Helps to Faith, not Hindrances* (1865); *The Lost Found, and the Wanderer Welcomed* (1870); *Memoirs and Remains of Rev. M. Dickie, Bristol* (1872); *David, King of Israel* (1874); *Elijah the Prophet* (1875); *The Ministry of the Word* (1876); *Peter the Apostle* (1877); *Limitations of Life, and other Sermons* (1879); *The Gospel Miracles* (1880); *Paul the Missionary* (1881); *Contrary Winds, and other Sermons* (1883); *John Knox* (1885); *Joseph, the Prime Minister*; *The Parables of Our Saviour* (1886); *The Miracles of Our Lord* (1890); and *The Scottish Pulpit from the Reformation* (1887).

Revised by G. P. FISHER.

**Taylor**, ZACHARY: twelfth President of the U. S.; b. in Orange co., Va., Sept. 24, 1784. His father, Richard Taylor (1744–1822), was colonel of a Virginia regiment in the war of the Revolution; removed to Kentucky in 1785: became a member of the convention which framed the constitution of Kentucky; served in both branches of the Legislature and was collector of the port at Louisville under Washington. Zachary remained on his father's plantation until 1808, in which year (May 3) he was appointed first lieutenant in the Seventh Infantry. Promoted to be captain in Nov., 1810, in the summer of 1812 he was in command of Fort Harrison, near the present site of Terre Haute, his successful defense of which (Sept. 4–5), with but a handful of men against a large force of Indians, was one of the first marked military achievements of the war of 1812; was breveted major, and in 1814 promoted to the full rank. In the peace organization of the army in 1815 he was retained as captain, but soon after resigned and settled near Louisville. In May, 1816, he re-entered the army as major of the Third Infantry, became lieutenant-colonel Eighth Infantry in 1819, and in 1832 attained the colonelcy of the First Infantry, of which he had been lieutenant-colonel since 1821. On different occasions he had been a member of a military board for organizing the militia of the Union, and to aid the Government with his knowledge in the organization of the Indian bureau, having for many years discharged the duties of Indian agent over large tracts of Western country. He served through the Black Hawk war (1832), and in 1837 was ordered to take command in Florida, then the scene of war with the Indians. By the battle of Okechobee, Dec. 25, 1837, the savages were decisively defeated and the war was virtually ended. For this Taylor was breveted brigadier-general and made commander-in-chief in Florida; was transferred to command of the army of the Southwest in 1840; subsequently was stationed on the Arkansas frontier at Forts Gibson, Smith, and Jesup. He proceeded, upon the annexation of Texas in 1845, with about 1,500 men, to Corpus Christi, where his force was increased to some 4,000. In Mar., 1846, he was ordered to advance to the banks of the Rio Grande, opposite Matamoros, where a camp was constructed, and established his dépôt of supplies at Point Isabel, 25 miles to the E. He was ordered by Gen. Ampudia to retire beyond the Nueces, to which he replied that under instructions of his Government he should maintain his position. Apprehending an attempt to cut him off from his base of supplies, he started for Point Isabel (May 1) with the main body of his troops. On May 3 the sound of heavy cannonading warned him of an attack on his camp, guarded only by a weak garrison, and he returned to its relief May 7. The battle of Palo Alto was fought next day, and that of Resaca de la Palma May 9; Matamoros was occupied without resistance May 18, where he remained until September. Taylor was breveted major-general May 28, and a month later (June 29, 1846) his full commission to that grade was issued. After re-enforcement, he advanced in September on Monterey, which capitulated after three days' resistance. Here he took up his winter quarters. The plan for the invasion of Mexico by way of Vera Cruz, with Gen. Scott in command, was now determined upon, and at the moment Taylor was about to resume active operations he received orders to send the larger part of his force (Worth and Quitman's divisions and most of Gen. Wool's volunteers) to re-enforce the army of Gen. Scott. Though subsequently re-enforced by raw recruits, yet after providing a garrison for Monterey and Saltillo he had but about 5,300 effective troops, of whom only 600 were regulars. In this weakened condition, however, he was destined to achieve his greatest victory. Relying upon the strength of Vera Cruz to resist the enemy for a long time, Santa Anna directed his entire army against Taylor to overwhelm him, and then return to oppose the advance of Scott's more formidable invasion. The battle of Buena Vista was fought Feb. 22–23, 1847. Taylor received the thanks of Congress and a gold medal, and "Old Rough and Ready," as he was called in the army, became a household word. He remained in possession of the Rio Grande valley until November, when he returned to the U. S. In the Whig convention which met at Philadelphia June 7, 1848, Taylor was nominated on the fourth ballot (June 8) as the candidate of the Whig party for President over Clay, Scott, and Webster. In November Taylor received a majority of the electoral votes and a popular vote of 1,360,752 against 1,219,962 for Cass and Butler, and 291,342 for Van Buren and Adams. Gen. Taylor was inaugurated President Mar. 4, 1849. Among the questions requiring the attention of the President was the organization of the large territories newly acquired by conquest and treaty, the question of the admission of California, the formation of new Territories, and the settlement of the boundary-line between Texas and New Mexico. The free and slave States being then equal in number, the struggle for supremacy on the part of the leaders in Congress was violent and bitter. California adopted in convention, in the summer of 1849, a constitution prohibiting slavery within its borders. Taylor advocated the immediate admission of

California with her constitution, and the postponement of the question as to the other Territories until they could hold conventions and decide for themselves whether slavery should exist within their borders. This policy ultimately prevailed through the "Compromise measures" of Henry Clay. On July 5 Taylor was taken ill with a bilious fever, which proved fatal, his death occurring July 9, 1850. Gen. Taylor's wife was Margaret (1790–1852), daughter of Walter Smith, a Maryland planter. One of his daughters married Col. William W. S. Bliss, his adjutant-general and chief of staff in Mexico, and private secretary during his presidency; after his death she became Mrs. Philip Pendleton Dandridge; another was married to Jefferson Davis.—His son, RICHARD TAYLOR (*q. v.*), was an officer in the Confederate army. The best *Life* of Taylor, written by Gen. O. O. Howard, appeared in 1892, being the second of the Great Commander Series. Revised by JAMES GRANT WILSON.

**Taylor, Mount**: an isolated mountain in New Mexico, 80 miles W. of Santa Fé. It was named San Mateo by the Spanish, but the name Taylor, afterward bestowed by American explorers in honor of President Taylor, is now generally used. It is an extinct volcano, composed chiefly of andesitic lava. Its altitude is 11,388 feet, and it rises over 3,000 feet above its immediate base, which is a plateau of lava 36 miles by 12. The Atlantic and Pacific Railroad winds about the southern base of the plateau. The geology of the mountain and its environs is described by C. E. Dutton in the sixth annual report of the U. S. Geological Survey. G. K. G.

**Taylor's Theorem**: in mathematics, a theorem first demonstrated by Dr. Brook Taylor, and published by him in his *Methodus Incrementorum* in 1715. The object of the theorem is to show how to develop a function of the sum of two variables into a series arranged according to the ascending powers of one with coefficients that are functions of the other. The formula for making the development may be written:

$$f(x+y) = u + \frac{du}{dx}y + \frac{d^2u}{dx^2}\frac{y^2}{1.2} + \frac{d^3u}{dx^3}\frac{y^3}{1.2.3} + \text{, etc.}$$

The first member of this formula denotes any function of the sum $x$ and $y$, and $u$ is what that function becomes when $y$ is made equal to 0. The formula is always applicable, but it sometimes happens that $u$ or one of its successive differential coefficients reduces to $\infty$ for a particular value of $x$. This is called the *failing case* of Taylor's theorem. It is more proper to say that the function fails to be developable in powers of $y$ for the value in question. If the series is infinite, it must satisfy a test of convergence, in order to represent accurately the function on the left-hand side.

**Taylorville**: city; capital of Christian co., Ill.; on the South Fork of the Sangamon river, and on the Balt. and O. S. W. and the Wabash railways; 25 miles S. E. of Springfield, 28 miles S. W. of Decatur (for location, see map of Illinois, ref. 7–E). It is in a coal-mining, grain and hay growing, and stock-raising region, and contains a high school (building cost $35,000), 2 ward schools, 7 churches, a national bank with capital of $75,000, 2 private banks, and a daily, a monthly, and 4 weekly periodicals. Pop. (1880) 2,237; (1890) 2,829; (1900) 4,248.

**Tchad**, or **Tsad**: a lake of Central Sudan. See CHAD.

**Tchernigov**: another spelling of CHERNIGOFF (*q. v.*).

**Tchernyshev'skiĭ**, NIKOLAĬ GAVRILOVICH: author; b. in Saratov, Russia, 1828; educated by ecclesiastical teachers and at the University of St. Petersburg, was for a time editor of a military journal and then of the *Sovremenik* (Contemporary, 1855–64), in which he published a number of able articles on literature, history, economics, and social questions, besides which he wrote a book on Lessing (1854), translated Mill and Adam Smith, and other authors. Finally he expressed such pronounced socialist views that he was arrested and sent to Siberia. It was while he was in prison that he composed his famous novel *Shto Delat* (What is to be Done? English translation with the title *A Vital Question*, 1886, and by Benjamin R. Tucker, *What 's to be Done?*, Boston, 1893), which as a literary work is full of impossible characters and unreadable, but was hailed as the gospel of the earlier generation of Nihilists, who saw in it their ideals of emancipated mankind. In 1883 Tchernyshevskiĭ was allowed to live in Astrakhan and occupy himself with the translation of foreign scientific works. He was pardoned in 1889, and died in Saratov, Oct. 29, 1889. His complete works were published at Vevey, Switzerland, 1868–70. A. C. COOLIDGE.

**Tchooktchees**, chook'chēez: a tribe inhabiting the northeastern corner of Siberia from the 160th meridian to Bering Strait. It consists of two divisions—one settled along the coast, and occupied in hunting the whale, the seal, and the walrus; and the other wandering across the bleak, barren plateaus with their herds of reindeer. The Tchooktchees, whose number is variously estimated at from 6,000 to 13,000, are a well-grown, vigorous people, hospitable and bold, but almost entirely destitute of civilization. They are dependents of the Russian Government. Ethnologically, they belong to the same family as the Eskimos of North America, and the Tchooktchee builds his house and his boat exactly like the Greenlander. See ESKIMAUAN INDIANS.

**Tea** [originally pronounced *tay*, the local pronunciation in Fuhkien, China, of *te*, a dialectal form of Chinese *ch'a*]: 1, the prepared leaves of a plant of the genus *Thea*, and specifically of the *Thea chinensis*; 2, the plant itself: and, 3, an infusion of the leaves of the tea-plant, in universal use as a beverage in China, Japan, and other Oriental countries, and widely used throughout Christendom. See the article FOOD.

By some authorities the tea-plant has been assigned to the genus *Camellia* as *C. thea* or *theifera*. Formerly, when it was erroneously supposed that black and green teas were derived from different plants, the attempt was made to distinguish between *Thea bohea* and *T. viridis*. Geographically and practically it is desirable to recognize as distinct sorts *T. assamica* (Assamese), *T. sinensis* (Chinese), and the intermediate hybrids which have resulted from the near cultivation of the two. It is probable that all tea owes its origin to Assam, a province of Burma ceded to Great Britain in 1826, and annexed to the Presidency of Bengal. There in the jungle bordering on the Brahmaputra were found a few years later thickets of indigenous tea-trees, often attaining a height of 30 feet. It has been claimed by some writers that indigenous tea exists in China and Japan; but it is probable that the plant was introduced into China from India 1,500 years ago, and into Japan from China not later than the ninth century. The Japanese declare that wild tea grows freely in the hills of Kiushiu, Shikoku, and the central part of the main island, although acknowledging that its leaf is inferior to that from the gardens which were established with imported seed. Tea was introduced into Europe by the Dutch about the beginning of the seventeenth century. It remained, however, for the East India Company to develop the great British trade in Chinese tea, of which it enjoyed the monopoly until 1834.

*The Tea-plant.*—Two extremes of growth and product are presented by the Assamese and Chinese plants. The Assamese in its natural condition, as originally found in the hot, moist, and still atmosphere of its native jungles, exhibits a most luxuriant growth, often developing into a small tree with a clean stem. Its leaves are of a bright green, not infrequently 9 inches long and 3 wide. It resents transplanting after the tap-root has attained any considerable size. It does not bear drought, cold, nor rough usage from high winds or otherwise. It requires rich soil, abundant moisture, good drainage, and a rather elevated temperature; and these conditions are difficult to fill beyond the region where it was found. Under suitable conditions of cultivation this variety produces twenty or more "flushes," i. e. successive crops of young leaf, during each picking season. The small young leaf is of a golden color and soft texture; it is better adapted for the manufacture of black tea. The tea made from the Assam leaf is strong, often pungent and rasping; it is half again as strong as the Chinese, hence the Assam leaf is frequently blended with the Chinese leaf by the trade.

The Chinese plant, whether indigenous in China or of Indian origin and altered by long exposure to a colder climate and otherwise less favorable conditions, is of bushy growth and of far less attractive appearance than its Assamese relative. It is tough and hardy, successfully enduring the severe winters of the higher latitudes of China and Japan or of the elevated gardens on the Himalayan slopes. It survives deficiencies in moisture, soil, and cultivation, but gratefully acknowledges care and enrichment with an improved growth and higher leaf qualities. Under ordinary agricultural conditions it annually produces only four or five flushes. The leaf is smaller, tougher, and darker. It yields when properly prepared a more delicate if weaker tea than the Assamese. It is usually made into green tea. See TEA-PLANT.

*The Hybrids.*—As the result of the introduction into India in 1835 of Chinese tea-plants and seeds and their cultivation in gardens adjacent to those of the Assamese variety, hybridization has so thoroughly taken place that there are in India very few gardens of pure stock. In the resultant hybrids are blended the qualities of the parents, although there is a frequent tendency to exhibit the marked characteristics of one. Many intermediate varieties have been described, but it is very difficult to maintain any one of them pure unless by distinct separation from other kinds or by propagation from cuttings.

*Conditions Favorable for Growth.*—Climatic and agricultural conditions improve or deteriorate the tea-plant. It quickly responds to favorable conditions in larger bush and leaf, more frequent and abundant flushes, tenderer leaf, and better tea. Neglect, drought, and cold gradually develop the opposite, while their extremes absolutely destroy the better grades. Thus while the tea-plant will often grow under disadvantageous conditions the produce may be scant and almost worthless. The plant does best in a moist, warm, equable climate; in a rich soil sufficiently friable for the penetration of its tap-root; in a situation protected from strong winds, freshets, or stagnant subsoil water. It is a strong feeder, and except when planted out in virgin soil should receive abundant manuring. Unfortunately the very conditions conducive to its best growth create the worst malarial disorders among Europeans and those from other temperate climates. "Fever and tea go together."

*Growth of the Plant.*—Cultivated tea is raised from seed. The plant produces small white flowers, which one year later become capsules containing from one to four seeds about half the size of the American chestnut. Neither well-plucked bushes nor the better varieties of the tea-plant afford much seed. The preferable plan is to pick the ripe seeds in the autumn before the opening of the capsules causes them to fall to the ground. The sooner thereafter the seed is planted out the better. The seeds do not bear transportation to a distance without serious loss of their germinating power. About one consignment in four reaches the U. S. in good order. They are apt to be mildewed or dried up, too often the result of careless packing or unaccountable mishaps in transportation. When received in prime order it is possible to germinate 50 per cent. of them. The seed is planted either in the future tea-garden or in nurseries whence the young trees are subsequently transplanted. Indian gardens usually contain from 2,000 to 3,000 plants to the acre, according to their habit of growth and the lay of the land. Where cultivators and draft animals are used, the number of plants to the acre should not exceed 1,500 to 2,500. In the U. S. and similar climates the seedlings require protection by shingles from the hot sun and by mulching from cold weather and drought. The plants are allowed to attain under favorable conditions two or three years' growth without interference; they are then subjected to severe pruning, which in temperate climates should be done when the trees are not in sap. The objects to be attained are to give the plants a form suitable for leaf-picking and to remove useless or objectionable branches, but particularly to induce an abnormal production of foliage.

*Leaf-picking.*—To obtain abundant young leaf, from which alone good tea is made, it is necessary to make two essential departures from the original mode of growth, viz., the thick shade of the jungle must be exchanged for the open, sunny garden, and the total amount of foliage must be reduced below the normal proportion. Nature will then make a supreme effort to re-establish the equilibrium, and will put forth a tender shoot from every leaf-bud, which in turn gives rise to countless others if unmolested. Yet in spite of sufficiently severe pruning to secure good picking, cultivated tea-plants occasionally attain great size, so that with a height of 4 feet and a stem 10 inches in diameter the circumference of the bush may exceed 40 feet. The tender leaves should be carefully plucked, so as to avoid making too serious inroads on the vitality of the plant or interfering with the speedy formation of another flush.

*Pekoe Tea.*—At the end of the young shoot is an undeveloped bud, which is of all the new foliage the tenderest and choicest. It is called the pekoe tip, or flowery pekoe when made into tea. Pekoe in Chinese means white hair or down, referring to the delicate fuzz on the very young foliage. Mandarin tea is prepared from it in China; the tips are slightly rolled and dried, and finally tied up with ribbons in tiny bunches, like cigars. Except as a curiosity one does not see this tea outside of China, as in that country it commands a very high price. The next leaves are called the orange pekoe and pekoe. They, with the tip, yield pekoe tea, especially esteemed for strength and flavor. When not fermented, but prepared as green tea from the half-opened leaves in April, it is known as young hyson, hyson being a corruption of the Chinese "yu tsien," meaning "before the rains." Most pekoe teas are sent to Great Britain and Russia.

*Souchong and Congou.*—Following the pekoe leaves the next two are called souchong (small kind), and whatever of young leaf may yet be present is termed congou, or the "well worked" (from Chinese kung-foo, "labor").

*Quality of Tea.*—In this order of enumeration, from the pekoe tip downward, the size of the leaf increases, but the quality falls off. The finer the picking, i. e. the more strictly it is confined to the bud and smaller leaves, the better is the quality, but the more expensive and curtailed is the crop. In China, at the time of the second picking, in the early summer, men, women, and children flock to the tea-gardens to pick leaf, as in other countries to pick hops or cotton. They practically strip the twigs of all the green leaf. The necessary result is a poor tea; and if the small quantity of fine leaf is sifted out from the mass, the balance is "tea," but decidedly trashy. The highest grades of Chinese teas are injured by subjecting them to the elevated temperature by which teas are rendered capable of enduring long sea voyages. They command high prices in China, and some of them can be bought only by the very rich. The lowest grades also find a home market, or are made up with some glutinous substance into bricks (brick-tea) for sale in the interior of Asia.

*Yield of Tea.*—The annual produce per plant may be stated at from 2 to 6 oz. of cured tea according to the climatic and cultural conditions, the richness of the soil or its fertilization, the variety of plant and the degree of picking. In India and Ceylon the yield per acre averages about 400 lb.; occasionally it amounts to 1,000 lb.

*Green and Black Teas.*—As before mentioned, green and black teas are not derived from distinct plants. It is possible to make either from the same leaf; but that from the Assamese plant is better adapted for the manufacture of black, and that from the Chinese for green; while some hybrids serve better for the former and others for the latter. The Chinese distinguish between green tea, as affording a greenish liquor, and red tea, as giving one of that color. They do not employ the term black tea, nor do they use any of the artificially colored bright-green teas so popular in the U. S. The great difference between the two most important classes of tea lies in this, that genuine green teas are the result of quickly drying the fresh leaf, whereas black teas are subjected to oxidation before being "fired," as the drying of the moist leaf over fire or in furnaces is called. The most important chemical difference between the simply dried tea-leaves (i. e. green) and the fermented (i. e. black) lies in the decidedly less amount of tannin in the latter. The multiplicity of brands of tea corresponds to the many varieties of the tea-plant, to differences in the mode of growth and manufacture which reflect racial characteristics, and finally to the taste of the consumer.

Some of the trade-names have geographical significance; others relate to the gardens where the tea was made or to the mode of manufacture; others to the quality; and finally many are accidental or unaccountable. The great bulk of the teas sent to the U. S. might be properly classified as "low-middling," with occasional consignments of superior grades and very rarely of fancy.

*Manufacture.*—The green leaf is tasteless and odorless; it contains almost 80 per cent. of water. To prepare it for receiving the rolling to which almost all tea-leaf is subjected, it is spread out thin and withered by exposure to light, heat, and air. Direct sunshine comprises all of these requirements, but it is apt to turn the leaf red. In the manufacture of green tea, where it is desirable to avoid any lengthy exposure of the fresh leaf to the air and light, withering is performed in iron vessels over a quick fire or the leaves are steamed on mats. Withered leaf is flaccid; it has the feel of an old kid glove; it does not crackle when held to the ear and compressed. When over-withered or after exposure to sunshine it becomes dark in color.

Rolling is necessary for breaking up the cellular tissues which contain the essential oil. The juice is expressed and coats the outside of the leaves and their fragments, whereby better cup-qualities are later obtained. Rolling is essential in the manufacture of black tea, as it masses the leaf in a state conducive to speedy oxidation. It is also desirable for giving form to the finished product. Well-withered leaf does not break into fragments under this operation; it retains its original shape. Rolling is performed by hand on tables or mats, or by the use of specially designed machinery. The finest finish is given by hand-rolling; machines perform the task more uniformly and cheaply. Under the pressure of rolling, juice exudes from the ball of leaf. In India it is carefully sopped up into the "roll," and the strength of the tea is thus retained. From much of the Chinese teas it has been expressed and lost.

For the manufacture of black tea, the fresh leaf is thinly spread out to wither. When sufficiently flaccid it is rolled, then the balls or mass of rolled leaf are broken up, spread out thinly, moistened, and are subjected to oxidation, whereby tea loses its raw smell and acquires a fine flavor. This constitutes the most critical operation in the whole process, there being no fixed rules to determine its length and intensity. Due allowance must be made for differences in leaf and in temperature. The effect of oxidation is chemical, the chief change being a loss in astringency, indueed by a diminution of the tannin; the tea also becomes darker in color. After the rolled leaf is broken it is fired in iron vessels over charcoal fires or in suitably constructed furnaces. The thoroughly dried and brittle tea should be packed while yet hot in metallic cases, and afterward hermetically sealed to exclude moisture.

In preparing green tea the essential points are that the fresh leaf should be taken into treatment with the least possible delay. It is sufficiently withered, usually by artificial heat, to admit of its being slightly rolled, then reheated. These steps are repeated several times, until the desired form has been put on the tea and it has lost a large part of its moisture. It is then subjected to long-continued drying over low fires, whereby a decidedly greenish hue is imparted to the finished tea. These are the fundamental rules for making tea. In different countries are practiced various departures or additional processes, such as screening and fanning.

*Tea-industry in China.*—The tea-plant is said to grow in all except the most northern provinces. Extremes of climate prevail in China as a whole, particularly in the interior, the temperature ranging from severe heat in midsummer to bitter cold in winter, with abundant ice and snow. There is reason to believe that in the principal tea-districts the frost is less intense and of shorter duration. The annual crop of tea has been estimated at from 400,000,000 to 2,000,000,000 lb.; in any case, it is immense, and is mostly consumed by the natives. Teas for exportation are raised chiefly in the central and southeastern provinces. In 1893 Chinese tea to the extent of nearly 250,000,000 lb., valued at 30,558,723 haikwan taels, was exported. Tea is China's most important export next after silk.

The Chinese cultivate the tea-plant in small gardens, or in outlying corners and on steep hill-sides where no other crop can be raised. The farmer often sells his crop on the bushes, as oranges are sold in Florida. Or if he picks the leaf, he sells it to the middlemen who in hordes invade the tea-districts at the time of leaf-picking. The tea that has not been mortgaged to the factors is sold at the large tea-hongs—brick buildings embracing with their courts an acre or two of land, and quite common in the Chinese towns. There it is prepared and packed for the market, or it is forwarded in an unfinished state to the great commercial centers on the coast. There are also very choice gardens, well manured and cultivated, whieh have a long-established reputation. They frequently belong to priests, and are tended by them and their acolytes.

*Japan.*—Tea-drinking in Japan began 692 A. D. Tea-seeds were brought from China in the eighth century, and gardens then established which are yet in existence. Although, as before mentioned, wild tea is found in Japan, the most celebrated gardens have been sown with seed imported from China. The chief tea-producing districts are in the Tokaido, in the region around Kioto, known as the Kinai, and in the islands of Shikoku and Kiushiu. The total production of the empire in 1891 was 59,000,000 lb., of which 41,000,000 were sent to the U. S. The climate of the Japanese tea-districts is moist, averaging 72 inches rainfall yearly on 165 days. The extremes of temperature are 93° and 20° F., with a yearly average of 55° F.

Japanese teas are almost wholly green. The leaf is not adapted for the manufacture of black tea. Steam-withering is practiced to reduce the raw flavor. The general finish is very elegant, but artificial coloring and facing are common features of the export trade. The choicest tea is that raised under protection from direct sunlight, as it contains 30 per cent. more theine than that grown in the open. The most esteemed brand is called *tencha* or flat tea, because it is not rolled; indeed, it is claimed that it is not touched by hand after being put on the steaming apparatus. It commands a high price in Japan. Such teas are finely ground shortly before use, and after stirring with warm (not boiling) water for a few minutes, the whole infusion is drank. They play an important part in the ceremonial tea-drinking—an institution dating back to the fifteenth century, and constituting a very curious feature of Japanese political history and social life.

*India and Ceylon.*—The climate of Assam has been already referred to under the conditions favorable to the growth of the tea-plant. It is steaming hot; its yearly average, nearly 75° F., with a maximum temperature of almost 100° and a minimum rarely below 50° F. The total yearly precipitation of moisture is from 90 to 100 inches. It is free from hot, dry winds. Fogs are quite prevalent there. The cutting down of the jungle and its transformation into a vast tea-garden has unquestionably altered the climate; nevertheless, Assam still affords the best tea-climate. That of the elevated gardens on the Himalayan slopes and in the Neilgherries is better suited for the Chinese plant and hybrids similar to it in ability to resist cold wintry weather and to dispense with excessive rainfall. Although situated in 7° lat., Ceylon enjoys, even at the intermediate levels, a comparatively temperate and equable climate; and naturally on the most elevated gardens (some being at 5,000 feet and more), it is quite mild. The thermometer at the intermediate levels rarely indicates 100 F., and above 2,000 feet elevation seldom over 90° F. At none of the meteorological stations in the districts does the thermometer fall below 32° F. in winter. The number of rainy days approximates 200, and the total yearly rainfall about 90 inches. At the higher stations the average temperature is about 15° F., and the rainfall 25 inches less than at the lower ones. The tea-plant continues to grow and produce leaf through the whole year on the lower estates. The development of the Ceylon tea-industry has occurred since about 1876. It is largely in consequence of the replanting in tea of the great coffee estates which were ruined by the leaf disease. Desultory experimentation in tea-planting had occurred before, but without material results.

The whole system of tea-production in the British Indies is on a large scale. Wealthy corporations or individuals cultivate hundreds or thousands of acres, employing great capital and immense numbers of laborers. The operations in the field are performed under the piece system and in a thoroughly systematic manner. In the factory, the simplification of processes and the substitution of machinery for manual labor have reduced the eost of manufacture, and resulted in the production of a more uniform and cleaner article.

The following statistics are from a paper on tea by A. G. Stanton (of Gow, Wilson & Stanton). The United Kingdom eonsumed in 1800 20,000,000 lb. of tea; in 1850, 51,000,000; in 1870, 118,000,000; and in 1894, 214,000,000. The annual consumption per head of population, and the displacement of Chinese and all other sorts by Indian and Ceylon teas in the United Kingdom, are shown by the following table:

| YEAR. | China, etc. | Indian. | Ceylon. | Quantity per head of population. |
|---|---|---|---|---|
| | per cent. | per cent. | per cent. | lb. |
| 1866 | 96 | 4 | .. | 3·42 |
| 1883 | 66 | 33 | 1 | 4·82 |
| 1894 | 12 | 55 | 33 | 5·53 |

*Java.*—Tea-seeds from Japan were planted in 1826, and shortly thereafter some gardens were established by the Dutch Government. They were not financially successful, and, consequently, the last of them were relinquished to private parties in 1860. The best localities for growing tea are at a height of 3,000 to 4,000 feet above sea-level, on the slopes of the mountains. Cold weather is not felt there and leaf-picking extends through the year. The plants are kept within small dimensions, being pruned down to 2 feet in height; they are planted in rows 4 by 2 feet apart. The tea is well made and highly esteemed for its fine flavor, but it is not strong. The crop for 1892 was 9,000,000 lb. It is chiefly sent to Holland, North Germany, and England. In regard to Java, parts of Ceylon, and similarly situated tea-districts where the tea-plant flushes through the whole year, it is believed that in vigor of growth and strength of tea they do not compare favorably with situations where the plant hibernates for a few months.

*United States.*—In other lands than those already described attempts have been made to establish the cultivation of tea. Some of these trials have resulted in failure, others are full of promise, but have not progressed far enough to warrant description here. In view, however, of the general interest which has been manifested in the experiments conducted in an intermittent manner since about 1850 to determine the feasibility of establishing the tea-industry in the U. S., and more recently by Charles U. Shepard, near Summerville, S. C., it may be proper to add a brief summary of the results thus far gained and the present outlook. It has been shown that ordinary hybrids, as also Chinese and Japanese plants, will thrive and produce exceptionally good teas, at least under the stimulus of high cultivation, in several of the Southern States. It is doubtful if the U. S. affords a suitable locality for the growth of the Assamese species. The main difficulties in the path of the tea-grower in the U. S. are the lack of a favorable climate and cheap labor. In regard to climate, at least in the Southeastern States, the variations of temperature are great, equaling those of the Chinese tea-districts, while the amount of rainfall during the picking season hardly meets the requirements for a successful crop. Thus at Charleston, S. C., the mean annual temperature is 66° F., with average extremes of 94° and 20½° F.; and the rainfall amounts to 57 inches per annum on 118 days. Climate materially affects the production. A dry spring retards luxuriant growth and the formation of early tender flushes. The tea-plant needs alternating gentle showers and warm sunshine. Violent storms of wind and rain cause considerable damage. Day labor costs at least five times as much as in the far East. The difference in the cost of leaf-picking amounts to five cents a pound of cured tea, and that is almost the cost of a pound of fair tea on some Oriental estates.

The Southern States, therefore, can not be regarded as ideal tea-districts. Indeed, it has been evident for some years that Asiatic competition precludes the successful raising of the cheaper classes of tea. Nevertheless, there is ground to believe that the better qualities may be profitably grown provided the yield of fine leaf can be made to equal the average of Asiatic gardens. Assuming that by high manuring and careful cultivation a yield of 400 lb. of cured leaf may be obtained from an acre containing 2,000 plants, the cost should not exceed 20 to 25 cents a pound, and 30 cents a pound is the price of similar Asiatic teas in "importers' bulk" at the chief ports of the U. S. Finally, it is very improbable that in the U. S. low-grade and sophisticated teas will always satisfy the wants of the public in general. With increasing wealth and intelligence tea-drinkers will demand and be willing to pay for the better qualities. There will be some who will want the best; that can be furnished only from gardens in the U. S., as it will not bear transportation to a distance.

*Adulterations of Tea.*—There can be no doubt that a great deal of the tea, especially green tea, imported into the U. S. would fall under the condemnation of the law of New York, by "being colored, or coated, or polished, whereby damage is concealed, or it is made to appear better than it really is, or of greater value." On the contrary, it should be regarded as very exceptional in any tea "if it contain any added poisonous ingredient, or any ingredient which may render such article injurious to the health of the person consuming it." The adulterants of tea have been carefully investigated, especially in the U. S., by J. P. Battershall (*Food Adulteration and its Detection*) and G. L. Spencer (*Foods and Food Adulterants*, U. S. Department of Agriculture, Division of Chemistry, Bulletin No. 13).

Tampering with tea has for its objects the improvement of its appearance, its increase in weight or bulk, or the heightening of some quality of flavor. The origin and method of imparting a bright green to tea, as practiced in China and Japan, more particularly for the benefit of tea-drinkers in the U. S., have been described as follows by S. Wells Williams (*The Middle Kingdom*):

"When green tea is intended for home consumption soon after it is made, the color is of little consequence; but when the hue influences the sale, then it is not to be overlooked by the manufacturer or broker. The first tea brought to Europe was from Fuhkien, and all black; but as the trade extended, probably some of the delicate hyson sorts were now and then seen at Canton, and their appearance in England and Holland appreciated as more and more was sent. It was found, however, to be difficult to maintain a uniform tint. Chinese ingenuity was equal to the call. The operation of giving green tea its color is a simple one. A quantity of Prussian blue is pulverized to a very fine powder, and kept ready at the last roasting. Pure gypsum is burned in the charcoal fire till it is soft and fit for easily triturating. Four parts are then thoroughly mixed with three parts of Prussian blue, making a light-blue powder. About five minutes before taking off the dried leaves this powder is sprinkled on them, and instantly the whole panful of 2 or 3 lb. is turned over by the workman's hands till a uniform color is obtained. His hands come out quite blue, but the compound gives the green leaves a brighter green hue. If foreigners preferred yellow teas no doubt they could be favored, for the Chinese are much perplexed to account for this strange predilection, as they never drink this colored or faced tea." The amount of Prussian blue used in coloring green tea is so infinitesimal that it would be necessary for a tea-drinker to consume at one sitting 1 lb. of such tea in order to take what was formerly regarded as one dose of it. The prevalent idea that green tea owes its color to copper is erroneous. Indigo, turmeric, plumbago, and iron sulphate are also used for imparting color. Lie-tea is a mixture of the dust of tea with old tea-leaves and occasionally the leaves of other plants, starch, gum, and mineral substances, worked down to a convenient mass, artificially colored, and usually made to imitate gunpowder tea. For facing or giving a gloss to teas, plumbago, soapstone, and similar materials are employed. Tannin is added for heightening the astringency, which with most tea-drinkers is synonymous with strength and high quality. Foreign substances, such as fragments of brick, sand, etc., up to a reasonable content, may be regarded as the result of carelessness; beyond that of fraudulent intent. Scented teas chiefly owe their fragrance to the odors of the rose, *Osmanthus* (*Olea*) *fragrans*, tuberose, and gardenia; the jasmine and azalea are also employed for this purpose. But scented teas can hardly fall into the category of adulterations. Spent leaves are rarely to be found in tea, except in small quantity; and the presence of the leaves of other plants has been seldom detected. The poorest teas are raised at such a modicum of expense that adulteration becomes remunerative only in response to the demands of the consumer, or at the hands of the middle men. "Tea," although unrecognizable in the cup, can be made almost to satisfy the buyer who wants something for nothing. The detection of adulterants lies in the application of the usual chemical tests, the determination under prescribed conditions of the matter extracted by hot water, and an examination of the leaves with the microscope.

CHARLES U. SHEPARD.

PHYSIOLOGICAL EFFECTS OF TEA.—The chief active ingredient of tea, upon which depends most of its influence upon the human body, is the alkaloid or active principle called theine, which is practically identical with caffeine derived from coffee, guaranine derived from guarana, and similar substances. It is stated on good authority that as a matter of fact most of the caffeine which is used in medicine is in reality theine derived from damaged teas which can not be used for the ordinary purposes, as this is a much cheaper source of supply than is coffee. In addition to theine tea-leaves contain some tannic acid, which gives them their somewhat bitter taste, and a small amount of volatile oil, upon which a "cup of tea" depends for its aroma. The percentage of theine in tea-leaves varies from ½ to 6 per cent., the tannic acid from 12 to 18 per cent., and the volatile oil equals about half of 1 per cent. In addition to these constituents there are numerous vegetable extractives, such as coloring-matter, albumen, gum, and slight traces of mineral substances.

When tea infusion, or in other words, a "cup of tea," is swallowed by the ordinary adult human being it produces a powerful stimulant influence which is chiefly exercised upon the nervous system, especially the brain and spinal cord. As a result of this, thought-processes are more rapidly and readily carried out and the reflexes are increased from the spinal stimulation, so that a mild condition of "nervousness" may develop. The heat which is also taken into the body in drinking tea acts as a powerful stimulant and aids very materially in the absorption of the drug by the stomach. If the tea is taken in over-dose the condition of cerebral and spinal excitation may be so great as to be quite annoying, the chief symptom, if the tea be taken in the evening, being often excessive wakefulness. Because of the stimulant influence of tea upon the human being it is employed very largely, and in many cases to excess, so that persons who are wont to pay little attention to their diet and habits of life frequently become addicted to its excessive use, resorting to it as a "whip" to overcome the apathetic condition arising from the nervous exhaustion from which they are suffering. While there is no doubt that tea is capable, by its stimulating influence, of removing temporary nervous depression, it should never be forgotten that its constant employment for this purpose is always followed sooner or later by physical bankruptcy, a condition which is seen most commonly in nervous women. Tea belongs to that class of substances, such as coffee, cocoa, tobacco, alcohol, and opium, which retard tissue waste, or, in other words, decrease nitrogenous break-down in the body, thereby conserving the tissues, and it is thought by some that human beings resort to these drugs as a result of an instinctive feeling that they are saving themselves to some extent from wear and tear.

A strong infusion of tea is valuable in two dangerous conditions as an antidote: (1) in opium-poisoning, for the purpose of stimulating the respiration and heart; and (2) in antimonial poisoning, for the same purpose, and also for the purpose of forming an insoluble tannate of antimony so slow in its action that acute poisoning will not ensue.

In preparing tea for drinking purposes care should be taken that perfectly pure water is employed which is devoid of either taste or smell, and which is neither too hard nor too soft. It should be poured upon the tea-leaves when actually boiling and the mixture allowed to steep for but a short time. Boiling tea-leaves for the purpose of making an infusion for drinking purposes should never be done, as this process extracts a large amount of organic matter from the leaf and dissipates the aroma, leaving in its stead an acrid, bitter taste. See CAFFEINE. H. A. HARE.

**Teachers' Institutes**: institutions, original in the U. S., for giving professional instruction to teachers already at work. The institute is usually held for a week during the school term at some central point in the county or commissioners' district, the teachers being required to attend and being paid as though they were teaching. The institutes are led by experienced conductors, and are substantially normal schools with a course of study of a week. Gatherings of this kind were held as early as 1834. In 1839 Henry Barnard assembled a number of teachers for this purpose at Hartford, but the first meeting that was called an institute was held in Tompkins co., N. Y., in 1843. The character and work of the institutes vary widely with different localities. See Boone, *Education in the United States* (1890).
C. H. THURBER.

**Teachers' Seminaries**: in Germany, Russia, Scandinavia, Denmark, and Finland, schools for the training of teachers. Such institutions all have the same general character, as described especially for German seminaries in the article *Normal Schools* under SCHOOLS.

**Tea Family**: the *Ternstrœmiaceæ*, a small group (310 species) of dicotyledonous trees and shrubs of warm and hot climates, with regular showy flowers, having usually five sepals, five petals, many stamens, and a superior three-celled to five-celled compound ovary, each cell containing from two to many ovules. The most important genus is CAMELLIA (*q. v.*), in which Bentham and Hooker include the TEA-PLANT (*q. v.*), *C. theifera*. Other botanists maintain *Thea* as a separate genus, and designate the tea-plant as *T. chinensis* or *T. sinensis*, while others still would include all the camellias in *Thea*. In the southern parts of the U. S. there are two species of GORDONIA (*q. v.*) and two of *Stuartia*, all shrubs with pretty flowers. CHARLES E. BESSEY.

**Teak** [from Malayalam *tekka*]: a forest-tree, *Tectona grandis*, of the family *Verbenaceæ*, of India and Farther India. It is the best timber known for ship-building. It is more durable than oak, more easily seasoned, equally strong, considerably lighter, and far more easily worked. It is used for making decks and planking, for the keel, timbers, and even masts and spars. Many all-teak ships are reported to be over 100 years old, and still seaworthy. The wood somewhat resembles mahogany. The flowers and leaves have medicinal qualities, and are used in dyeing. African teak, the wood of a euphorbiaceous tree, *Oldfieldia africana*, resembles true teak, but is much inferior to it.
Revised by L. H. BAILEY.

**Teal**: any one of several small ducks having a bill but little longer than the foot, rather narrow, and with small lamellæ. The wing bears a conspicuous mark, or speculum, of blue or metallic green. They are birds of rapid flight, partial to fresh water, and their flesh is excellent food. There are about twenty species scattered through the world, three occurring as regular residents within the U. S. These are the blue-winged teal (*Anas discors*), the green-winged teal (*A. carolinensis*), and the cinnamon teal (*A. cyanoptera*). The European green-winged teal (*A. crecca*) occurs as a straggler in the Eastern U. S. For the summer teal, see GARGANEY. F. A. LUCAS.

**Tea, Paraguay**: See MATE.

**Tea-plant**: a shrub with smooth evergreen leaves, bearing white flowers (an inch or more broad) in their axils, resembling those of a small camellia, belonging to the same family (*Ternstrœmiaceæ*), and in the opinion of many recent botanists to the same genus. A distinguishing character is that camellias have numerous unconnected stamens within the ring of outer ones, the united filaments of which form a short tube, cohering with the base of the petals, and falling with them; while in the tea-plants there are only five or six of these inner and separate stamens. In both the blossom is succeeded by a globular, thick-walled, woody capsule, internally divided into three or four cells, tardily splitting open; each cell ripening from one to four large and oily seeds, with a hard and smooth seed-coat. See TEA.

**Tear-gland**: See LACHRYMAL GLAND.

**Tears** [O. Eng. *tēar* : O. H. Germ. *zahar* ( > Mod. Germ. *zähre*) : Icel. *tār* : Goth. *tagr* < Teuton. **tahr-*, **tagr-* < Indo-Eur. **dakru* > Sanskr. *daçru* : Gr. δάκρυ : O. Lat. *dacruma* > Lat. *lacrima*]: the slightly saline watery secretion of the LACHRYMAL GLAND (*q. v.*). The ordinary function of this secretion is to assist in the work of moistening and lubricating the eyeball; but in the human species, at least, the exercise of certain strong emotions acts as a powerful stimulus upon this secretion. Pungent odors, as that from the onion, sometimes provoke a copious and even painful discharge of tears. To certain of the lower animals, as the crocodile and the hyæna, folk-lore ascribes the power of shedding voluntary tears for the deception of the beholder; and observers old and recent testify that certain species of deer and of the seal family express grief by the shedding of tears. Most of the lower animals do not secrete a noteworthy flow of tears except after injury of the eye or in some diseases of the gland or of some adjacent part.

**Teasel** [Mod. Eng. *tesel* < O. Eng. *tǣsel*, deriv. of *tǣsan*, pluck, tease (wool)]: the *Dipsacus fullonum*, a biennial plant of the south of Europe, naturalized to some extent in the U. S. It is cultivated in Europe, as in the U. S., on account of its burs or heads, covered with hooked bracts. These heads are fastened to a revolving cylinder, and are used by woolen manufacturers to raise a nap on cloth. No artificial contrivance has been found to equal the teasel for this purpose. "Male" and "female" teasels are merely varieties in size and stiffness, each adapted to the dressing of special cloths.

**Teasel Family**: the *Dipsaceæ*; a small group (150 species) of dicotyledonous herbs (rarely shrubs) of the Old World, with small flowers, having a small calyx, tubular corolla, stamens two to four inserted on the corolla, anthers free, and ovary inferior, one-celled and one-ovuled. They are closely related to the COMPOSITES (*q. v.*), from which they are separated mainly by their free anthers. The teasel and the ornamental species of *Scabiosa* are the most important plants of the family. CHARLES E. BESSEY.

**Têche** (tesh), **Bayou**: one of several small tide-water navigable channels in Southern Louisiana, which were once the main channels of large rivers. This bayou lies immediately W. of Grand Lake, and the Atchafalaya river basin and its high banks, formed by the overflows centuries ago, when it was a main river outlet, now form one of the most fertile and productive portions of the State of Louisiana. It produces large crops of sugar and cotton, these lands being above overflow. It is navigable to St. Martinsville, about 100 miles above its mouth, where it empties into the lower Atchafalaya, near Morgan City. Above St. Martinsville the Têche is only navigable for very small boats a portion of the year. What is now termed Bayou Têche was once the lower portion of the ancient channel of Red river, extending from the present Bayou Courtableau, E. of Opelousas, La., around and to the W. and S. of what is now the

Grand Lake basin—then probably an inland bay into which the Mississippi river discharged—to the Gulf of Mexico, but now, too, the lower Atchafalaya river, S. of Grand Lake. St. Martinsville, Pattersonville, Centerville, Franklin, and New Iberia are prominent towns on the Têche.

Revised by J. B. JOHNSON.

**Technical Schools** : See SCHOOLS.

**Technology** [from Gr. τέχνη, art + λόγος, discourse]: a general name for industrial science. Strictly, there is no such science, but all the sciences contribute much which is of the greatest value to the various industries; and technology is the teaching of those parts of science which are of direct industrial importance. See *Technical Schools* and *Trade Schools* under SCHOOLS.

**Teck** : small duchy situated in Suabia, and called so after the castle of Teck. It was held successively by several families during the Middle Ages, but in the fourteenth century passed into the possession of the Dukes of Würtemberg. In 1863 the King of Würtemberg conferred it on the children of Duke Alexander of Würtemberg by his marriage with the Countess Rhédey. Their son Francis (b. 1837), who became Duke of Teck by this arrangement, is the father of the Princess Victoria May, who married the Duke of York of the British royal house (July 6, 1893). F. M. COLBY.

**Tectibranchia'ta** [Mod. Lat.; Lat. *tec'tus*, perf. partic. of *te'gere*, cover + *bran'chiæ*, gills]: a group of opisthobranchiate molluscs in which the gills are covered by the mantle. See GASTEROPODA.

**Tecum'seh** : village (settled in 1824): Lenawee co., Mich.; on the Raisin river, and the Cin., Jack. and Mack. and the Lake Shore and Mich. S. railways; 13 miles N. E. of Adrian, and 33 S. E. of Jackson (for location, see map of Michigan, ref. 8–J). It is in an agricultural and fruit-growing region, has large manufacturing interests, and contains 6 churches, a central and 3 ward schools, a public library, 2 State banks with combined capital of $66,000, 3 flour-mills, 2 planing-mills, a paper-mill, brick and tile machine-works, 2 foundries, carriage-factory, table and furniture factory, and 2 weekly newspapers. Pop. (1880) 2,111; (1890) 2,310; (1900) 2,400. EDITOR OF "HERALD."

**Tecumseh** : city (founded in 1857); capital of Johnson co., Neb.; on the Big Nemaha river and the Burl. and Mo. River Railroad; 30 miles W. of Missouri river, and 50 miles S. E. of Lincoln (for location, see map of Nebraska, ref. 11–H). It contains 8 churches, 4 public-school buildings, high school, water-works, electric lights, a national bank with capital of $50,000, a State bank with capital of $50,000, and 3 weekly newspapers. Pop. (1880) 1,268; (1890) 1,654; (1900) 2,005. EDITOR OF "CHIEFTAIN."

**Tecumseh**, or **Tecumtha** : chief of the Shawnee Indians; b. near Springfield, O., about 1768; took part in the war with the Kentucky forces about 1791; was engaged in the battle of Mad river and in the attack on Fort Recovery, 1794; joined his brother, Elskwatawa (called The Prophet), about 1805 in the attempt to organize all the Western Indians in a confederacy against the whites; visited all the tribes on the upper lakes and in the Mississippi valley down to the Gulf of Mexico; collected a considerable force on the upper Wabash in the autumn of 1811, which, under command of the Prophet, attacked Gen. Harrison and was defeated at Tippecanoe Nov. 7, during Tecumseh's absence among the Southern tribes; went to Canada with a band of Shawnees in the following year on the outbreak of hostilities with Great Britain; was a useful ally to the British in the battles of Raisin river and of Maguaga, where he was wounded; was made a brigadier-general in the British service; was joint commander with Gen. Proctor at the siege of Fort Meigs, and protected the American prisoners from massacre; was wounded at the battle of Lake Erie, and commanded the right wing at the battle near the Moravian towns on the Thames. Having, it is said, a presentiment of his approaching death, he laid aside his sword and uniform, put on his hunting-costume, and plunged into the hottest of the fight, in which he was killed Oct. 5, 1813. It was asserted for many years that he fell by the hand of Col. Richard M. Johnson, afterward Vice-President of the U. S. (1837–41). See Drake, *Life of Tecumseh and his Brother the Prophet, with an Historical Sketch of the Shawnee Indians* (Cincinnati, 1841), and Eggleston, *Tecumseh and the Shawnee Prophet* (New York, 1878).

**Te De'um** [Lat., so called from the first words, *Te Deum (laudamus)*, Thee God (we praise), Eng. version, "We praise thee, O God"]: the most famous "non-biblical" hymn of the Western Church, dating from the fifth century. It was intended to be a daily morning hymn. Its authorship is unknown. It is first referred to by Cæsarius of Arles (502), who ordered it to form part of the regular morning service of his monks, and as he cites it only by the first three words it indicates that it was then well known. So it passed into the service books of the Western Church, and has always constituted a portion of the Morning Service (as one of its supplications, "Keep us *this day* without sin," implies) in the English and American church services between the first and second lessons for the morning, the rubric prescribing that it shall be "said or sung."

Besides the use in the Morning Service, this triumphal hymn is used, arranged to elaborate music, as a special service of thanksgiving. The sovereigns of England have been accustomed to go in state to the singing of the Te Deum after great victories, Handel's *Dettingen Te Deum* having been composed for one of these occasions. At the conclusion of coronations it has been used from time immemorial throughout Europe. When it is said in the ordinary Morning Service, its verses are antiphonally recited by minister and congregation, but it is very generally sung by choir and congregation. The music which has come down in connection with this hymn is probably pre-Gregorian. No hymn or form of words has been the subject of so many musical renderings by composers of all grades, of all ages, and of all nations. Among the elaborate works are those of Handel (just cited), Romberg, André, Lassen, and Wüllner. Revised by S. M. JACKSON.

**Teeth** [plur. of *tooth* < O. Eng. *tōð* (plur. *tēð*): O. H. Germ. *zand* (> Mod. Germ. *zahn*): Icel. *tönn*: Goth. *tunþus*; cf. Lith. *dantis*: Lat. *dens, dentis*: Gr. ὀδούς, ὀδόντος: Sanskr. *danta*]: certain hard bodies situated in the mouth or at the beginning of the alimentary canal. This definition, comprehensive and vague as it may appear, is as exact as the nature of the case permits. Under it would be included not only the teeth of mammals and other vertebrates, but also the hard bodies that stud the surface of the odontophore or lingual ribbon of molluscs, etc., although these parts are not at all homologous. The teeth of vertebrates, which alone are considered here, are exceedingly variable in development, as well as form and position, and their characteristics in the several classes may be briefly examined in order, while much information as to dentition will be found in the articles treating of the various families, etc.

The teeth of vertebrates, and particularly those of mammals, are closely related to the entire structure of the animal to which they belong, and as the teeth, owing to their hardness, often remain after other parts have wholly or largely disappeared, they are for these reasons of great importance to the palæontologist.

Following Tomes, the main features in the development of teeth are, briefly, as follows: "In all animals the tooth-germ consists primarily of two structures, and two only—the dentine-germ and the enamel-germ. The simplest tooth-germ never comprises anything more. When a capsule is developed it is derived partly from a secondary upgrowth of the tissue at the base of the dentine-germ, partly from an accidental condensation of the surrounding connective tissue. The existence of an enamel-organ is quite universal, and is in no way dependent upon the presence or absence of enamel upon the completed tooth, although the degree to which it is developed has distinct relation to the thickness of the future enamel. So far as researches go, a stellate reticulum, constituting a large bulk of the enamel-organ, is a structure confined to the Mammalia. The dentine-papilla is a dermal structure, the enamel-organ an epithelial or epidermic structure. As the enamel is formed by an actual conversion of the cells of the enamel-organ, this makes the dentine dermal and the enamel epidermic structures. In Teleostei the new enamel-germs are formed directly from the oral epithelium, and are new formations arising quite independently of any portion of the tooth-germs of the teeth which have preceded them. In mammals and reptiles, and in some, at all events, of the Batrachia, new tooth-germs are derived from portions of their predecessors. In all animals examined the phenomena are very uniform: a process dips in from the oral epithelium, often to a great depth; the end of the process becomes transformed into an enamel-organ coincidently with the formation of a dentine-papilla beneath it. The differences lie rather in such minor details as the extent to which a capsule is developed, and no such generalization as that the teeth of fish in their development represent only an earlier stage of the development of the teeth of Mammalia can be drawn."

The leptocardians or pharyngobranchiates are entirely destitute of teeth.

The marsipobranchiates have teeth developed on the tongue, and more or less from the surface of the oral disk; in the myxinoids a single tooth is present on the roof of the mouth; but in the petromyzonts numerous teeth exist in oblique rows on the disk.

The selachians or elasmobranchiates exhibit a very considerable diversity in their dentition, but the principal types are as follows: In sharks the teeth vary in shape from flat and broadly triangular, with serrate edges (*Carcharias*), to long, slender, and smooth (*Lamna*). They differ considerably in shape, according to their position in the jaw, and are arranged in several (six to eight) rows, although those of the front row only are in active use. The others form a reserve series, and move continually forward to replace the others, while new teeth are continually being developed at the back. The skates and rays have either numerous small, pointed teeth, arranged in alternating rows, but so thickly set as to form one mass (*Raja*), or they are flat, six-sided, and so disposed as to form a sort of pavement (*Myliobatis*). In either case new teeth are constantly forming at the back to replace the loss by wear in front.

The fishes are, more than any other class, distinguished by the diversity in development and position of the teeth, as well as form and mode of attachment.

As to position, they may be entirely absent from at least the mouth proper, or they may be present on almost all the bones—i. e. the intermaxillaries, the supramaxillaries, the vomer, the palatines, the pterygoids, the ento-pterygoids, and the tongue, as well as the pharyngeal bones, the branchial arches, and the beginning of the œsophagus. There may be also a considerable diversity in dentition within the limits of the same natural family, although, as a rule, the differences are inconsiderable: as examples among American fishes the cyprinoids and centrarchoids may be mentioned. All of the cyprinoids (carp and suckers) are totally devoid of teeth in the mouth, although they have them well developed on the pharyngeal bones. The centrarchoids (bass) offer considerable diversity: in *Pomotis* and *Lepomis* teeth are present only on the jaws and vomer, but in *Ambloplites* and *Chænobryttus* they exist not only on the jaws and vomer, but also on the palatine and pterygoid bones. A still more noticeable case of diversity is afforded by the family of clupeids, including the herrings, shad, etc.: in *Alosa* (the shad) the mouth is almost toothless, while in *Clupeoides* teeth are developed on the intermaxillaries and supramaxillaries (as crenulations), as well as on the dentaries, vomer, palatines, pterygoids, and tongue: between these there is almost every gradation. These variations in the clupeids are so generally unaccompanied by other modifications of structure that their systematic value is very slight. Nevertheless, in most cases there is a quite close concordance between the development of the teeth and other characters, so that, on the whole, the nature of the dentition may be tolerably well predicated from the associated characters. The most common combination, too, at least among the specialized acanthopterygian fishes, is expressed in the aggregation of teeth on the intermaxillaries, dentaries, vomer, and palatines. The *Percidæ*, *Serranidæ*, and *Scombridæ* (but not all their species) are examples of this class. Closely related types, however, have the teeth confined to the intermaxillaries and dentaries; such are, e. g., the typical *Pristipomatidæ* and *Sparidæ*. In *Stromateidæ* teeth are developed on plates at the entrance of the œsophagus.

In form there is great variety. The most common shape is an elongated but more or less curved cone, or some slight modification thereof. The most noteworthy examples of other types are the following: Extremely elongated, slender, and almost hair-like teeth are found in the chætodontids; incisors like those of mammals, superficially at least, are developed in the *Sargi* (sheepshead, etc.); molar-like teeth are present in the jaws of many *Sparidæ* and on the palate in *Anarrhicadidæ* (wolf-fishes); barbed or arrow-like teeth are exemplified in the *Trichiuridæ* and related forms; compressed, lancet-like teeth exist in the jaws of *Pomatomus* or *Temnodon* (the bluefish); slender spoon-like teeth are to be seen on the lips of the loricariids, a group of peculiar South American catfishes; squamiform, imbricated teeth cover the jaws in the *Scaridæ* (parrot-fishes); and broad incisorial teeth are confluent with the jaws in the diodons and tetrodons.

In their combinations and mode of attachment there is almost equal variety. In most fishes the teeth are very numerous, and grouped in many rows on the jaws as well as on the palate; in many they are a single row; often they are differentiated into two or more kinds—e. g. the foremost tooth or the hindmost ones, and sometimes (as in different labrids) both, may be developed as canines, while the others are small; often, too, the teeth of the anterior row are much larger than the others; again, as in the sparids, the teeth of the front of the jaws are conic or incisorial, and those of the sides molar. In fishes generally the teeth are immovably implanted in sockets in the jaws, but readily detached therefrom; in some (e. g. in *Salarias*, *Euchalarodus*, certain *Serranidæ*, etc.) they are more or less movable, while in loricariids they seem to be loosely attached to the lips; in the scarids they are imbricated on the jaws; and in the diodons and tetrodons they are inseparable from the jaws.

In the amphibians there is much less diversity than in the fishes, or even the selachians. In form they are mostly slender, conic, and pointed. In position they exhibit much greater diversities: in the *Gradientia* (salamanders and other tailed species) they are present on the jaws and palate under various combinations. In the *Salientia* they are less constantly present; in many (e. g. the frogs) they are suppressed in the lower jaw, and present only in the upper; in numerous others (e. g. the toads) they are absent from the upper as well as the lower jaw; in the frogs teeth are developed on the vomer, but in the toads are entirely wanting on the palate as on the jaws.

In the reptiles the varieties of dentition are quite numerous, but less so than in the fishes. In shape their teeth are usually more or less conical or rounded, but they may be somewhat notched or pectinated. It need only be added here that, according to Tomes, but contrary to the older authors, "the teeth, as far as known, consist of dentine, to which is very generally superadded an investment of enamel, partial or complete, but that cementum is only present in a few instances," the only forms having teeth covered with cementum being "those which have them implanted in more or less complete sockets or in a groove," as the crocodilians and ichthyosaurians. The teeth of reptiles are usually succeeded as they wear out by others which either grow up at their sides, as in serpents, or are pushed up from beneath, as in crocodiles and most lizards.

The birds of the present epoch are entirely destitute of true teeth, and the mandibles have generally more or less trenchant, unarmed linear edges, but sometimes they are armed with processes of bone simulating teeth, but in no other respect entitled to that name. In former epochs, however, there existed types actually provided with true teeth, having all the structural characteristics of those organs, and fitting in sockets in the jaws; these have been combined by Marsh under the general term *Odontornithes* (i. e. toothed birds).

In the mammals teeth are confined to the jaws—i. e. the intermaxillary, supramaxillary, and dentary bones—and are almost always developed, although in a few forms, representing several orders, they are entirely wanting. No teeth have been discovered in the Monotremes belonging to the family *Tachyglossidæ*, but in the *Ornithorhynchidæ* very young animals possess three minute, many-tuberculed teeth on either side of each jaw. A little later these are hidden under the large, horny, epidermal plates which serve as teeth in the adult, and ultimately the rudimentary teeth are absorbed, so that until recently the *Ornithorhynchidæ* were considered to be toothless. In the marsupials and placental mammals the teeth are homologous with each other, and developed in the same manner. The fully developed teeth are composed essentially of three substances: the dentine, the enamel, and the cement. The dentine is the chief component of the teeth, and is a dense, fine-grained, elastic substance, permeated by minute tubes; there is a familiar and well-marked example of dentine in ivory, but it varies much in appearance and hardness, although it always contains a considerable portion of animal matter. The enamel is generally more or less developed around the dentine on the crown of the tooth, or is present in the form of vertical plates as among ungulates. It is composed of extremely minute fibers standing outward over the dentine, and is the hardest of animal tissues. The enamel is developed around the teeth of most mammals, but to a varying extent, and is wanting chiefly in most of the representatives of the order *Bruta*. The cement is quite like bone in appearance and composition, and enters to a varying extent into the composition of the tooth. It is generally most developed around the roots, and least so on the crowns, although in ungulates it fills the valleys between the plates of enamel also. See the illustration in the article HISTOLOGY.

The teeth of mammals are always inserted in sockets in the jaws, surrounded by gums. They are severally divided into two portions—the exposed portion or crown, and the inserted portion, known as the fangs or roots. The difference is generally well defined, but in some forms, especially in certain rodents (*Arvicolinæ*), etc., there is no abrupt distinction between the inserted and exserted portions, and true roots are not developed.

In nearly all mammals there is a limit to the growth of a tooth, but the incisors of all rodents and all the teeth of some species, as well as the teeth of sloths, continue to grow upward throughout life, the pulp-cavity remaining open and new material being added at the base as it is worn away above.

The teeth of mammals not increasing in size, as do the other parts of the body, a provision must exist for the accommodation of their size and development to that of the animal. This is effected in part by the late development of some of the teeth, which do not appear until the animal has attained a large size; and, in part, as well, by the replacement of some of the teeth developed about the time of birth by subsequent ones of larger size. Those animals which have only one set of teeth are said to be monophyodont (μόνος, single + φύειν, to put forth + ὀδούς, tooth); those which have two sets of teeth, an early (deciduous) and a later (non-deciduous) set, are called in contrast diphyodont (δίς, twice + φύειν, to put forth + ὀδούς, tooth); these characters, however, are not co-ordinated with others, and mammals, therefore, can not be contrasted, as has been attempted, into natural sections distinguished by such characteristics. In the marsupials only four teeth (one in each jaw on each side) are succeeded by larger teeth, the teeth which correspond to the milk teeth of other mammals persisting during life, with the exception of the third premolar. The teeth of the second set are developed from diverticula of the sacs in which originated those of the first set. The edentates, so far as known, are mostly monophyodont, but the armadillos and aard-vark are diphyodont, a set of milk teeth existing for a longer or shorter time after birth, and being finally succeeded, sometimes not until near maturity, by a second permanent set. The sloths are not yet fully known, but there is reason to suppose that they may also prove to be diphyodont also. Among the Carnivores, in the Fissipedes, or terrestrial species, the diphyodont type is well exemplified, the milk teeth being rather large, and retained for quite a long period, until finally replaced by the permanent set; but in the Pinnipeds the milk teeth are extremely rudimentary, and replaced before birth by those of the permanent series. In the majority of the toothed whales the teeth are those of the first or milk dentition, which persist throughout life, but the porpoise (*Phocæna*) is partly diphyodont, although the majority of the teeth belong to the milk dentition. Fœtal whalebone whales have a single set of simple teeth which are absorbed before birth. In the rodents the great incisor teeth are permanent, and have no deciduous predecessors. In the case of those forms which have only three molars or less, as in the *Muridæ*, etc., these are permanent, being persistent milk teeth. In those forms, however, where the number of molars exceed three, the teeth in front of them are premolars, or teeth which have had deciduous predecessors.

Recent investigations have shown that the rudiments of teeth are present in many mammals previously classed as monophyodont, but that they fail to develop, and that diphyodont mammals possess germs of a third set, possibly of a fourth.

The rows of teeth in almost all species exhibit interruptions of varying extent. These interruptions (diastemas or diastemata) most frequently exist between the incisors and canines of the upper jaw for the reception of the canines of the lower, and in the lower jaw between the canines and molars for the reception of the canines of the upper jaw. When the canines are reduced in size, there is often a corresponding reduction in the extent of the diastemas; and in man, where the teeth are all nearly on the same level, the series in both jaws are perfectly uninterrupted; and in this respect man is distinguished from all the other living mammals, although approached by certain of the lemuroid species. The character is, however, not exclusive, and in certain extinct forms, notably those of the ruminant family of *Anoplotheriidæ*, there are also uninterrupted series of teeth in the two jaws. The diastemas, however, are by no means always co-ordinated with the development of the canine teeth, but very frequently result from the elongation of the jaws and the reduction of the anterior molar teeth, as in most of the ungulates and in all the rodents, in which latter the canines are never developed.

The teeth of mammals are, in respect to situation, function, or mode of replacement, divisible into four groups, incisors, canines, premolars, and molars. The incisors (Lat. *incidere*, to cut) are the teeth in the front of the jaws; those implanted in the premaxillaries above, and those immediately opposing them below. The canines (Lat. *caninus*, dog-like) are the usually prominent teeth just back of the incisors. The upper canine is the tooth situated immediately behind the suture dividing the premaxillary from the maxillary; the lower canine is that tooth which, when the jaws are closed, lies in front of the upper canine. Premolars are teeth back of the canines which have taken the place of those borne at or developed soon after birth, and molars are those back teeth which have had no deciduous predecessors. In some marsupials there may be as many as ten incisors, but in the placental mammals there are never more than six in either jaw. This is the normal number, but in some species there may be fewer, or even none. There are never more than four canines, one on either side of each jaw, and they may be entirely wanting. The number of premolars and molars is variable, particularly so in the lower groups; in the higher groups the typical number is four premolars and three molars. A complete typical dentition may therefore be said to comprise 44 teeth: incisors $\frac{3}{3}$, canines $\frac{1}{1}$, premolars $\frac{4}{4}$, molars $\frac{3}{3}$, a number shown by the hog, although uncommon among existing mammals. See Owen, *Odontography* (London, 1840–45) and *Comparative Anatomy and Physiology of Vertebrates* (London, 1866–68); C. S. Tomes, *Manual of Dental Anatomy, Human and Comparative* (London, 1882); and Wortman, *Comparative Anatomy of the Teeth of Vertebrates*, in *American System of Dentistry* (Philadelphia, 1886). See also DENTISTRY.

Revised by F. A. LUCAS.

**Teffé**, tef-fā', formerly **Ega** or **Egas**: a town of the state of Amazonas, Brazil; on a lake formed by the little river Teffé near its mouth, on the southern side of the Amazon; 1,215 miles by the river route from Pará. Originally a Jesuit mission, it is now the most important river-port above Manáos, exporting rubber, sarsaparilla, etc. Teffé, or Ega, as it is still commonly called in English books, is celebrated in science as the residence of Bates, Agassiz, and other distinguished naturalists. Pop. about 5,000. H. H. S.

**Tegnér**, teg-nār', ESAIAS: poet; b. at Kyrkerud, Wermland, Sweden, Nov. 13, 1782. His father, who was a poor parish priest, died early, but the son contrived to go to Lund in 1799, and in 1802 he graduated from the university with great honor; became docent in æsthetics, and in 1812 was promoted to the chair of Greek Literature. In 1818 he was elected a member of the Academy, and in 1824 he was made Bishop of Wexiö. In this position, for which he was but ill fitted by nature, he exercised a great and beneficial influence by his powerful eloquence and his energy in school matters. His talent was essentially lyrical, with a tendency toward the didactic. His first great poem, *Svea* (1811), although crowned by the Academy, was a protest against the conventionalism of the Academy, and had a decisive influence on the poetic development of the time. In *Nattvärdsbarnen* (The Children of the Lord's Supper, 1820), translated by Longfellow, he displayed his skill as a didactic poet, his model being taken from Goethe's *Hermann und Dorothea*. *Axel* (1820), influenced by Byron, though more popular than the preceding poem, is vastly inferior to it as a work of art, the poet's tendency to sentimentality and rhetoric appearing to excess. *Frithiof's Saga* (1825), which is his most celebrated work, and which has been translated into almost every European language and nineteen times into English, is a combination of ballads. In opposition to the French school, which with its pompous and pedantic or superficial and frivolous elegance predominated in the Swedish literature at the beginning of the nineteenth century, Tegnér unveiled the ideal of the romantic school, with its new relations between nature and art, and between art and religion. He avoided, however, the excesses of the Phosphorists (see SWEDISH LITERATURE), whose obscurity was repugnant to his clear, logical mind. During the latter years of his life he suffered from melancholia, which in 1840 assumed an acute form. D. at Wexiö, Nov. 2, 1846. His collected writings (*Samlade Skrifter*) were published at Stockholm (7 vols., 1847–51; additional, 3 vols., 1873–74). See Georg Brandes, *Eminent Authors of the Nineteenth Century* (R. B. Anderson's trans., New York, 1886). Revised by D. K. DODGE.

**Tegucigalpa**, tā-gōō-thēē-gaal'pāā: capital (since 1880) and largest city of Honduras; beautifully situated in a plain or basin surrounded by mountains, 3,250 feet above the sea; 60 miles from its port of Amapala on the Gulf of Fonseca (see map of Central America, ref. 4–H). It is in the most thickly populated region of the republic, is the center of a fertile agricultural district, and has mines of gold and silver, which were formerly much more important. The most conspicuous building is the cathedral; the president's palace and other public edifices are unpretentious, and most of the dwellings have but a single floor. The city has a university, library, ladies' seminary, etc. The climate is mild and salubrious. A railway to San Lorenzo on the Gulf of Fonseca is projected. Pop. about 15,000. Tegucigalpa is the capital of a department of the same name, having an area of 3,475 sq. miles and a population (1889) of 60,170. H. H. S.

**Teheran'**, or **Tehran**: capital of Persia; in lat. 35° 41′ N., lon. 51° 23′ E.; province of Irak-Ajmi, 70 miles S. of the Caspian Sea; in a sandy and stony plain at the southern foot of the Elburz Mountains, which rise here, in Mt. Demavend, 18,600 feet above the level of the sea (see map of Persia and Arabia, ref. 2–G). It was formerly surrounded by a mud wall 4 miles in circumference, 20 feet high, with 6 gates, but it has been extended beyond these limits. The streets for the most part are narrow, crooked, ill paved, and filthy, and the houses low and insignificant, generally built of mud, although there are some modern boulevards and houses in Western style. Some mosques, bazaars, and caravansaries are handsome structures, however, and the palace of the shah, forming a city by itself, adjoining the northern part of the wall, is vast and elegant. Teheran became the residence of the shah in 1796, and has increased considerably since that time. It has some manufactures of carpets, cotton and linen goods, shoes and hats, and carries on a brisk trade. Its population varies much from winter to summer, as the shah and all the wealthier citizens leave it early in spring on account of the intolerable heat and unhealthful atmosphere. Pop. estimated at 210,000. In the vicinity are the ruins of Rei, the *Rhages* of Scripture, the ancient capital of Parthia and the birthplace of Harun al Raschid.

Revised by M. W. HARRINGTON.

**Tehri'**: a small hill-state under British control in the Himalayas. See GARHWAL.

**Tehuacan**, tā-wāā-kāān', or **Tehuacan de los Granados**: a town of the state of Puebla, Mexico; in a dry but fertile valley, 31 miles, by a branch road, from Esperanza on the Mexican Railway; station on the Mexican Southern Railway on the line from Puebla to Oaxaca; 5,250 feet above the sea (see map of Mexico, ref. 7–H). Lying on the best route from the plateau to the Gulf of Tehuantepec, it is a place of considerable commercial importance. At the time of the Spanish conquest it was occupied by a powerful Nahuatl tribe. In the vicinity are ruins of pyramids and other structures, supposed to have been built by the Toltecs. Pop. about 12,000. HERBERT H. SMITH.

**Tehuantepec**, tā-wāān-tā-pek': town; state of Oaxaca, Mexico; on the Tehuantepec river, 13 miles from its mouth in the gulf of that name; station on the Tehuantepec Railway (see map of Mexico, ref. 9–I). It is of very ancient origin, was at one time the chief town of the Zapotec Indians, and later was occupied by a branch of that tribe which submitted to Alvarado in 1522. Pop. 8,000. H. H. S.

**Tehuantepec, Isthmus of**: a constriction of the American continent, in Southeastern Mexico, between the Bay of Campeche (Gulf of Mexico) on the N., and the Gulf of Tehuantepec, an arm of the Pacific, on the S. Its width, in the narrowest part, is 134 miles. The mountain chains, on reaching the isthmus, are suddenly depressed, with several passes below 700 feet. There have been many projects for a canal across this neck, and careful surveys, one by order of the U. S. Government, have been made with this end in view. Some of the reports are favorable, but the work would be enormously expensive. A railway from Coatzacoalcos on the N. to Salina Cruz on the S. now runs across the isthmus; it was constructed by the Mexican Government and was opened for traffic in 1894. (See also SHIP-RAILWAYS.) As long ago as 1847 the U. S. Government endeavored, without results, to procure a right of way over the same route. The great importance of communication through the isthmus may be seen from the accompanying illustration.

Map showing the relation of Tehuantepec to commerce.

Physically, the Isthmus of Tehuantepec separates Mexico from Central America, the land E. of it, with Yucatan, belonging rather with the latter than with the former region. HERBERT H. SMITH.

**Te'idæ** [Mod. Lat., named from *Te'ius*, the typical genus; cf. Braz. *teguexin*, name of one of the species]: a family of leptiglossate lizards distinguished by the single premaxillary bones and deeply bifid tongue covered with scale-like papillæ. The family is peculiar to America (especially the tropical portions). *Teius teguexin*, of Brazil, attains the length of 6 feet. When pursued and brought to bay it fights with its tail, with which it can inflict violent blows, as well as with its teeth. It is an indiscriminate feeder, taking small animals (mammals, frogs, and birds), and frequently robbing bees of their honey after driving them from their nests. Its flesh is esteemed, and is somewhat like that of a chicken.

**Teignmouth**, tin'mŭth: town; in Devonshire, England; at the mouth of the Teign in the English Channel; 12 miles S. of Exeter (see map of England, ref. 14–E). Teignmouth is a popular watering-place; has a promenade, a pier, baths, etc. Pop. (1891) 8,292.

**Teignmouth**, John Shore, First Baron: b. in Devonshire, England, Oct. 8, 1751; went to India as a cadet 1769; became Persian translator at Murshedabad 1773; accompanied Warren Hastings to England 1785; became a member of the supreme council at Calcutta 1786; took a prominent part in the formation of the revenue and judicial systems of India, especially the measure of zemindar proprietorship of the soil, which took effect under Lord Cornwallis's administration; was made a baronet 1792; was Governor-General of India from Aug., 1793–97; was an intimate friend of Sir William Jones, whom he succeeded as president of the Asiatic Society of Bengal Apr., 1794; was chief author of the code of laws for Bengal published in 1793; was created Baron Teignmouth at the expiration of his term of office 1797; returned shortly after to England; was the first president of the British and Foreign Bible Society 1804–34; became a member of the board of control and of the privy council Apr., 1807, and was a prominent member of the religio-philanthropic circle known as the Clapham Sect. D. in London, Feb. 14, 1834. He edited the *Works* of Sir William Jones (13 vols.), to which he prefixed a memoir; and his own *Life and Correspondence* (2 vols., 1842) was published by his son, the second baron.

**Teinds**: originally, the tenth part of the produce of lands appropriated by the law of Scotland to the support of the clergy. The earliest statute on the subject is that of David II., c. 42. Teinds were limited to the products of industry, and were drawn in kind; for example, the beneficiary went upon the land and carried off every tenth sheaf of wheat. After the Reformation teinds were not collected by the clergy, but belonged either to the crown, to lords of erection (called titulars), to the original founding patrons, or to grantees from the Church, although they were chargeable with the payment of stipends to the clergy of the established Church. At present teinds are a burden not on the fruits of land nor on the land itself, but on its rent or annual value to the extent of one-fifth thereof. This change has been beneficial to the land-owner, as most of the rentals were valued nearly two centuries ago at a rate not above one-thirtieth of their present worth. Provision has also been made for the redemption of teinds by the land-owner upon his paying a sum equal to nine years' purchase of their value if they belong to titulars, or to six years' purchase if they are in the hands of patrons. The management of teinds, including their collection, valuation, and sale, as well as the power of "assigning or modifying competent stipends to the parochial clergy out of the teinds of the parish and of uniting and disjoining parishes," is vested in the court of session as commissioners of teinds. See Erskine, *Principles of the Law of Scotland*, bk. 2, tit. 10; Bell, *Principles of the Law of Scotland*, §§ 837, 1146–1163. F. M. Burdick.

**Teisias**: See Stesichorus.

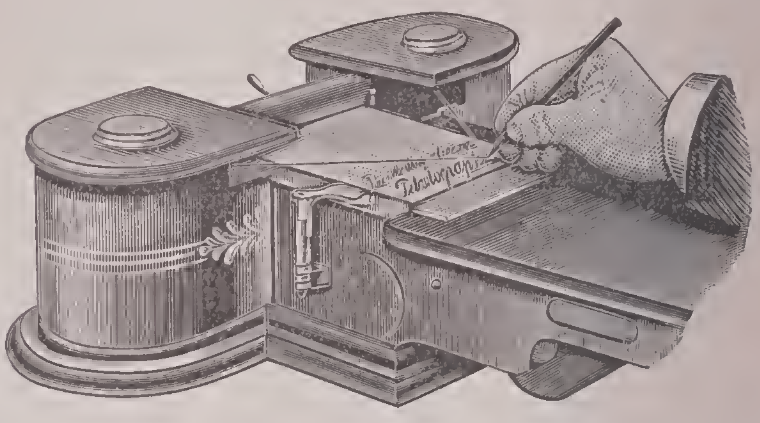
**Tejada, Lerdo de**: See Lerdo de Tejada y Correal.

**Tejuco**: See Diamantina.

**Teka'mah**: town; capital of Burt co., Neb.; on the Tekamah creek, and the Chi., St. P., Minn. and Omaha Railway; 5 miles from the Missouri river, and 42 miles N. of Omaha (for location, see map of Nebraska, ref. 9–H). It is in an agricultural, stock-raising, and fruit-growing region, and has 4 churches, a system of public schools whose diplomas admit to the State University, a national bank with capital of $50,000, a State bank with capital of $30,000, and 2 weekly papers. Pop. (1880) 776; (1890) 1,244; (1900) 1,597. Editor of "Burt County Herald."

**Tekirdagh**: See Rodosto.

**Telautograph** [from Gr. τῆλε, far + αὐτός, self + γράφειν, write]: the name given by Elisha Gray to an instrument invented by him by which autographic messages can be transmitted electrically. The mechanism consists of a transmitting and a receiving instrument, together with two conducting wires, and by its use handwriting, drawings, etc., are instantly reproduced at the receiving-point in facsimile. The message or drawing is produced with an ordinary lead pencil near the point of which two silk cords are fastened at right angles with each other. These cords connect with the mechanism of the transmitter, and, following the motion of the pencil, produce positive and negative electrical impulses through the action of a permanently magnetized steel gear-wheel, the teeth of which induce pulsations as they pass by an electro-magnet. The receiving mechanism at the terminus of the conducting wire is driven by an electric motor operated by a local battery. The pulsations, as they arrive, control an escapement-wheel driven by the motor which moves the writing lever in exact unison with the writing pencil of the transmitter. The movements of the pencil of the writer are reproduced by the shifting of a friction-wheel driven by two disks, one of which gives it an advance and the other a retrograde movement, dependent upon the wheel being brought into contact with one or the other of the two disks. The receiving pen is a capillary glass tube placed at the junction of two aluminum arms; it is supplied with ink from a reservoir through a small rubber tube in one of these



The telautograph (transmitting instrument).

arms. The pen passing over the paper leaves a facsimile of the sender's motions. The writing is made and reproduced on continuous strips of ordinary paper 5 inches in width. As each line is completed the movement of a lever advances the paper the proper distance for the beginning of a new line. The same operation brings the two instruments into unison in case of discrepancy in their movements. Satisfactory tests of the practical working of the telautograph have been made between Chicago and Cleveland, and London and Paris. Ralph W. Pope.

**Tel'edu**, or **Stinkard**: a small carnivorous mammal, *Mydaus meliceps*, of the family *Mustelidæ*, found in the mountainous parts of Java and Sumatra. It is said rarely if ever to descend much below the level of 7,000 feet above the sea. It secretes, like the skunks of America, an intolerably offensive fluid. It is rather nearer the badgers than the skunks in its structure and habits, as well as appearance. The teledu is blackish brown, with a broad white mark along its back and head. Its motions are slow. Its flesh is eaten by the natives. Revised by F. A. Lucas.

**Telegraph** [from Gr. τῆλε, far + γράφειν, write]: in general, any apparatus or process for conveying intelligence to a distance other than by voice or writing. The idea of speed is included, the telegraph being employed only to transmit intelligence more quickly than can be done by ordinary means. Sound, light, and electricity, owing to the rapidity with which they are propagated, form the most convenient agencies for telegraphing. For long distances light and electricity are immeasurably superior to sound.

The necessity of transmitting intelligence to a distance with rapidity and certainty was felt by the ancients, and many expedients were resorted to under different circumstances. These were usually simple, and exhibited little mechanical contrivance. The *semaphore* was the first really efficient telegraph. It was invented by Claude Chappé, and adopted by the French Government in 1794. It consisted of an upright post supporting a pivoted horizontal bar, which could be placed at various inclinations. This had two smaller arms pivoted to its extremities, and capable of being placed at various angles. By independent movements the apparatus was susceptible of ninety-eight distinct positions, and of thus exhibiting the same number of different signals, conventionally representing letters, numbers, words, or sentences. The speed of transmission under the most favorable circumstances was about three signals per minute. The semaphores were placed upon high towers, 4 or 5 miles apart. Much ingenuity was expended by Chappé and others in arranging a system of lights to enable the semaphore to be used at night, but with only partial success. In fogs and snowstorms this system was entirely useless. Before the introduction of the electric telegraph almost every country in Europe maintained lines of semaphores between its capital and the principal ports upon its seaboard. Perhaps the most important and costly undertaking of this kind was the great line constructed by Nicholas I. of Russia, from the Austrian frontier through Warsaw to St. Petersburg, which had 220 stations. The semaphores were erected upon the summits of substantial and lofty towers, and the whole work cost several millions of dollars.

Another system of ocular telegraphy consists of alternately exposing and cutting off a continuous beam of light directed from the sending to the receiving stations, the characters being formed on the same principle as those of the conventional telegraphic alphabet, shortly to be described, which consists in breaking a continuous line into sections of varying length. In 1861 Moses G. Farmer made a series of successful experiments with this method between Hull and Nantasket on the coast of Massachusetts, and it also appears to have been employed about the same time by the officers of the U. S. Coast Survey on Lake Superior, where, by means of equatorially mounted mirrors, telegraphic messages were exchanged between stations 90 miles apart with ease and rapidity. During the campaign of Gen. Miles against the Apaches in New Mexico and Arizona a system of thirteen stations was established, over which, during a period of four months, more than 1,800 messages, containing some 35,000 words, were sent. The savages were surprised and confounded by the way in which intelligence of their hostile movements became known hundreds of miles away. The French have established heliographic communication between the islands of Mauritius and Reunion in the Indian Ocean, the stations, which are on mountain-peaks, being no less than 133 miles apart. Even this has been surpassed by the U. S. Signal-corps, which has exchanged messages between Mt. Uncompahgre, Col., and Mt. Ellen, Utah, a distance of 183 miles. In 1862 this system was taken up by Capt. Colomb and Maj. Bolton and introduced into the British navy, electric and calcium lights being employed at night and a collapsing drum closing upon its central hoop by day. During the siege of Paris messages were often sent 20 or 30 miles from one elevated point to another by the use of a calcium light concentrated and directed by lenses. More recently it has been proposed to employ a similar alphabet of short and long sounds for signaling between vessels at sea.

*Telegraphing by Electricity.*—As soon as it became known that electricity could be conducted by wires to a distance, it began to be regarded as a possible means of conveying intelligence. The earliest suggestion of this kind seems to have been contained in a letter to *The Scots Magazine* dated Feb. 1, 1753, the authorship of which has never been satisfactorily determined. The writer proposed to employ insulated wires equal in number to the letters of the alphabet, the signals being given by means of frictional electricity. In 1774 Lesage, of Geneva, constructed the first electric telegraph, which was practically a realization of the above idea. It had twenty-four wires, each connected with a pith-ball electroscope, the signals being given by frictional electricity. From this time forward many ingenious attempts were made to employ frictional electricity for telegraphic purposes, most of which it is unnecessary to notice in detail. In 1816 Francis Ronalds constructed a telegraph, making use of frictional electricity and a single wire, and exhibited signals by the divergence of pith-balls combined with synchronously revolving dials. He fully appreciated the value of his idea, and strove to bring it before the British Government, but was informed that "telegraphs of any kind are now wholly unnecessary, and no other than the one now in use will be adopted." In 1828 Harrison Gray Dyar, of New York, invented a telegraph, the principle of which consisted in sending discharges of frictional electricity through a wire, which were to be recorded upon a sheet of moistened litmus-paper moving at a uniform rate. The relative intervals between the discharges were to indicate the letters of the alphabet. There is evidence that this invention was experimentally tried on Long Island the same year in which it was invented, but little is definitely known respecting the results. In 1820 Ampère suggested that the deflection of a needle by the galvanic current might be used for telegraphic purposes. In 1830 Baron Schilling constructed a telegraph having five vertical needles, and in 1835 he exhibited his invention, simplified to a single needle, at Bonn. This was shown by Moncke at Heidelberg in 1836 to W. Fothergill Cooke, who immediately set to work to devise and construct a telegraph for practical use, consisting of a pair of three-needle instruments, with keys and reciprocal system. He also invented the electro-mechanical alarm and the detector for discovering the position of faults in the lines. In Feb., 1837, he became associated with Wheatstone, and took out a patent with him the same year. In 1839 the first actual electric telegraph was constructed, extending from Paddington to Drayton, in England, a distance of 13 miles. It had six wires and five needles. The wires were wound with hemp and laid in a pipe on the surface of the ground. In 1839 Dr. W. O'Shaughnessy at Calcutta, India, built the first over-ground line of iron wire on bamboo poles. It was 21 miles long, and worked by Cooke's signal-needle instrument. Meanwhile in the U. S. Joseph Henry's experiments in electro-magnetism had demonstrated the feasibility of transmitting signals by a current of electricity through insulated wire.

Samuel F. B. Morse, of New York, during a voyage home from France in 1832, conceived the idea of making signs at a distance by means of a pencil moved by an electro-magnet and a single conducting circuit, the paper being moved under the pencil by clockwork. He constructed a working model of his invention in 1836, and exhibited it to several persons the same year, but not publicly until 1837. Several years were devoted by Morse and his associate Alfred Vail to improving the invention and endeavoring to interest the public in the project. It was not until 1844 that the first public line was completed between Washington and Baltimore (40 miles), and the first message transmitted May 27 of that year. Within a few years, however, lines were extended to the principal cities of the U. S. The Morse telegraph was introduced into Germany in 1847, whence it has spread all over the Eastern hemisphere, and may now be said to be the universal telegraph of the world. Gauss and Weber, of Göttingen, Germany, constructed a telegraph in 1833 consisting of a magnetic needle acted upon by magneto-electric currents. Their invention was taken up by Steinheil in 1836–37, and practically worked out to a high degree of perfection. The discovery that the earth may be employed as part of a telegraphic circuit was made by him. Steinheil's telegraph never went into extensive use, owing to the introduction of the Morse system in Germany.

The earliest experiment on record in submarine telegraphy was made by Dr. W. O'Shaughnessy at Calcutta in 1839. He laid a copper wire, insulated with a coating of cotton thread saturated with pitch and tar, across the river Hugli, and transmitted signals through it. In 1842 Morse made experiments with a cable between Castle Garden and Governor's island in New York, and obtained results that demonstrated the practicability of submarine telegraphy. In 1847 J. J. Craven, of Newark, N. J., insulated an iron wire with gutta-percha and placed it in the circuit of the New York and Washington telegraph line, submerging it in the waters of a small creek. The success of this experiment led to the laying of a gutta-percha cable between New York and Jersey City in 1848. In 1850 an experimental line was laid across the English Channel, followed in 1851 by a permanent cable, which is still in use. The success of this undertaking at once revived the suggestion of laying a cable across the Atlantic Ocean from Ireland to Newfoundland. In 1854 the attention of Cyrus W. Field, of New York, was directed to the subject, and mainly through his efforts a company was formed, principally of British capitalists, to undertake the enterprise. The first attempt was made in Aug., 1857, but it was unsuccessful, the cable parting 300 miles from shore. The following year the attempt was renewed, and the enterprise successfully completed Aug. 5, 1858. The electrical condition of the cable was faulty from the first, but signals and communications were exchanged with more or less facility until Sept. 1, when the cable failed altogether. During this time 366 messages, containing 3,942 words, were interchanged between Europe and America. Several attempts to raise and repair the cable were made without success, and this disastrous result discouraged further enterprise in the same direction for a number of years. The experience gained, however, was of the highest value, and the success of the Malta and Alexandria (1861), Persian Gulf (1864), and other deep-sea cables led to a renewal of the attempt to cross the Atlantic in 1865, which again resulted in the breaking of the cable after 1,186 miles had been paid out. The following year, however, a new cable was successfully submerged, being landed at Newfoundland in perfect working order July 27, 1866, and the great problem was thus at last definitely solved. In September following the lost cable of 1865 was picked up and completed. From that date such rapid progress has been made in the extension of telegraphic cables that no isolated system of telegraphs is to be found throughout the world.

All electric telegraphs may be said to consist of three parts: first, an apparatus for generating or producing the electric current; second, a conductor for conveying the electricity from one point to another as required; and, third, apparatus for transmitting and receiving the signals.

I. Sources of Electricity.—The electricity used in telegraphy may be derived either from the voltaic battery, the magneto-electric machine, or the thermo-electric battery. Of these, the voltaic battery has been the most commonly used, though latterly much has been done in developing the capacity of the dynamo-electric machine, which in most large stations has successfully replaced the voltaic system. The employment of the thermo-battery is very infrequent.

A. *Voltaic Batteries.*—Of these, the sulphate of copper battery, invented by Daniell in 1836, is the most generally employed. It is constructed in various forms, the most useful of which are (1) the gravity battery, invented by Fuller in 1853, which is almost exclusively used in the U. S., and (2) the trough battery, another form of the same, used in England. (3) The manganese battery, invented by Leclanché in 1867, is extensively used in France and England; (4) the nitric-acid battery of Grove; and (5) the chromic-acid battery, such as that of Bunsen is now but little used. (6) Storage batteries or accumulators are employed in many of the larger European stations and in some few instances in the U. S.

B. *Magneto-electric Machines.*—The earliest form of this apparatus was Pixii's, which is employed in Wheatstone's dial telegraph. Siemens's (1855), a much more efficient apparatus, is largely used in dial and other special telegraphs. In 1879 S. D. Field successfully applied the Siemens dynamo machine in the Western Union telegraph office in New York, with highly economical results, ten small dynamos replacing 35,000 cells of battery. Since that date the dynamo machine has been adopted in most of the larger stations.

C. *Thermo-electric Batteries.*—No permanently successful installation of this kind was made until the year 1895, when H. B. Cox's apparatus was introduced on the lines of the Commercial Cable Company in New York. The consumption of gas in the ordinary operations of the lines is 7 cubic feet an hour.

*Circuits.*—In applying electricity from any source to the production of telegraphic signals, it is generally done in one of three ways: (1) by completing the circuit of a battery or other generator, and giving signals by causing currents of determinate polarity to traverse a line normally free from electricity; or (2) by connecting the battery and line, so that a constant current will traverse the latter, the signal being given by interrupting this current; or (3) by arranging the battery and line as in the last case, and giving signals by reversing the polarity of the current instead of interrupting it.

II. Telegraphic Conductors.—Conductors are usually carried through the air, but when required may be placed under ground or under water. In either case they must be well insulated with non-conducting materials.

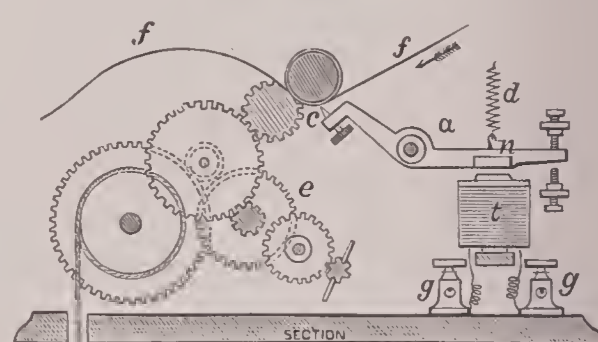
A. *Over-ground.*—Galvanized iron wire weighing from 320 to 740 lb. per mile and hard-drawn copper wire weighing from 166 to 209 lb. per mile are used in the U. S. The largest wire is used for the longest lines, and equivalent sizes are used in most of the European countries. The wires are supported on wooden poles placed along railways or highways from 8 to 10 rods apart. From 1 to 50 wires may be conveniently placed on one line of poles, the lowest being 20 feet from the ground. Iron poles are seldom used except in desert and tropical countries. The wires are attached to the poles by insulators of a bell or inverted cup shape, which are supported by brackets or cross-arms of wood or iron. In the U. S. insulators are usually of glass, in Europe and Asia of brown earthenware or white porcelain. In large cities the wires are frequently carried on standards fixed upon tall buildings.

B. *Under-ground.*—Wires are now laid under ground in the principal cities of Europe and also in New York and other large cities of the U. S. In London No. 13 copper wires, coated with gutta-percha to a diameter of $\frac{3}{16}$ths of an inch, are used. The required number of these are laid in a cable served with tarred tape. The cables are made in lengths of 400 yards, and drawn into iron pipes laid 2 or 3 feet below the surface of the ground. Boxes with trap-covers are placed every 400 yards for convenience in testing wires and drawing them in and out. The same system has been adopted in other cities of Great Britain, and also in New York. In Paris the cables are placed in the sewers. The plan of inclosing wires wrapped with fibrous material loosely within a metal tube filled with paraffin oil under pressure (Brooks's system) is much less expensive, and has been used to some extent. Paper insulation has also proved successful.

C. *Submarine.*—The early submarine lines were simply ordinary iron wires coated with gutta-percha to a diameter of half an inch. In the cable laid between Dover and Calais in 1851 four gutta-percha coated wires were wrapped with hemp and inclosed in a wire rope for protection. This general plan has been followed in all cables since constructed. The Atlantic cables are composed of a copper strand of seven wires, forming the conductor, surrounded by several distinct layers of gutta-percha and covered by a serving of jute; outside of this is a protecting armor of ten wires of homogeneous iron, each enveloped in fine strands of Manilla hemp. In shallow waters, where cables are exposed to injury from anchors, the armor is often made enormously thick and heavy, sometimes weighing as much as 20 tons a mile. The modern type of deep-sea cable weighs about 2 tons for each mile.

III. Telegraphic Apparatus.—The apparatus used in telegraphy may be conveniently divided into recording and non-recording. Of each of these there are several varieties, which will be described in order.

A. *Recording Telegraphs.*—These are of two classes, one recording arbitrary signs, and the other ordinary printed letters. (1) *Marking Telegraphs.*—(*a*) Morse's is by far the best known and the most extensively used of this class. Its characteristic feature is the *register*, which is constructed in many forms, but upon the general principle shown in the diagram. A horizontal lever is mounted upon a fulcrum, *a*, and armed at one end with a steel point, *c*, projecting upward and nearly touching a ribbon of paper, *f*, which is carried along at a uniform rate by a grooved roller just above it, the roller




The telegraphic register.

being impelled by a system of clockwork, *e*. The opposite end of the lever carries a soft iron armature, *n*, suspended just above the poles of an electro-magnet, *t*. The end of the wire helix surrounding this magnet terminates in binding-screws, *g g*, to which the conducting wires are attached. A current of electricity traversing the helix of the electro-magnet causes it to become powerfully magnetic, attracting the armature, *n*, to its poles, and thus pressing the steel point, *c*, against the paper ribbon moving above it upon the grooved roller. A continuous line will in this manner be embossed upon the paper as long as the armature remains attached to the poles of the magnet. When the current is interrupted, the magnetism disappears, and the spring, *d*, draws the marking-point away from the paper. Thus the length of the line embossed upon the paper corresponds to the greater or less length of time that the electric current is allowed to traverse the helix of the electro-magnet, *t*. This is governed by the transmitting instrument termed the key, which is simply a small horizontal lever with a finger-knob at one end and a spring beneath. The wire leading from the line is connected to this lever, and when the latter is depressed by the finger of the operator, it comes in contact with a metallic stud, known as the anvil, to which the battery wire is attached; thus the circuit is completed and the current permitted to flow into the line. When the latter is but a few miles long, the battery and key are connected directly by a wire with the electro-magnet of the register: but when the distance is greater, an instrument called the *relay* is employed. This consists of an electro-magnet with a lever mounted like that of a register, except that the marking-point is replaced by a contact-point, which opens and closes the circuit of a local battery, and this in turn operates the register. A considerable number of relays with their registers may be placed at as many different points upon the same line, and all operated simultaneously by a key at any point; and, in fact, this is the arrangement usually adopted in the U. S. The greatest length of line ordinarily worked in one circuit is about 500 miles, and the number of relays at different points varies from 2 to 30, and even 40. The line or main batteries are usually placed at the two ends of the route, though each station has of course its local battery of one or two cells. The alphabetical code, believed to have been devised by Vail, consists of arbitrary characters composed of combinations of short lines termed dots and longer ones termed dashes, separated by varying spaces. This alphabet, it will be seen, is capable of being written with facility by means of the key and register above described. The following is the alphabetical code used in the U. S., Canada, Mexico, and Central America:

THE AMERICAN TELEGRAPHIC ALPHABET.

| | | |
|---|---|---|
| A ·— | J —·—· | S ··· |
| B —··· | K —·— | T — |
| C ·· · | L ⸺ | U ··— |
| D —·· | M —— | V ···— |
| E · | N —· | W ·—— |
| F ·—· | O · · | X ·—·· |
| G ——· | P ····· | Y ·· ·· |
| H ···· | Q ··—· | Z ··· · |
| I ·· | R · ·· | & · ··· |
| 1 ·——· | 4 ····— | 8 —···· |
| 2 ··—·· | 5 ——— | 9 —··— |
| 3 ···—· | 6 ······ | 0 ⸻ |
| | 7 ——·· | |

Period (.) ··——··
Comma (,) ·—·—
Interrogation (?) —··—·
Exclamation (!) ———·

In all other parts of the world the *international telegraph alphabet* is used, as follows:

| | | |
|---|---|---|
| A ·— | J ·——— | S ··· |
| B —··· | K —·— | T — |
| C —·—· | L ·—·· | U ··— |
| D —·· | M —— | V ···— |
| E · | N —· | W ·—— |
| F ··—· | O ——— | X —··— |
| G ——· | P ·——· | Y —·—— |
| H ···· | Q ——·— | Z ——·· |
| I ·· | R ·—· | |

| | |
|---|---|
| 1 ·———— | 6 —···· |
| 2 ··——— | 7 ——··· |
| 3 ···—— | 8 ———·· |
| 4 ····— | 9 ————· |
| 5 ····· | 0 ————— |

Period (.) ······
Comma (,) ·—·—·—
Interrogation (?) ··——··
Exclamation (!) ——··——

The international alphabet is preferable, as it contains no spaced letters; these sometimes give rise to errors in reading communications. In Europe and Asia an improved register ealled the ink-writer is much used. A sharp-edged wheel is kept constantly revolving in a dish of colored fluid. The slightest pressure of this against the paper suffices to make a distinct mark, and thus the relay may be in most cases dispensed with, as a very feeble current is sufficient to make a perfect reeord. Electro-magnets intended for use in the main circuit, whether for relays or ink-writers, usually have helices composed of several thousand convolutions of very fine insulated wire, but for local circuits a small number of convolutions of coarse wire is sufficient. In order to transmit direct between points more than 500 or 600 miles apart, two or more circuits are coupled together by means of an automatic repeater, which was first accomplished by C. S. Bulkley in 1848. By this means each circuit operates the succeeding one upon the principle of the relay. In this way direct communication has been had between points several thousand miles apart.

(*b*) Bain's electro-chemical telegraph was invented in 1846, and extensively used in the U. S., Great Britain, and Germany from 1849 to 1860, but is now superseded by Morse's. The system of signs and the transmitting key are similar to those of Morse. The record is made by passing the current from the line over an iron style and thence directly through a moving strip or disk of paper. The paper is saturated with a mixture of 10 parts of saturated solution of potassium ferrocyanide, 2 parts each of nitric and hydrochloric acid, and 1 part of chlorinated lime. The electric current causes the solution to unite chemically with the iron of the style, forming Prussian blue. A very weak current suffices to give a distinct mark. No electro-magnet is required in this system except to operate an alarm.

(2) *Printing Telegraphs.*—The earliest conception of a telegraph which should record messages in printed Roman letters is due to Alfred Vail, of New Jersey (1837). The first model of such an instrument was made by Wheatstone (1841). (*a*) *House's Telegraph.*—This was the earliest practical printing instrument. It was first invented in 1844, introduced in 1847, and largely used in the U. S. until about 1860. It is simple in principle, though complicated in construction. The twenty-six letters of the alphabet, a period, and a blank are engraved on the edge of a type-wheel, upon the shaft of which is a scape-wheel of fourteen teeth. The type-wheel revolves by manual power, but is held in check by a double-acting anchor escapement. The latter vibrates by the alternate action of an axial electro-magnet and a retracting spring. When at rest, the blank space on the type-wheel is in front, the circuit being complete. If it is interrupted the scape-wheel advances half a tooth, presenting the letter *A*, and when restored it again advances, presenting *B*. If the circuit is opened fourteen times and closed fourteen times alternately, the type-wheel will make a complete revolution. It is obvious that any particular letter may be presented by breaking and closing the circuit the proper number of times. This is effected in practice by a metallic contact-wheel at the transmitting station. This wheel has fourteen teeth and fourteen equal spaces; its axis is connected to the line. A flat spring connected with the battery touches each tooth as it revolves and transmits the electric pulsations. The revolution of this contact-wheel is stopped at the proper place for each letter by a keyboard having twenty-eight keys. A cylinder fixed upon the axis of the contact-wheel carries twenty-eight pins arranged in a spiral, each pin turning with the cylinder underneath its own key. Each key is provided with a stop, which falls into the path of the pin and arrests the cylinder when the key is depressed. Thus when the cylinder is turned from one letter to another, just so many contacts and interruptions are given as will advance the type-wheel the same distance. The printing is effected at the receiving station by the action of an eccentric which is automatically released when the wheel pauses at any letter. It makes a single revolution, forcing the paper against the letter presented by the type-wheel, and then advances the paper, which is in the form of a continuous ribbon, so as to leave a clear space for the impression of the succeeding letter. Thus it will be seen that the instrument is operated wholly by manual power, the only office of the electric current being to secure a corresponding movement between the type-wheel of the receiving and the contact-wheel of the transmitting instrument. The apparatus requires a powerful electric current, and it seldom operates satisfactorily on a line more than 250 miles in length. (*b*) *Hughes's Telegraph.*—This was invented by D. E. Hughes in 1855, and has been extensively used in Europe since 1860. The essential principle of the apparatus is the synchronous movement of two constantly revolving shafts at two stations. This is effected by means of a governor consisting of a recoil escapement and a vibrating bar. The shaft at the transmitting station carries a revolving contact-maker, and the corresponding one at the receiving station a type-wheel similar to that of House. The contact-maker travels over a circle of twenty-eight pins which are connected with the same number of piano-keys. Each pin represents a letter, and is raised by the depression of the corresponding key when a letter is to be transmitted. The contact-maker, which travels round the circle of pins with a motion uniform with that of the type-wheel at the receiving station, comes in contact with the raised pin at the same instant that the corresponding type upon the type-wheel is passing the platen and closes the circuit. An electro-magnet at the receiving station releases a cam which throws the platen carrying the paper against the type as it is passing, thus printing the letter. Only one pulsation is thus required for the printing of each letter, and by the use of a peculiar form of electro-magnet a very weak current suffices to do the work. (*c*) The *combination instrument* is a modification of Hughes's. It retains the principle of synchronous mechanism at the sending and receiving stations, but it differs much in details. It has an electro-magnetic governor instead of a vibrating spring, and is more simple and durable in its construction than the Hughes apparatus. It was invented in 1859 by G. M. Phelps, and was formerly used on many of the principal lines in the eastern part of the U. S. (*d*) *Phelps's Electro-motor Telegraph.*—This apparatus was invented in 1869, and in 1875 was put in use by the Western Union Telegraph Company between Boston and Washington. The mechanism is driven by a small electric motor connected with a special battery. This is more convenient and economical than the manual power required by the House machine or the heavy weight and clockwork of the Hughes apparatus. The synchronous movements of the

transmitting mechanism at one station and the type-wheel at the other are maintained by means of a centrifugal governor attached to the motor, which instantly reduces the strength of the local current by which the latter is propelled whenever the speed of revolution tends to exceed the prescribed limit. The synchronous movement of the Hughes apparatus is retained, except that both the type-wheel and the revolving contact-maker are simultaneously arrested for a given integral portion of a revolution during the transmission and printing of each letter. An improved form of the automatic unison for bringing the two instruments into correspondence whenever transmission is suspended for a few moments (invented by Farmer, 1858) has also been applied to this instrument. (*e*) *Telegraphs for Financial and Commercial Reporting.*—The method of reporting the fluctuations of the prices of stocks, gold, merchandise, etc., by means of automatic-printing telegraph instruments placed in the offices of merchants, brokers, and other interested persons, and of which several hundred are often simultaneously operated by a single person located in the central exchange, originated in New York in 1867, and has since extended to the principal cities of the U. S. and of Europe. The instruments which have been principally used are those of Calahan, Pope, Edison, Phelps, Van Hoevenbergh, and Smith, though many others have aided in the perfection of the apparatus. The general principle is the step-by-step movement of the House apparatus, but two type-wheels are made use of—one for letters and the other for numerals and fractions—which print in parallel lines on the same strip of paper. By an ingenious device invented by Dujardin in 1867 the platen is automatically shifted from one type-wheel to the other by the operator at the central station according as he wishes to print letters or numerals. These instruments also have an automatic unison invented by Foote (1869). The printing is in most cases effected by a special electro-magnet. (*f*) *Printing Telegraphs for Private Use.*—These are constructed upon a plan similar to the instrument for commercial reporting, and thousands of them were used by manufacturers, merchants, and others from 1870 to 1878, after which they were practically superseded by the speaking telephone. The most successful were those of Gray, Chester, and Anders. Any intelligent person after a few minutes' instruction can print a communication at any distance, even in the absence of an attendant, by depressing the proper keys upon a lettered keyboard. The speed of transmission is from 10 to 30 words per minute, depending upon the instrument used and the skill of the operator.

B. *Non-recording Telegraphs.*—These may be divided into two classes—visual and acoustic. They give only evanescent signals, and are sometimes termed semaphores.

(1) *Visual Telegraphs.*—(*a*) *Cooke's Needle Instrument.*—This is simply an upright galvanometer needle surrounded by a coil of fine insulated wire, and is operated from the sending station by two keys, one of which sends a positive current, deflecting the needle to the right, and the other a negative current, deflecting it to the left. The alphabetical code is the same as the Morse, a deflection to the left signifying a dot, and to the right a dash. Owing to its simplicity and convenience this apparatus was almost universally used in Great Britain from 1840 until within a few years, since which time it has been superseded on all the important lines by the Morse system. It still retains its supremacy for railway use. (*b*) The dial instrument, invented by Wheatstone in 1840, is arranged on the same plan as a type-printer, but is much more simple, as an index-hand and dial carrying the alphabet replaces the somewhat complex type-wheel and printing apparatus. These are largely used for private and police telegraphs, and in Europe for railway purposes, as they are easily operated by unskilled persons. The best known are those of Wheatstone, Siemens, Anders, Bréguet, and Chester. The three first mentioned are operated by magneto-generators and require no battery. (*c*) The visual indicator, invented by C. H. Pond (1880), is a species of dial telegraph employed in connection with the fire-alarm system (see below), to exhibit the number of a signal-box simultaneously when an alarm is given.

(2) *Acoustic Telegraphs.*—Of these, the best known and most important is (*a*) the sounder, which is simply a Morse register stripped of all its parts except the electro-magnet, writing lever, and retracting spring. The operator interprets the sounds made by the motion of the lever up and down between its stops. This method was taken up by operators in the U. S. about 1848, and the sounder has now almost entirely superseded the recording apparatus in the U. S. and Canada, as experience proves that the speed of transmission is practically doubled, while, somewhat paradoxically, the proportion of errors is largely diminished. The same method is employed in India, and to an increasing extent in Great Britain and other parts of Europe. The operator reads from the instrument, and simultaneously copies the message. For military purposes the sounder, together with a manipulating key, is often reduced in size, so as to be contained in a pocket-case not larger than a tobacco-box and weighing but a few ounces, and yet forming a completely equipped Morse telegraph station, which may be connected with a line at any required point. (*b*) The fire-alarm telegraph, invented by W. F. Channing and M. G. Farmer, of Boston (1851), is a most ingenious and useful application of the telegraph, in use in the principal cities and towns in the U. S., and other countries. A series of locked signal-boxes are placed at convenient intervals throughout a city or town; each of these contains mechanism which, when wound up by simply pulling a hook, will instantly transmit through the connecting telegraph wires a determinate numerical signal representing that individual box and no other. The signal thus transmitted is instantly sounded, by means of mechanism controlled by electro-magnets in the circuit, upon the church and tower bells and upon large gongs placed in all the fire-engine houses. So effective is this system in practice that frequently in less than thirty seconds after the discovery of a fire a number of engines will be on their way to the spot. This invention has been the means of saving millions of dollars' worth of property and thousands of lives since its introduction. By a subsequent invention of W. B. Watkins (1871) the fire itself is made to transmit a numerical alarm-signal automatically. Thermostats are placed in the rooms of a building, which when heated above the normal temperature close a circuit and trip the clockwork of an automatic transmitter. The rest of the apparatus resembles Channing and Farmer's. (*c*) The district telegraph (1870) is another application of the above system. Signal-boxes are placed in the houses of persons desiring them, and connected telegraphically with a central station. By simply turning a crank at any hour of the day or night a messenger or policeman may be instantly summoned or a fire-alarm transmitted. Many thousands of these signal-boxes are in use in New York and other important cities of the U. S. (*d*) An application of the same principle is found in the municipal or police telegraph, one arrangement of which, for public use, employs a number of street stations, from any of which police assistance may be summoned by a citizen at a moment's notice. Another adaptation is an automatic attachment to safes, vaults, and other structures having valuable contents, so that in case the fastenings are tampered with by unauthorized persons a definite alarm is silently sent to a central station, at which officers are always on the alert.

IV. Special Methods of Telegraphy.—A. *The Automatic Process.*—At an early period in the history of telegraphy attempts were made to devise methods of transmission, by which means the capacity of each individual wire might be largely increased, and the evils which necessarily arise from a multiplication of wires in a great measure avoided. In 1846 Alexander Bain, of Scotland, patented an automatic telegraph, in which the messages, instead of being transmitted by a key or manipulator, were first prepared by punching out the telegraphic characters in a ribbon of paper, the dots and dashes being represented by perforations of different lengths. In order to transmit the prepared message the strip was caused to pass rapidly over a metallic roller driven by clockwork or otherwise, and a light spring or brush of metal, resting upon the paper over the roller, made contact with the latter through each of the perforations as they successively passed under it, and thus completed the electric circuit between the battery and the line. By this means several operators could be employed simultaneously in preparing messages, which could be run through the machine and recorded on chemical paper at the receiving station at a high rate of speed. The system was tried in Great Britain and the U. S. in 1849 and 1850, but no practical advantage over hand-labor resulted, perhaps largely owing to the fact that no convenient means of perforating the paper had been devised. In 1856 Dr. W. Siemens, of Berlin, invented a perforating-machine with three keys, by which the time required to prepare a dispatch was much lessened. He applied this method in conjunction with Morse's receiving apparatus on many Russian lines in 1853–55, but the automatic feature was soon abandoned. In 1856 J. P. Humaston, of Connecticut, invented a keyboard perforator which produced a complete character by the touch of a single key. The same year Siemens introduced the polarized relay, operated by alternate positive and negative currents. In 1858 Wheatstone, in England, modified Siemens's apparatus, and in its subsequently improved form it is largely used on the Government lines in Great Britain, especially for sending large quantities of press news in duplicate. The same system is used on a number of the more important lines in the U. S., and is probably destined to be still more extensively employed.

B. *The Autographic Process.*—In 1848 F. C. Bakewell, of London, patented a modification of Bain's automatic process by which a facsimile of the transmitted dispatch is produced at the receiving station. The original is written on tin-foil with insulating ink, and wrapped round a metallic cylinder rotated by clockwork at a uniform rate. A style rests upon the cylinder as it turns, and also receives a slight lateral motion by a screw as the cylinder revolves; it thus describes a spiral path, passing successively over the whole surface of the tin-foil on the cylinder. The battery-current passes through the style to the tin-foil, thence to the cylinder and over the line, but is necessarily interrupted when passing over the insulating lines of the writing. The cylinder at the receiving station is covered with Bain's chemical paper, and revolves synchronously with that of the transmitter. The iron style traces a continuous blue line on the paper, except when the current is interrupted by the style passing over the lines of writing upon the tin-foil. The chemical paper therefore appears covered with fine parallel blue lines, forming a ground-tint upon which a facsimile of the writing appears in white. This apparatus, though practically unsuccessful on account of the difficulty in maintaining sufficiently accurate synchronism, illustrates the principle of all its successors. Abbé Caselli, of Florence, in 1856 greatly improved this process by employing a pendulum to control the synchronous movements of the two corresponding instruments, and by so arranging his electrical connections that the facsimile appeared in blue on a white ground. In 1865 this process was put in actual service on some of the French and Russian telegraphs, and has given very good results. The more recent inventions of Lenoir and Meyer in France record in ink by means of electromagnets. W. E. Sawyer in 1874 invented several improvements in the autographic process, one of which consists in transferring the original message, written upon ordinary paper, to a metal plate for transmission. (See also TELAUTOGRAPH.) As the autographic process dispenses entirely with specially skilled labor, it is not unlikely that it may yet prove to be of considerable economic value.

C. *The Multiple Process.*—The idea of increasing the capacity of a line by transmitting two or more communications simultaneously appears to have been first suggested by Farmer, who in 1852 made a successful experiment on one of the municipal lines in Boston. He employed two rapidly revolving synchronous commutators, one at each end of the line, which served to bring the latter successively and simultaneously into connection with two or more short branches at each terminus, in each of which ordinary telegraphic instruments were inserted. Thus the current in the corresponding branches at each terminus, though apparently continuous, actually consisted of rapidly recurring pulsations. From the difficulty of maintaining synchronism, and other causes, nothing practical resulted from the experiment. In 1873 Meyer, of France, exhibited at Vienna an apparatus on this principle capable of transmitting four simultaneous communications. It has been employed in actual service between Lyons and Paris, and is said to have a capacity of 110 messages per hour. In 1853 Dr. W. Gintl, of Austria, invented a method of simultaneous transmission in opposite directions by connecting an auxiliary local circuit with the Morse key, which passed through a separate but opposing helix upon the instrument at the home station, and thus neutralized the effect of the current transmitted over the line upon the home instrument, while at the same time it was left free to respond to the increased current in the line due to the depression of the distant key. Practically it was found impossible to adjust the local current so as to perfectly compensate that of the main line. The following year Carl Frischen, of Hanover, substituted a branch of the main current for the local current of Gintl, and the method thus improved was used to a limited extent in Austria and Holland. In 1855 Stark, of Austria, proposed a method of simultaneous transmission in the same direction, and suggested that it might be combined with Frischen's plan, thus enabling four simultaneous dispatches to be sent over one wire. In 1858–59 Farmer made successful experiments with a modification of Frischen's method on several American lines. J. B. Stearns, of Massachusetts, revived Frischen's method in 1868, and in 1872 enormously improved it by adding a condenser to compensate the effects of induction in long lines. He introduced the improved method known as the "duplex" into general use, first in the U. S. and afterward in Europe. In 1874 Thomas A. Edison invented a new method of simultaneous transmission in the same direction, which has been combined with Stearns's method, forming a "quadruplex." Subsequent improvements by G. Smith and others have vastly increased the effectiveness of this method. It is in extensive use, and is regarded as an improvement of the highest value.

D. *Submarine or Cable Telegraphy.*—Owing to the embarrassment arising from electrostatic induction in long submarine cables, special arrangements have been devised by Lord Kelvin (better known as Sir William Thomson), C. F. Varley, and others without which it would scarcely be possible to transmit through them at a sufficient rate of speed to render them commercially valuable. The method employed on the Atlantic cables is a modification of Cooke's single-needle method, and is arranged as follows: Two keys, which when depressed transmit respectively positive and negative currents, are employed at the sending station in connection with a battery of a few elements only. The current of the battery does not pass directly into the cable, but into a condenser of considerable capacity composed of tin-foil plates interleaved with paraffined paper, the opposite side of which is attached to the cable, and the condenser transmits a wave of electricity through the cable. As there is no actual circuit from one terminus to the other, this arrangement serves to cut off the earth-currents, which would otherwise be troublesome. The receiving instrument employed is Thomson's reflecting galvanometer, the message being read by the right and left deflections of a spot of light upon a screen, which moves to and fro as in the ordinary needle telegraph. The recording or siphon galvanometer of the same inventor writes down the deflections by means of ink spurted from a fine glass siphon-tube attached to a coil suspended between powerful fixed magnets, and which swings to the right or left as the positive or negative pulsations pass through it. The record appears upon a ribbon of paper in the form of a straight line when no signal is passing, but with waves to the right or left when pulsations pass through the coil. Important improvements in this apparatus have been introduced by Charles Cuttriss. Mr. Stearns successfully applied his system of duplex telegraphy to the Valentia-Newfoundland cables in 1877–78, thereby doubling their carrying capacity. Dr. Muirhead about the same time effected the same result upon the Marseilles-Alexandria cable by a different system. All the important cables are now worked in this manner.

E. *Telegraphy without Wires.*—This idea was originally based on the principle of induction, and is nearly as old as the ordinary electric telegraph. Until the invention of the telephone, however, there was no practical instrument of sufficient sensibility to permit of tangible results. The only commercial application of the principle is the so-called "train telegraph," by which communication may be practically established with moving railway trains. The method of accomplishing this is the connection of the metallic roof of the car with the receiving apparatus therein, the principal feature of which is a magneto-telephone. An ordinary telegraph line alongside the track, but closer to it than usual, conveys the induced pulsations to and from the station. This system is entirely practicable, and was operated for some time on the Lehigh Valley Railroad. On Dec. 12, 1896, a young Italian electrician, Signor Marconi, exhibited through Mr. W. H. Preece, at Toynbee Hall, London, a system of telegraphy without wires depending upon electrostatic instead of electro-magnetic effects, in which electric (Hertzian) waves at the rate of 250,000,000 per second were utilized. Like light, these smaller waves are capable of being projected in one direction only, and consequently their power was not so enormously diminished in transmission to any distance. The apparatus was concealed in two boxes, one of which was placed in each end of the hall. The signal was made in one, and a bell immediately rung in the other. A previous experiment had been made on the top of the General Post-office, followed by another at Salisbury Plain, where signals were transmitted $1\frac{1}{4}$ miles. No complete description of the apparatus has been divulged, beyond the fact that a 10-inch induction coil was used with a Lodge originator and a parabolic reflector.

F. *Pneumatic Telegraph.*—This system has been employed for many years in Europe, and is extensively used in the U. S. Brass tubes $2\frac{1}{2}$ inches in diameter are laid in trenches under the streets. The messages are rolled up and placed in a cylindrical carrier of leather or felt about 8 inches in length, closed at the front, and provided with a flange loosely fitting the inside of the tube, while the rear end is left open. The carriers are driven in one direction by compressed air and in the other by an exhaust, both operated by a powerful air-pump at the central station. Packages of ten or twelve messages are sent a distance of half a mile in a few seconds. See PNEUMATIC TRANSMISSION.

The best authorities give the total length of telegraph line in all countries at the beginning of 1894 as 900,000 miles, of which 158,000 were submarine. The total mileage of wire was 2,632,000. Nearly all the submarine lines have been established by British companies.

The most extensive telegraphic system in the world is that of the Western Union Company of the U. S. In 1900 it had 192,705 miles of telegraph lines, 933,153 miles of wire, 22,900 offices, and transmitted 63,167,783 messages.

The number of messages transmitted in 1898–1900 in some of the principal countries of the world was as follows:

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|---|---|---|---|
| Great Britain (1900) | 90,415,123 | India (1899) | 5,448,600 |
| Germany (1899) | 44,558,742 | Italy (1898) | 8,667,460 |
| Austria (1899) | 14,697,898 | Netherlands (1899) | 5,218,320 |
| Belgium (1899) | 12,550,871 | Norway (1899) | 2,236,229 |
| Denmark (1899) | 2,215,572 | Sweden (1898) | 2,451,708 |
| France (1898) | 43,963,811 | Japan (1900) | 14,763,777 |
| Switzerland (1899) | 3,970,098 | Russia (1898) | 19,217,238 |
| Hungary (1899) | 13,919,737 | Canada (1899) | 4,830,501 |

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**Telegraph Companies**, LAWS RELATING TO: The business of telegraph companies is so "affected with a public interest" that they may be authorized to take private property for their use, upon making due compensation (see EMINENT DOMAIN), and that the construction of their lines, as well as their rates and their treatment of customers, may be regulated by the state. It is now settled, contrary to the doctrine of a few early decisions, that these companies are not common carriers. Their legal status, however, is quite analogous to that of common carriers. Their employment is of a public nature, which subjects them to duties over and above those created by their contract obligations. For example, they must take all lawful messages that are offered, up to the limit of their facilities; they must transmit them, as a rule, in the order of reception; they must treat all customers impartially, even to the extent of furnishing facilities for rival companies. *Del., etc. Telephone Co.* vs. *State of Del. ex rel. Postal Telegraph Co.*, 50 *Fed. R.* 677.

*Regulations.*—They have the right to make reasonable rules and regulations touching their dealings with customers. All messages may be required to be plainly written; prepayment may be required, as well as a deposit for an answer; and the hours during which messages will be received and sent may be fixed. Whether the regulation that the company will not be responsible for the correctness of a message, unless it is repeated, is reasonable, and therefore binding on customers who assent to it, is a question upon which the courts are divided. In Great Britain, in New York, and in other States of the U. S. the regulation is approved. (*Kiley* vs. *W. U. Tel. Co.*, 109 N. Y. 231.) The weight of authority in the U. S., however, is against its validity. Two main reasons are assigned for this view: first, that a company can exempt itself from liability from errors only arising from causes beyond its control; second, if the repetition of the message is necessary to insure its accurate transmission, then the law devolves upon the company the duty of repeating it. (*W. U. Tel. Co.* vs. *Blanchard*, 68 Ga. 299; 45 *Am. R.* 480.) Some authorities enforce express contracts between customer and company that the latter shall be liable only for gross negligence or willful wrongdoing; but by most courts in the U. S. they are deemed against public policy, and void. *Gillis* vs. *W. U. Tel. Co.*, 61 Vt. 461.

*Liability.*—British courts hold that the duty of the company to transmit and deliver a message arises wholly out of the contract with the sender, and there is no duty toward the receiver. This view is not entertained to any extent by courts in the U. S. On the other hand, it is generally held that a receiver may recover against the company such damages as proximately result to him from its negligent default. (*Tel. Co.* vs. *Dryburg*, 35 Pa. St. 298.) This liability is rested in part upon the common-law duty incident to the exercise of a public calling, and in part upon the theory that the receiver may sue because he is a beneficiary under the contract between the sender and the company. It is held generally that the company will not be liable beyond the charge for sending the message, where it does not show on its face that it relates to a business transaction, or is in cipher. (Cf. *Baldwin* vs. *Tel. Co.*, 45 N. Y. 744, with *W. U. Tel. Co.* vs. *Hyer*, 22 Fla. 637.) The foregoing rules are applicable to telephone companies. F. M. BURDICK.

**Telegrapher's Cramp**: See NEUROSIS.

**Telegraphy without Wires**: See the Appendix.

**Telem'achus** (in Gr. Τηλέμαχος): in Greek mythology, son of Odysseus and Penelope. He was an infant when his father joined in the war against Troy. After the termination of the war, he sailed out, accompanied by Athene in the shape of Mentor, and visited Pylos, Sparta, and other places, where he expected to gather some information concerning the fate of his father; and on his return to Ithaca he found Odysseus living there in disguise with the swineherd Eumæus. A recognition took place, and he then aided Odysseus in slaying the suitors and clearing the house of its many burdensome guests, who ate up its wealth without bringing it any honor. His voyage forms the subject of Fénelon's celebrated epic *Télémaque*.

**Telemeter**: See STADIA MEASUREMENT.

**Teleoceph'ali** [Mod. Lat.; from Gr. τέλεος, complete + κεφαλή, head]: a group of fishes, recognized by some authors, containing most of the teleost or true bony fishes.

**Teleol'ogy** [from Gr. τέλος, τέλεος, end, purpose + λόγος, discourse, reason]: the doctrine which finds intelligent ends or purposes in the processes and forms of nature. The evidences of purpose in nature were recognized by the Greeks, especially by Aristotle, who distinguished the final or teleological cause of a thing—i. e. the purpose of its existence or activity—from the material and efficient causes of the same thing.

Teleology has been used to support the theistic theory of the world in each of the periods of modern speculation. The teleological argument for the existence of God is by many made the strongest argument—from the evidence of design in nature to the existence of an intelligent designer. The rise of modern evolutionary theory, using the principle of natural selection to account for single instances of adaptation found in nature, tended for a period to throw the theory of design into disrepute, the conception of mechanical law being substituted for that of purpose in the interpretation of nature. Undoubtedly the evolutionary conception does remove much of the force from the oft-cited instances of adaptation, such as of the eye to light, of the color of an animal to its environment, etc. But while this is true, the theory of teleology takes on, in view of it, a profounder and more inspiring form, as part of the broader idealistic philosophy of the world. The new construction of teleology exhibits two great contrasts to the old view as it was urged in the natural theology of such men as Butler and Paley.

1. We are now led to look for design in nature not in the planning of a particular instance of adaptation, for all such instances might have come about by the more mechanical operation of natural selection upon variations; but we are to look for it in the very conception of law—be it mechanical or be it mental. The principles of natural selection and probability when expressed in formulas are themselves consistent expressions of plan or mind in nature. For why should mechanical law, uniformity, conservation of motion—why should any steady *conception* be applicable to nature at all, if not because nature is in some sense the expression or embodiment of that steady conception or idea? So the presence of the idea which we ordinarily call *law* in nature is itself the best teleology, although the law be what is called mechanical, and subversive of the old theory of design.

2. Further, the old view of design made the designer and the design or plan both logically apart from nature. God, it held, imposed certain designs upon nature. This conception also goes under in the minds both of naturalists and of philosophers who accept current evolutionary doctrine. But again the resulting conception is more profound and inspiring. The idea of plan or law in nature yields what is known as the modern doctrine of immanence. Nature is law-abiding and progressive just because it is itself the manifestation and realization of intelligence. God is immanent in the world and in man; both the world and man in their law-abiding character show just the nature and reality of God. And the universe as a whole gives the movement of development which naturalists construe in its particular aspects in terms of law. This newer statement of teleology is found both in intellectual idealists, such as Caird and Green, and in the critical realists, as represented by Trendelenberg and Lotze.

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J. Mark Baldwin.

**Teleos'tei** [from Gr. τέλεος, complete + ὀστέον, ὀστοῦν, bone]: a primary division of fishes embracing the great majority of living species, so called on account of the ossified condition of the skeleton, the cartilages being almost entirely replaced by bone. Among other characters which separate them from the other true fishes are the absence of a conus arteriosus in the heart, of a spiral valve in the intestine; the presence of a gill-cover (operculum), and usually the presence of true scales on the body, although the skin is sometimes naked, sometimes covered by bony plates. The subdivision of the group is yet in a most unsatisfactory condition, and the various species have probably descended from more than one ganoid ancestor. In general words, the sub-class can be divided into two groups. In the one, the *Physostomi*, the air-bladder, when present, is connected by a duct with the alimentary canal, and the ventral fins are never spined. In the *Physoclisti* the connection between air-bladder and alimentary canal becomes lost with growth, and the fins are usually spined. The *Teleostei* are further subdivided into more than a dozen orders, the names and characters of which must be sought in the article Ichthyology and in technical works, such as there cited.

J. S. Kingsley.

**Telep'athy** [from Gr. τῆλε, far + πάθος, feeling]: thought-transference, or the phenomenon of the reception by the mind of an impression not traceable to any of the ordinarily recognized channels of sense, and assumed to be due to an influence from the mind of another person, near or remote. Thus the sphere of telepathy is not the same as that of *clairvoyance*, in which it is assumed that the mind of the subject may receive an impression of *impersonal facts*, or things at a distance. The subject who receives the impression is called the percipient, the one from whom the influence emanates is usually called the agent, in accounts of experiments on this phenomenon.

In the earlier works on animal magnetism there are many reports concerning subjects who are said to have developed the faculty of obeying the unspoken will of their magnetizer, going to sleep and waking, moving, acting, and speaking in accordance with his silent commands. More recently there have been public exhibitors of "mind-reading," and their performances have been imitated in private circles by the so-called willing-game. In most of these feats the agent is required to think intently of some act while he lays his hands on some part of the so-called mind-reader's person. The mind-reader, either promptly or hesitatingly, will then usually perform the act. It is safe to assume that wherever such personal contact between the pair is allowed, the percipient is guided by the encouragment or checking which the agent's hands more or less unconsciously exert upon his at first tentative movements; so that muscle-reading, and not mind-reading, is the proper name for this phenomenon. There are, it is true, reports of success in the willing-game where no contact was allowed; but in the absence of authentic details, they can not be taken as evidence that telepathy exists. For the same reason the earlier mesmeric reports have doubtful evidential value. The operators took too few precautions against "suggesting" to the subjects by other channels than speech what their will might be. It is only within recent years that we have learned to measure the acuteness with which an entranced person with his mind concentrated upon his hypnotizer will divine the intentions of the latter by indications which he gives quite unconsciously by voice or movement, or even by the mere order of sequence of what he does. On these accounts, evidence in the strict sense for telepathy must be sought in a small number of experiments conducted by a few more careful observers since about 1880. These experiments, taken in the aggregate, appear to make it unreasonable to doubt any longer the fact that occasionally a telepathic relation between one mind and another may exist.

In a faultless experiment on thought-transference certain precautions must be observed. To avoid previous collusion between agent and percipient the agent should receive from a third party the idea to be transferred; and the latter should, when possible, select it by drawing lots or by some other appeal to chance. This is to exclude the possibility of himself and the percipient being led by number-habits, diagram-habits, or other parallel paths of inner association to a common result. The percipient should not be in the room when the idea is determined on; and when possible it should be chosen in silence, written down, and shown, if it need be shown beforehand, in written form. The percipient should, if possible, do his guessing in another room. In any case he should be blindfolded, and there should be no conversation with him during the performance, the signal that he must attend to his inner impressions being given by bell or other sound. Physical contact between agent and percipient must not occur, and if the percipient writes or draws his result the agent should not look on, since an unconscious commentary by changes in breathing, etc., might reveal to the percipient whether he was going right or wrong.

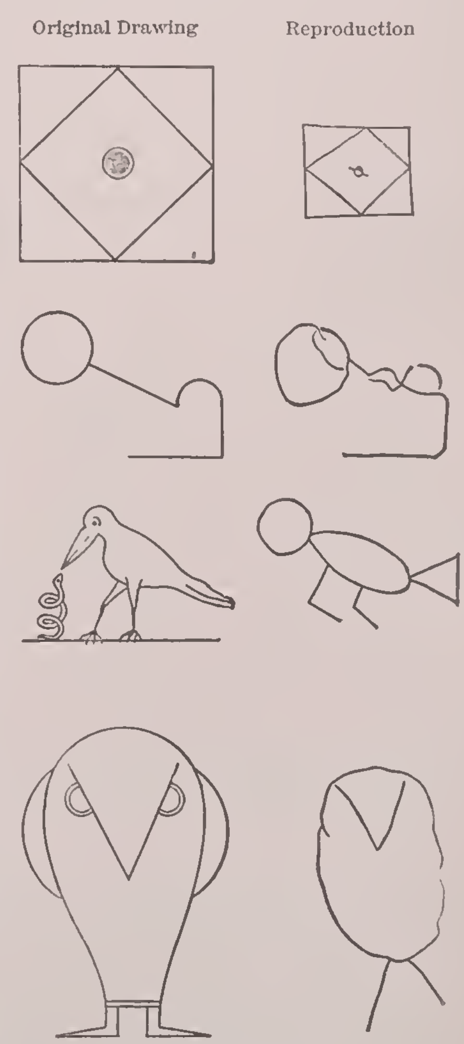


Fig. 1.

The *Proceedings* of the Society for Psychical Research contain some records of experiments made under approximately faultless conditions. In certain cases the ideas to be transferred were diagrams or drawings. A couple of examples will show the success reached when at its best. Fig. 1 is from a series made with Mr. Blackburn, agent, G. A. Smith, percipient, in which out of thirty-three trials without contact, though with percipient and agent in one room, there were twenty-five reproductions as good as those here given of a figure prepared and kept outside of the room. Fig. 2 gives the first six trials of a series reported by Malcolm Guthrie, of Liverpool, he being agent and a Miss E. percipient. The conditions seem almost faultless, if the account is accurate, though the figures are simpler than in the former series. In all, with various agents, Miss E. made 150 trials, the majority of which were successful entirely or in part. Sixteen specimens are printed in the report, all about as good as those in Fig. 2.

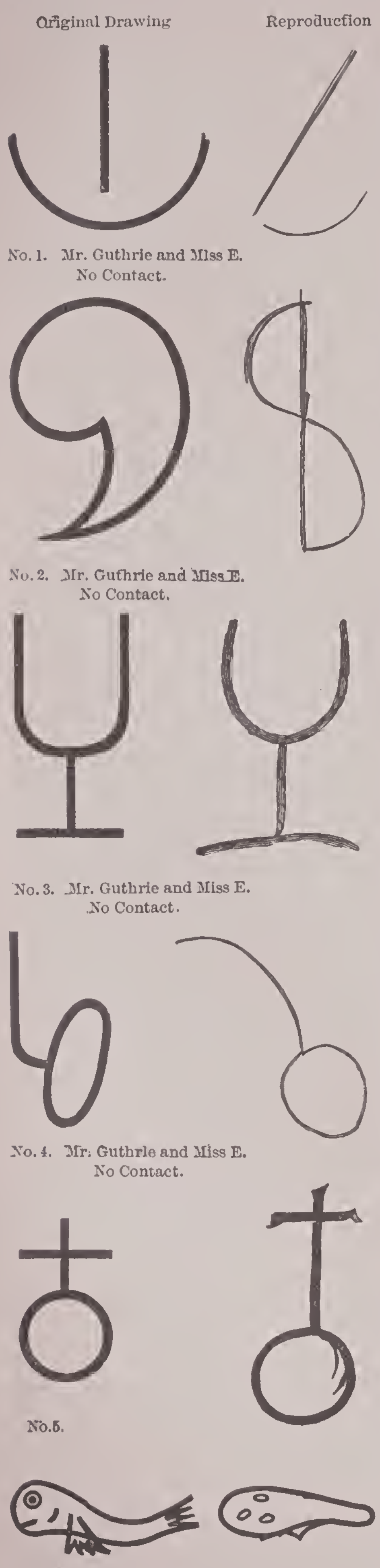


Fig. 2.

The same Miss E. and a Miss R. were subjected at Liverpool in 1883 to a series of experiments in transferring ideas and sensations of every order, the agents being Mr. Guthrie and others. Out of 713 trials there were but 252 cases in which the percipient either got no impression or described the object wrongly. In the remaining 461 cases the success was either complete or partial.

"Miss X." has published (*Proceedings* of Society for Psychical Research, vol. vi.) a long series of telepathic interchange of experiences over a long distance with "Miss D.," corroborated by independent entries in their respective diaries. Of 20 such entries 14 refer to a consciousness on the part of Miss D. that Miss X. was at that hour (the hours are quite irregular) playing a certain definite piece of music.

Miss Wingfield was the subject of a series of number-guessings, where out of 2,624 trials there were 275 successes instead of 29, which was the figure probable on the assumption of "chance." The numbers thought of were the 90 two-digital ones, from 10 to 99. They were drawn at random from a bowl and thought of by the percipient's sister. In a later series of 400 trials with this percipient the completely right guesses were 27 instead of the chance number 4; there were moreover, 21 guesses with the digits reversed, and 162 with a single digit in its right place.

Similar, though less extended and perhaps less conclusive, series of experiments at guessing ideas have been reported in the Society for Psychical Research *Proceedings* by various experimenters—Dessoir, Schmall and Mabire, W. J. Smith, von Schrenk-Notzing, and Barrett and Gurney. The observations last referred to were those first published. The subjects were two girls who, four years later when experiments were resumed, were found, when tested in each other's presence, to be cheating by a code of signals. Much has been made of the breakdown of this case. But very many of the earlier successes recorded of these children occurred when they were singly present, and often when only one experimenter knew the thing to be guessed. Collusion under such circumstances can not well be charged, although willingness to cheat rightly casts vague suspicion on all trials done with the percipient concerned, and shows the importance of making all tests under the conditions described as "faultless" a few lines back. Mr. Rawson finally, in vol. xi. of the *Proceedings*, gives a striking series of correct card and diagram guesses.

On telepathy in the hypnotic state there are recorded in the *Proceedings* experiments by Dr. B. Thaw and Prof. and Mrs. H. Sidgwick. The conditions in the latter set seem to have been, on the whole, very careful, though not quite faultless in the technical sense. The agent was the hypnotizer, G. A. Smith. The things to be impressed were usually the numbers (of two digits) on eighty-one lotto-counters, drawn by Prof. Sidgwick from a bag and handed to Mr. Smith to gaze at, while the hypnotized percipient awaited the impression. There were four percipients, with 644 trials made with agent and percipient in the same rooms, and 218 made with them in different rooms. In the former set 131 trials were successful, though the digits were named in reverse order in 14 of these 131 cases. In the latter set there were only 9 successes. The "probable" number of successes by chance would have been in the former set 8, in the latter at most 3. Later, with three of the same percipients and three new ones, Mr. Smith still being agent, Mrs. Sidgwick and Miss Johnson report 252 trials and 27 successes (chance number = 4), with agent and percipient in different rooms. Mr. Smith transferred "mental pictures" to five subjects, successfully in 31 out of 71 trials in one room, in 2 out of 55 in different rooms. The subjects of the mental pictures were such things as "a boy skating," "a baby in a perambulator with nurse," "a mouse in a trap," etc.

Prof. Richet has described (*Proceedings* of Society for Psychical Research, vol. v.) a series of successes in guessing drawings in the hypnotic state; but as he found that the same subjects succeeded 30 times out of 180 trials in guessing the drawing when it was inclosed in an envelope and unknown to any one present, it is doubtful whether telepathy or clairvoyance be the cause of the success. Control-experiments showed that "chance" could give as many as 3·5 per cent. of good successes at matching pictures made arbitrarily by different persons with others taken at random from a large collection previously prepared. Richet's hypnotic subjects gave, however, 10 per cent. of good successes in 200 trials, and he concludes the existence of an unknown power.

Thus, to count only systematically pursued experiments, some of which are not mentioned here, there are accounts from more than a dozen competent observers concerning about a score of subjects, all seeming to show a degree of success in guessing very much greater than that which chance would give. Different readers, however, will weigh the evidence differently, according to their prepossessions. Much of it is fragmentary, and in much one or other condition of "faultlessness" in experimenting is violated. The mass, however, is decidedly imposing; and if more and more of this solitary kind of evidence should accumulate, it would probably end by convincing the world.

Meanwhile there are other kinds of telepathy which, illogically perhaps, impress the believing imagination more than high percentages of success in guessing numbers can. Such are cases of the induction of sleep in hypnotic subjects by mental commands given at a distance. Pierre Janet, Richet, Gibert, Ochorowicz, Héricourt, Dufay, Danicx, Tolosa, Latour, and others are the relaters of these observations, of which the most important evidentially are those made on the celebrated somnambulic subject, Madame B., or "Léonie." Out of one series of 25 trials with this woman, there were 18 complete and 4 partial successes. Mr. Ochorowicz vouches for some of these, and gives also a long series in which silent commands were acted out by another hypnotic subject of his own, both he and she being, however, in the same room. The most convincing sort of evidence for thought-transference is given by the sittings of certain "test-mediums," of which the best worked-out case is that of Mrs. Piper, published in the Society for Psychical Research *Proceedings* for 1890–92–95. This lady shows a profuse intimacy, not so much with the actual passing thoughts of her sitters as with the whole reservoir of their memory or potential thinking; and as the larger covers the less, so the present writer, being as convinced of the reality of the phenomenon in her as he can be convinced of anything in the world, probably makes less exacting demands than he otherwise would on the sort of evidence given for minor grades of the power.

The authors of the word telepathy have used it as a theory whereby to explain "veridical hallucinations" such as would be the apparition of a person at a distance at the time of his death. The theory is that one who is dying or passing through some crisis is for some unknown reason peculiarly able to serve as "agent" and project an impression, and that the telepathic "impact" in such a case produces hallucination. Stated thus boldly the theory sounds most fanciful, but it rests on certain actual analogies. Thus a suggestion made to a suitable subject in the hypnotic trance that at a certain appointed time after his awakening he shall see the operator or other designated person enter the room, will post-hypnotically take effect and be followed at the appointed time by an exteriorized apparition of the person named. Moreover, strange as the fact may appear, there seems evidence, small in amount but good in quality, that one may, by exerting one's will to that effect, cause one's self to appear present to a person at a distance. As many as eight persons worthy of confidence have recently reported successes in this sort of experiment. The writer knows a ninth case, impossible to publish, but where the evidence (as far as taken) is good. Now the committee on the census of hallucinations of the Society for Psychical Research find that the "veridical" ones among them—those, namely, in which the apparition coincides with the death of the person who appears—are 440 times more numerous than they ought to be if they were the result of mere chance. For the particular data and logic by which this figure is obtained, see the report in vol. x. of the Society for Psychical Research *Proceedings*. Of course, if such a conclusion ever be accepted, and if the telepathic theory of such apparitions be credible, the probability that telepathy is the cause of success in the simpler number-guessing cases would be greatly re-enforced. The whole subject, so far as definite observation goes, is still in its earliest infancy.

Bibliography.—J. Ochorowicz, *De la Suggestion mentale* (Paris, 1887); *Proceedings of the Society for Psychical Research, passim*; F. Podmore, *Apparitions and Thought-transference* (1894). William James.

**Telephone** [from Gr. τῆλε, far + φωνή, sound, voice]: a term originally applied by Wheatstone in 1840 to the various forms of rod and string telephones (as they are now called) in which sound-vibrations are transmitted from one point to another by means of a rod or tightly stretched string connecting two elastic diaphragms of membrane, wood, or other suitable material, and of which the well-known lover's telegraph is a type; but while in strictness the word telephone still refers to the acoustic as well as the electric telephone, the latter, on account of its universal use, is the instrument to which the term is chiefly applied.

As early as 1854 a crude suggestion as to the possibility of transmitting speech electrically was made by Charles Bourseul in *L'Illustration* (Paris), and in 1861 at Frankfort, Germany, Philipp Reis exhibited and for the first time published an account of his extended experiments in the same direction. Reis endeavored to secure the transmission of speech by a circuit-breaking operation. For a transmitter he employed a membrane to which was fastened a flexible strip of metal connected with one terminal of a voltaic battery. In the instrument originally described the membrane was stretched over the smaller end of a conical speaking-tube bored in a cubical block of wood, whence this form of transmitter is known as the bored-block transmitter. Opposite the outer surface of the membrane was placed a stiff brass spring connected with the conducting line-wire which ran to the receiver. From the end of this spring, which was opposite the center of the membrane, a platinum point projected toward the metallic strip. The distance between this point and the strip was such that when the membrane was set into vibration by the voice of one speaking into the conical sound-tube, the metallic strip came into contact with the point on the forward motion of the membrane and broke contact with the point as the membrane retreated, thus making and breaking the battery-current once at each complete vibration of the membrane. The receiver employed consisted of a long helix of insulated wire wound about a knitting-needle, the whole being mounted upon a sounding-box. As was shown by Charles G. Page (1837), whenever the coils of an electromagnet are traversed by such an intermittent current there is a click produced at each make and break owing to the successive magnetization and demagnetization of the cores, and if the intermittences are sufficiently frequent the clicks will blend into a continuous musical sound, whose pitch is determined by the frequency of the breaks. Hence when the Reis receiver was connected in circuit with the transmitter and a battery, and the transmitter was operated as described, the alternate makes and breaks of the current produced by the intermittent contact between the metallic strip and point of the transmitter caused a sound to issue from the receiver. This sound would necessarily correspond in pitch with that uttered into the transmitter, since the pitch of a sound is determined wholly by the frequency or rate of vibration, which is necessarily the same for the knitting-needle of the receiver as for the membrane of the circuit-breaking transmitter which produces those intermittences of the current which excite the vibrations of the former. After the publication of his first paper Reis altered the shape of his transmitter, and caused to be manufactured and sold an instrument consisting of a hollow cubical box having a circular hole at the top which was closed by a membrane and furnished with a speaking-tube which entered the side of the box. To the membrane was fastened a flexible strip of metal. A light piece of sheet brass bent at right angles in a horizontal plane was loosely supported at its ends, while a pointed leg of platinum wire projecting from the angle rested upon the metallic strip over the center of the membrane. The circuit was completed through the strip and point. On speaking into the transmitter the angle-piece was tossed out of contact with the metal strip when the membrane diaphragm vibrated, thus producing an intermittent current. From its wide sale this transmitter, known as the cubical box transmitter, became more generally known than the earlier instrument.

Reis recognized the fact that much more than the reproduction of pitch at the receiver was necessary to reproduce speech. But he thought incorrectly that the amplitude of the vibrations of the receiver, upon which the loudness of the resulting sound depends, would be proportional to the amplitude of the vibration of the membrane of the transmitter, and that the reproduction of these two characteristics of the sound actuating the transmitter would be sufficient to reproduce that sound in its completeness.

Every sound possesses three characteristics, which determine and define it. They are pitch, which depends upon the frequency of the vibrations of the particles of the sounding body or those constituting the air-waves produced by it; loudness, which depends (other things being the same) upon the amplitude of vibration; and quality, which depends upon what is called the "form" of the vibration. Quality is that characteristic by means of which is recognized the particular kind of instrument producing the sound, as a piano, a violin, or the voice. It was proved by Helmholtz to depend upon the number, pitch, and relative loudness of the partial tones which constitute sound-vibrations, and which differ with different instruments. As these differ, the particular velocity with which the vibrating particle moves from instant to instant while executing its complete vibration will differ. See articles Acoustics and Voice.

If represented graphically according to the usual mode of illustrating such motions, the curves representing such different vibrations will have different forms to the eye, whence it has become customary to designate the corresponding differences in the vibrations thus represented by the term "form." And since the sound-waves possess a varying density from point to point corresponding to the varying velocity of their particles, they are also spoken of as having "form."

It follows from what has been said that no transmitter like that of Reis, which operates by breaking the circuit once at each full or complete vibration, can completely reproduce any sound, for it can not reproduce the quality. The receiver takes no cognizance of the mode of vibration of the transmitter between the breaks. The quality of the sound issuing from the receiver depends substantially upon the physical conditions of the circuit, and whatever may be the character of the particular instrument whose sound actuates the transmitter when operated as described, the sound issuing from the receiver will be the same.

A method by which the quality of sounds in general, including those of articulate speech, can be reproduced, together with an apparatus embodying this method, was invented by Alexander Graham Bell and first published in U. S. Patent No. 174,465, dated Mar. 7, 1876. The method consists in the production and utilization of electrical undulations similar in form to the vibrations of the air of the sound-waves. The electrical condition of the line particles and the vibration of the receiver are controlled, not intermittently, at the end of each complete vibration, but throughout the whole duration and extent of this vibration. To do this the transmitting instrument must produce in the line an electrical current which possesses a variation in strength from instant to instant, similar to the corresponding changes in the density of the air in the sound-waves which actuate the transmitter, in which case the electrical changes will copy the aërial vibrations, so to speak, and the varying electrical current will be represented graphically by substantially the same curve that represents the air-waves. Hence the electrical undulations are spoken of as being similar in form to the air-waves. By the action of this undulatory current upon a suitable receiver, it will reproduce at the receiving end of the line air-waves which are similar in form to the electrical variations, and hence to the sound-waves actuating the transmitter.

The original apparatus devised by Bell was a form of what is now called a "magneto-telephone." It will be sufficient to consider the improved instrument, which has chiefly been used in the U. S. The transmitter and receiver are alike, and are shown in Fig. 1. F F is a compound-bar magnet,

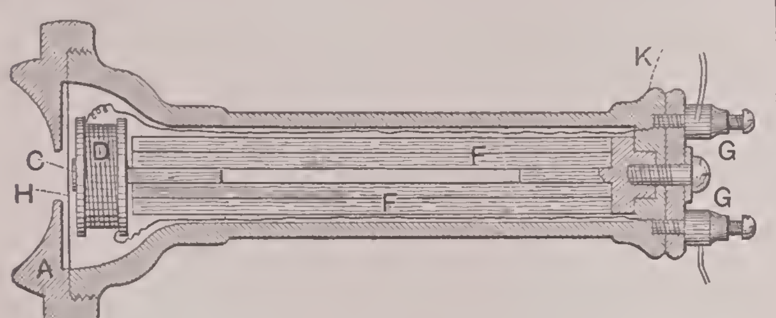



Fig. 1.

with a soft-iron pole-piece, C, around which is wound a coil of insulated wire, D, whose terminals run to the binding posts, G G. H is a circular diaphragm of thin ferrotype iron, held at its edge between the case of the instrument, K, and the mouth-piece, A. When used as a transmitter the instrument is put in circuit with a second one at the further end of the line, which serves as a receiver. The operation is as follows:

When the soft-iron diaphragm, H, is spoken to it takes up the motions of the particles of air and vibrates in accordance with these motions, and so moves toward and away from the magnetized pole-piece periodically with a velocity varying from instant to instant, according to the characteristic form of the air-waves.

In accordance with the well-known laws of electricity and magnetism, whenever the iron diaphragm approaches the pole of the magnet this will become stronger; an induced current of electricity will be generated in the coil, D, and will flow through the circuit. When the diaphragm recedes the pole will become weaker, and a current will be induced in the opposite direction. Moreover, the strength of the induced current will be proportional at each instant to the velocity with which the diaphragm is moving. (See Electricity.) Hence an undulatory current will be set up in the circuit which will be similar in form to the air-waves produced by the voice at the transmitter. This undulatory current flows through the coils, D, of the receiver, and increases or diminishes the strength of the pole of its magnet in a degree depending on the direction and strength of the current, that is, according to the direction and velocity of the motion of the diaphragm of the transmitter. Hence the magnet of the receiver will exert a varying pull upon the diaphragm, H, deflecting it more or less against the restoring force of its elasticity, and the vibrations thus impressed upon the diaphragm will be communicated to the air at the receiving station. Since these possess all the characteristics impressed upon the electrical current by the vibrations of the diaphragm of the transmitter, the receiver will give out a sound similar to that uttered into the transmitter.

*The Microphone.*—The magneto-telephone just described has been universally employed as a receiver. As a transmitter, however, it was soon superseded by a subsequently invented and more powerful apparatus, the microphone. It had been known for a long time that when an electric current passed from one conductor to another through a "loose contact"—that is, when the contact-surfaces or electrodes rested only very lightly upon one another—there was at the joint a resistance to the electrical flow, which was lessened when the pressure was increased. Early in 1877 Émile Berliner proposed to utilize this property in a telephone transmitter. A metal diaphragm rested firmly against a metallic point or ball. A battery current passed from the former into the latter and thence to a suitable telephone receiver. On speaking to the diaphragm the vibrations of this produced a variation of pressure between it and the metal point without ever breaking the circuit, thus producing electrical undulations. The law of variation of resistance with pressure is such that the electrical and acoustic undulations have a like form. Shortly afterward Thomas A. Edison invented an apparatus identical in principle, but employing soft carbon as the material of one of the electrodes instead of making both of them of metal. Still later (May, 1878), Prof. David E. Hughes devised and described another apparatus of the same character, employing hard carbon, and gave to it the name microphone. Carbon is so excellent a material for the purpose that in practice it has always been made to constitute either one or both of the electrodes of the microphone transmitter.

Many forms of microphone transmitter have been employed. The two described are the ones that have been principally used in the U. S.

The Blake transmitter, the best known of these, was invented by Francis Blake, and first introduced into public use late in 1878. Its construction is illustrated in Fig. 2.

D is a diaphragm of sheet-iron against which rests lightly a small platinum button, K, which is suspended by a light leaf-spring, A. Around a button of hard carbon, C, is spun a brass weight, W. A rather stiff spring, S, sustains W and C. A and S are insulated from each other at their upper ends. K and W are the hammer and anvil electrodes respectively of the microphone. A current from a battery, B, passes through the joint between the two electrodes. When the diaphragm enters into vibration under the action of the voice it pushes the hammer electrode, K, into more or less intimate contact with the anvil electrode, C. The inertia of C, weighted as it is by W, keeps the anvil electrode from jumping away from the hammer electrode, and the spring S holds the two electrodes in proper position as regards the diaphragm. The varying pressure between K and C causes a corresponding variation in the strength of the current to take place, so that when a magneto-receiver is put in circuit with the transmitter speech is reproduced.

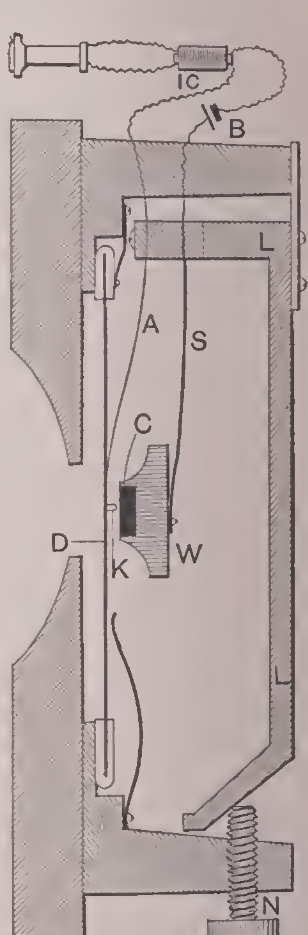



Fig. 2.

The proper normal pressure between the electrodes is secured by means of the bent lever, L, and adjusting screw, N.

Instead of placing the receiver in direct circuit with the battery and microphone, it is customary to cause the undulatory battery current to pass through the primary of an induction-coil in whose secondary, of much higher resistance, the receiving telephone is placed. This gives better electrical conditions for transmission over lines of considerable length. This arrangement is symbolically indicated at IC in the figure.

A very powerful form of microphonic transmitter, developed in the laboratory of the American Bell Telephone Company by A. C. White, is employed for long-distance transmission. Its construction is shown in Fig. 3. K K′ are

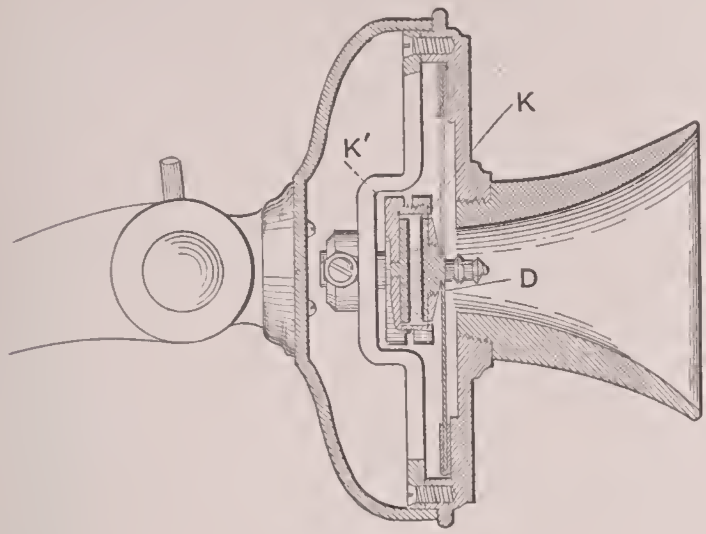



FIG. 3.

two polished buttons of hard carbon, the rear one of which is fastened solidly in a frame, while the forward one is riveted to the center of the metal diaphragm, D, and moves to and fro like a plunger when the diaphragm vibrates. The two carbon buttons are insulated from each other and form the opposite faces of a flat, cylindrical cell, which is closed at the front by a thin, flexible disk of mica concentric with the forward button and of greater diameter than this, so that the mica projects beyond the edge of the button. The disk is in front of the button, carried by the same piece that carries this and secured at its edges by an annular cap which holds it firmly while allowing perfect freedom of vibratory motion to the plunger and front button. The cell is filled partly full with coarse, granulated carbon powder. The current from a battery passes from the front button through the granulated carbon to the rear button. The buttons and the particles of carbon constitute the electrodes of the transmitter. An induction-coil is used, as with the Blake transmitter.

It is evident from what has been said regarding the microphone that microphonic action may be produced with a Reis transmitter by operating it so as to prevent any breaking of the circuit. When the Reis transmitter is coupled with a sufficiently sensitive receiver it is possible to transmit and reproduce speech by this operation. Whatever of quality has ever been transmitted by a Reis instrument was the result of this action, of which Reis was entirely ignorant.

The development of the art of telephony has necessitated the invention of a vast number of special contrivances for local and long-distance transmission. For long-distance transmission complete metallic circuits are employed rather than the grounded circuits usual in telegraphy, and such lines are also far more satisfactory for local business on account of their greater freedom from electrical disturbances.

Substantially all of the telephone business of the U. S. has been carried on by the licensees of the American Bell Telephone Company. Under the company's control there were on Jan. 1, 1900, 150,380 miles of long-distance ("extra-territorial") lines in use and 1,016,737 miles of local ("exchange") lines, of which 489,250 miles were underground. The total number of telephones in use was 1,580,101, the number of persons employed 25,741. The number of magneto-telephones in use Sept. 20, 1894, was 289,495, the number of Blake transmitters 218,782, and the number of long-distance transmitters 49,435. The number of telephone connections made at exchanges daily is 5,173,803, or more than 1,666,000,000 in a year. The longest telephone line in actual commercial use extends from Portland, Me., to Milwaukee viâ Boston, New York, and Chicago, a distance of 1,337 miles. The complete history and theory of the speaking telephone have been brought out very fully in the protracted litigation regarding it which has been carried on in the U. S. courts. The fullest accessible discussion of these topics will be found in vol. cxxvi., *United States Reports*. The laws relating to the duties of telephone companies are in general the same as those relating to telegraph companies. See TELEPHONE LAW, in the Appendix.

CHARLES R. CROSS.

**Telescope** [from Gr. τῆλε, far + σκοπεῖν, to view]: an optical instrument for increasing the apparent magnitude of distant objects, or the size of their images on the retina. The essential parts of the instrument are two in number: a mirror or combination of lenses for bringing the rays of light which emanate from each point of the distant object to a focus, thus forming an image of the object, and an ocular for viewing this image. A refracting telescope is one in which the rays of light are made to converge to the focus by a system of lenses; a reflecting telescope is one in which they are made to converge by being reflected from the surface of a slightly concave, polished reflector.

*The Refracting Telescope.*—If the light reflected or emitted by the object to be observed were all of one color and one degree of refrangibility, and if a lens could be made of any shape desired, then a single lens would suffice for the object-glass of a telescope. Practically, however, such a lens will not bring all the rays to one and the same focus. Since glass exerts a more powerful refraction on blue than on red rays, a lens brings the blue rays to a shorter focus than the red ones; hence the use of a single lens gives a row of foci, making distinct vision impossible. This effect is called chromatic aberration. Moreover, if the lens is spherical, the rays which pass near the circumference of the lens will come to a shorter focus than those which pass through the central portions. This makes a second defect, which is called spherical aberration.

*The Aplanatic Objective.*—In the modern aplanatic telescope these aberrations are in great part obviated by the combination of two lenses, a double convex lens of crown glass and a concave lens of flint glass, as shown in Fig. 1. For a statement of the principle by which chromatic aberration is thus obviated, see ACHROMATISM. The two lenses disperse the red and

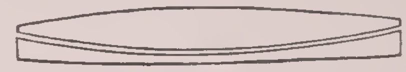


FIG. 1.

blue rays in opposite directions; that is to say, the crown lens, being convex converges the blue rays more than it does the red ones, while the flint glass, being concave, tends in an equal degree to diverge the blue rays away from the axis more than the red ones. On the other hand, the refracting power of the crown lens is stronger than that of the flint lens, so that the combined effect of the two is to bring the rays to a focus, while their opposite dispersions neutralize each other, and bring both blue and red rays to nearly the same focus. In addition, such curves may be given to the lenses that the spherical aberrations shall also annul each other, and thus all the rays be brought to one focus. It is this combination of achromatism with freedom from spherical aberration which gives perfection to the telescope.

The fact is, however, that no objective can be made of crown glass and flint glass which will bring all the rays absolutely to one focus. The reason of this is that the latter disperses the rays more and more in proportion to the former, as we pass toward the violet end of the spectrum. The result is that when the nearest approach to achromatism is gained, the extreme rays (blue and red) will come to a focus a little farther away from the objective than the intermediate rays, which are yellow or pale green. This defect is not serious in a small telescope, but becomes very serious in greater refractors. Makers of optical glass in Germany have devoted great attention to discovering kinds of glass which will not produce this secondary aberration. Partial success has been gained, but it is still questionable whether the new glasses possess the durability of the ordinary kinds and can be made of the requisite size for great telescopes.

*The Photographic Telescope.*—In consequence of the defect just described, a telescope which is best adapted for seeing will not be the best for taking photographs of heavenly bodies. The reason is that the best visual telescope brings the yellow rays to the shortest focus, and scatters the blue and violet rays farther along the axis. But the latter are those which have the best photographic effect. Consequently, in order to take the best photographs, the telescope must either have a weaker (less concave) flint lens or a stronger (more convex) crown lens than the ordinary visual telescope. In order that a telescope may be well adapted for both purposes some device must be employed to increase the effect of the crown lens, or diminish that of the flint lens. In the great Lick telescope a third lens is supplied, which is put over the objective when photographs are taken. One necessary effect of this method is to shorten the focus by several feet.

*The Reflecting Telescope.*—This instrument is so called because the rays from the star or other distant object are brought to a focus by a slightly concave, parabolic reflector, which may be either of polished metal or of glass. For the great telescopes of Herschel, Rosse, Lassell, De la Rue, and all others previously to 1857, the reflectors were made of a combination of tin and copper, called speculum metal, which would bear a high polish. It is now more common to grind a reflector of glass, which is then coated with a film of silver, about $\frac{1}{200000}$th of an inch thick, on the side toward the object. These latter must not be confounded with looking-glass mirrors, which are coated with tin-amalgam on the posterior side. Silvered-glass telescopes were invented by Steinheil, and reinvented in the same year by Foucault, whose admirable paper in the *Annales de l'Observatoire de Paris* (vol. v., 1859) is a model of what such memoirs should be. See Henry Draper's paper on this subject in the *Smithsonian Contributions to Science* (1864). Ever since the introduction of silvered glass, there has been a controversy as to its utility compared with speculum metal, but the balance has inclined finally to the former. A silvered speculum is permanent; for even though the silver coating be tarnished it may readily be repolished, or, if injured by dampness, be replaced without affecting the figure of the glass; it is many times lighter, and therefore demands less weight in the mounting, and is correspondingly more manageable; it is more reflecting, in the proportion of about 92 to 65, and in consequence a smaller aperture will give an equal brilliancy to objects, this being a great advantage in an unsteady atmosphere. Speculum metal is composed of copper and tin in the proportion of 32 to 14·911; it must be cast on a chill —that is, a slightly warmed iron surface; and that it must be annealed with the greatest care and for a long time.

*Grinding and Polishing.*—These operations do not differ much in the cases of metal and glass, except that the latter, being more rigid, will not take a permanent set if raised from its bearings, and, being lighter, can be more easily manipulated. The grinding and polishing of specula may be accomplished by machinery or by hand. When Hadley, Mudge, Edwards, Molyneux, Short, and others were making reflecting telescopes, the work was done altogether by hand, the tools being fixed on an optician's post, which allowed free motion all round the surface to be worked; but when the elder Herschel had advanced to the larger telescopes which he constructed, he found it desirable to use machinery. For many years the arrangement of this machinery was kept a profound secret until finally revealed by Sir John Herschel shortly before his death.

*Silvering of Glass.*—A large number of processes have been invented for coating glass with a thin and uniform film of silver. They all depend on reducing metallic silver from a solution of silver nitrate and ammonia, with perhaps the addition of potash. The reducing agent may be Rochelle salt, milk-sugar, inverted sugar, oil of cloves, aldehyde, etc. The best process is described in the *Monthly Notices* of the Royal Astronomical Society (Dec., 1875, vol. xxxvi., p. 76) by Martin, who made a 4-foot silvered-glass telescope for the Paris Observatory. The glass must be carefully cleaned with nitric acid, and afterward with potash and alcohol, and then placed face downward on a mixture of equal parts of the following four liquids: (1) A solution of 40 grammes of crystallized silver nitrate in a liter of distilled water; (2) a solution of 6 grammes of pure ammonium nitrate in 100 grammes of water; (3) a solution of 10 grammes of caustic potash (quite free from carbonate and chloride) in 100 grammes of water; (4) a solution of 25 grammes of sugar in 250 grammes of water, to which is added 3 grammes of tartaric acid, and the liquid is then boiled for about ten minutes to produce the inversion of the sugar. After the solution has cooled 50 cubic centimeters of alcohol are added to hinder any subsequent fermentation. The volume is made half a liter by dilution with water if the silvering is to be done in winter, or dilute still more if it is to be done in summer. The film of silver, if the potash is pure, may not need any polishing, and should in any case require only a few strokes of a buckskin pad slightly tinged with fine rouge.

The great difficulty with the reflecting telescope is that the speculum throws the rays back directly toward the object, so that the observer can not place his eye in front of the focus to see the object without obstructing the light which falls upon the mirror. This light must therefore be reflected backward or laterally by a second reflector. There are two ways of doing this; one, called the Newtonian, is shown in Fig. 2. A mirror, M, is placed at an angle of 45° between the focus and mirror, but nearer the former, in such a position as to throw the light through the opening

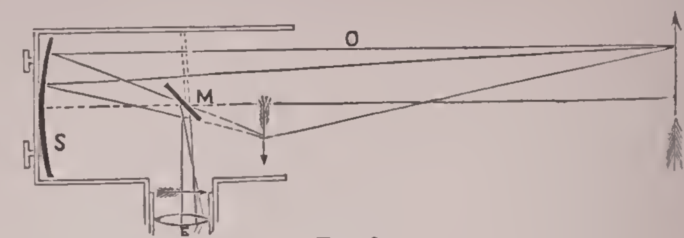



FIG. 2.

at the side of the telescope where the image is formed, and is viewed by an eye-piece of the usual construction. A more convenient form is that shown in Fig. 3, which is known as

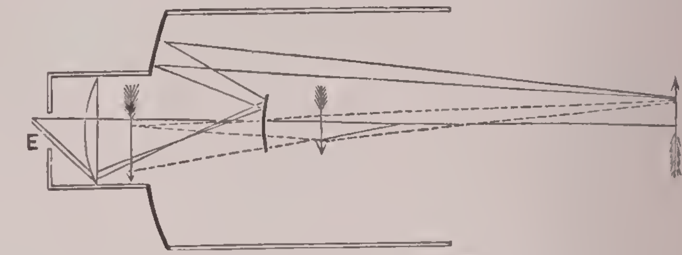



FIG. 3.—Cassegrainian telescope.

the Cassegrainian telescope. Here the light from the principal mirror meets a second slightly convex mirror placed between the principal mirror and the focus. From the second mirror it is thrown back through a central opening through the principal mirror, where the eye-piece is placed. This form is most convenient, because the observer looks directly up at the object.

In a modified form of the Cassegrainian telescope, called the brachi-telescope, which has been tried in Germany, the speculum is slightly inclined, so as to throw the rays to one side, admitting of the second reflector being so placed as not to prevent any of the light from falling on the speculum.

The reflecting telescope has the great advantage that chromatic aberration does not exist, because in all rays the angle of reflection is equal to that of incidence; while by making the mirror truly parabolic the spherical aberration can also be entirely obviated. It is therefore, in theory, the only perfect telescope. There is no limit to its possible size, and therefore no theoretical limit to its power. Unfortunately, the mechanical difficulties in its construction and use are so great that the astronomical work of the world is almost entirely done with refractors. The first difficulty is that if the mirror is more than a foot in diameter it is liable to bend under the influence of its own weight, and thus fail to bring the rays to one focus. By ingenious systems of supporting the mirror this defect can be partially cured, so that reflectors have been made of so great a diameter as 5 or even 6 feet. In the case of the celebrated telescope of Lord Rosse the diameter is 6 feet. Yet it does not appear that the contrivances for securing perfection of figure are entirely successful. Nothing has yet been seen or done with these great reflectors which can not be at least as well seen or done with much smaller refracting telescopes.

For the purposes of the amateur, small reflectors, say from 6 to 12 inches in diameter, can be made free from this difficulty, and are much cheaper than refractors of equal power. Another difficulty associated with them is the liability of the silver film to tarnish, especially near a city where gas is burned. Consequently the possessor of such an instrument must know how to resilver and repolish the mirror, directions for doing which are found in a preceding paragraph of this article, or must be near an expert who can do this.

*The Eye-piece, or Ocular.*—As essential as the object-glass or mirror of a telescope is a lens, or combination of lenses, for collecting the light from the image so as to form a second image on the retina of the observer's eye. In strictness, a single lens of short focus, such as is in common use for viewing minute objects, would suffice. But such a lens gives distinct vision only for a single point in the center of the field of view. Hence an astronomical eye-piece is made with two lenses. One of these, called the field-lens, is placed very near the focus of the objective; the other, called the eye-lens, is next the observer's eye. If the most distinct vision throughout the whole field is to be obtained, the best eye-piece is one of the Huyghenian form, shown in the article MICROSCOPE, Figs. 11 and 12. Here the field-lens is placed a little inside the focus, so that the image is formed between the two lenses. A further improvement on this form was made by Airy, who proposed a meniscus for the field-lens. The eye-pieces of this pattern are called negative. Since the image is formed in the eye-piece itself, a micrometer can not be used with a negative eye-piece. Hence, in ordinary astronomical observations, when measures are made by the micrometer, a form known as the Ramsden eye-piece is used. This consists of two plano-convex lenses, having the plane sides outward, as shown in Fig. 4. Every eye-piece must be fixed in a little sliding tube, so that the observer can push it in or out, and thus get it into such a position as to secure the sharpest vision. The more near-sighted an observer is, the further he must push an eye-piece in, to attain this object.

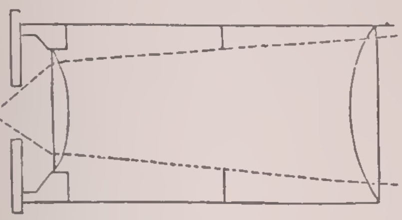


Fig. 4.

*Mounting of the Telescope.*—Owing to the diurnal motion of the earth, if a telescope is pointed at any object in the heavens, the latter will be seen to move across the field of view, and speedily disappear from sight. If a high power is used, it will be very difficult to point the telescope so as to find the object again. The telescope must therefore be mounted on axes, so as to admit of being continually moved. The arrangement for this purpose is called the mounting of the telescope. It varies with the size and with the needs of the observer. A small, cheap instrument, say of three inches in diameter, is usually mounted in the simplest way, so that the observer can himself turn it in any direction at pleasure. No exact observations are, however, possible with this sort of mounting. When the telescope is to follow a star closely, an equatorial mounting is used. In this form the principal axis of the instrument, around which it may be turned, is inclined to the horizon at an angle equal to the latitude of the place, and directed toward the north pole of the heavens. In other words, it is set exactly parallel to the axis of the earth. Thus as the earth turns in one direction, the observer has only to move his telescope around its axis in the other direction in order to keep it constantly pointed at a heavenly body. Attached to the principal axis is a secondary one, at right angles to it, by which the telescope may be pointed at any required distance from the pole. This is called the declination axis, while the principal one is called the polar axis. If the telescope is not very

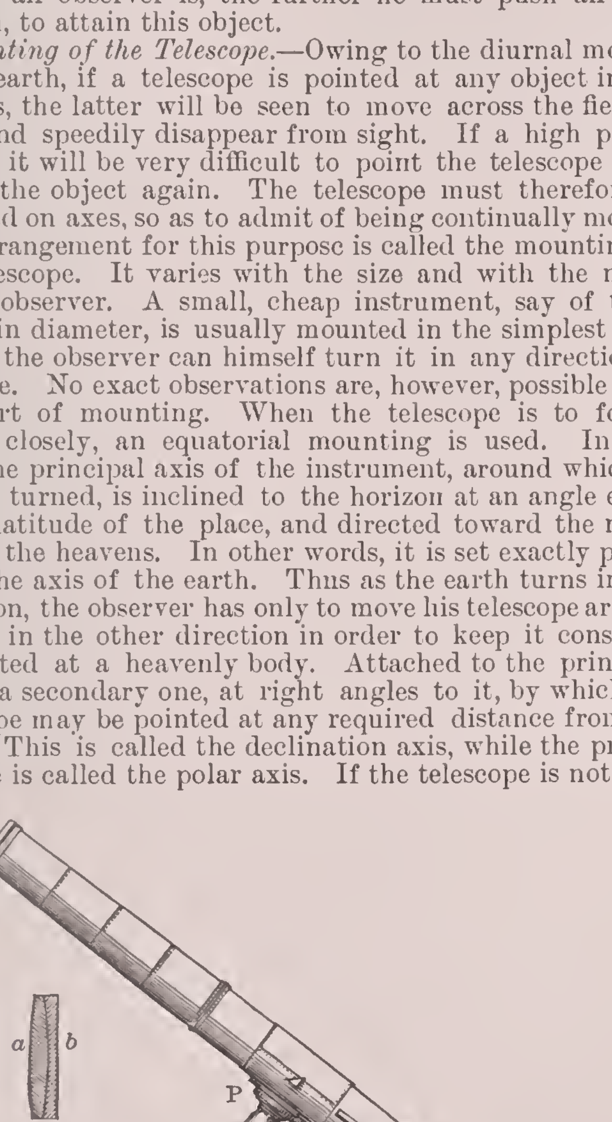



Fig. 5.—An equatorial telescope: A, section of object glass; *a*, crown lens; *b*, flint lens; PQ, polar axis; PD, declination axis; H, clockwork to turn telescope round the polar axis; F, finder; E, eye-piece.

large, it is frequently constructed so that the observer can move it around the polar axis by turning an endless screw. This would be very troublesome in a large instrument. A complete telescope must therefore be fitted with clock-work, so arranged as to make this motion automatically. Then, when the telescope is pointed at a star, clamped, and the clock-work set in motion, the star remains in whatever point of the field the observer may set it, just as if the earth were at rest.

*History of the Telescope.*—The question as to who was the first real inventor of the telescope is involved in some obscurity. What is certainly known is that telescopes were first made in Holland, about the year 1608, when Hans Lipperhey applied for a patent for such an instrument. It seems an attempt was made by the Dutch authorities to have the invention kept secret. The first telescopes were of course very imperfect instruments, the object-glass consisting only of a single small lens. It does not seem that the Dutch inventors attempted to apply the instrument to any important purpose. This was first done by Galileo in 1610, who, having heard of it, reasoned out the principles on which it ought to be constructed. Galilean telescopes consisted of an object-glass and a concave eye-piece, the latter being placed inside the focus. This form is still used in opera-glasses, but does not admit of a high power being obtained with distinctness. Galileo, however, was able with this imperfect instrument to see the phases of Venus and the satellites of Jupiter, making the discoveries which have made his name immortal.

The great difficulty encountered by the astronomers of the seventeenth century arose from the chromatic aberration of the telescope. It was found that this defect could be diminished by increasing the focal length, but then the instrument would soon become unmanageable. This led to the invention of the reflecting telescope, in which no such defect exists. The latter instrument underwent gradual improvement from the time of Newton to that of Herschel, a hundred years later, who brought it to great perfection. Meanwhile Chester More Hall, of England, about 1733, invented the combination of crown lenses and flint lenses already described, which would in great part correct not only the chromatic but also the spherical aberration. The invention was brought into practical use by Dollond, of London, whose telescopes acquired great celebrity during the latter half of the eighteenth century; but their size was only what is now considered the smallest. Up to 1800 it was thought almost impossible to make a good disk of flint glass of more than 4 or 5 inches in diameter. The difficulty was that the great density of the lead, which is a component of the flint glass, caused the lower part of the pot of glass to be denser than the upper part. By skill and attention glassmakers learned how to obviate this difficulty, so that early in the nineteenth century disks of 8 or 10 inches became common, and before the middle of the century they were carried to 15 inches. The difficulty then was on the part of the optician to grind lenses of this size so perfect in figure that they would bring all the rays to the same focus. The greatest artist in this respect during the first half of the century was Fraunhofer, of Germany. None of his immediate European successors was able to improve upon his work. The first person to do this was a comparatively obscure portrait-painter, Alvan Clark, of Cambridgeport, Mass. About 1846 he began to experiment in grinding lenses, and by 1853 had attained such success that a glass of nearly 8 inches diameter was purchased from him by Rev. W. R. Dawes, a member of the Royal Astronomical Society. This gentleman found that Mr. Clark's glass was superior to any that he had been able to obtain elsewhere; a conclusion which speedily established the reputation of the maker. He and his two sons continued to make larger and larger instruments, as orders were given, until his work culminated in the grinding of the 36-inch telescope of the Lick Observatory and that of his son, Alvan G., in the Yerkes telescope of Chicago, 40 inches in diameter.

So far it would seem that the refracting telescope has outstripped the reflector. The difficulties already mentioned are such that no great improvement has certainly been made in reflecting telescopes in recent times. Those of 4 and 5 feet diameter, made for or by A. A. Common, of England, may be taken as the latest and best result of art in this direction.

*Principal Telescopes of the World.*—The greatest refracting telescope ever made is that given by Charles T. Yerkes, of Chicago, to the university of that city. The diameter of the object-glass, made by Alvan Clark & Sons, is about 40 inches, and the focal length 64 feet. The mounting is by Warner & Swazey, of Cleveland, O. To give some idea of its dimensions, it may be stated that the movable part of the instrument, which turns on the polar axis, weighs about 12 tons, and the clock which turns the telescope weighs 1½ tons. It is to be mounted near Geneva Lake, Wis., so as to be away from the smoke of the city.

Next in size comes the great telescope of the Lick Observatory, California, which, under the terms on which the institution was founded, was to be supplied with the largest telescope in existence. It was completed in 1887. The object-glass was figured by Alvan Clark & Sons, and the mounting was done by Warner & Swazey.

Third in size are two practically equal telescopes of 30 inches diameter: that of the Russian Imperial Observatory, at Pulkowa, of which the object-glass is by Clark & Sons, and the mounting by the Repsolds, of Hamburg, and the telescope of the Nice Observatory, in France, of which the object-glass is by the Henry Brothers, of Paris, and the mounting by Gauthier, of the same city.

There are also two refracting telescopes of 26 inches aperture: one at the Naval Observatory in Washington, the other at the Leander McCormick Observatory, University of Virginia. Both were originally made by Alvan Clark & Sons, but the Washington telescope was remounted in 1893 by Warner & Swazey.

A telescope of 25 inches aperture was constructed in England by Messrs. Cook, for Mr. Newall, of Gateshead, in 1870; it was later given to the University of Cambridge.

The Vienna telescope is 27 inches in diameter, and was made by Sir Howard Grubb, of Dublin, in 1882. There are also at various observatories in the U. S. telescopes of considerable size, which are mentioned in the general list at the end of this article.

Bibliography.—For very full information about the use of a telescope by an amateur observer, see Chambers's *Astronomy*, 4th ed., vol. ii. (London, 1890). For a popular account, see Newcomb's *Popular Astronomy*. The mathematical theory of the formation of images by lenses is developed in the classic memoir of Gauss, *Dioptrische Untersuchungen* (*Werke*, vol. v.); in Pendlebury's *Lenses and Systems of Lenses* (London, 1884); and in Steinheil and Voit's *Angewandte Optik* (Leipzig, 1891). A brief but fairly complete history of the invention is found in Poggendorf's *Geschichte der Physik* (Leipzig, 1879) and a shorter one in Grant's *History of Physical Astronomy* (London, 1852). Discussions of recent improvements are found in great number in the volumes of *Monthly Notices of the Royal Astronomical Society*. The *Journal of Astrophysics*, published monthly at Chicago, and the *Observatory*, published at Greenwich, are also valuable for discussions of the latest proposed improvements.
S. Newcomb.

LIST OF THE PRINCIPAL TELESCOPES (BY PROF. J. K. REES).

*I. Refracting Telescopes with Object Glasses 13 Inches in Diameter and over.*

| OBSERVATORY. | Maker of lenses. | Aperture. | Focal length. | Remarks. |
|---|---|---|---|---|
| Yerkes, Geneva Lake, Wis. | A. G. Clark, 1894 | 40·0 in. | 64 ft. | For University of Chicago. |
| Lick, California | A. Clark & Sons, 1887 | 36·0 in. | 57 ft. 10 in. | |
| Meudon, France | .......... | 32·0 in. } | .......... | Photographic lens. |
| | | 24·0 in. } | .......... | Visual lens. |
| Imperial, Pulkowa, Russia | A. Clark & Sons, 1885 | 30·0 in. | | |
| Nice, France | Henry Brothers, 1886 | 29·9 iu. | | |
| Meudon, France | Martin | 29·0 in. | | |
| Royal, Greenwich, England | Sir H. Grubb, 1893 | 28·0 in. | | |
| Imperial, Vienna, Austria | Sir H. Grubb, 1881 | 27·0 in. | 29 ft. | |
| Royal, Greenwich, England | Sir H. Grubb, 1895 | 26·0 in. | | Astrographic equatorial. |
| Naval, Washington, D. C | A. Clark & Sons, 1873 | 26·0 in. | | |
| Leander McCormick, Charlottesville, Va. | A. Clark & Sons, 1881 | 26·0 in. | 32½ ft. | University of Virginia. |
| Cambridge, England | Cooke & Sons, 1870 | 25·0 in. | | |
| Harvard University, Cambridge, Mass. | A. G. Clark | 24·0 in. | .......... | Photographic doublet. |
| National, Paris, France | Henry Brothers | 23.6 in. | 59 ft. | Equatorial Coudé. |
| Halsted, Princeton, N. J | A. Clark & Sons, 1883 | 23·0 in. | | |
| Chamberlin, Denver, Col | A. Clark & Sons, 1881 | 20·0 in. | | |
| Brera, Milan, Italy | Merz | 19·1 in. | | |
| Manila, Philippine islands | Merz | 19·2 in. | | |
| University, Strassburg, Germany | Merz & Mahler | 19·0 in. | 27⅛ ft. | |
| University of Chicago | A. Clark & Sons, 1862 | 18½ in. | 23 ft. | |
| Van der Zee, Buffalo, N. Y | Fitz | 18·0 in. | .......... | Dismounted. |
| Lowell, Flagstaff, Ariz. | A. Clark & Sons | 18·0 in. | | |
| Lowe, Echo Mountain, Cal | A. Clark & Sons | 16·0 in. | 22 ft. | Formerly in Rochester, N. Y. |
| Goodsell, Northfield, Minn. | A. Clark & Sons | 16·0 in. | | |
| Washburn, Madison, Wis. | A. Clark & Sons, 1879 | 15·6 in. | 20 ft. 3 in. | |
| Dunecht, Aberdeen, Scotland. | T. Grubb, 1872 | 15·1 in. | 15 ft. | |
| Tulse Hill, London, England | T. Grubb | 15·0 in. | | |
| Pulkowa, Russia | Merz & Mahler, 1840 | 15·0 in. | | |
| Harvard University, Cambridge, Mass. | Merz & Mahler, 1843 | 15·0 in. | 22 ft. 6 in. | |
| National, Paris, France | Lerebours | 15.0 in. | | |
| Madrid, Spain | Merz & Son | 15·0 in. | | |
| Royal, Brussels, Belgium | Merz & Son | 15·0 in. | 25 ft. | |
| Bordeaux, France | Merz & Son | 14·9 in. | 27 ft. | |
| Nice, France | Henry Brothers | 14·9 in. | 27½ ft. | |
| Lisbon, Portugal | Merz & Mahler | 14·6 in. | | |
| Markree Castle, Ireland | .......... | 14·0 in. | | |
| Hamilton College, Clinton, N. Y | Spencer | 13·5 in. | | |
| Dudley, Albany, N. Y | Fitz | 13·0 in. | 15 ft. | |
| Columbia College, New York | Rutherfurd & Fitz | 13·0 in. | 15 ft. 2 in. | |
| Allegheny, Pa | Fitz | 13·0 in. | | |

*II. Reflectors with Mirrors of 24 Inches Diameter and over.*

| | | Diam. of mirror. | | |
|---|---|---|---|---|
| Birr Castle, Ireland | Rosse, 1844 | 6 ft. | 54 ft. | Speculum metal. |
| Common, Ealing, England | A. A. Common, 1891 | 5 ft. | 27 ft. | Silver on glass. |
| Herschel, Slough, England | W. Herschel | 4 ft. | 40 ft. | Dismounted. Speculum metal. |
| Lassell, Liverpool, England | Lassell, 1860 | 4 ft. | 37 ft. | Destroyed. Speculum metal. |
| Melbourne, Australia | T. Grubb, 1870 | 4 ft. | 28 ft. | Speculum metal. |
| National, Paris | Martin, 1875 | 4 ft. | .......... | Silver on glass. |
| Birr Castle, Ireland | Rosse, 1839 | 3 ft. | .......... | Speculum metal. |
| Bermerside, Halifax, England | Calver, 1879 | 3 ft. | .......... | Silver on glass. |
| Toulouse, France | Henry Brothers | 31½ in. | .......... | Silver on glass. |
| Marseilles, France | Foucault | 31½ in. | .......... | Silver on glass. |
| Harvard University, Cambridge, Mass. | H. Draper, 1870 | 28 in. | .......... | Silver on glass. |
| Royal, Greenwich, England | W. Lassell, 1846 | 24 in. | 20 ft. | Speculum metal. |
| Royal, Edinburgh, Scotland | T. Grubb, 1872 | 24 in. | .......... | Silver on glass. |
| Westmeath, Ireland | Sir H. Grubb, 1881 | 24 in. | 10½ ft. | |

Photographic telescopes, employed in taking photographs for the purpose of making a catalogue of the stars to be measured on the plates, and in the construction of a photographic chart of the heavens (photographic lens 13 inches, with 11-inch visual refractor in each case), are mounted at the following observatories: Paris, Algiers, Bordeaux, Toulouse, San Fernando, the Vatican, La Plata, Rio de Janeiro, Santiago, Helsingfors, Potsdam, Catania, Greenwich, Oxford, the Cape of Good Hope, Melbourne, Sydney, and Tacubaya.

**Telesil'la** (Gr. Τελέσιλλα) **of Argos**: lyric poet and heroine, who flourished about 510 b. c. Her warlike deeds in the struggle of Argos against Sparta are probably mythical, and her poetry is represented by two lines in Bergk's *Poetæ Lyrici Græci* (vol. iii., p. 380, 4th ed.). B. L. G.

**Telford**, Thomas: engineer; b. at Westerkirk, Dumfriesshire, Scotland, Aug. 9, 1757; became a stone-mason, and studied architecture and drawing; went to London 1783, and was architect in the Portsmouth dockyard; in 1787 removed to Shrewsbury. His first great engineering work was the construction of the Ellesmere Canal, 103 miles long, which was begun in 1793 and completed in ten years. In 1803 he was intrusted with the construction of the CALEDONIAN CANAL (*q. v.*), connecting the Atlantic Ocean with the North Sea, the ascent and descent being accomplished by locks of a size surpassing any heretofore attempted; this was completed in 1823. Besides other works, as engineer to the commissioners of Highland roads and bridges, he built about 1,000 miles of road in Scotland, upon which are more than 1,200 bridges; he constructed eight canals in Great Britain, the Göta Canal in Sweden, and the beautiful suspension railway bridge over the Menai Strait. The Telford pavement was invented by him. The Institution of Civil Engineers was founded in 1818 mainly through his influence, and he was its first president. Before he left his native district he wrote several very creditable poems in the Scottish dialect; he contributed valuable papers to *The Edinburgh Encyclopædia*, and left *The Life of Thomas Telford, Civil Engineer, written by himself* (1838). D. at Westminster, Sept. 2, 1834. Revised by MANSFIELD MERRIMAN.

**Telford Pavement**: See ROADS.

**Tell**, WILLIAM: according to Swiss legends, a celebrated marksman with the bow, living as a hunter at Bürglen in the canton of Uri. He was a member of the conspiracy which was formed against Austria at Grütli Nov. 7, 1307, by Walter Fürst, of Uri, his father-in-law, Werner Stauffacher, of Schwytz, and Arnold von Melchthal, of Unterwalden, and which finally succeeded in freeing the country from the foreign yoke. At this time Gessler, the Austrian bailiff in Küssnacht, raised a cap on a pole in the market-place of Altorf and ordered all passers-by to bow to the cap in token of submission. Tell refused, and was condemned to death, but pardoned on condition that he should shoot an apple from the head of his son. He ventured the shot and succeeded, but Gessler noticed that he had put two arrows in his quiver, and asked why he had done so; and when Tell answered that if he had killed his son with the one he would have killed the bailiff with the other he was again put in chains and taken on board the bailiff's boat to be brought to Küssnacht. While crossing the lake the boat was overtaken by a fearful storm and Tell was unchained in order to steer it, but at a certain point, known as Tell's Leap, he jumped ashore, lay in ambush in a defile through which Gessler had to pass on his way to Küssnacht, and shot him; which deed became the occasion of a general rising in the cantons. Of this story about Gessler, Tell, Stauffacher, etc., the oldest Swiss chroniclers, Johannes, of Winterthur, Justinger, of Berne, and Hemmerlin, of Zurich, know nothing. The first mention of these names and incidents is made in the latter part of the fifteenth century by *Das weisse Buch*, and a complete narrative does not occur until the middle of the sixteenth century in the *Chronicon Helveticum*, by Ægidius Tschudi. The monuments erected in various places in honor of Tell are of a much later date. These circumstances early made the story of William Tell somewhat suspected, though as a general rule it was considered as real history; even Johannes von Müller accepted it. Later critics, however, have proved that the whole story is nothing but a legend common among the nations of the Aryan race, found with all its principal features in the Persian poet Farîd Uddîn Attâr, the Icelandic *Thidreksaga*, the Danish historian Saxo Grammaticus, the English popular song on William of Cloudesley, etc., and only modified to suit Swiss circumstances. It has been proved further, especially by Rochholz, that Gessler, too, is the product of imagination, and that a bailiff of that name did not exist at the time when Tell is said to have lived. The best poetic treatment of the Tell saga is that by Schiller in his famous drama *Wilhelm Tell*. Besides the account of the Tell legend in Tschudi, Schiller probably knew and used some of the old Tell plays popular in Switzerland. See Ideler, *Die Sage vom Schusse des Tells* (1836); Häusser, *Die Sage vom Tell* (1840); Hisely, *Recherches critiques sur l'Histoire de Guillaume Tell* (1843); Huber, *Die Waldstädte Uri, Schwyz und Unterwalden bis zur festen Begründung ihrer Eidgenossenschaft* (1861); Vischer, *Die Sage von der Befreiung der Waldstädte* (1867); Rochholz, *Tell und Gessler in Sage und Geschichte* (1877); and G. Röthe, *Die dramatischen Quellen des Schill. Tell*, in *Forsch. z. d. Philologie* (1894). Revised by JULIUS GOEBEL.

**Tell City**: city (settled by Swiss colonists in 1858); Perry co., Ind.; on the Ohio river, and the Louisv., Evansv. and St. L. Consolidated Railroad; 3 miles N. W. of Cannelton and 75 miles E. of Evansville (for location, see map of Indiana, ref. 11–D). It is in a coal-mining region; has Lutheran and English and German Methodist and Roman Catholic churches, a parochial and 2 public-school buildings, an incorporated bank with capital of $25,000, and 3 weekly newspapers; and flour, woolen, saw, and shingle mills, foundry and machine-shop, distilleries, breweries, and chair, furniture, and plow factories. Pop. (1880) 2,112; (1890) 2,094; (1900) 2,680. EDITOR OF "JOURNAL."

**Tell el-Amar'na**: a modern Arab village in Egypt, on the east side of the Nile, midway between ancient Thebes and Memphis, and 190 miles S. of Cairo (27° 30′ N. lat.). It is near the ancient site of the capital founded and built by Amenophis IV., or KHUNATEN (*q. v.*), the "heretic" king who attempted to supplant the cult of Amon of Thebes by that of Aten, being a form of solar monotheism. Abandoning Thebes, the previous royal residence, Khunaten chose the plain of el-Amarna. It is about 12 miles long by 5 broad. The city occupied its southwestern portion, and its site is indicated by low mounds which are about 5 by 2 miles in extent. These ruins show a systematic plan and are intersected by broad streets. The materials used in construction were mud bricks faced with plaster, except that stone was employed for altars, stelæ, and for pavements, doorsteps, and in other places exposed to hard usage. The king's palace was located on the side toward the river, and its painted pavements have been uncovered. The central and eastern portions were occupied by the temple of Aten, while the southern portion was devoted to the quarters of workmen and artisans. The designs are Egyptian in character, but bear a foreign appearance as though executed by foreign workmen. As is well known, the royal court of the time was under foreign influence, even if it was not itself of foreign stock. In the cliff back of the city are many tombs of adherents of the new form of the Egyptian religion.

In the winter of 1887–88 some 320 clay tablets, perfect or fragmentary, inscribed with cuneiform inscriptions, were found among the ruins of a building adjacent to the palace, and are now preserved in the museums of London, Berlin, and Gizeh. They were written in the Babylonian language and date from the fifteenth century B. C. Most of them are communications from various persons in the East, kings, governors, or agents, made to Amenophis III. and Amenophis IV., or Khunaten. They contain many well-known local names, such as Jerusalem, Lachish, Ascalon, Gezer, Joppa, Hazor, Accho, Sidon, Tyre, and Beirut. See Bezold and Budge, *The Tell el-Amarna Tablets in the British Museum* (London, 1892); Bezold, *Oriental Diplomacy* (London, 1893); Sayce, *Records of the Past*, 2d series, vols. ii., iii., v., vi.; *Higher Criticism and the Monuments* (London, 1893); Evetts, *New Light on the Bible and the Holy Land* (London, 1894); *Proceedings of the Society of Biblical Archæology*, x., 540–569 (Budge); x., 488–525, xi., 326–413 (Sayce); *Zeitschrift für Assyriologie*, iii., 372–406 (Lehman, *Aus dem Funde von Tell el-Amarna*); v., 137–165 (Zimmern, *Briefe aus dem Funde in el-Amarna*); vi., 245–63 (Zimmern, *Die Keilschriftbriefe aus Jerusalem*). See also Baedeker's *Upper Egypt*, p. 20 ff. CHARLES R. GILLETT.

**Tell el-Kebir'** [Arab. = the great mound]: a village in the province of Sharkiah in Lower Egypt; situated upon a canal of sweet water which flows from Suez to Zagazig. It lies slightly N. of Tell el-Mashkutah, the site of ancient Pithom. Tell el-Kebir was the scene of a fierce battle between British and Egyptian troops, which decided the fate of the rebellion instigated by Arabi Pasha. In this place, chosen by nature to be a fortress, Arabi had intrenched 50,000 men with 150 cannon and plenty of ammunition. Sir Garnet Wolseley, the British commander-in-chief, had, by a ruse, become possessed of the Suez Canal. On the march toward Cairo, Maj.-Gen. Graham had advanced as far as Kassassin, where he had been attacked by the Arabs. It was not until the night of Sept. 12, 1882, that Wolseley felt secure enough in order to move forward. On the morning of the 13th the British forces, to the number of 14,000, moved forward and took the fortifications raised at Tell el-Kebir at the point of the bayonet. Though the Egyptians fought bravely, their camp and 3,000 soldiers fell into the hands of the British. By continued prompt action Wolseley saved Cairo from a destruction which Arabi had prepared for it.

See Appletons' *Annual Cyclopædia* (new series, vol. vii., 1887, p. 251); Goodrich, *Report of the British Naval and Military Operations in Egypt: Information from Abroad* (War Series, No. 3, p. 146). R. GOTTHEIL.

**Teller**, HENRY MOORE, LL. D.: U. S. Senator; b. at Granger, Allegany co., N. Y., May 23, 1830; educated at Alfred University, New York; studied law, and was admitted to the bar at Binghamton, N. Y., 1858; removed to Illinois in 1858, thence to Colorado in 1861; was elected U. S. Senator (Republican) on the admission of Colorado as a State in 1876; re-elected for 1877–83; chairman of special committee on election frauds, known as the Teller committee, 1877–78. He was U. S. Secretary of Interior from Apr. 6, 1882, to Mar. 4, 1885; re-elected U. S. Senator from Colorado in 1885, 1891, and 1897.

**Téllez**, tel'yāth, GABRIEL, Maestro Fray (better known by his *nom de guerre* of TIRSO DE MOLINA): dramatist; b. in Madrid, Spain, some time between 1570 and 1585. The details of his life are almost entirely unknown. He was educated at Alcalá de Henares, and later (perhaps when well advanced in life) took orders in the Church. He entered the order of Nuestra Señora de la Merced Calzada, and became a famous preacher; was made chronicler of his order; inspector of the convents in Old Castile; and Sept. 29, 1645, was elected prior of the monastery of Soria. D. in Soria about 1648. As a dramatist he belonged to the school of Lope de Vega, as he himself acknowledged. So prolific was he, however, that he is one of the chief figures of the golden age of the Spanish drama. He informs us that he had written 300 plays, but only fifty-nine are extant. Many of these are remarkable for the looseness of their situations and their language; and the Inquisition is known to have hunted down and destroyed his works on this account, wherever it could find them. Undoubtedly the most famous of his plays is *El Burlador de Sevilla*, in which, using a dramatic situation from Lope's *Dineros son Calidad* and a theme perhaps derived from real life, the poet first worked out the story of Don Juan Tenorio, so famous in European literature since. Another play, a most intricate comedy of intrigue, *Don Gil de las Calzas Verdes*, has held its place on the Spanish stage down to the present. A different side of Tirso's genius is shown in the grave and deeply religious play *El Condenado por desconfiado* (The Doubter Damned). Like all the Spanish dramatists of his time, he showed the greatest facility in turning from the gay to the serious; and several of his *Autos*, or religious dramas, are excellent in their kind. Besides plays, Tirso wrote two famous collections of stories after the fashion of the *Decameron*—the *Cigarrales de Toledo* (1st ed. 1621 or 1624)—giving the stories, verses, and plays supposed to have been recited to a wedding company at country-houses (*cigarrales*) near Toledo, and *Deleitar Aprovechando* (Pleasure with Profit, 1625), more moral, but never finished. The *Comedias* of Tirso de Molina, so far as published, first appeared in five parts, between 1627 and 1636. A selection of thirty-six of the best plays was edited by Hartzenbusch, 12 vols., 1839–42; 3d ed. 1 vol., 1885 (vol. v. of Rivadeneyra's *Biblioteca de Autores Españoles*). Tirso's *Novelas* are printed in vol. i. of Ochoa's *Tesoro de Novelistas españoles* (Paris, 1847). A. R. MARSH.

**Tellicher'ry**: town of Malabar, Madras, British India; picturesquely situated on the open sea in a beautiful, fertile, and well-cultivated district rich in spices, rice, and cocoanut-palms (see map of S. India, ref. 6–C). It has a good harbor and exports spices and sandal-wood. Pop. (1891) 27,196, of which number 10,000 are Mohammedans and 1,800 Christians. Revised by M. W. HARRINGTON.

**Tel'lurides** [deriv. of *tellurium*]: compounds of the element tellurium with other metals. They constitute chiefly the native mineral compounds of tellurium.

*Bismuth telluride* is the mineral tetradymite, which, as found in gold mines in Virginia and Georgia, has the composition, according to Genth, of pure bismuth telluride, $Bi_2Te_3$, while that from the Uncle Sam lode in Montana contains sulphur and has the composition $Bi_4Te_5S$. Other Montana tetradymites, from placer gold, were found by Genth to be free from sulphur. Genth discovered with these latter tetradymites, and also in Davidson co., N. C., a mineral montanite, a bismuth tellurate, $Bi_2O_3.TeO_3.2H_2O$. Tetradymite is a steel-gray mineral, in inflexible folia or laminæ like graphite, soft and marking paper like the latter, hexagonal in form. It may be distinguished from graphite by roasting in a glass tube open at both ends, when a white sublimate of tellurous oxide will appear, fusible to transparent, colorless droplets. It is also fusible and combustible before the blowpipe, tingeing the flame bluish green.

*Lead telluride* is altaite, a rare white metallic sectile mineral, sometimes in cubical crystals, like galena, the corresponding sulphide. It is PbTe. It is found in the Altai Mountains, and in the U. S. at the Red Cloud mine, Colorado, and at the King's Mountain gold mine in Gaston co., N. C.

*Silver telluride* is the rare mineral hessite, $Ag_2Te$. It is metallic, iron gray, and sectile, and in crystallization right rhombic. It usually contains some gold. It is found in the Altai Mountains, at several Hungarian localities, and at the Stanislaus mine in Calaveras co., Cal. Genth has also noted it in small quantity from the Red Cloud mine, Colorado.

*Gold and silver telluride* is the mineral petzite, found at Nagy-Ag in Transylvania, and also by Genth among the ores of the Red Cloud mine. Genth's analyses indicated 24 and 25 per cent. of gold in the composition of the Colorado petzite. It is scarcely to be distinguished without analysis from hessite in appearance or character. The auriferous mineral is somewhat lighter in color and more brittle. It is right rhombic, like hessite.

*Gold telluride* is sylvanite, which always contains some silver (12 to 13 per cent. at the Red Cloud mine), is monoclinic, steel gray or silver white, and varies in composition and density within wide limits, containing from 23 to 30 per cent. of gold. It is found at two Transylvanian localities in Europe, Nagy-Ag and Offenbanya, and it was unknown in the U. S. until the younger Silliman found it at the Red Cloud mine; but Dana gives also the Melones and Stanislaus mines in Calaveras co., Cal., as localities. Genth obtained gold telluride, calaverite, from the Stanislaus mine, having the composition $AuTe_4$, with about 41 per cent. of gold. Its color is bronze yellow, and its streak yellowish gray. It is brittle, and not crystalline. Revised by IRA REMSEN.

**Tellu'rium** [from Lat. *tel'lus*, *tellu'ris*, earth]: one of the elements of matter belonging to the same family as sulphur and selenium. It is one of the rarer elements, though it is found in a number of minerals. Von Reichenstein believed that he had found a new metal in 1782 while working with some gold ores. Not trusting his own work he sent specimens of the ores to Torbern Bergmann; but Bergmann would not venture a positive conclusion, and it was not until 1798 that Klaproth confirmed the discovery, and then he named the element tellurium. It has been since investigated mainly by Berzelius. Brauner has also contributed to the knowledge of its properties. The occurrence of the element is described in the article TELLURIDES (*q. v.*). It is found in a number of localities in North America, and if there were a demand for it no doubt it could be obtained in any desired quantity. The ores are treated with strong oxidizing agents, such as aqua regia, chlorine, etc., by which the tellurium is converted into tellurous acid, $H_2TeO_3$. By treating with sulphurous acid the acid is then reduced to the form of the element. Tellurium is silver white, very lustrous, and crystallizes very easily. It is brittle, does not conduct heat well, and conducts electricity very little. Under the influence of light the electrical conductivity is somewhat increased, though the increase is by no means as marked as in the case of selenium. When tellurium is strongly heated, it takes fire and burns with a strong flame which is blue with green edges, and gives off a thick white smoke of tellurium dioxide, $TeO_2$, which has a peculiar weak acid odor. It was formerly supposed that this vapor has the odor of rotten radishes, but this is wrong, as the latter odor is caused by the presence of a small quantity of selenium. Tellurium melts at about 500° C., and at a higher temperature it is converted into a golden yellow vapor. Its atomic weight is 125. Revised by IRA REMSEN.

**Telugu**: See DRAVIDIAN LANGUAGES.

**Temesvar**, tăm-esh-vaar': town; in Hungary; on the navigable Bega Canal, which joins the Theiss at Titel, 5 miles from the Danube (see map of Austria-Hungary, ref. 8–J). It is well built with broad, straight streets lined by handsome houses. Its cathedral and synagogue are splendid edifices, and it has fine monuments and educational institutions. The castle, erected by Huniadi in 1443, is now the arsenal. The town was held by the Ottomans from 1552 to 1716, when it was taken by Prince Eugene of Savoy. It was almost destroyed when besieged by the Hungarians from Apr. 25 to Aug. 9, 1849, but was delivered by Haynau. It manufactures leather, silk and cotton fabrics, and carries on an extensive transport trade in wheat and wine. Pop. (1890) 39,884. E. A. GROSVENOR.

**Temis'camingue Lake**: a body of water on the boundary between the provinces of Ontario and Quebec of the Dominion of Canada. It is 30 miles long and 15 broad, and is in lat. 47° 30′ N., lon. 80° W. Its waters flow into Ottawa river. Its basin is the seat of a French-Canadian colonization of several hundred families.

**Tem'minck**, CONRAD JACOB: naturalist; b. in Amsterdam, Holland, Mar. 31, 1778; entered the service of the Dutch East India Company, and became a student of natural history. His principal work was *Manuel d'Ornithologie* (1815; enlarged ed., 4 vols. 8vo, 1835–40). He was also author of *Nouveau Recueil de Planches coloriées d'Oiseaux* (folio, 1820–44), consisting of 600 plates. He became director of the Natural History Museum at Leyden in 1820. He wrote a number of important works respecting the East Indies; among others, *Coup d'œil général sur les possessions Neerlandaises dans l'Inde Archipélagique* (3 vols., Leyden, 1847–49). D. Jan. 30, 1858. Revised by F. A. LUCAS.

**Tem'pe** (in Gr. τὰ Τέμπη): a valley, or rather a gorge, in Northeastern Thessaly, Greece; 5 miles long, and in some places so narrow that between the high cliffs which rise almost perpendicularly on both sides there is space only for the river Peneus, which traverses the valley, and a carriage-road. In antiquity it was very celebrated for the beauty of its scenery. It was strongly fortified at several points, and ruins of these fortifications are still visible. It is now called Lykostomo. Revised by J. R. S. STERRETT.

**Temperament** [from Lat. *temperamen'tum*, a mixing in due proportion, temperament, disposition, deriv. of *temperare*, divide, proportion, mingle in due proportion]: in keyed instruments, such as the organ and piano, a certain adjustment or regulation of the sounds or intervals of the scale, with the view of removing an apparent imperfection, and fitting the scale for use in all keys without offense to the ear. The musical scale in use in keyed instruments is a compromise, or a scale in which most of the intervals are not mathematically correct, or true to the scale of nature as deduced from the MONOCHORD (*q. v.*), but are slightly modified by elevation or depression, a process absolutely necessary to meet the various exigencies of modern music. This modifying or nice adjustment of the sounds of the scale is the office of temperament; and in tuning an organ or piano the first thing done is the fixing of the temperament by adjusting with great care a single octave in the middle of the keyboard as a pattern from which all the other pipes or strings, above or below, are to be tuned by octaves, double octaves, etc.

It has been found that though the perfect octave seems to be divisible into six major tones, as C—D, D—E, E—F♯, F♯—G♯, A♭—B♭, and B♭—C, yet these, when added together, are really somewhat more than an octave. Again, though the octave seems divisible into three major thirds, as C—E, E—G♯, and A♭—C, yet by strict measurement these three thirds prove to be less than the octave in extent. This is illustrated in the following manner by E. J. Hopkins, of the Temple church, London, in his work on *The Organ*: "Supposing the perfect octave to be divided into 3,010 equal parts, the interval of a major tone would contain 511 of those parts. But if we multiply 511 by 6, we have 3,066, instead of 3,010, plus 56 parts; so that the octave contains less than 6 major tones by 56 parts. A major third also would contain 969 parts, which multiplied by 3 would make 2,907, instead of 3,010, minus 103 parts; the octave in this case containing 103 parts more than the three major thirds." To distribute or get rid of this excess or shortcoming resource can only be had to temperament—i. e. the modifying of several of the intervals by very slightly raising or lowering them, so as to extend or contract their whole sum to the exact limits of the octave. In the practice of tuning, this apparent irregularity or imperfection of the scale is usually treated as an overplus, which must be disposed of by some method which shall not so affect any interval of the scale as to make it offensive to the ear. Several modes of doing this have been devised, and these are commonly classed under the heads of equal and unequal temperament.

On an instrument unequally tempered the excess is unevenly distributed, so that some of the intervals will be perfectly smooth and agreeable, while others will be harsh. In old church organs this temperament was in general use. Music formerly was written in very few keys, and modulations were seldom carried into remote scales. It was customary, therefore, to make the keys that were in common use as perfect as possible, at the expense of the other keys, on which all the roughness of the temperament was concentrated. Under the requirements of modern music, with the whole circle of the keys in common use, this unequal temperament has become obsolete. In equal temperament the excess or deficiency above noted is distributed among all the keys, thereby rendering them all available for use, and enabling the composer to present harmonious combinations in the remotest keys without any disagreeable effect. There are, however, several shades or degrees of equal temperament, from the strictest uniformity to any amount of inequality which is still bearable. If all keys were made exactly alike, there would be an undesirable loss of their individual character, and no difference perceptible except in their degree of acuteness. To avoid this, some discrimination is commonly used in favor of certain popular keys, yet not to such an extent as sensibly to injure the effect of keys less favored. A difference is recognized at once between the major keys of D and A♭, even though the instrument in use is said to be equally tempered. In musical theory and in treatises on harmony a tempered interval does not differ by name from an untempered one. Thus the fifth C—G, though reduced by temperament, is still called and assumed to be a perfect fifth; and all terms indicating chords, combinations, and progressions remain unaffected by any influence from temperament. Revised by DUDLEY BUCK.

**Temperament**: the general temper or disposition of a person. The word is of popular origin, signifying the most general characteristics which distinguish one person from another. Such differences as those between phlegmatic and nervous individuals have a fairly evident basis in the popular use of the terms. Yet the doctrine of temperaments is very undeveloped. In the older physiology and medicine humors or bodily fluids were supposed to exist in varying quantities and varied mixtures in different persons; so among philosophers, Descartes and Priestley. Four temperaments were distinguished—the choleric, the sanguine, the phlegmatic, and the melancholic. Later writers, to whom the problem was one mainly of psychological interest, have classed the temperaments under much the same words, but with more adequate theoretical grounds. For example, Wundt arranges the temperaments under two great classes, each again having two divisions: first, as having a prevailing degree of quickness or sluggishness (i. e. fast and slow), and second, as being weak or strong. As follows:

| CLASS. | Strong. | Weak. |
|---|---|---|
| Fast | Choleric. | Sanguine. |
| Slow | Melancholic. | Phlegmatic. |

The grounds of explanation of such vaguely defined characteristics are about as vague in both medical and psychological literature. Two general suppositions underlie current explanations: The differences are considered either vaso-motor in their seat, due to differences in the blood-circulation, pressure, etc., or nervous, matters of hereditary variation on the side of sensibility. This latter explanation, vague as it is in respect to any definite determination of the actual basis of any of the so-called temperaments, is probably the line of inquiry which offers most promise for future research. An attempt has been made by Paulhan to distinguish the temperaments on the ground of individual peculiarities in the manner and facility of movement, giving such divisions as impulsive, inhibitive, reflective temperaments, etc. This has also a certain interest.

A distinction made by the pathologists in investigating speech-troubles seems to throw a little light upon this obscure subject. Men are distinguished as of various types, such as visuals, auditives, motors, etc., according as they depend mainly on one kind of sense-memories or another (those of sight, hearing, etc.) for the readiest speech. These distinctions probably apply also to other functions, and it is possible that in the future the criteria of mental "type" may be so defined as to cover broadly the phenomena now ascribed to temperament. This, combined with the investigation of nervous heredity, may be expected to clear up the topic somewhat. J. MARK BALDWIN.

**Temperance** [viâ O. Fr. from Lat. *temperan'tia*, moderation, sobriety, deriv. of *tem'perans*, pres. partic. of *tempera're*, mix in due proportion, temper, moderate]: moderation or abstinence respecting the use of intoxicating liquors. It is more common among the more educated and refined classes in the community than it was a century ago. At that time all classes indulged often to excess and without a thought of the impropriety of so doing. The disgusting stories of what happened without rebuke from public opinion in Europe or the U. S. are not myths. Some of the worst of these occurrences, which would not now be tolerated in any decent society, were then generally considered as mere practical jokes; but such facts could not long occur in any reasonable community without exciting decided opposition from the more thoughtful members of it. The evils arising therefrom were too patent. Hence arose temperance societies, so called—societies of men and women pledged to promote temperance in the use of intoxicating drinks, *not* total abstinence as now generally inculcated by their successors. After some years their efforts seemed weak and success impossible to the more earnest advocates. Hence have arisen various movements, all aiming to promote the same general object, the suppression of the liquor traffic and the disuse of alcohol in any form as a beverage. During the first half of the nineteenth century the so-called Washingtonian movement began in Baltimore. This for a season aroused the whole people and was the means of exciting a deep interest in the subject. It may be styled the confessional phase of the temperance movement. The pioneers and chief workers in it pleaded the cause of temperance by minutely detailing at public meetings their own erratic courses. Every drunkard became for the time being a most effective apostle, not only of temperance, but of total abstinence; but this movement did not last long, because (1) some of these apostles became backsliders, and (2) because after a time the community became nauseated with the revelations made by some of the speakers. Total abstinence was an essential article of faith for every Washingtonian. For him certainly that rule was supreme and admitted by all to be absolutely necessary. Following these have arisen societies, some of which declare that the taking of stimulants in any amount by any person is unnecessary and virtually a crime against society, a sin *per se*, while others acknowledge that many, perhaps a majority of, persons may indulge with personal safety, but urge that all should practice abstention as needful for the remainder, the strong assisting to bear the burdens of the weak and thus carrying out the Christian law of charity as taught by St. Paul. The doctrine that everybody should forego the use of all liquors because some became drunkards was a logical and practical one for the Washingtonians; but it was by no means an equally obvious conclusion when applied to the whole public, as the Prohibitionists for many years have been trying to do. The old temperance societies opposed this idea, but either failed of meeting it or were finally subdued by it. Licenses given by the state are by Prohibitionists deemed wrong in principle, as licensing a crime, or at least a great social evil which should be made the subject of legal restriction as well as gambling. Hence for years the questions of prohibition and license have been the watchwords of bitterly opposing partisans. It is proposed briefly to examine these two systems of promoting temperance.

Alcohol has been proved to be at times a remedy of immense value to man. In order to be thus valuable to mankind it must be used legitimately and under proper safeguards. On the contrary, if used on improper occasions or too frequently or too freely, it ruins man and injures society to its very depths. These two propositions are strictly, scientifically true. It would seem as if none but bigots of either of the contending parties could deny them. Hence it follows that we may properly and justly under the varying circumstances of life take one or the other position of favoring or of opposing either license or prohibition in our dealings practically with the question of temperance. It has been proved by correspondents living in various and widely separated portions of the earth's surface that a tendency to use stimulants exists among all people. From the savage to the most highly civilized race of men there is no one of them that has not this instinct; and with the instinct naturally arises the tendency to excess in the indulgence of it. The desire for this gratification appears, however, to vary much according to a cosmic law of heat and climate. The isothermal lines which limit the growth of the grape N. and S. of the equator seem to divide the northern and southern hemispheres into three tolerably well-marked zones —namely, (1) the tropical, (2) the temperate or grape-growing, and (3) the northern or colder. In the first drunkenness is almost unknown and it is deemed disgraceful, while lusts of other kinds, which are rare at the north, have full sway, unopposed by public opinion. In the second region milder drinks, such as native grape wines, mild beers, and ales, are used, perhaps in very large quantities, producing when drunkenness follows a milder and more jovial, less offensive, less destructive type of it than is observed in the more northern regions. In the third zone man drinks less in amount perhaps, but it is of a more potent fiery liquor. It makes him brutal and beastly, and frequently he becomes destructive of persons and of property. If this be so—and such seems to be the fact—it is plain that prohibition in the first zone would scarcely be thought of; in the second some moralists might suggest it, though it would not be likely to be adopted; in the third it would find its strongest advocates. Parties there would inevitably arise prepared to stop the whole traffic in liquor because of its vile influence on man; and the zeal of these parties would be just in proportion to the enormity of the evil sought to be eradicated. Surely any reasonable plan which proposes to prevent a man from degrading and making a tiger of himself in his intercourse with others should be sustained. Another great influence—viz., that of race, with its centuries of education of certain habits—should always be taken into consideration in judging of this question.

From these considerations it seems to many people that the state as a guardian of the public health is bound to use its great powers to restrain its citizens by actual prohibition from the use of every alcoholic stimulus or to allow the use of them under more or less restriction to all, provided that in so doing it does not interfere with the inherent right of the individual to use any food or drink he may prefer without injury to himself or others. In deciding these delicate questions the community may be divided into childhood and manhood. This is already done on the subject of voting and on many others. Only at certain ages does the male in the eyes of the law become a man and the female a woman. For the former of these classes—i. e. for all persons under the age of legal manhood—the prohibition of the use of liquors or a most restrictive license should be inaugurated and as far as possible thoroughly carried out. For the very young statute law would be rarely needed if the parental authority were duly exercised. The custom in some families, more common formerly than now, of allowing children to sip wine at their father's table is fraught with dangers of the most deadly kind for the future wellbeing of the man and of society; and it must be added that if the father sips his wine at table it will be very difficult to prevent the sons from doing the same when opportunity offers. Statute law should provide still further for the correct guidance of the youthful years of the future citizen, and the giving or selling of liquor to a minor should be prohibited under the severest penalties. When the state appreciates its high prerogative of contributing to the best education of every citizen, then the selling or giving of liquor to a minor will be deemed one of the most heinous of crimes. After the youth arrives at manhood or womanhood—viz., at the age at which even by statute law he or she has the fullest privileges in the choice of good or evil—we can not proceed in this arbitrary way. In consequence, however, of the inherent infirmity of human nature some will then be induced to drink inordinately and behave in a manner contrary not only to their own interests, but to the peace of the commonwealth. All such persons will need the watchful care of the state, and it must assume the parental relation or that of a stern judge, and if no punishment should be sufficient to restrain the drunkard, then the state should seclude him as an insane man in an inebriate asylum.

Again, it has been most justly urged that the state should not only prohibit the sale of liquor to an habitual drunkard, but that the dealer who for the sake of gain violates such a law should be held responsible, not only for that violation, but for all the damages the victim may commit while intoxicated; and, moreover, that the family of the latter, which is bereft of its natural guardian, should be allowed a weekly stipend from the vender during the illness or imprisonment of the father.

Finally, the state, for its own safety and on the sacred principle of *salus populi suprema lex*, should deprive the incorrigible drunkard of his civil rights, as the state treats the felon. Virtually the drunkard throws his recklessly away in the very act of becoming intoxicated. But shall we have prohibition or a limited license for the community at large? This question divides itself when applied to the practical customs of life. The system of open bars for the sale of the coarser liquors and the custom of treating, as practiced by the English-speaking race, and especially in the U. S., are unmitigated evils, and should be forthwith given up or should be crushed by state power. Although they would undoubtedly exist in secret places, it would nevertheless be the greatest boon to the community to have them, at least like the felons they make, obliged to keep out of sight. Should the same prompt measures be applied to the sellers of milder beers, ales, and wines? Undoubtedly these too should be under state and municipal surveillance. Moreover, some of the stronger beers or ales should be classed with the coarser liquors, as they steal away the senses almost as quickly and quite as powerfully as absinthe, whisky, or rum. Another question arises: Should the same rigid rule be applied to native light wines and beers which contain but a small quantity of alcohol and may therefore be used with comparative safety? The difficulty is that, as shown by practical experience, tavernkeepers, licensed to sell beer, will usually sell whisky also, surreptitiously. It is, moreover, argued that though beer and light wines may be indulged in more freely than stronger drinks, there is a danger that this use of milder liquors will lead to the use of grosser ones. It is probable that this is true in many cases, and doubtless it would be wrong to allow any one having tendencies to intoxication, either from hereditary descent or previous bad habits, to use even these milder liquors. With all such, total abstinence is absolutely essential; but it does not follow that this is necessary for all, and the only valid argument for total abstinence with those who are free from such tendencies must be the Scriptural one—that every man should be willing to curtail his own liberty lest his weaker brother be made to offend.

The final conclusion is this—viz., education and a cultivation of all the amenities of life should be promoted for the sake of temperance. In the school, and above all in the family, no opportunity should be lost of impressing on the tender consciences of the young the utter beastliness of drunkenness. A child should be taught to reverence the mind within him, and to shrink with horror from the thought of ever once depriving himself of its perfect control; and where public opinion will sustain such action the state may properly place liquor-saloons in the same category with gambling-houses, and rigidly suppress both. See PROHIBITION and ABSTINENCE, TOTAL.

Revised by JOHN ASHHURST, Jr.

**Temperature** [viâ O. Fr. from Lat. *temperatu'ra*, a mixing in due measure, proportion, temper, temperament, temperature, deriv. of *tempera're*, mix in due proportion, temper]: the condition of a body in relation to the molecular activity manifested as heat, which condition determines its interchange, either of radiation or absorption, with neighboring bodies. (See GAS and HEAT.) The addition of heat to a body communicates to it a higher temperature in all cases except when a change of form occurs, as from a liquid to a gaseous condition, or when there is chemical action. (See THERMO-CHEMISTRY.) Measurements of the temperature of a body by thermometers are not strict measurements from a scientific point of view, but rather comparisons with certain other effects depending on change of temperature in special bodies. (See THERMOMETER and THERMOMETRY.) In gases the temperature can be expressed in an absolute manner in terms of the kinetic energy of the molecules, if we suppose the rigorous truth of Boyle's and Gay-Lussac's laws; that is, in a perfect gas the temperature is proportional to the average kinetic energy per molecule. As this is not the case, only a part of the temperature can be so expressed in consequence of the existence of intermolecular actions. See THERMODYNAMICS. See also METEOROLOGY.

R. A. ROBERTS.

**Temperature of the Body**: The temperature of the human adult in a state of health averages from 98·4° to 98·6° F., the fractionally higher temperature existing in the warmer-blooded races, as those of Southern Europe, the lower average being found in northern nations and the Anglo-Saxon race. The fluctuations of temperature in health are exceedingly small—fractions of a degree, rarely more—dependent on physical activity or inactivity in sleep or wakefulness, or functional activity, as digestion. The extremities and surfaces may show a lowered temperature in winter, but the temperature taken by a thermometer in the mouth, rectum, armpit, or fold of the groin reveals a nearly uniform heat of the blood and internal organs. Animal heat is generated by the nutritive supply and assimilation with destructive tissue-waste. These processes lead to a certain production of heat; at the same time there is a constant dissipation of heat from the skin, through the lungs, and by the various other excretions. The regulation of the production and dissipation of heat is controlled by nervous centers situated in the basal portions of the brain. Any disturbance of these by conditions of the blood or circulation may therefore lead to disturbances of the temperature. As well-known examples "shock" or nervous depression causes reduced temperature, while excitement, pleasure, anger accelerate the circulation and elevate temperature. The temperature of children and infants is one to two degrees higher than that of adults. The temperature of aged persons is half a degree or more below the adult average. "Medical thermometry," the use of the thermometer to register and study temperature in disease, is a constant practice in medical work. De Haen (during the fever at Breslau a century and more ago), John Hunter, and Currie employed the thermometer, but the German school—and notably Wunderlich—has popularized its use by the profession within a comparatively recent period. The self-registering thermometer is employed, and the observations may therefore be taken by the nurse or attendant. In many diseases there is elevation of temperature. Where this is but a symptom in some distinct local disease the fever is regarded as but a symptom. On the other hand, there are diseases in which the fever is the most decided symptom. These have long been known as the fevers, or of late, from the present knowledge of their causation, as the infectious fevers. Among such are typhoid fever, malarial fever, and the like. In these there is usually a period of onset, a stage of continued symptoms, and a stage of decline. The temperature of the body varies greatly in different cases of the same fever or other disease and at different times. This may depend either upon the individual or upon the severity of the disease. As a rule, its range is from 101° to 105° F. When above the latter point the term *hyperpyrexia* is applied. Such may occur in various infectious diseases, and especially in pernicious malarial fever, in sunstroke, and in certain cases of rheumatism. In the last-named diseases, temperatures of 110° or 112° F. have not infrequently been noted where recovery ensued. Occasionally cases of elevation of the temperature to 118° or 120° or even more are recorded; but in many of these deception has been practiced. The reverse of fever, subnormal temperature, is also frequent. Moderate grades are noted in conditions of depression or shock. It reaches serious grades in collapse from injury or such diseases as cholera, in which debilitating discharges occur. The external temperature may here sink to 90° or even to 85° F. In practice the temperature is usually taken in the axilla or mouth, though the rectal temperature is less liable to accidental errors of observation. Revised by W. PEPPER.

**Temperature of the Earth**: See EARTH.

**Templar Knights**: See KNIGHTS TEMPLARS.

**Temple**: city (founded in 1882): Bell co., Tex.: on the Gulf, Col. and S. Fé and the Mo., Kan. and Tex. railways; 36 miles S. by W. of Waco, and 218 miles N. W. of Galveston (for location, see map of Texas, ref. 4-H). It is in an agricultural and stock-raising region, and has 7 churches, a graded public school, a private high school, 2 national banks with combined capital of $180,000, 5 weekly newspapers, 3 large cottonseed-oil mills, cotton-compresses, and agricultural-implement works. It is principally engaged in mercantile business. Pop. (1890) 4,047; (1900) 7,065.

EDITOR OF "TIMES."

**Temple**, FREDERICK, D. D.: Archbishop of Canterbury; b. in England, Nov. 30, 1821; educated in the grammar school at Tiverton; graduated at Oxford University 1842; became fellow of Baliol College; took orders in the Church of England 1846; was principal of the training-college at Kneller Hall, near Twickenham, 1848-55; one of the Government inspectors of schools 1855-58; master of Rugby School from 1858 to 1869; appointed by Lord Palmerston Bishop of Exeter 1869; appointed Bishop of London 1885, and Archbishop of Canterbury 1896. He was one of the authors of the famous *Essays and Reviews* (1860), and his confirmation to a bishopric was ineffectually opposed by the conservative party in the Church. He wrote three volumes of *Sermons preached in Rugby Chapel* (1861-71), and was Bampton lecturer at Oxford for 1884. Revised by C. H. THURBER.

**Temple**, HENRY JOHN: See PALMERSTON, VISCOUNT.

**Temple**, Sir RICHARD, D. C. L., LL. D.: statesman and author; b. in Worcestershire, England, in 1826; entered the India civil service in 1846; was knighted in 1867; was for several years lieutenant-governor and actual ruler of Bengal, in which capacity he did much to benefit the natives, especially during the famine of 1874; was governor of the Presidency of Bombay, and having returned to England in 1880 entered Parliament in 1885 as Conservative member for the southern division of Worcestershire; has been a member of the London school board since 1885. He is the author of *India in 1880*; *Men and Events of my Time in India* (1882); *Oriental Experience* (1883); *Cosmopolitan Essays* (1886); *Palestine Illustrated* (1888); and the memoir of *John Lawrence* in *English Men of Action*. F. M. COLBY.

**Temple**, RICHARD GRENVILLE, Earl: statesman; brother of George Grenville; b. in England, Sept. 26, 1711; entered Parliament for Buckingham 1734; was advanced in political life by the elder Pitt, and held the offices of Lord of the Admiralty 1756–57 and Lord Privy Seal 1757–61. D. at Stowe, Sept. 11, 1779. His correspondence, and that of his brother George, with Pitt, was edited as *The Grenville Papers* (4 vols., 1852–53), by W. J. Smith.

**Temple**, Sir WILLIAM: diplomatist and author; b. in London, England, in 1628; educated at Emmanuel College, Cambridge; traveled on the Continent 1647–54; married Dorothy Osborne 1654; was a member of the Irish convention 1660; a joint commissioner of the Irish Parliament to Charles II. 1662; was sent on a secret mission to the Bishop of Münster 1665; was made a baronet and minister resident at the court of Brussels 1666; visited Holland to urge the formation of a league against Louis XIV. 1667; negotiated the triple alliance between England, Holland, and Sweden, Jan., 1668; assisted in perfecting the Peace of Aix-la-Chapelle, and was commissioned ambassador to The Hague 1668; returned to England Sept., 1670; was dismissed from office June, 1671, in consequence of the change of policy which had already (1670) led to a secret treaty with France, but was again appointed to negotiate a peace with the States-General of Netherlands 1674; assisted at the Congress of Nymwegen 1675–79; devised for Charles II. the plan of his privy council of thirty members Apr., 1679, and himself became a member. He declined the secretaryship of state in the same year; served in Parliament as member for the University of Cambridge for a single session, but in 1680 his name was stricken from the roll of privy councilors and he lived in retirement at Sheen and at Moor Park during his later years, having as secretary and literary assistant Jonathan Swift; was visited and consulted by William III., but declined to return to political life. D. at Moor Park, Surrey, Jan. 27, 1699. Author of *Observations upon the United Provinces* (1672); *The Origin and Nature of Government*; *Essay upon Ancient and Modern Learning*; and other publications, collectively issued as his *Works* (2 vols., 1720), edited with a *Memoir* by Dr. Swift. His collected writings were republished in four volumes in 1814. See the *Memoirs* by T. P. Courtenay (1836) and the *Letters* of Dorothy Osborne, edited by E. A. Parry (1888).

**Temple of the Sun**: See CUZCO and INCAN ANTIQUITIES.

**Temple, The**: See JERUSALEM.

**Templeton**: town; Worcester co., Mass.; on the Boston and Albany Railroad; 10 miles S. of Winchenden, 30 miles N. W. of Worcester (for location, see map of Massachusetts, ref. 2–F). It contains the villages of Baldwinsville, Otter River, and East Templeton; has 6 churches, high school, 14 schools, Boynton Public Library, a savings-bank, and a weekly newspaper; and is principally engaged in the manufacture of articles from asbestos, chairs, furniture, pails, and boxes. Pop. (1880) 2,789; (1890) 2,999; (1900) 3,489.

**Tem′poral Bones** [*temporal* is from Lat. *tempora′lis*, pertaining to the temples, deriv. of *tem′pora*, temples (of the head)]: a pair of irregular bones which in man constitute a portion of the sides and base of the skull. Each consists of (1) a squamous portion, perhaps a part of the expanded neural spine of the second cephalic vertebra; (2) a mastoid portion; and (3) a petrous portion. Some regard these last two as parts of the splanchno skeleton rather than of the vertebral skeleton, considering them as structurally parts of the auditory apparatus, although they are functionally, at least in part, identified with the rest of the temporal bones. Others regard the mastoid as belonging to the neural arch of the second vertebra. The zygomatic process reaches forward from the outer surface of the squamous portion, and joins the malar bone, forming the zygomatic arch; while attached to the petrous portion are a long styloid process and a nearly circular auditory process, the pleurapophyses, or ribs, of the third and second vertebræ of the skull. Attached to the mastoid portion is the mastoid (teat-shaped) process, which after puberty becomes hollowed into mastoid cells. Revised by W. PEPPER.

**Temporal Power**: See PAPAL STATES and ROMAN CATHOLIC CHURCH.

**Temudjin**: See GENGHIS KHAN.

**Tenacity of Metals**: See STRENGTH OF MATERIALS.

**Tenaille**: in fortification, a rampart in the main ditch, in front of the curtain, between two bastions. See FORTIFICATION.

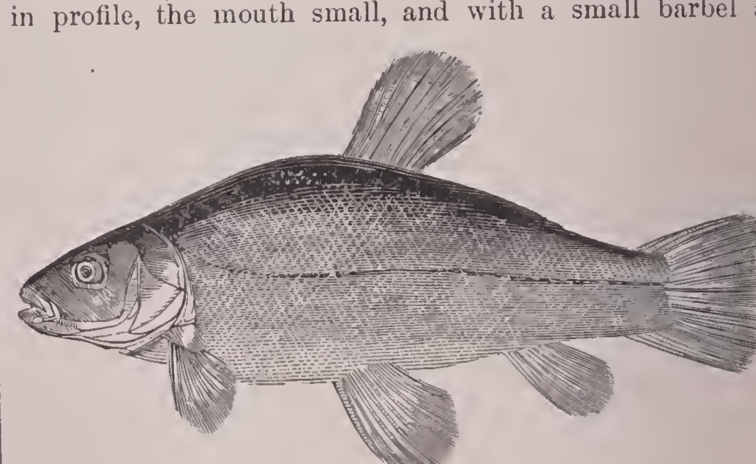
**Tenancy in Common**: See ESTATE, LANDLORD AND TENANT, and JOINT OWNERSHIP.

**Tenant for Years, at Will, and by Sufferance**: See ESTATE and LANDLORD AND TENANT.

**Tenas′serim**: a division of BURMA (*q. v.*), forming part of the British empire in India. It is a long narrow tract of country, in from 10° to 17° N. lat., between Siam and the Bay of Bengal. Area, 46,590 sq. miles. The principal river is the Tenasserim, which rises in about 15° N. lat., and empties into the sea by two mouths. Pop. (1891) 971,660. The principal town is MAULMAIN (*q. v.*).

**Ten Brink**, BERNHARD ÆGIDIUS KONRAD: See BRINK.

**Tench** [from O. Fr. *tenche* > Fr. *tanche* < Lat. *tin′ca*]: the *Tinca vulgaris*, a cyprinid fish, abundant in European streams and lakes, and the only member of its genus. It has a compressed, fusiform shape; the trunk covered with small scales, the lateral line little decurved, the head conic in profile, the mouth small, and with a small barbel at



The tench.

each corner, the dorsal above the pectorals, and short, the anal also short, and the caudal little emarginated; the pharyngeal teeth are compressed, club-shaped, and in one row, generally five on the left and four on the right side; the color is generally dark-greenish olive above and on the sides, lighter below; the fins dark brownish. It occasionally attains a length of nearly 3 feet and a weight of 12 lb., but does not often weigh more than 3 lb. It prefers rather deep and weedy, and apparently even foul water. It is very tenacious of life. The female spawns in the late spring. The fish is popularly supposed to possess healing properties. Its flesh is rather insipid. Revised by F. A. LUCAS.

**Tendai-Shiu** (in Chinese *T′ien-tai Tsung*): a Buddhist sect, whose doctrines were introduced from China into Japan in the year 805 A. D. by Dengio, the first abbot of Hiyeisan, Kioto. It divided later into three, the *Enriakuji*, the *Onjoji*, *Miidera* or *Jimon-Ha*, and the *Saikioji* or *Shinsei-Ha*. The name comes from the sacred mountain T′ien-tai in China, where Chisa first taught his doctrines. Recognizing the highest truths as incomprehensible, it makes spiritual enlightenment the result of contemplation and asceticism, which is confined to monks, who may impart their teaching by word of mouth to the laity. There is an exoteric teaching suitable for the vulgar, and another revelation of truth in itself. The deities worshiped formerly included many Shinto gods, who were regarded as Avatâras of Buddhist deities. Nirvâna is the final result of existence, a state of absolute unconditioned existence, in which the thinking substance while remaining individual is unaffected by feeling, thought, or passion. J. M. DIXON.

**Tender** [from Fr. *tendre* < Lat. *ten′dere*, stretch, extend]: in law, the attempt to perform a promise to do something or to pay something. The tender must be made by the promiser, or by one duly acting on his behalf, to the promisee or his duly authorized representative; it must be of the kind and must be made at the time and place stipulated in the contract or fixed by law, and it must be unconditional. If the law imposes upon the promisee the performance of some act as a condition of receiving the thing tendered, the fulfillment of such condition may be required by the tenderer. For example, the debtor upon tendering the amount due on a note or a mortgage may demand the surrender of the note or a satisfaction of the mortgage. (*Halpin* vs. *Phœnix Ins. Co.*, 118 N. Y. 165.) Defects in a tender may be waived by the promisee, and the waiver may be by express words or by conduct. The subject is regulated by statute in some States. The effect of a rejected tender to pay money is somewhat different from that of a rejected tender of goods. In the latter case the seller is discharged by his tender, "and may either maintain or defend successfully an action for the breach of the contract." According to the prevailing view in the U. S., the tender, although rejected, vests title to the goods in the purchaser. (2 Kent's *Commentaries*, 508.) Such is not the effect in England, unless the buyer has previously assented to the appropriation of the goods to the contract by the seller. (See SALE.) A tender of money in performance of a promise does not discharge the debt. It does, however, if kept good, stop interest and entitle the tenderer to costs, if he is subsequently sued upon the contract. It also discharges the lien of a mortgage or other security for the debt tendered. The money must be of a kind declared by law to be tenderable. In Great Britain gold coins of the realm are a legal tender to any amount, silver coins to the amount of 40 shillings, bronze coins to the amount of 1 shilling, and Bank of England notes for debts exceeding £5 are also tenderable. The U. S. Constitution (Art. I, § 10, cl. 1) provides that no State shall make anything but gold and silver a tender in payment of debts. The Federal Government has declared U. S. gold coins a legal tender to any extent, also silver dollars, except when otherwise expressly stipulated in the contract, also U. S. notes; while silver certificates are tenderable for customs, taxes, and public dues, and silver coins below the dollar are tenderable in sums not exceeding $10, and other minor coins for an amount not exceeding 25 cents. (U. S. R. S., §§ 3584–3590; ch. 20, Laws of 1878; ch. 12, Laws of 1879; *Legal Tender Cases*, 12 Wallace 457.) Silver coins are tenderable although worn smooth by wear, as are gold coins unless reduced one-half of 1 per cent. below standard weight. *Railroad* vs. *Morgan*, 52 N. J. L. 60, 558.

FRANCIS M. BURDICK.

**Tendon** [from Fr., deriv. of *tendre* < Lat. *ten'dere*, stretch, extend; cf. Gr. *τένων*, sinew, tendon, deriv. of *τείνειν*, stretch, extend]: in anatomy, the name of a white fibrous tissue connecting the end of a muscle with the bone which it is intended to move. It has sometimes the form of a cylindrical cord, sometimes of a broad ribbon, and in a few cases of a wide, thin sheet, but it is always inextensible and inelastic, and transfers at once the motion imparted by the contraction of the muscle to the bone into which it is inserted. See HISTOLOGY and ACHILLES' TENDON.

Revised by W. PEPPER.

**Teneb'rio** [Mod. Lat., from Lat. *teneb'rio*, one who loves darkness, trickster, deriv of *te'nebræ*, darkness]: a genus of beetles, one species of which (*T. molitor*) in the larval state is the well-known meal-worm, which feeds upon meal and other farinaceous substances. There are very few allied species in the eastern parts of the U. S. In California tenebrionid beetles "form the characteristic feature of the insect fauna."

**Ten'edos**: island belonging to Turkey; in the Ægean, 12 miles S. of the Strait of the Dardanelles and 4½ miles from the mainland; famous as the place where the Greek vessels were concealed during the stratagem of the wooden horse which resulted in the fall of Troy. On the E. it has a good harbor, sheltered from the west wind, but the east coast verifies Vergil—*statio malefida carinis.* During the Greek revolution Tenedos was the headquarters of the Ottoman fleet, which was destroyed here by Kanaris (Nov. 22, 1822). The island is famous for its wines and melons, and during the season abounds in red partridges and quail. Pop. of Tenedos, the capital, 6,000; of the island 15,000, almost exclusively Greeks, quiet and contented and less enterprising than most of their race.

E. A. GROSVENOR.

**Tenement** [viâ O. Fr. from Late Lat. *tenemen'tum*, holding, fief, deriv. of *tene're*, hold; cf. TENANT, etc.]: in law, any real property, corporeal or incorporeal, which was susceptible of tenure. Literally, the term signifies "that which is held," and the *holding* referred to is the feudal tenure of real property of and under a superior lord. In the familiar phrase employed by the common law to describe real property—"lands, tenements, and hereditaments"—the term tenement has the most extensive signification; for it comprehends not only lands proper, but everything in the nature of a right, interest, or estate in the lands of another; and it includes not only hereditaments, or estates of inheritance, but such interests also as are incapable of transmission by descent. For a fuller exposition, see articles on FEUDAL SYSTEM, LANDLORD AND TENANT, PROPERTY, and TENURE.

GEORGE W. KIRCHWEY.

**Tenement-houses** (originally *Tenant-houses*): dwellings sheltering under one roof several tenants, whose tenements, i. e. living-rooms, are independent of each other, but access to which is had by a common entrance. The number of tenants requisite to fixing their character as such varies with the legal definition of the term tenement-house. In New York it is a building "occupied by three or more families living independently and doing their cooking on the premises, or by more than two families on a floor, so living and cooking, and having a common right in the halls, stairways, yards, etc." (Ch. 84, Laws of 1887.) In Massachusetts the standard is "more than three families," while in some cities in the U. S. it is "two or more families having a common entrance." Of this latter kind are the small two-family houses common to factory towns in the U. S. which are often leased by the mill-owners to their employees. In England and in continental Europe the tenement-house may be a small two-story dwelling, originally built for and occupied by one family, or a barracks containing a hundred. In Scotland a "tenement" contains so many "houses" for tenants. There, as in England, the one-room apartment is common. In the U. S. it has never been so.

New York is pre-eminently the tenement city of the U. S. In 1893 1,332,773 persons out of an estimated population of 1,891,306 lived in 39,138 tenements (board of health census of 1893), but this included the better apartment-houses, which are legally tenements. Deducting one-fifth as inhabiting these, eight-fifteenths of the entire population lived in what are commonly called tenement-houses. The tenement of New York is generally from four to six stories high, of brick, on a lot 25 feet wide by 100, or less, deep, with air-shafts and more or less light on stairs and in hallways if built since 1880, when reform began in earnest, with none of these things if it antedates that period; stores on the ground floor, and two or four families on each of the floors above. Each family has a living-room with windows opening on street or yard, and usually two interior bedrooms, to which air and light are admitted only by the air-shaft or through the front room. In the old tenements the bedrooms are not lighted at all. They are ventilated only by windows cut through to the dark hall. Almost the first task the health department found to do after its organization was to order 40,000 such windows cut through tenement bedroom walls in one year. The four-families-on-a-floor tenement is styled the double-decker. "A five-story house of this character contains apartments for eighteen or twenty families, a population frequently amounting to 100 people, and sometimes increased by boarders and lodgers to 150 or more. The double-decker can not be well ventilated; it can not be well lighted. It is not safe in case of fire." *Report* of Tenement-house Committee, New York, 1894.

Bethnal Green, London, before its partial demolition by the authorities, presented a view of the Old World slum tenement: "An area of some 15 acres was covered with ancient two-story cottages facing on streets barely 18 feet wide and with the diminutive back-yards completely filled with outbuildings and workshops. Bethnal Green had been a thriving community of Huguenot weavers who had taken refuge in England from persecution in France, and had domiciled themselves in what was then a little village in the suburbs of London. But it had been swallowed up in the growth of the metropolis, and its tiny cottages had become packed with a slum population of the worst sort. The county council found five or six thousand people living in such a manner as to furnish an object-lesson." (Albert Shaw, *Municipal Government in Great Britain.*) In Glasgow "houses which were only intended to accommodate single families had been increased in height, and were found tenanted by separate families in every apartment, until they appeared to teem with inhabitants. . . . A worse state was disclosed by an inspection of some of the more recently erected houses for the working classes. Tenements of great height were reared on either side of narrow lanes with no back-yard space, and were divided from top to bottom into numberless small dwellings, all crowded with occupants." *Report* of Municipal Committee, 1859.

Tenements are as old as the race, wherever the crowding of population made building space scarce and dear. When there was no longer room to build houses beside each other, they were put on top of each other and so the tenement grew. The communal dwellings of the Pueblo Indians of the U. S. and Mexico are tenement barracks built so for the common defense. The same reason crowded the population of Old World cities within their walls. In the second century Juvenal drew in his satires (see the third) a scornful picture of the towering tenements of Rome—called *insulæ*, because of their being built with narrow alleys between—in which 500,000 of his fellow citizens lived, squeezed into single rooms (*cœnacula*), for which they paid rent that would have purchased cheerful and commodious cottages in provincial towns. The architect Vitruvius, who lived in the Augustan era, speaks of the crowding of the poor within their cramped quarters. The palaces of the wealthy Romans spread themselves over vast areas, leaving little room for the propertyless, and compelling recourse to the "common though inconvenient practice of raising the houses to a considerable height in the air. But the loftiness of these buildings, which often consisted of hasty work and insufficient material, was the cause of frequent and fatal accidents, and it was enacted by Augustus, as well as by Nero, that the height of private edifices within the walls of Rome should not exceed the measure of 70 feet from the ground." (Gibbon's *Rome*, ch. xxxi.) Modern cities have copied Nero's enactment for their own safety.

The development of the factory system with its changed industrial conditions, in the age of steam, caused the drift of population to the cities that has characterized the nineteenth century. Their sudden growth, for which no preparation had been made, caused an unprecedented packing of the population and a corresponding expansion of the tenement-house system. The result is shown in the case of New York. Its tenement-house system is entirely a growth of the century. The old dwellings, deserted by their wealthier inhabitants, were first turned into tenant-houses. Then rear houses were built in the yard, and great barracks without light or ventilation run up to shelter the crowds. Topographical conditions aided this development. The rivers shut in the population of workers, chiefly poor, who must live near their work. The greater the crowding grew, the higher the rent and the more pressing the need of crowding to pay it. New York in 1894 had a density of population of 143·2 to the acre, and stood in this respect at the head of the world's cities. Paris came next with a density of 125·2 to the acre, and Berlin third with 113·6. The Tenth Ward of New York had 626·26 to the acre, and one sanitary district of 32 acres in the Eleventh Ward averaged as high as 986·4 persons to the acre. The densest small section in Europe is given as that of Josefstadt, Prague, with 485·4 to the acre, but the Tenth Ward in New York alone is five times as large as Josefstadt. *Report* of the Tenement-house Committee, 1894.

*Evils of Tenement-house Crowding.*—Directly and indirectly, such crowding breeds bad social and moral conditions. "The more crowded a community, the greater, speaking generally, is the amount of abject want, of filth, of crime, of drunkenness, and other excesses, the more keen is competition, and the more feverish and exhausting the conditions of life." (Dr. Ogle, of the Registrar-General's office, England.) "Such conditions . . . interfere with the separateness and sacredness of home life, lead to the promiscuous mixing of all ages and sexes in a single room, . . . thus breaking down the barriers of modesty and conducing to the corruption of the young." (*Report* of the Tenement-house Committee, New York, 1894.) The death-rate rises in proportion to the crowding and the age of the tenements, except, usually, in quarters inhabited by Hebrews, whose general hardiness, great vitality, and habits of abstemiousness, enforced by the precepts of the Mosaic faith, counteract the deteriorating influences of the slum. Thus the Tenth Ward, in New York, while the most crowded, has of all the well-peopled wards of the city the lowest death-rate. Its rate in 1893, with an average density of 57·2 tenants to the house, was 17·14 per 1,000 of the living; while the general tenement-house death-rate of the entire city was 22·75, with an average number of 34 tenants in each house. But among the other elements of the population the oldest and most crowded houses, which were built before the era of sanitary reform, have the highest mortality. The rear tenements, generally the oldest, with the poorest tenants and the greatest swarms, are the worst. According to the New York health department's census of 1893 the death-rate for houses having rear tenements was 27·66, against 22·21 for the single tenements. The adult death-rate for the First (the oldest) Ward was for houses standing singly on the lot 29·03; where there were front and rear houses it was 61·97. The infant mortality for the same ward was respectively 109·58 and 204·54. In England, Dr. Tatham, of Salford, gave the following results in houses built on the "back-to-back" plan, now condemned as unfit to live in:

| | | General death-rate. |
|---|---|---|
| Regent Road Sub-district ......... | 1. No back-to-back houses ................ | 26·1 |
| | 2. Average of 18 per cent. of back-to-back houses .............................. | 29·1 |
| | 3. Average of 50 per cent, of back-to-back houses .............................. | 37·3 |

*Tenement-house Reform.*—These evils compelled recognition in the Old World about the middle of the nineteenth century, and measures were set on foot to better the condition of the tenants. They led, after twenty years of discussion, in Glasgow to the foundation in 1866 of the Improvement Trust, by which a wholesale destruction of old unsanitary tenement-house property was begun; 29 new streets were formed, 25 old ones widened and much improved, a new square and a park opened, all at a cost of about £2,000,000. The improvement in the condition of the people has been great. In 1871 30·4 per cent. lived in one-room tenements. In 1881 the proportion had fallen to 24·7 per cent., and in 1891 to 18 per cent. Great undertakings of the same character followed in Birmingham, in Liverpool, Huddersfield, and in London. Greenock, Sheffield, and Dublin struck the same path with much success. In many instances the city became landlord and engaged in the erection of municipal tenements. Under the Housing of the Working Classes Act (1890) great powers were given to local authorities in the matter of expropriation and acquisition of property that gave a impetus to this wholesome activity. London replaced its Bethnal Green slum and its narrow alleys with wide streets lined with model five-story tenements, from which the one-room family apartment was eliminated. In France, in Belgium, and throughout Europe the great cities engaged in the battle with their tenement slums. Napoleon III. made light in darkest Paris. In Naples and Rome immense public improvements have been instituted. Budapest has, from one of the filthiest capitals in Europe, become a model city. In the U. S. the cholera epidemic of 1866 gave the impetus to tenement-house reform, but it was not until 1885 that the first tenement-house committee was appointed. The second committee (1894) carried its work further. The sanitary condition of tenements has been greatly improved, and in New York their death-rate has been brought apparently even below that of the general death-rate of the city. In 1893 the registered tenement-house death-rate was 22·75, while that of the city as a whole was 23·52. (When, however, all deaths in institutions and all unknown dead that can not be referred back to the tenements are counted as belonging there, their showing is 25·77, and this is doubtless the more correct statement.) Light and air have been secured to the poor tenant, and steps taken to protect him from the danger of fire. The Tenement-house Committee in its report (1894) demanded the power of expropriation of unsanitary property. The Mulberry Bend tenement property, the worst in the city, has been acquired by the city. A park is to be opened on the site. Other cities in the U. S. in which the dangers due to the tenement-house system were impending are taking steps to prevent them. The 25-foot lot remains the chief obstacle to reform in New York.

*Model Tenements.*—In London Octavia Hill has shown that even old tenement property can be improved when proper attention is paid to it by the owner. Similar results have followed the efforts of Ellen Collins and others in New York. Philanthropists have erected model tenements in the effort to solve the problem of housing the poor, with excellent results. The general plan of these is that of a central court-yard, around which the buildings are grouped with two and three room flats, every room opening on the outer air. As a rule, they have yielded a fair return upon the investment where the management has been upon a business basis. The Peabody Fund tenements in London shelter about 20,000 tenants. Their death-rate, both adult and infant, averages below that of London as a whole. The Artisan's Block buildings house more than 100,000 tenants. There are some 600 "model" tenements in London, but not all of them are models, nor did philanthropy dictate the erection of all. In general, the barracks plan of these huge buildings is not accepted in England as the best.

In New York the model tenements of the Improved Dwellings Association, and in Brooklyn those erected by A. T. White upon substantially the London plan, have proved successful business enterprises, though the rate of rental of the poorer tenements has not been exceeded. If anything, rents have been cheapened. It was found by the Tenement-house Committee (1894) that the worst slum tenements yielded the biggest profits to the landlords, even as high as 25 per cent., while for the better class they ranged from 8 to 10 per cent. The model tenement has paid 5 per cent. and over to the owner.

The solution of the tenement-house question must come, apparently, through still greater crowding, which will compel the scattering of the population to the suburbs by some adequate system of rapid transit, as a measure of self-protection. Such a result has already followed in London, and has been greatly encouraged by the authorities. In its real essence the tenement-house question is in all the large cities of the world a question of transportation, and must be solved finally along that line.

LITERATURE.—*Old Glasgow*, by James B. Russell, medical health officer; *Report* of Parliamentary Commission on the Houses of the Working Classes (London, 1885); *Reports* of New York Board of Health (1869, 1891, and 1893); Dr. O. Du Mesnil, *L'Habitation du Pauvre* (Paris); Dr. Albert Palmberg, *Traité de l'Hygiéne publique*; *Reports* of the Tenement-house Commissions of 1884–85 and 1894 (New York); Albert Shaw, *Municipal Government in Great Britain* (New York); Charles Booth, *Life and Labour of the People* (London); Jacob A. Riis, *How the Other Half Lives* (New York). JACOB A. RIIS.

**Tenerani**, tā-nā-raa'nēe, PIETRO: sculptor; b. at Torano, near Carrara, Italy, Nov. 11, 1789; was a pupil of Canova, and also of Thorwaldsen, and worked under Desmarais in Rome. He resided almost wholly in that city, and had many public duties there connected with the museums and galleries. D. in Rome, Dec. 14, 1869. His principal works are a *Psyche with the Vase of Pandora*; a group of *Venus and Psyche*; a *Venus reclining, with Cupid drawing a Thorn from her Foot*; a *Piping Faun*; a *Crucifix*; a statue of *Bolivar* for Colombia; a bas-relief representing the *Deposition from the Cross*; the *Angel of the Last Judgment*, a statue of great power; busts of Thorwaldsen, of Pius IX. etc., and many other works for churches and cemeteries. Revised by RUSSELL STURGIS.

**Teneriffe'**: the largest of the Canary islands (see CANARIES); area, 780 sq. miles. The coasts are rocky and wild, and afford only one good harbor, that of Santa Cruz de Santiago. The interior is mountainous, and in the center is the mighty volcano of Pico de Teyde, 12,182 feet in height. The middle region is clad with beautiful forests of chestnut and oak, and the foot, as well as the hills and valleys around it, is covered with vineyards, olive and almond groves, wheat-fields, and orchards in which oranges and figs ripen to perfection. Prior to 1853 the average annual yield of wine was 25,000 pipes, but the grape disease appeared and the yield fell to 8,000 pipes. Land previously devoted to vineyards was given up to the cultivation of the cochineal insect, and it became the chief product. Pop. (1887) 108,081. Principal town, Santa Cruz de Santiago.

**Teniers**, ten'yėrs, Fr. pron. tā'nyār', DAVID: the elder; painter; b. at Antwerp in 1582. He lived in Rome for some time, where he studied under Elsheimer. He became a member of the Guild of St. Luke, in Antwerp, 1605. He taught his son painting, and their works are so similar in style as to be often mistaken the one for the other. D. in Antwerp, July 29, 1649. W. J. S.

**Teniers**, DAVID, the younger: painter; b. in Antwerp, Dec. 15, 1610. He studied under his father, but the influence of Rubens and Adrian Brouwer is recognizable in his work. In 1632 he was elected a member of the Guild of St. Luke, and in 1644 its president. His works were extremely popular, and he became wealthy and distinguished by honors. Archduke Leopold William, the governor of the Spanish Netherlands, appointed him to be his court painter and chamberlain. Teniers bought an estate at Perck, between Antwerp and Mechlin, whither people of distinction went to visit him; removed to Brussels in 1647; d. there Apr. 25, 1690, and was buried at Perck. He married twice. His first wife was the daughter of Jan Breughel. This artist is well represented in all European collections. He painted very rapidly, and produced hundreds of genre-pictures, also some landscapes. The father's signature seems to have been a T within a D, while the son wrote his name D. Teniers F. For further information, see *Teniers, David*, by C. de Brou; *D. Teniers*, by Arsène Houssaye; and P. Lacroix, *Le Cabinet de l'Amateur*, vol. ii., p. 481. W. J. STILLMAN.

**Tenimber Islands**: See TIMOR-LAUT.

**Ten Kate**, ten-kaa'te, JAN JACOB LODEWIJK: poet and theologian; b. at The Hague, Holland, Dec. 23, 1819. His youth was passed as clerk and bookkeeper in a mercantile establishment at The Hague, but he very early felt the influence of the romantic poetical movement, then in full swing in Holland. He was an enthusiastic admirer of Walter Scott, Macpherson's *Ossian*, Byron, and the Dutch poets Bilderdijk and Da Costa. He tried his own hand at verses, and in 1836 appeared his first volume, *Gedichten*. In 1837 he determined to give up trade and prepare himself for the Church. He studied at the University in Utrecht 1838–43, and passed his candidate's examination in May, 1844; and in Jan., 1845, he was called as pastor to the little fishing-village of Marcken. During these years, however, he had not neglected poetry. In 1837 he had published with a friend a translation of the *Odes* of Anacreon, the first of the long series of translations that have distinguished him among modern Dutch poets. In 1839 appeared *Bladeren en bloemen*, *Rozen*, *Nieuwe rozen*, and *Vertaalde poëzie*. In 1840 he published a translation of Byron's *Giaour*, and the poem *Ahasverus op den Grimsel*; in 1841, *Poëzy voor Hollands schoonen* and *Zangen des tijds*. In 1842 he became the leading spirit in a curious venture, a periodical wholly in verse, called *Braga*, devoted largely to satiric criticism of the literary tendencies of the time. In the same year appeared his poem *Thomas Chatterton*, and in 1846 the collection *Legenden en Mengelpoëzy*. In 1847 he was called to the church at Almkerk; in 1850 to Middelburg. Here he remained till 1860, when he was called to Amsterdam. There the remainder of his life has been passed. As has been indicated, the first productive years of Ten Kate were largely influenced by romanticism in its extreme form. After he had taken up the profession of clergyman, however, the influence of Bilderdijk became predominant with him, and the religious element in his thought grew much stronger. Through his later years his poetry has steadily held this religious coloring; and he has produced besides a number of treatises of a religious or philosophical character in prose. Among the poetical works in this manner are the didactic *Dood en leven* (1856); the poem on the creation of the world, *De Schepping* (1866; Eng. trans., *The Creation*, by Rev. D. van de Pelt, New York, 1888); *De Planeten* (1869); *De Jaargetijden* (1871); *Eunoë* (1874); *Godsdienstige poëzy* (1879); *Mozaiek* (1881); *Palmbladen en dichtbloemen* (1884); *Elck wat wils* (1887). Of great importance also are Ten Kate's translations into Dutch from other languages, many of which are among the best his country has produced. Among these are Tasso's *Gerusalemme Liberata* (1856); Tegnér's *Frithiof's Saga* (1861); Schiller's *Maria Stuart* (1866); La Fontaine's *Fables* (1868); Oehlenschläger's *Correggio* (1868); Dante's *Inferno* (1876); the first part of Goethe's *Faust* (1878); Milton's *Paradise Lost* (1880); Victor Hugo's *Lyric Poems* (1881); and strangely, but characteristically, the *Gospel Hymns* of Ira D. Sankey (1875). In these translations, as well as in his original verse, Ten Kate has shown very remarkable command of the Dutch language and imaginative powers of no mean order. A collected edition of his poems appeared in 8 vols. (Leyden, 1861–66; 2d ed. 1867). For his *Life* and a bibliography of his works see J. Ten Brink's *Geschiedenis der Noord-Nederlandsche Letteren in de XIXe Eeuw* (Amsterdam, 1888). A. R. MARSH.

**Tennant**, WILLIAM: poet and Oriental scholar; b. at Anstruther Easter, Fifeshire, Scotland, May 15, 1784; studied at the University of St. Andrews 1799–1801; was for some years clerk to his brother, a grain-dealer in Glasgow, and afterward in his native town; published *The Anster Concert* (1811), a poem in the Scottish dialect, and *Anster Fair, a Poem in Six Cantos* (1812), in *ottava rima*, both descriptive of rural Scottish life, which gradually acquired popularity; was parish schoolmaster of Dunino 1812–16, and at Lasswade 1816–19; acquired the Arabic, Syriac, and Persian languages; taught Oriental and classical languages in the

academy of Dollar, Clackmannanshire, 1819–34; became in 1834 Professor of Oriental Languages in St. Mary's College, St. Andrews. He was the author of several later poems and dramas which were not successful, of a *Syriac and Chaldee Grammar* (1840), a *Life of Allan Ramsay* (1808), and of numerous contributions to periodicals, including some translations from Oriental poets. D. near Dollar, Feb. 15, 1848.
Revised by H. A. BEERS.

**Tennent**, Sir JAMES EMERSON: author; b. in Belfast, Ireland, Apr. 7, 1804; son of William Emerson, a wealthy merchant; was educated at Trinity College, Dublin; traveled after graduation (1824–25) through Europe and the Levant, also in Greece; published *A Picture of Greece in 1825* (1826), *Letters from the Ægean or Grecian Islands* (2 vols., 1829), and a *History of Modern Greece* (2 vols., 1830); married (June, 1831) the only daughter of William Tennent, a wealthy banker of Belfast, whose name he assumed; was called to the bar at Lincoln's Inn in 1831; was chosen for Belfast to Parliament in 1832, and several times subsequently; was secretary to the Indian board 1841–45; published a work on *Belgium* (2 vols., 1841); procured the passage of an act establishing copyright in designs 1843; was civil secretary to the colonial government of Ceylon 1845–50; was one of the joint secretaries to the Board of Trade from 1852 to 1867, when he retired from office. D. in London, Mar. 6, 1869. He is best known as the author of *Ceylon, an Account of the Island, Physical, Historical, and Topographical* (2 vols., 1859); he also wrote *Christianity in Ceylon* (1850) and *Natural History of Ceylon* (1861).

**Tennessee′**: one of the U. S. of North America (South Central group); the third State admitted into the Union.

*Location and Area.*—It extends from the Appalachian Mountains on the E. to the Mississippi river on the W.; between lat. 35° and 36° 36′ N. and lon. 81° 37′ and 90° 28′ W.; is bounded N. by Kentucky and Virginia, E. by North Carolina, S. by Georgia, Alabama, and Mississippi, and W. by Arkansas and Missouri; extreme length from E. to W., 432 miles; breadth from N. to S., 109 miles; area, 42,050 sq. miles, of which 300 sq. miles are water surface.

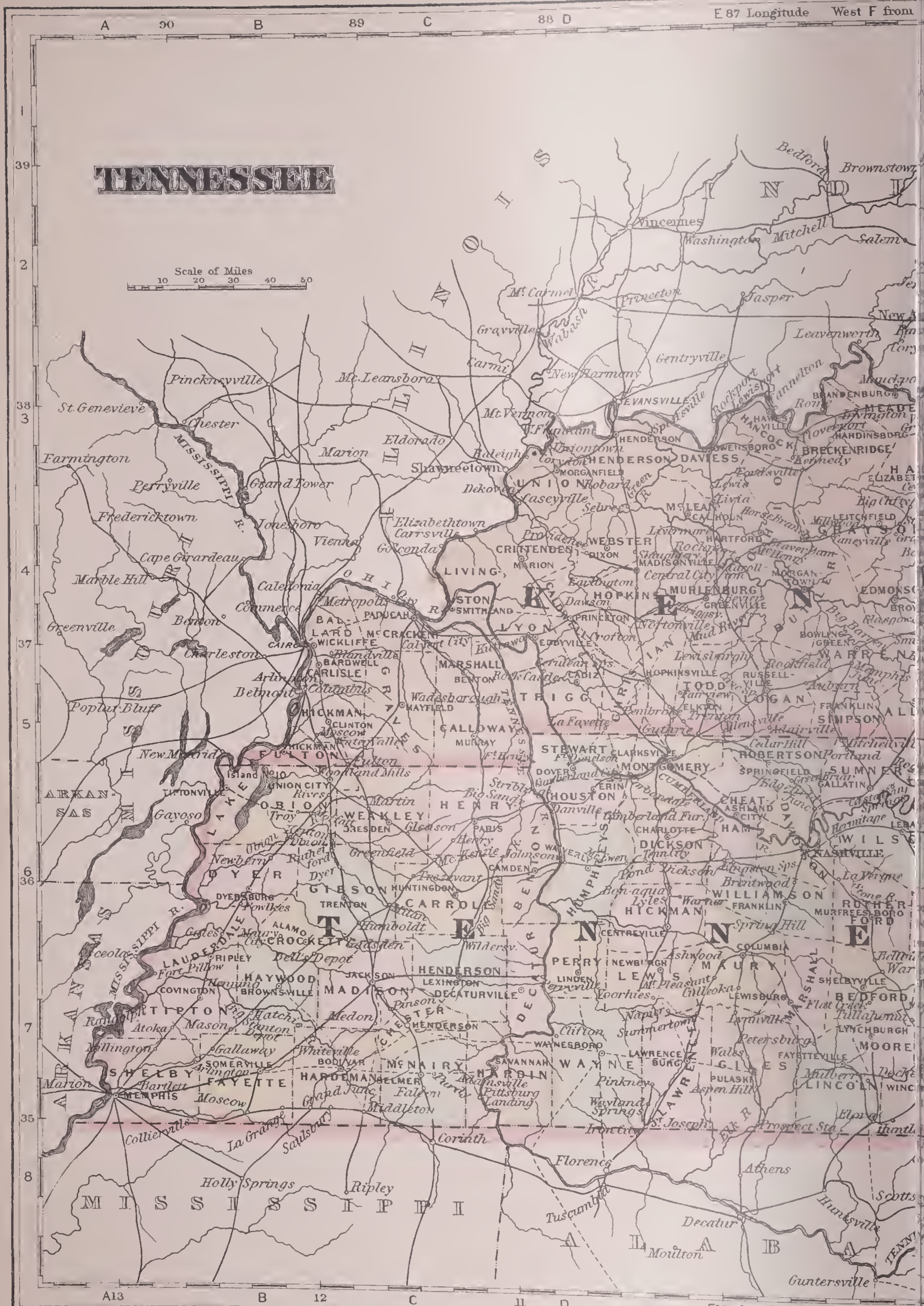

Seal of Tennessee.

*Physical Features.*—The eastern third of the State is hilly and mountainous, the middle undulating, and the west comparatively low and level. Reckoned from the altitude of its river-beds, there is a gradual, but irregular, slope from an elevation of 1,264 feet on the E., to 200 feet on the W. There are eight natural divisions: (1) *The Unaka Range* on the eastern border, comprising numerous wooded mountain-ridges with outlying spurs and intervening coves of great fertility; also lofty peaks with treeless summits covered with luxuriant natural grasses and having the flora of Canada and the climate of New England; area about 2,000 sq. miles. (2) *The valley of East Tennessee*, a fluted region of parallel ridges and narrow valleys, extending diagonally from N. E. to S. W. through the eastern part of the State; elevation, 1,000 feet; area, 9,200 sq. miles. (3) Next on the W. the *Cumberland Table-land*, or level top of the Cumberland Mountains, which rise abruptly 1,000 feet above the valley of East Tennessee and 2,000 feet above the sea; surface shows low ridges and shallow valleys; much of it is covered with native grasses; summers are cool and climate healthful; area, 5,100 sq. miles. (4) *The Highland Rim* bounds the table-land on the W., and, extending on the N. and S., as far W. as the Tennessee valley, incloses the Central Basin; elevation, 1,000 feet; has numerous mineral springs and many summer resorts; area, 9,300 sq. miles. (5) *The Central Basin*, a depression of 5,450 sq. miles; resembles the bed of a drained lake with its main slope to the N. W.; greatest diameter from N. E. to S. W., 120 miles; breadth from 55 to 60 miles; altitude 550 feet, with variations of 200 to 300 feet. (6) *The western valley* of the Tennessee river embraces 1,200 sq. miles of river lowlands and subordinate valleys extending into the highlands; elevation above the sea, 360 feet; reaches across the State from N. to S., with a breadth of 10 to 12 miles. (7) Adjoining this is the *plateau slope* of West Tennessee, descending gently to the Mississippi; surface slightly undulating, but often showing abrupt hills and narrow valleys; streams sluggish; western border terminates abruptly with steep hills which overlook the Mississippi bottoms; average elevation about 500 feet; area, 8,850 sq. miles. (8) The alluvial *Mississippi bottoms* are low and level, with numerous swamps and many lakes, abounding in fish and wildfowl; elevation above the Gulf about 295 feet; area, 950 sq. miles. The Clinch, Powell's, and Holston rivers drain upper East Tennessee; the French Broad, Little Tennessee, and Hiwassee assist, lower down; and the Tennessee, formed by the union of the two forks of the HOLSTON (*q. v.*), carries all this water into Alabama, thence back north across Tennessee and Kentucky into the Ohio. The Cumberland pours into the Ohio the drainage of northern Middle Tennessee; the Duck, the Elk, and Caney Fork drain the rest of this section; and the Obion, Forked Deer, Big Hatchie, and Wolf carry most of the West Tennessee waters into the Mississippi. The principal rivers are the Mississippi, the Cumberland, and the Tennessee. The only lakes are found in the Mississippi bottoms, and are little more than expansions of small rivers. Reelfoot, between Lake and Obion Counties, is the most noted; it was largely produced by the earthquake of 1811–12.

*Geology and Mineral Resources.*—The geology presents a striking variety, ranging from the oldest metamorphic rocks of the Lower Silurian formation on the east border to the most recent alluvial deposits on the west. The natural divisions whose area is occupied almost wholly by the Lower Silurian are the Unaka Range, the valley of East Tennessee, and the Central Basin. The Cumberland Table-land and the Highland Rim are Carboniferous; the Western valley, Upper Silurian and Devonian; the plateau slope of West Tennessee, mainly Cretaceous and Tertiary; the Mississippi bottoms, Recent. All the important mountains are in the east end of the State, which rests upon the west slope of the Appalachian system. The Great Smoky Range is on the North Carolina border; extreme height, 6,660 feet; average, 5,000 feet. Parallel with this, through the valley of East Tennessee, extend Clinch Mountain (2,000 feet), Powell's Mountain, and numerous minor ridges. To the W. of these and parallel is the broad plateau of the Cumberland. The rest are unimportant.

The total value of mineral products in 1889 was $6,455,-283, coal and iron being most important. The coal-fields are coextensive with the Cumberland Table-land and form a part of the great system which extends from Pennsylvania to Alabama; area, 5,100 sq. miles; total output in 1899, 3,330,659 short tons. The coal is bituminous, makes a good coke (435,308 tons in 1899), and is adapted to smelting, manufacturing, domestic, and general purposes. There are three main iron-producing belts extending across the State: the eastern belt, along the Smoky Mountains; the Dyestone belt, parallel with the eastern base of the Cumberland Table-land, yielding hematite ore; and the western belt, 50 miles wide, on the dividing-line between Middle and West Tennessee. A fourth belt of minor importance coincides with the coal-fields. In 1899 there were produced 346,166 long tons of pig iron. In 1899 the output of iron ore was 632,-046 long tons. The marble-industry, confined mainly to East Tennessee, has experienced a rapid growth. The stone product in 1899 was valued: slate, $250; marble, $384,705; limestone, $208,097. Jefferson, Union, and Claiborne Counties, in the northeastern part of the State, produce large quantities of zinc ore. The copper mines of Polk County, in the southeast corner of the State, are very productive. One mine produces 150 tons of ore daily. In 1889 there were 3,057 tons of mineral paint produced. Blue Springs, in Bradley County, produces considerable lead. Gold is found in small quantities in Monroe County. Pyrite, manganese ores, alum, barite, salt, niter, gypsum, hydraulic rocks, building-stone, potter's clay, fire-clay, and epsomite abound. Overton and Dickson Counties produce petroleum, although in limited quantities.

*Soil and Productions.*—The soils of the State are as varied as its rocks. The greatest diversity is found in the east part, where only the best valleys and river-bottoms have high fertility. General farm products are here raised. The soil of the Cumberland Table-land is usually sandy, porous, and not very productive, though adapted to pasturage, the


TENNESSEE
Scale of Miles
10 20 30 40 50
E 87 Longitude West F from
E10 Longitude West F from
ILLINOIS
INDIANA
MISSOURI
ARKANSAS
MISSISSIPPI
ALABAMA
KENTUCKY
TENNESSEE
MISSISSIPPI R.
OHIO R.
Vincennes
Washington
Mitchell
Bedford
Brownstown
Salem
Mt. Carmel
Princeton
Jasper
Grayville
Wabash R.
Leavenworth
Gentryville
Carmi
New Harmony
Mc. Leansboro
Pinckneyville
Mt. Vernon
Evansville
Rockport
Lewisport
Cannelton
St. Genevieve
Chester
Marion
Eldorado
Raleigh
Shawneetown
Henderson
Owensboro
Hancock
Breckenridge
Farmington
Perryville
Grand Tower
Dekoven
Union
Caseyville
Daviess
McLean
Calhoun
Fredericktown
Jonesboro
Elizabethtown
Carrsville
Vienna
Golconda
Providence
Webster
Dixon
Crittenden
Marion
Livermore
Hartford
Ohio
Cape Girardeau
Marble Hill
Caledonia
Commerce
Metropolis
Paducah
Livingston
Smithland
Madisonville
Central City
Hopkins
Muhlenburg
Greenville
Benton
Charleston
Cairo
Ballard
Wickliffe
McCracken
Lyon
Eddyville
Princeton
Dawson
Greenville
Blandville
Bardwell
Carlisle
Arlington
Belmont
Columbus
Graves
Marshall
Benton
Caldwell
Hopkinsville
Christian
Todd
Elkton
Trenton
Logan
Russellville
Bowling Green
Warren
Poplar Bluff
Hickman
Clinton
Moscow
Mayfield
Calloway
Murray
Trigg
Cadiz
La Fayette
Guthrie
Adairsville
Simpson
Franklin
Tennessee R.
New Madrid
Fulton
Stewart
Dover
Clarksville
Montgomery
Robertson
Springfield
Sumner
Gallatin
Tiptonville
Island 10
Union City
Obion
Troy
Martin
Weakley
Dresden
Gleason
Henry
Paris
Big Sandy
Houston
Erin
Cumberland Fur.
Charlotte
Cheatham
Ashland City
Davidson
Nashville
Wilson
Arkansas
Gayoso
Lake
Newbern
Dyer
Dyersburg
Trenton
Gibson
Humboldt
Huntingdon
Carroll
McKenzie
Camden
Benton
Waverly
Humphreys
Dickson
Bon Aqua
Lyles
Hickman
Centreville
Williamson
Franklin
Brentwood
Murfreesboro
Rutherford
Columbia
Maury
Spring Hill
Osceola
Lauderdale
Ripley
Fort Pillow
Alamo
Crockett
Gadsden
Bells Depot
Jackson
Madison
Haywood
Brownsville
Henderson
Lexington
Decaturville
Decatur
Perry
Linden
Newburgh
Lewis
Mt. Pleasant
Culleoka
Lewisburg
Marshall
Shelbyville
Bedford
Tullahoma
Covington
Tipton
Randolph
Atoka
Mason
Millington
Hatchie
Stanton Depot
Medon
Chester
Henderson
Pinson
Clifton
Waynesboro
Wayne
Lawrence
Lawrenceburg
Summertown
Pulaski
Giles
Fayetteville
Lincoln
Lynchburgh
Moore
Shelby
Bartlett
Memphis
Marion
Somerville
Fayette
Moscow
Gallaway
Hardeman
Bolivar
Grand Junc.
McNairy
Purdy
Belmer
Savannah
Hardin
Pittsburg Landing
Waynesville
Pinkney
Waynesboro
Wayland Springs
Aspen Hill
Collierville
La Grange
Saulsbury
Middleton
Corinth
Iron City
St. Joseph
Elk R.
Prospect Sta.
Huntsville
Holly Springs
Ripley
Florence
Tuscumbia
Athens
Decatur
Moulton
Huntsville
Scottsboro
Guntersville

Greenwich G
85
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J 83
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Washington G
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35
Hamilton
Lebanon
Wilmington
Chillicothe
Marietta
Athens
Parkersburg
McArthur
Hillsboro
Waverly
O H I O
CINCINNATI
Lawrenceburg
Batavia
Pomeroy
Jackson
New Richmond
Georgetown
Ripley
W. Union
Portsmouth
Gallipolis
Pt. Pleasant
Ironton
Russell
Ashland
Kenova
Huntington
Charleston
Madison
Logan C.H.
Oceana
Grundy
Peerysville
Ervinton
Madison
Milton
Vevay
Rising Sun
Petersburg
COVINGTON
NEWPORT
ALEXANDRIA
CAMPBELL
BOONE
KENTON
GALLATIN
CARROLL
GRANT
PENDLETON
BRACKEN
MASON
LEWIS
GREENUP
VANCEBURG
HENRY
OWEN
HARRISON
ROBERTSON
FLEMING
NICHOLAS
CARTER
BOYD
CATLETTSBURG
GRAYSON
SHELBY
SCOTT
FRANKLIN
BOURBON
BATH
ROWAN
ELLIOTT
LAWRENCE
JEFFERSON
LOUISVILLE
FRANKFORT
WOODFORD
FAYETTE
MONTGOMERY
CLARK
MENIFEE
MORGAN
JOHNSON
MARTIN
SPENCER
ANDERSON
BULLITT
NELSON
MERCER
JESSAMINE
MADISON
POWELL
WOLFE
MAGOFFIN
FLOYD
PIKE
WASHINGTON
BOYLE
GARRARD
ESTILL
LEE
BREATHITT
KNOTT
MARION
LINCOLN
JACKSON
OWSLEY
PERRY
TAYLOR
CASEY
ROCKCASTLE
CLAY
LESLIE
LETCHER
GREEN
ADAIR
PULASKI
LAUREL
KNOX
HARLAN
RUSSELL
METCALFE
CUMBERLAND
WAYNE
WHITLEY
BELL
MONROE
CLINTON
Middlesborough
Wise C.H.
Lebanon
VIRGINIA
Clinch R.
Holston R.
Abingdon
Bristol
Gate City
Jonesville
CLAY
PICKETT
SCOTT
CLAIBORNE
HANCOCK
HAWKINS
SULLIVAN
JOHNSON
JACKSON
OVERTON
FENTRESS
CAMPBELL
UNION
GRAINGER
WASHINGTON
CARTER
PUTNAM
MORGAN
ANDERSON
HAMBLEN
GREENE
UNICOI
DEKALB
WHITE
CUMBERLAND
ROANE
KNOX
JEFFERSON
SEVIER
COCKE
KNOXVILLE
VAN BUREN
WARREN
BLEDSOE
RHEA
LOUDON
BLOUNT
GRUNDY
SEQUATCHIE
MEIGS
McMINN
MONROE
MARION
HAMILTON
JAMES
BRADLEY
POLK
CHATTANOOGA
CLEVELAND
T E N N E S S E E
K E N T U C K Y
Hot Springs
Marshall
Burnsville
Bakersville
Granberry
Boone
Clingman's Dome
Asheville
Waynesville
Bryson City
Marion
NORTH CAROLINA
Robbinsville
Rocky Bald
Webster
Franklin
Hendersonville
Rutherfordton
Brevard
Columbus
Broad R.
Murphy
Ducktown
Spartanburg C.H.
Greenville C.H.
Walhalla
Clayton
Blue Ridge
Dalton
Ellijay
La Fayette
Trenton
Toccoa
S. CAROLINA
GEORGIA
Dahlonega
Savannah R.
Anderson C.H.
Calhoun
Ft. Payne
Lula
Bridgeport
S. Pittsburg
Jasper
Sewanee

growth of fruit, garden vegetables, and Irish potatoes. On the Highland Rim some sections have good fertility, but most of its area, called the Barrens, is flinty and little productive. Fruit and wild grass for pasturage are the main productions, excepting tobacco in the northern part. The rich limestone soils of the Central Basin make it the garden-spot of the State, and produce abundantly Indian corn, wheat, blue grass, and, in the south part, cotton. The soils of West Tennessee are sandy and mellow, but generally fertile. Cotton is produced abundantly in the south and general crops in the north. In the Mississippi bottoms is a black loam, the richest soil in the State; it produces cotton, Indian corn, and general crops in luxuriance.

The following summary of 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 | 165,650 | 174,412 | * 5·3 |
| Number of acres in farms | 20,666,915 | 20,161,583 | † 2·4 |
| Value of farms, including buildings and fences | $206,749,837 | $242,700,540 | * 17·4 |

* Increase. † Decrease.

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

| CROPS. | Acreage. | Yield. | Value. |
|---|---|---|---|
| Corn | 2,849,894 | 56,997,880 bush. | $27,928,961 |
| Wheat | 1,181,423 | 11,696,088 " | 9,239,910 |
| Oats | 350,010 | 5,810,166 " | 2,033,558 |
| Rye | 11,297 | 124,267 " | 84,502 |
| Barley | 1,743 | 25,622 " | 15,886 |
| Buckwheat | 955 | 13,370 " | 7,888 |
| Tobacco (1896) | 53,351 | 35,211,660 lb. | 2,464,816 |
| Potatoes | 25,290 | 1,365,660 bush. | 792,083 |
| Hay | 223,880 | 313,432 tons | 3,698,498 |
| Totals | 4,697,843 | ................ | $46,266,102 |

The farm animals on Jan. 1, 1900, comprised 308,073 horses, value $13,251,442; 139,164 mules, value $6,664,988; 239,394 milch cows, value $5,781,365; 286,841 oxen and other cattle, value $5,390,598; 251,735 sheep, value $596,485; and about 2,000,000 swine, value $7,000,000; total head, 3,225,207; total value, $38,684,878.

*Climate.*—The average annual mean temperature is 59°. Though in summer and winter marked extremes are sometimes reached, yet these seasons are generally mild, and spring and autumn are delightfully temperate and pleasant. A limited amount of snow falls. Temperature and rainfall by months for twenty-three years (1871 to 1893, inclusive) are as follows:

| MONTHS. | Average mean temperature. | Average rainfall, in inches. | MONTHS. | Average mean temperature. | Average rainfall, in inches. |
|---|---|---|---|---|---|
| January | 39·0° | 5·53 | July | 79·0° | 3·95 |
| February | 43·7 | 5·49 | August | 77·0 | 3·78 |
| March | 48·7 | 5·48 | September | 70·3 | 3·35 |
| April | 59·7 | 5·15 | October | 59·7 | 2·79 |
| May | 68·0 | 4·03 | November | 48·3 | 4·28 |
| June | 76·0 | 4·49 | December | 41·7 | 3·88 |

The extremes for the above period in the three sections of the State are:

| SECTION. | Coldest month. | Average temperature. | Hottest month. | Average temperature. |
|---|---|---|---|---|
| West Tennessee | Jan., 1886. | 30° | July, 1878. | 84° |
| Middle Tennessee | Jan., 1886. | 29 | July, 1879. | 83 |
| East Tennessee | Jan., 1893. | 29 | July, 1878. | 80 |

A difference of elevation produces a difference of about 2° in the mean temperature of the extreme ends of the State.

*Divisions.*—The State has three distinctly recognized civil or political divisions: East Tennessee, Middle Tennessee, and West Tennessee. The first occupies the east end of the State to the middle of the Cumberland Table-land, and contains 34 counties; the second reaches to the west valley of the Tennessee river, and contains 41 counties; the third lies between the Tennessee and Mississippi rivers, and contains 21 counties. Much local feeling exists in these divisions as to the apportionment of State officers, the charitable institutions, etc. In many respects the divisions resemble different States.

COUNTIES AND COUNTY-TOWNS, WITH POPULATION.

| COUNTIES. | * Ref. | Pop. 1890. | Pop. 1900. | COUNTY-TOWNS. | Pop. 1900. |
|---|---|---|---|---|---|
| Anderson | 6–I | 15,128 | 17,634 | Clinton | 1,111 |
| Bedford | 7–F | 24,739 | 23,845 | Shelbyville | 2,236 |
| Benton | 6–D | 11,230 | 11,888 | Camdeu | 399 |
| Bledsoe | 7–H | 6,134 | 6,626 | Pikeville | ..... |
| Blount | 6–I | 17,589 | 19,206 | Maryville | ..... |
| Bradley | 7–H | 13,607 | 15,759 | Cleveland | 3,858 |
| Campbell | 6–I | 13,486 | 17,379 | Jacksboro | 621 |
| Cannon | 6–F | 12,197 | 12,121 | Woodbury | 468 |
| Carroll | 6–C | 23,630 | 24,250 | Huntingdon | 1,332 |
| Carter | 5–K | 13,389 | 16,688 | Elizabethton | ..... |
| Cheatham | 6–E | 8,845 | 10,112 | Ashland City | ..... |
| Chester | 7–C | 9,069 | 9,896 | Henderson | ..... |
| Claiborne | 5–J | 15,103 | 20,696 | Tazewell † | 2,761 |
| Clay | 5–G | 7,260 | 8,421 | Celina | ..... |
| Cocke | 6–J | 16,523 | 19,153 | Newport | 1,630 |
| Coffee | 7–F | 13,827 | 15,574 | Manchester | ..... |
| Crockett | 6–B | 15,146 | 15,867 | Alamo | ..... |
| Cumberland | 6–H | 5,376 | 8,311 | Crossville | ..... |
| Davidson | 6–E | 108,174 | 122,815 | Nashville | 80,865 |
| Decatur | 7–D | 8,995 | 10,439 | Decaturville † | 1,475 |
| Dekalb | 6–G | 15,650 | 16,460 | Smithville | ..... |
| Dicksou | 6–E | 13,645 | 18,635 | Charlotte | ..... |
| Dyer | 6–B | 19,878 | 23,776 | Dyersburg | 3,647 |
| Fayette | 7–B | 28,878 | 29,701 | Somerville | 777 |
| Fentress | 5–H | 5,226 | 6,106 | Jamestown | ..... |
| Frankliu | 7–F | 18,929 | 20,392 | Winchester | 1,338 |
| Gibson | 6–B | 35,859 | 39,408 | Trenton | 2,328 |
| Giles | 7–E | 34,957 | 33,035 | Pulaski | 2,838 |
| Grainger | 6–J | 13,196 | 15,512 | Rutledge | ..... |
| Greene | 6–J | 26,614 | 30,596 | Greeneville | 1,817 |
| Grundy | 7–G | 6,345 | 7,802 | Altamont | ..... |
| Hamblen | 6–J | 11,418 | 12,728 | Morristown | 2,973 |
| Hamilton | 7–H | 53,482 | 61,695 | Chattanooga | 30,154 |
| Hancock | 5–J | 10,342 | 11,147 | Sneedville | ..... |
| Hardeman | 7–B | 21,029 | 22,976 | Bolivar | 1,035 |
| Hardin | 7–D | 17,698 | 19,246 | Savannah | ..... |
| Hawkins | 5–J | 22,246 | 24,267 | Rogersville | 1,386 |
| Haywood | 7–B | 23,558 | 25,189 | Brownsville | 2,645 |
| Henderson | 7–C | 16,336 | 18,117 | Lexington | 1,332 |
| Henry | 6–C | 21,070 | 24,208 | Paris | 2,018 |
| Hickman | 6–E | 14,499 | 16,367 | Centerville | ..... |
| Houston | 6–D | 5,390 | 6,476 | Erin | ..... |
| Humphreys | 6–D | 11,720 | 13,398 | Waverly | 786 |
| Jackson | 5–G | 13,325 | 15,039 | Gainesboro | ..... |
| James | 7–H | 4,903 | 5,407 | Ooltewah | ..... |
| Jefferson | 6–J | 16,478 | 18,590 | Dandridge | ..... |
| Johnson | 5–L | 8,858 | 10,589 | Mountain City | ..... |
| Knox | 6–I | 59,557 | 74,302 | Knoxville ‡ | 32,637 |
| Lake | 6–B | 5,304 | 7,368 | Tiptonville | ..... |
| Lauderdale | 6–A | 18,756 | 21,971 | Ripley | 1,640 |
| Lawrence | 7–E | 12,286 | 15,402 | Lawrenceburg | 823 |
| Lewis | 7–E | 2,555 | 4,455 | Newburg | ..... |
| Lincoln | 7–F | 27,382 | 26,304 | Fayetteville | 2,708 |
| Loudon | 6–I | 9,273 | 10,838 | Loudon | 875 |
| McMinn | 7–I | 17,890 | 19,163 | Athens | 1,849 |
| McNairy | 7-C | 15,510 | 17,760 | Selmer | 588 |
| Macon | 5–F | 10,878 | 12,881 | Lafayette | ..... |
| Madison | 7–C | 30,497 | 36,333 | Jackson | 14,511 |
| Marion | 7–G | 15,411 | 17,281 | Jasper | ..... |
| Marshall | 7–E | 18,906 | 18,763 | Lewisburg | 1,421 |
| Maury | 7–E | 38,112 | 42,703 | Columbia | 6,042 |
| Meigs | 7–H | 6,930 | 7,491 | Decatur | ..... |
| Monroe | 7–I | 15,329 | 18,585 | Madisonville | ..... |
| Montgomery | 5–E | 29,697 | 36,017 | Clarksville | 9,431 |
| Moore | 7–F | 5,975 | 5,706 | Lynchburg | 417 |
| Morgan | 6–H | 7,639 | 9,587 | Wartburg | ..... |
| Obion | 6–B | 27,273 | 28,286 | Union City | 3,407 |
| Overton | 5–H | 12,039 | 13,353 | Livingston | ..... |
| Perry | 7–D | 7,785 | 8,800 | Linden | ..... |
| Pickett | 5–H | 4,736 | 5,366 | Byrdstown | ..... |
| Polk | 7–I | 8,361 | 11,357 | Benton | ..... |
| Putnam | 6–G | 13,683 | 16,890 | Cookeville | ..... |
| Rhea | 7–H | 12,647 | 14,318 | Daytou | 2,004 |
| Roane | 6–H | 17,418 | 22,738 | Kingston † | 548 |
| Robertson | 5–E | 20,078 | 25,029 | Springfield | 1,732 |
| Rutherford | 6–F | 35,097 | 33,543 | Murfreesboro | 3,999 |
| Scott | 5–H | 9,794 | 11,077 | Huntsville | ..... |
| Sequatchie | 7–G | 3,027 | 3,326 | Dunlap | ..... |
| Sevier | 6–J | 18,761 | 22,021 | Sevierville | ..... |
| Shelby | 7–A | 112,740 | 153,557 | Memphis | 102,320 |
| Smith | 6–G | 18,404 | 19,026 | Carthage | ..... |
| Stewart | 5–D | 12,193 | 15,224 | Dover | 400 |
| Sullivan | 5–K | 20,879 | 24,935 | Blountville | .... |
| Sumner | 5–F | 23,668 | 26,072 | Gallatin | 2,409 |
| Tipton | 7–A | 24,271 | 29,273 | Covington | 2,787 |
| Trousdale | 6–F | 5,850 | 6,004 | Hartsville | ..... |
| Unicoi | 6-K | 4,619 | 5,851 | Erwin | ..... |
| Union | 6–I | 11,459 | 12,894 | Maynardville | ..... |
| Van Buren | 6–G | 2,863 | 3,126 | Spencer | ..... |
| Warren | 6–G | 14,413 | 16,410 | McMinnville | 1,980 |
| Washington | 5–K | 20,354 | 22,604 | Jonesboro | 854 |
| Wayne | 7–D | 11,471 | 12,934 | Waynesboro | ..... |
| Weakley | 6–B | 28,955 | 32,546 | Dresden | ..... |
| White | 6–G | 12,348 | 14,157 | Sparta | 895 |
| Williamson | 6–E | 26,321 | 26,429 | Franklin | 2,180 |
| Wilson | 6–F | 27,148 | 27,078 | Lebauon | 1,956 |
| Totals | ...... | 1,767,518 | 2,020,616 | | |

* Reference for location of counties, see map of Tennessee.
† District. ‡ West, North, and South Knoxville included.

*Principal Cities and Towns, with Population in 1900.*—Memphis, 102,320; Nashville, 80,865; Knoxville, 32,637;

Chattanooga, 30,154; Jackson, 14,511; Clarksville, 9,431; Columbia, 6,052; Bristol, part in Tennessee, 5,271.

*Population and Races.*—In 1860, 1,109,801; 1870, 1,258,520; 1880, 1,542,359; 1890, 1,767,518 (natives, 1,747,489; foreign, 20,029; males, 891,585; females, 875,933; whites, 1,336,637; colored, 430,881, comprising 430,678 persons of African descent, 51 Chinese, 6 Japanese, and 146 civilized Indians); in 1900, 2,020,616.

*Industries and Business Interests.*—In 1900 the State debt was $17,023,600; value of taxable property, $340,359,148; State tax, $1,221,256; revenue (biennial period ending Dec. 19, 1900), $6,120,231.44. Sept. 5, 1900, there were 50 national banks with combined capital of $7,337,645, surplus and profits of $2,845,706.41, and deposits of $22,082,775; on June 30, 56 State banks, capital $2,806,315, surplus and profits $542,012, and deposits $7,303,710; and 7 stock savings-banks, capital $372,500, surplus and profits $192,931, and $2,015,472 in savings deposits from 19,687 depositors. The number of newspapers and periodicals in 1901 was 288. The census of 1890 reported the manufactures of cities only, the total of which for all industries was: Number of establishments reporting, 1,264; value of hired property, $4,346,153; direct investment, $29,713,423; miscellaneous expenses, $2,666,795; average number of persons employed, 23,094; total wages, $11,297,019; cost of materials used, $22,487,757; value of products, $43,071,586. There were 23 cotton-mills and 19 woolen-mills. The value of the annual product of flour is $10,000,000; lumber, $5,000,000; leather, $2,000,000. The manufacture of cottonseed-oil reaches about 3,000,000 gal. per annum, and the manufacture of distilled spirits 1,000,000 gal.

*Means of Communication.*—In 1900 there were 3,132 miles of railway; assessed valuation, $55,295,972.94. The most important roads are the Nashville, Chattanooga and St. Louis; the Louisville and Nashville; and the Southern. The number of electric railways in 1893 was 12; miles, 188; capital stock, $5,065,000. The rivers navigable for steamers are the Mississippi, 160 miles; the Tennessee, its whole course; the Cumberland, 304 miles; Clinch and Emery rivers, to Harriman; French Broad, 90 miles, to Leadvale; Hiwassee, 20 miles, to Charleston; Clinch, to Clinton; the Big Hatchie, Forked Deer, and other minor ones, to a limited extent. At high water many other streams float barges and rafts.

*Churches.*—The census of 1890 gave the following statistics concerning the principal religious bodies:

| DENOMINATIONS. | Organizations. | Churches and halls. | Members. | Value of church property. |
|---|---|---|---|---|
| Methodist Episcopal South | 1,367 | 1,317 | 121,398 | $1,994,382 |
| Baptist, Regular, South | 1,287 | 1,269 | 106,632 | 1,802,015 |
| Baptist, Regular, Colored | 575 | 581 | 54,252 | 525,573 |
| Methodist Episcopal | 609 | 603 | 42,873 | 665,460 |
| Disciples of Christ | 322 | 313 | 41,125 | 410,660 |
| Cumberland Presbyterian | 529 | 510 | 39,477 | 745,605 |
| African Methodist Episcopal | 144 | 236 | 23,718 | 461,305 |
| Methodist Episcopal, Colored | 206 | 205 | 18,968 | 258,120 |
| Roman Catholic | 60 | 60 | 17,950 | 434,200 |
| Presbyterian in the U. S. | 155 | 152 | 15,954 | 927,320 |
| African Meth. Episcopal Zion | 55 | 55 | 12,134 | 78,813 |
| Baptist, Primitive | 269 | 262 | 10,535 | 119,455 |
| Lutheran, United Synod in the South | 107 | 103 | 10,086 | 143,790 |
| Protestant Episcopal | 69 | 63 | 5,671 | 575,900 |
| Cumberland Presb., Colored | 81 | 79 | 5,202 | 88,660 |
| Baptist, Church of Christ | 69 | 69 | 5,065 | 31,355 |

*Schools.*—In 1891–92 the universities and colleges numbered 22; instructors, 404; students, 6,283; income, $368,304; value of grounds and buildings, $3,062,400. The most noted of these are the UNIVERSITY OF TENNESSEE (*q. v.*), at Knoxville; VANDERBILT UNIVERSITY (*q. v.*) and the University of Nashville (Peabody Normal College), at Nashville; the University of the South, at Sewanee; Cumberland University, at Lebanon; Southwestern Presbyterian University, at Clarksville; Southwestern Baptist University, at Jackson; and FISK UNIVERSITY (*q. v.*), at Nashville. The number of children of school age (six to twenty-one years) in 1899 was 760,162, of whom 499,845 were enrolled in the public schools, and 341,138 were in average daily attendance. There were 5,184 white primary district schools and 641 white secondary; 1,555 colored primary and 24 colored secondary; city schools, 156. The total number of public schools was 7,560; teachers, 9,214—average monthly salary, $29.03; the expenditures were $1,628,813. The number of schoolhouses was 7,076; value of school property, $3,935,671. In 1891 there were 978 private schools with an enrollment of 43,342 pupils.

*Libraries.*—According to a U. S. Government report on public libraries of 1,000 volumes and upward each in 1891, Tennessee had 53 libraries, containing 239,929 bound volumes and 39,595 pamphlets. The libraries were classified as follows: General, 11; school, 7; college, 25; college society, 6; law, 1; Y. M. C. A., 2; and society, 1.

*Charitable, Reformatory, and Penal Institutions.*—There is an insane asylum in each of the three divisions of the State, as follows: the Eastern, at Knoxville; the Central, at Nashville; the Western, at Bolivar. The disbursements for the insane in 1899–1900 were about $500,000. The School for the Deaf and Dumb is at Knoxville; the School for the Blind at Nashville; and the State also has at Nashville the Tennessee Industrial School, a reform school for both sexes. A home for Confederate soldiers was opened at the Hermitage (near Nashville) in 1892, with accommodations for 125 persons. Disabled and indigent Confederate soldiers who enlisted from the State receive pensions ranging from $8.33⅓ to $25.00 per month. The State penitentiary is at Nashville, but the convicts are worked by the lease (six years) system, and are scattered over the State, mainly in coal mines. There are poorhouses and jails in every county, and the most populous counties have workhouses.

*Political Organization.*—The State government has the usual legislative, executive, and judicial departments. The Legislature has two chambers, the House and the Senate. Its members are elected for two years and receive $4 a day during the session, which is limited to seventy-five days. At the head of the executive department is the Governor, elected for two years. He must have been a citizen of the State seven years and be thirty years old. In case of a vacancy the Speaker of the Senate succeeds him. Three State officers are elected by the Legislature, namely, a secretary of State (four years), comptroller (two years), and treasurer (two years). The Governor appoints, subject to confirmation by the Senate, a superintendent of public instruction, superintendent of prisons, commissioner of agriculture, statistics, and mines, etc. The judicial power is vested in a Supreme Court of five judges, elected for eight years, who sit in Jackson, Nashville, and Knoxville. There are also chancery or equity courts, circuit or law courts, and a court of chancery appeals. Some of the larger counties have separate criminal courts. Each county has a sheriff (two years), a trustee (two years), a register of deeds, and clerks of courts. Every civil district has two or more justices of the peace (six years), who, besides their individual jurisdiction, form the county court, a body of legislative and judicial powers. Each city has a mayor, a common council (some of one and some of two chambers), and the usual municipal officers. Suffrage is free to all males not convicted of infamous crime, who are citizens of the U. S. and have been one year in the State and six months in the county. A State law requires a modified form of the Australian ballot system in the large towns and counties. A State board of health has power to declare quarantine in times of epidemics.

*History.*—In 1541 the Spaniards under De Soto touched Tennessee where Memphis now stands, being the first European visitors. Here the French under La Salle, 141 years later, built a fort, and the Spaniards, in turn, afterward erected San Fernando. The country was claimed by the Spanish, the French, and the English. Charleville, coming up from Louisiana in 1714, built a trading-house near the present Nashville, and French and English struggled to secure the Indian trade. In 1748 Dr. Thomas Walker, with other Virginians, discovered the Cumberland Mountains, Gap, and river, which he named for the Duke of Cumberland. Fort London, the first Anglo-Saxon outpost in the great wilderness, was built by Andrew Lewis in 1756. It was taken by the Indians four years later. The tide of migration was from Virginia and the Carolinas. First came hunters, explorers (see BOONE, DANIEL), and traders, followed, in 1769, by immigrants who settled on the Watauga. In 1772 the first government, the Watauga Association, was formed. James Robertson settled on the Cumberland in 1779. The war of the Revolution found the settlements patriotic. Shelby and Sevier led 500 men into the Carolinas in 1780, where, under Campbell, they defeated the British Ferguson at King's Mountain. On his return the following year, Sevier made a conquest of the Cherokee Indians. After the Revolution North Carolina ceded the territory to the Federal Government and left the inhabitants without law or protection. Therefore, in 1784, the State of Franklin was formed, and, though the parent

State at once reversed her act of cession, lasted till 1788. The final cession, however, was made in 1790, and the "Territory South of the Ohio River" was formed, with William Blount as first governor. Knoxville was laid out in 1792, and the first territorial assembly met there in 1794. In 1796 the State was formed and admitted into the Union. The first two decades of the nineteenth century were characterized by rapid growth and contests with the Indians. The first bank (the Nashville) was chartered in 1807. Memphis was laid out in 1819. The State capital was Knoxville till 1811, except in 1807, when it was Kingston. Knoxville, Nashville, and Murfreesboro had the honor in turns till 1826, when Nashville became the permanent capital. Three Presidents of the U. S. have come from Tennessee: Andrew Jackson (1829–37); James K. Polk (1845–49); and Andrew Johnson (1865–69). The State was distinguished in the Mexican war (1845–47), Pillow, Haskall, Campbell, Trousdale, and Cheatham being prominent. In the civil war Tennessee at first hesitated, but on June 8, 1861, voted to join the Confederacy. The Federal Government soon regained the capital and a large part of the State, and President Lincoln appointed Andrew Johnson military governor. The contending forces fought successively the battles of Fort Henry, Fort Donelson, Pittsburg Landing (Shiloh), Stone River, Chickamauga, Lookout Mountain, Mission Ridge, Knoxville, Franklin, and Nashville. In Apr., 1865, the Legislature ratified the thirteenth amendment to the Federal Constitution, and on July 12, 1866, the fourteenth amendment. The usual reconstruction troubles succeeded the war. Prominent public leaders were William G. Brownlow, Andrew Johnson, and Horace Maynard, Republicans; and Isham G. Harris, John C. Brown, B. F. Cheatham, and others, Democrats. Following the war a large State debt accumulated, which has been greatly reduced.

GOVERNORS OF TENNESSEE.

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|---|---|---|---|
| *State of Franklin.* | | Aaron V. Brown | 1845–47 |
| John Sevier | 1785–88 | Neil S. Brown | 1847–49 |
| | | William Trousdale | 1849–51 |
| *Territory South of the Ohio.* | | William B. Campbell | 1851–53 |
| William Blount | 1790–96 | Andrew Johnson | 1853–57 |
| | | Isham G. Harris | 1857–63 |
| *State of Tennessee.* | | Andrew Johnson | 1863–65 |
| | | William G. Brownlow | 1865–69 |
| John Sevier | 1796–1801 | De Witt C. Senter | 1869–71 |
| Archibald Roane | 1801–03 | John C. Brown | 1871–75 |
| John Sevier | 1803–09 | James D. Porter | 1875–79 |
| Willie Blount | 1809–15 | Albert S. Marks | 1879–81 |
| Joseph McMinn | 1815–21 | Alvin Hawkins | 1881–83 |
| William Carroll | 1821–27 | William B. Bate | 1883–87 |
| Samuel Houston | 1827–29 | Robert L. Taylor | 1887–91 |
| William Hall | 1829–29 | John P. Buchanan | 1891–93 |
| William Carroll | 1829–35 | Peter Turney | 1893–97 |
| Newton Cannon | 1835–39 | Robert L. Taylor | 1897–99 |
| James K. Polk | 1839–41 | Benton McMillin | 1899– |
| James C. Jones | 1841–45 | | |

AUTHORITIES.—Phelan, *History of Tennessee*; Phelan, *School History of Tennessee*; Carpenter, *History of Tennessee*; Ramsay, *The Annals of Tennessee*; Killebrew, *Resources of Tennessee*; Safford, *Geology of Tennessee*; Safford, *Elementary Geology of Tennessee*; the U. S. census of 1890; Reports of the State Commissioners of Agriculture and of other State officers; and Reports of the U. S. Weather Bureau. T. C. KARNS.

**Tennessee Centennial and International Exposition**: See the Appendix.

**Tennessee River**: the chief affluent of the Ohio. It originates in the confluence of the Holston and the North Fork of the HOLSTON (*q. v.*), near Kingsport, Sullivan co., Tenn., flows S. W. to Chattanooga, thence W., and again S. W. Sweeping through Northern Alabama, it turns northward, traverses Tennessee and Kentucky, and joins the Ohio at Paducah, Ky. Its drainage-area is 41,000 sq. miles; total length to the head of the Holston, nearly 1,200 miles; below the confluence, 800 miles. It is navigable without obstruction 280 miles to Florence, Ala., at the foot of the Muscle Shoals. The shoals (20 miles long) are navigable about three weeks in the year during spring floods. Canals and locks now obviate this difficulty. Above this point the river is navigable throughout its course for the greater part of the year by light-draught steamers. There are 925 miles of naturally navigable waters above the shoals upon this river and its tributaries for six months in the year. Revised by I. C. RUSSELL.

**Tennessee, University of**: an institution at West Knoxville; chartered in 1794 as Blount College; name changed in 1807 to East Tennessee College; in 1840 to East Tennessee University; in 1879 to the University of Tennessee. It received the appropriations made by the U. S. Government in 1862, 1887, and 1890 for colleges of agricultural and mechanical arts in the several States. The university includes, besides the regular academic department, a department of law, a department of medicine, and a department of dentistry. In the academic department tuition is free to properly qualified students of both sexes from all States of the Union. Instruction is provided in military science. The university occupies twelve large brick and stone buildings situated on a beautiful campus of 40 acres. The elevation is over 1,100 feet above the sea. In 1888 a complete reorganization of the university was effected. In 1900 the number of instructors was 75; of students, 750. The library contains 16,000 volumes. The president is Charles W. Dabney, Jr. Revised by T. C. KARNS.

**Tenney**, SANBORN: naturalist; b. at Stoddard, N. H., Jan. 13, 1827; graduated at Amherst College 1853; afterward studied under Louis Agassiz at Cambridge; was lecturer on natural history in the Massachusetts Teachers' Institute 1856–65; was (1865–68) professor at Vassar College; became in 1868 professor at Williams College. Among his works are a text-book of *Geology* (1859); *Manual of Zoölogy* (1865); *Natural History of Animals*; and *Elements of Zoölogy*. D. at Buchanan, Mich., July 9, 1877.

**Tenniel**, ten-ni-eel', Sir JOHN: painter and illustrator; b. in London, England, in 1820; showed a decided taste for art in boyhood; pursued his studies in his own way, thus developing a very original style; was a successful competitor for painting pictures in fresco in Westminster Palace 1845; from 1851 to 1901, when he retired, he was one of the leading artists on the staff of *Punch*, for which he produced weekly most of the large full-page cartoons, and has illustrated many books, among which are *Æsop's Fables*, the *Ingoldsby Legends*, *Lalla Rookh*, and the celebrated books for children, *Alice's Adventures in Wonderland* and *Through the Looking-glass*, by Lewis Carroll (C. L. Dodgson). Revised by RUSSELL STURGIS.

**Tennis**: a game played with small, hard balls, formerly struck by the hand, perhaps always gloved; then by the hand covered with a special gauntlet, and finally by a bat or racket; but LAWN-TENNIS (*q. v.*) is a distinct game. In all its modifications tennis corresponds very closely with the French *jeu de paume*. Even in the elaborate game which developed in the seventeenth century, the resemblance between the French and English customs of playing and counting is marked, and the points of difference are few. Both in England and on the continent of Europe tennis was played by the populace out of doors, in a town moat, or wherever a blank wall could be had, and in like manner it was played by kings and their courtiers in large rooms especially built and prepared for it, and also out of doors. Toward the end of the seventeenth century it seems to have been thought improper for the populace to play tennis at all; it was the sport of those who had the privilege of leisure, as, indeed, none others could hope to excel in it. The antiquaries have discovered accounts of Henry VII. of England losing his balls at the game and losing money also, twelvepence at one time, and Henry VIII. was evidently an ardent player. Charles I., for all his gravity and dignity, both as prince royal and as king, played tennis a great deal. In literature allusions to the game are frequent. Pericles, Prince of Tyre, complains of being

> A man whom both the waters and the wind,
> In that vast tennis-court, have made the ball
> For them to play upon.

The "wild prince" Henry tells Poins that the tennis-court keeper knows more about the latter's wardrobe than anybody else because "it is a low ebb of linen with thee when thou keepest not racket there" (*2 Henry IV.*, ii., 2). To the same prince when king the Dauphin of France sends tennis-balls as a reproach for his idle frivolity (*Henry V.*, i., 2); but the king was not ashamed of tennis, for in his speech of defiance he goes into a discussion of the game which he means to play with the King of France, and revels in anticipation. The speech, some fifty lines long, is full of the language of tennis, not to be understood by those ignorant of the favorite game. In *Henry VIII.* (i., 3) Sir Thomas Lovell complains of the travelers who have so much faith "in tennis and tall stockings." Polonius, in *Hamlet* (ii., 1), giving advice to his servant, supposes "a falling-out at tennis." Benedick's whiskers are assumed, now that he is elegant and trim "for the love of Beatrice" (*Much Ado about Nothing*, iii., 2), to have stuffed tennis-balls.

In the 1894 edition of *Les Trois Mousquetaires*, with illustrations by Maurice Leloir, is a picture of Porthos in the *jeu de paume*, which shows a tennis-court as it may be thought to have been under Louis XIII. In the *Tableaux Historiques de la Révolution Francaise* (1791; reissued 1817) there is a contemporary picture of the famous *Jeu de Paume* at Versailles, in which was taken the oath of June 20, 1789, the *serment du jeu de paume*. It is very like a modern court.

A very large room, about three times as long as wide and 30 feet or more in height, is lighted with top light or at least with windows only at the top of the wall. Along one long side and both ends a wall about 7 feet high is built about 7 feet from the main wall, and a sloping, pent-house roof is carried from this wall back to the high wall. The gallery for spectators is high in the wall where there is no pent-house. What remains of unoccupied floor is divided into halves by what was originally a rope, afterward a net reaching to the floor. That half of the floor in which a player facing the net has the long pent-house on his left is the *service* side, the other is the *hazard* side. Behind the player on the service side is a long and large opening in the wall below the pent-house, and smaller openings are in other parts of it, as well as vertical break or step in the wall where there is no pent-house. The floor is marked with lines parallel to the net. The walls of the room are sometimes black to show the white balls the better, and it is stated that in India the British officers have their balls black so that they may keep the walls of the court white for coolness sake.

The game is played by striking the ball from the service side so as to bound from the upper wall or the pent-house on the hazard side, and by returning it from the hazard side. The ball must strike the floor within certain limits; it must be struck on the first bound; it must not strike the net, nor the roof, nor the high wall beyond a certain line. The player counts by sending a ball into any of the openings in the lower wall, and by striking the ball on its first bound in certain ways relatively to the cross-marks on the floor. Elaborate codes of laws are issued by tennis clubs, of which there are many in Great Britain and a few in the U. S. The not dissimilar game of racket is sometimes encouraged by the same association with tennis; thus in New York city the Racquet and Tennis Club has a court for each game, but nowhere does the game find many players, as it is superseded in popularity by other athletic sports, among which are lawn-tennis, cricket, and base-ball.

**Ten′nyson**, ALFRED, Baron Tennyson, D. C. L., F. R. S.: poet; b. at Somersby, Lincolnshire, England, Aug. 6, 1809; the fourth of twelve children (eight sons and four daughters) of George Clayton Tennyson, LL. D., rector of Somersby and other Lincolnshire parishes. Dr. Tennyson was the eldest son of George Tennyson (1750–1835), who belonged to the Lincolnshire gentry as owner of Bayons Manor and Usselby Hall, and was for several years a member of Parliament; he married (Aug. 6, 1805) Elizabeth, daughter of Stephen Fytche, Vicar of Louth. The poet's father (1778–1831) was a man of superior abilities and varied attainments. His mother (1781–1865) was a pious woman of many admirable qualities, being especially sensitive. From her he inherited his refined, shrinking nature. Alfred was a pupil of Louth Grammar School 1816–20. During the next eight years he was educated at home by his father and private teachers. The rector requiring only a moderate amount of intellectual work, he was out of doors much of the time, rambling in the woods and pastures about Somersby. He was solitary and reserved, moody and absent-minded, the mental habits of the boy foreshadowing the characteristics of the man. He was fond of reading and addicted to verse-writing at an early age. His literary career began in his youth, his boyish rhymes and those of his elder brother Charles being collected into a volume—*Poems by Two Brothers* (1827). In his nineteenth year he composed a labored narrative in blank verse, entitled *The Lover's Tale*, two parts of which were printed in 1833, but were immediately suppressed; in 1879 the entire poem was given to the world in a more finished dress, owing to the pirated republication of the fragment of 1833. In Oct., 1828, Tennyson entered Trinity College, Cambridge, leaving in 1831 without a degree. Here he formed friendships with Kemble, Milnes, Brookfield, Spedding, and other talented young men who afterward became famous as scholars and writers. He was fortunate in having the companionship of such choice spirits, but he owed most to one whose name is forever associated with his own—Arthur Henry Hallam, a son of the historian. This dearest of his friends, whom he calls more than brother, became the betrothed of his sister Emily. Together they traveled in the French Pyrenees in the summer of 1830. Hallam's sudden death (Sept. 15, 1833) in Vienna made an ineffaceable impression on Tennyson, and may be considered an important agency in shaping his character and poetical career. In producing the beautiful elegy known as *In Memoriam*, he conferred immortality upon his lost friend and won it for himself.

In 1829 young Tennyson won the chancellor's gold medal for the prize poem *Timbuctoo*. In 1830 appeared his first book—*Poems, chiefly Lyrical*, including a few pieces which are perennial favorites with lovers of Tennyson's poetry. His second book of *Poems*, published late in 1832 (dated 1833), was a more ambitious venture. There was nothing in it from the 1830 volume. It contained some of his loveliest lyrics, having the richness of melody and the indescribable witchery of style which constitute Tennyson's charm, yet it found but few admirers beyond the immediate circle of his acquaintances. Not many reviewers noticed it. Stung by the savage criticisms of Wilson and Lockhart, he set himself to the task of improving what he had written. Profiting by the advice of critics and the suggestions of friends, he subjected his verses to the most painstaking revision. He experimented with various styles and meters; thus he served his laborious apprenticeship as poetic artist. Ten years passed, then he issued his *Poems* (1842) in two volumes, comprising selections from his two earlier books and many new pieces. The singer, hitherto unrecognized, was greeted with universal praise. The new spirit of the age found an exponent in his verse, which reflected the unrest and hopefulness of a transitional era. This was the beginning of a series of triumphs and honors. In 1845 he was granted a pension of £200, in 1850 he was appointed poet-laureate to succeed Wordsworth, and in 1855 he received the honorary degree of D. C. L. from Oxford. After leaving college, Tennyson resided chiefly with his sisters and his widowed mother at Somersby, then at High Beech (1837–40), Tunbridge Wells and Boxley (1840–44), and Cheltenham. He roamed on foot through England and Wales, often visiting friends in London and elsewhere, and making occasional trips to Ireland and the Continent. His writings prove that he was a close observer of nature as well as a diligent student of books. More than Vergil, he was a "landscape-lover." The physical features of many of the places he visited are sketched by him with pictorial fidelity and vividness, though not with photographic accuracy. Hamerton called him the "prince of poet-landscapists." *The Princess*, in which he first essayed extended narrative in blank verse, was published in 1847; the six intercalary songs were inserted in the third edition (1850), and there were numerous additions and alterations in the fourth and fifth editions. In 1850, which is called his golden year, appeared anonymously the poem that is generally regarded as Tennyson's masterpiece, *In Memoriam*, a monumental work in process of growth during the seventeen years after Hallam's death. Canto lix. was inserted in the fourth edition (1851) and xxxix. about 1872. In 1855 *Maud and other Poems* was published. The volume contained two memorable patriotic lyrics previously printed—*Ode on the Death of the Duke of Wellington* (1852) and *The Charge of the Light Brigade* (1854). *Maud* was at first misjudged and underrated, but later won its way to a generous appreciation of its abundant merits. The appearance of *Idylls of the King* in 1859 can be described as a literary sensation. Tennyson's fame was now international, and his books sold by the hundreds of thousands. His next publication, *Enoch Arden* (1864), has been the most widely read of the laureate's writings in foreign lands, having been translated into Danish, German, Dutch, French, Bohemian, Italian, and Hungarian. Four more Arthurian romaunts were added in *The Holy Grail, and other Poems* (1869), two in 1872, and one in 1885. This series of tales, if not entitled to the name of epic, is certainly the greatest of his literary undertakings; the longest of his works, though not the most original. At threescore he showed no signs of failing powers. The last two decades of his life were exceptionally productive of works stamped with dignity of thought, felicitous expression, and musical versification. The list includes the dramas *Queen Mary* (1875); *Harold* (1876); *Becket* (1884); *The Cup* (1884): *The Falcon* (1884); and *The Foresters* (1892), several of which were put on the stage. There were also five volumes of minor poems—*Ballads, and other Poems* (1880); *Tiresias, and other Poems* (1885); *Locksley Hall Sixty Years After, etc.* (1886); *Demeter, and other Poems* (1889); and *The Death of Œnone, Akbar's Dream, and other Poems* (1892).

Tennyson is not a world poet, his appeal being more or less insular. He has been criticised for being a "chanter of the aristocratic idea," yet he was a poet of the common people as well as of lords and ladies. He drew his materials from many sources, finding subjects in the legends of antiquity, the mediæval world of romance, and the tangled skein of modern life. He was master of the technical resources of the poetic art, and possessed unrivaled power as a word-painter. But the domain of beauty was too narrow for him. Beyond any mere æsthetic influence that he exerted, he was a mighty force for good, his polished verse being the vehicle of ethical instruction and spiritual uplift. The personality and love of God, the divinity and mission of Christ, providence, free will, the immortality of the soul, the province of law, the ministry of sorrow in the development of character, the spheres and limits of faith and knowledge—these are some of the leading ideas or tenets of his theology and philosophy. His success is largely explained by the fact that he clothed in artistic form the higher thought and sentiment of his time, thus enriching the spiritual life of England and the world. Tennyson's career was unstained by excesses. He fulfilled Milton's condition; his life was a poem. He remained in the Anglican Church all his days, liberal but essentially orthodox in his creed. A friend of the Broad Church party, he contributed not a little to the growth of tolerance and the non-sectarian temper. In politics he was a moderate Conservative, an advocate of gradual reform in Church and state. He was a man of many-sided culture, keenly interested in astronomy, geology, botany, and other sciences. He was familiar with the discussions and speculations of physicists and metaphysicians. An idealist of the intuitional school, he was inclined to mysticism leavened with British sense.

Tennyson married (June 13, 1850) at Shiplake, Oxfordshire, Emily Sarah Sellwood, whom he had known and loved for many years (d. Aug. 10, 1896). She was the eldest daughter of Henry Sellwood, of Peasmore, in Berkshire, afterward a solicitor of Horncastle, Lincolnshire; her mother was a sister of Sir John Franklin, and her youngest sister the wife of Charles Tennyson Turner. A lady of high intelligence and gracious manner, she was in every way fitted to be the companion of her poet husband, who lovingly bore testimony to her loyalty and worth. Exalted as was the poet's ideal of woman as wife and mother, she seems to have met his exacting requirements almost perfectly. Their wedded life was harmonious and happy. They lived three years at Twickenham, where Hallam (the second Lord Tennyson) was born. In 1853 he bought the Farringford domain near Freshwater, Isle of Wight, where was born his second son Lionel. In 1867 he purchased a small estate on Blackdown, Sussex; in 1868 he built Aldworth, a fine Gothic mansion, which was his summer home for more than twenty years. He twice declined a baronetcy (1865 and 1868); was created a peer (Jan. 24, 1884) with the title Baron Tennyson of Aldworth and Freshwater. D. at Aldworth, Oct. 6, 1892; was buried in Westminster Abbey, Oct. 12. See Van Dyke's *Poetry of Tennyson*; Brooke's *Tennyson*; Waugh's *Alfred Lord Tennyson*; and Napier's *Homes and Haunts of Tennyson*. EUGENE PARSONS.

**Tennyson**, FREDERICK: poet; b. at Louth, Lincolnshire, England, June 5, 1807; second son of Dr. George Clayton Tennyson and a coheir of the Earls of Scarsdale; educated at Eton and Cambridge (entering Trinity College in 1827 and taking his degree in 1832), where he distinguished himself by writing Greek verse, winning the prize for a Sapphic ode, entitled *Egypt*, in 1828. He married an Italian lady, Maria Guiliotta (since deceased), lived in Italy many years, and since 1859 chiefly in Jersey, devoting his leisure to poetry and his favorite Hellenic studies. Author of three volumes of verse—*Days and Hours* (1854); *Isles of Greece: Sappho and Alcæus* (1890); *Daphne, and other Poems* (1891). D. Feb. 28, 1898. EUGENE PARSONS.

**Tennyson**, HALLAM, Lord Tennyson: author; eldest son of Alfred Tennyson; b. at Twickenham, England, Aug. 11, 1852; educated at Marlborough College and Trinity, Cambridge, also a student of the Inner Temple. He edited a volume (1880) of sonnets by his uncle, CHARLES TENNYSON TURNER (*q. v.*), for which he furnished a memoir of the author; issued a juvenile work, *Jack and the Beanstalk* (1886), illustrated by Randolph Caldecott; translated the old Saxon song of Brunanburh, which appeared in *The Contemporary Review* (Nov., 1876), and was later versified by his father. He has written a *Life* of the late poet-laureate. He was appointed Governor of South Australia in 1899. E. P.

**Tennyson**, LIONEL: author; second son of Alfred Tennyson; b. at Freshwater, Isle of Wight, Mar. 16, 1854; educated at Eton and at Trinity College, Cambridge; married (Feb. 28, 1878) Eleanor Mary Bertha, the accomplished daughter of Frederick Locker-Lampson; was connected with the India Office several years, and prepared a masterly report on *The Moral and Material Condition of India* for 1881–82. A profound student of dramatic poetry, he contributed valuable articles to the *Cornhill*, the *Nineteenth Century*, and other periodicals. D. on board the Chusan, near Aden, Apr. 20, 1886. EUGENE PARSONS.

**Tenochtitlan'**: See MEXICO (city) and MEXICAN ANTIQUITIES.

**Tenor**: the highest kind of adult male voice. The average compass of a true tenor is from C in the bass staff to A in the treble. Special cases may occasionally be found which can produce two or three tones higher. In written music the treble clef is usually employed for the part to be sung by this voice, although the tones produced are an octave lower in actual pitch. D. B.

**Tenos**: island in the Ægean Sea; one of the Cyclades, belonging to Greece. It is mountainous, but springs abound, and it is well cultivated. It has a good harbor, Porto Panormo, on the N. E. Wine, raw silk, and marble, especially vert antique, are exported. The Tenians took a memorable part in the battle of Salamis (479 B. C.), fiercely resisted the Ottomans, by whom they were conquered, and fought heroically in the Greek revolution (1821–27). Their cathedral of the Holy Virgin, the Evangelistria, is one of the finest edifices of modern Greece. Area, 79 sq. miles. Pop. 21,000, nearly half of whom are Roman Catholics. E. A. G.

**Tenpins**: See BOWLS AND BOWLING.

**Tenrec**: See TANREC.

**Tensas** or **Tensaw River**, or **Bayou Tensas**: a stream which rises in Carroll parish, La., and after a devious southerly course of 250 miles joins the Washita at Trinity, La. It is navigable 150 miles during good stages of water.

**Tensaw River**: a bayou of Alabama, which leaves Alabama river before its junction with the Tombigbee, and pursues a course parallel with that of Mobile river. Its waters flow into Mobile Bay.

**Tense**: See VERB.

**Tenshi**: See MIKADO.

**Tension of Electricity**: See ELECTRICITY, ELECTRIC DISCHARGE, and VOLT.

**Tension of Vapors**: See VAPORS.

**Tent** [from O. Fr. *tente* < Lat. *ten'tum*, neut. perf. partic. of *ten'dere*, stretch]: a pavilion or portable lodge made of skins, strong cloth, or canvas, sustained by one or more poles, and used as a shelter from the weather, especially by soldiers in camp. The material used as a covering is usually stretched by means of cords secured to tent-pegs. Such portable shelters, or tents of some sort, have been used as homes by nomadic tribes from the earliest ages. The patriarchs were dwellers in tents, and the poorer classes in Persia, China, and other Eastern countries still live in tents formed of frames of wood covered with thick cloth, felt, or matting. Tents have become indispensable to the equipment of armies. The Greeks encamped in tents at the siege of Troy, and the soldiers under Hannibal had tents of skins or canvas. Modern military tents are made of canvas, generally of cotton duck, on account of its being more impervious to water and cheaper than linen or hemp, though the latter are sometimes used. Different forms of tents for military purposes have been employed in the armies of the U. S. and of Europe. Prior to the civil war the Sibley tent, which is a conical tent, supported by a central pole resting on an iron tripod, and capable of sheltering fifteen infantry soldiers or thirteen mounted men, was used in the U. S. army. One of its advantages was that it could be warmed by an open fire or small stove, and afforded ample ventilation, having a circular opening at the apex partially covered by a movable piece of canvas so arranged as to be shifted according to the direction of the wind. It resembled a Sioux lodge, the chief difference being that it was constructed of canvas and supported by the central pole and tripod, while the Indian lodge was made of rudely tanned buffalo skins stretched on several long wooden poles. The tents used in the U. S. military service include the hospital tent, which is of cotton duck $28\frac{1}{2}$ inches wide, clear of all imperfection, and weighing 12 oz. to the linear yard, and has the following dimensions when pitched: Height, 11 feet; length of ridge, 14 feet; width, 14 ft. 6 in.; height of wall, 4 ft. 6 in.; wall eaves, 3 inches in width; height of door, 8 ft. 9 in.; width of door, 18 inches at bottom and 10 inches at top; and from top of ridge to wall, 9 ft. 10 in. Such tents are made to open at both ends, so that several may be placed together and form a continuous ward. Each tent holds from six to eight beds. The wall tent for officers is of similar material, and has the following dimensions: Height, 8 ft. 6 in.; length of ridge, 9 feet; width, 8 ft. $11\frac{1}{2}$ in.; height of wall, 3 ft. 9 in.; wall eaves, 2 inches wide; height of door, 6 ft. 8 in.; width of door, 12 inches at bottom, 4 inches at top; and from top of ridge to wall, 6 ft. 6 in.; and is furnished with a fly. The conical wall tent for enlisted men has the body of the tent of standard 12-oz. cotton duck, and the sod-cloth of standard 8-oz. cotton duck $28\frac{1}{2}$ inches wide, with eave-lines of six-thread manilla line (large), and foot-lines of nine-thread manilla line. Its roof is in the form of a frustum of a cone, 16 ft. 5 in. in diameter at the base, 18 inches in diameter at the top. Its wall is 3 feet high; the height to top of roof, 10 feet; eaves 2 inches wide, and tabling at bottom, $2\frac{1}{2}$ inches wide. From the top to the eave it measures 10 ft. $1\frac{1}{4}$ in. The shelter tent, which is a modification of the French *tente d'abri*, consists of two pieces of cotton duck; each half is 65 inches long on the ridge and 61 inches wide when finished. The center seam overlaps 1 inch. They are made of cotton duck 33 inches wide, to weigh from $7\frac{1}{2}$ to 8 oz. to the linear yard, and be free from imperfections, arranged to button together and stretch over a ridge supported by poles. In active service each soldier carries half a tent, which may serve as a cloak on the march, as a covering at night, and when the two pieces are joined forms a tent for both men. Besides military tents, there are special forms of tents made for emigrants, lumbermen, gypsies, surveyors; and prospecting parties, as in railway construction, have tents devised for their wants. There are pleasure tents of many forms, as those used for camping out, for lawns (square and oblong), for children, for screens, as the surf tents used on beaches. Besides large circus tents, which are of heavy twilled duck and special construction, there are boarding tents, stable tents, and house tents; also special tents for agricultural and other fairs, with varieties for the sale of refreshments and exhibition of side-shows, also photographers' tents, illusion tents, etc. The chief market for the duck in the U. S. is in Baltimore, and the centers of the tent-industry are in New York, St. Louis, Chicago, Cincinnati, and St. Paul. There is a large local demand in the U. S. for the many kinds of tents mentioned, and a small export trade dependent upon special causes; thus in 1894 and 1895 the demand was largely from Japan.

MARCUS BENJAMIN.

**Tentaculif'era**: a group of protozoans. See *Suctoria*, under INFUSORIA.

**Tenterden**, Lord, CHARLES ABBOTT: judge; b. at Canterbury, England, Oct. 17, 1762, his father being a barber; entered Oxford University in 1781; took degree of B. A. in 1785; acted as private tutor to the son of a judge, who persuaded him to take up the law; entered the Middle Temple 1787, practiced as a special pleader from 1789 to 1796, and then was admitted to the bar; became a judge in the court of common pleas in 1816, and lord chief justice of the king's bench in 1818. In 1827 he was raised to the peerage as Lord Tenterden. D. in 1832. He combined with an unusually quick mind extraordinary perseverance and application, and was recognized as the ablest lawyer of his time; but he was not called upon to decide any great constitutional questions. He published in 1802 a *Treatise on the Law relative to Merchant Ships and Seamen*, which has passed through more than a dozen editions and is a standard yet.

F. STURGES ALLEN.

**Ten Thousand, Retreat of the**: the homeward march of about 10,000 Greek mercenaries from Cunaxa, a town 60 miles N. of Babylon. At Cunaxa their leader, Cyrus the Younger, was killed in battle against his brother Artaxerxes II. (401 B. C.). Thereupon their Persian allies dispersed and the Greeks were left in a most critical position. Their only possible line of escape was by the upper Tigris through the country of the Kardouchi (the modern Kurds), and across the highlands of Armenia to some Greek city on the Black Sea. At the river Zapatas their five principal generals were assassinated by the Persian satrap Tissaphernes. Thereupon Xenophon, then a private soldier, was elected a general, and became practically commander-in-chief. After a winter's march of over 700 miles in an enemy's country, during which they endured terrible hardship and suffering, they reached Trapesus (Trebizond). Finally they arrived at Chrysopolis, opposite Byzantium (400 B. C.). Their successful escape revealed the weakness of the Persian empire, and encouraged Alexander to undertake its subjugation. In the *Anabasis* Xenophon describes this retreat, and gives the most vivid picture extant of Greek discipline and military methods.

E. A. GROSVENOR.

**Tennes**: See MEDIÆ.

**Tenuiros'tres** [Mod. Lat.; Lat. *te'nuis*, slender + *rostrum*, beak, bill]: a group (tribe or family) of birds, including forms whose only common characters consisted in the possession of a slender bill, and feet with three toes directed forward and one backward. According to Cuvier, it included the Linnæan genera *Sitta*, *Certhia*, *Trochilus*, and *Upupa*. The group was a very heterogeneous one, and has not been retained in the ornithological system.

**Tenure**: the manner in which real property is held or owned. As has been explained in the articles on LANDLORD AND TENANT and PROPERTY (*qq. v.*), the common law of England and the U. S. denied to real property the capacity of absolute ownership. The exigencies of the feudal system, which required the complete dependence of the man upon his lord and of the lord upon the king, substituted for the notion of absolute ownership of lands—such as was recognized in the case of goods and chattels—the conception of "estates" in land, the land being deemed to be held of and in subordination to the lord of the man and of the land. These estates were qualified interests, resting upon a recognition of a superior right vested in the person of whom the land was "held," and dependent for their continuance upon the due performance of the terms and conditions of such "holding." It is true that the early English law recognized an "allodial" or absolute ownership of lands, as well as of chattels, but this form of proprietorship did not long survive the Norman Conquest.

The feudal system was primarily a military and political organization of society, its system of land tenure being only an incident, though doubtless at first a necessary incident, of that social organization. As the article on the FEUDAL SYSTEM (*q. v.*) shows, these primary features of the system dominated and controlled its development on the continent of Europe, while its system of land tenure continued to be a thing apart. In England, on the other hand, where the feudal system in the generation following the Norman Conquest had an unparalleled expansion, its military and political features soon disappeared, while its system of land tenure entered into and completely transformed the property rights and the property law of the kingdom. From that time on the law of real property in England was the feudal law, and the allodial ownership of an earlier day disappeared so completely that its very existence was denied. It became a maxim of English law that the king is the ultimate and absolute owner of all the lands in the kingdom, and that all of his land-owning subjects are only his tenants. "Every acre of English soil and every proprietary right therein have been brought within the compass of a single formula, which may be expressed thus: *Z tenet terram illam de . . . domino Rege*. The king himself holds land which is in every sense his own; no one else has any proprietary right in it; but if we leave out of account these royal demesnes, then it is true that every acre of land is held of the king. The person whom we might be inclined to call its owner, the person who has the right to use and abuse the land, to cultivate it or leave it uncultivated, to keep all others off it, holds the land of the king either immediately or mediately" (*Pollock and Maitland*). He who held directly or immediately of the king was said to hold in chief (*in capite*); but the tenant *in capite* is not usually the person who deals with the land as owner. The latter is usually one to whom the tenant in chief has directly, or through still other links in the feudal chain, transmitted the power of dealing with the land. In other words, D, who is seized of the land in fee simple, holds of C, who in his turn holds of B, who holds of A, who holds *in capite* of the king. In this feudal order D is said to hold the land *in demesne*, while A, B, and C are *mesne lords*, being lords with respect to those standing below them, but tenants with respect to those standing above them.

There is another side to this relation of lord and tenant which has been developed out of the feudal relation of lord and man. The chief end of the transaction above described is not to confer lands on A, or B, or C, or D, but to secure to the king the services of A, to A the services of B, and so on. It is to secure these services that the land is granted, and it is only by the due performance of these services that it can be retained. The term "tenure" involves the obligation of service on the part of the tenant quite as much as it does the right of the tenant to hold the land for which the service is due. So important is this fact of service that the principal classification of tenures is by the service to be performed. A tenant may hold his lands in fee simple, fee tail, or for life, but his tenure is by "knight service," or by the service of "free alms," or by the service of "serjeanty," or by the service of "socage."

Classification of Tenures.—Land tenures under the feudal *régime* fell into two classes—(*a*) the free tenures and (*b*) such as were not free.

*The Free Tenures.*—1. *Knight's Service.*—This form of tenure, known also as military tenure, or tenure *in chivalry*, was the most important, as it was for many years the most numerous, class of tenures at common law. It was created by "homage," a solemn act by which the tenant acknowledged his lord as him of whom he held his land and to whom he was bound to render service, and from which, on the other hand, arose the duty on the part of the lord of protecting his tenant. This tenure was, as its various designations indicate, based upon the performance by the tenant of military service in the army of the king. Most of the tenants *in capite* held by this tenure, but wherever it existed, whether the holding was immediately of the king or of some *mesne* lord, the military service was still due directly to the king. Doubtless the practice of that feudal society conformed for a time to the theory upon which this form of tenure was based and the tenants in chivalry paid their service in person by actual military duty, but it was not long before tenure by knight's service stood for an irregular series of money payments, while the king, with his share of these payments (*scutage*, shield-money), recruited his army wherever he could. The "incidental" payments to the lord, however, were by far the most burdensome feature of military tenure, and, under the name of rights of *marriage*, *wardship*, *aids*, and *reliefs*, became the most characteristic and oppressive features of the feudal system in England. They continued until the abolition of military tenures by statute in the year 1660 (12 Car. II., cap. 24, *Stat. of Military Tenures*).

2. *Serjeanty.*—Closely allied to the tenures based on military service were those where the tenant held his land by the duty of performing some personal and ofttimes domestic or menial service to his lord. This form of service covered a wide range, from the "grand serjeanties" of the king's marshal, chancellor, or justiciar, to the "petty serjeanty" of the freeman who supplied his lord with arrows or knives for the chase.

3. *Frankalmoign.*—Most of the lands held by ecclesiastics or by the Church (and the quantity of land so held was, even at the beginning of the thirteenth century, very large) were held by this tenure of "free alms." The service implied was spiritual—to sing masses, to distribute money among the poor, etc.—and the land was, as between the donor and the tenant in frankalmoign, held free from any services or dues of a secular nature. Of course, if the land thus given was held by the donor of the king, or of some *mesne* lord by a tenure of secular service, the land would go even into the hands of the Church burdened with this external (*forinsec*) service; for it was a marked characteristic of all the feudal tenures that the services on which they were based were directly imposed upon the land, and could thus be exacted even of those tenants of the land who did not personally "owe" them.

4. *Socage.*—This was the great residual tenure of the feudal era, and comprehended all freehold lands not held by military, or "domestic," or spiritual service. The landowner who bought his land outright for a valuable consideration, the freehold tenant who held by the service of paying a perpetual rent in money, or produce, or labor, the secular tenant to whom the land was given as a free gift—all these held by the tenure of "free and common socage." Homage was not essential to the creation of this tenure, though doubtless it often arose by the performance of that solemn act. But the oath of fealty was indispensable, and often constituted the sole "service" of the tenant in socage. The principal characteristic of this tenure was the certainty, or definiteness, of the service required as compared with those exacted under the other feudal tenures, and its freedom from the most burdensome of the so-called feudal "*incidents*"—wardship and marriage—rendered it a popular and highly desirable form of tenure. The first socage tenants were doubtless primitive allodial proprietors, some of the more obscure of whom succeeded in escaping the general confiscation of lands after the Conquest by coming under the protection of the local lords and admitting their paramount title to their lands. At first the number of persons in socage must have been very small, but it must also have grown very rapidly as the advantages of this form of tenure became apparent and unoccupied lands were, more and more, granted out for agricultural uses. By the statute of Charles II., heretofore referred to, all freehold tenures were turned into free and common socage, and this has continued to be the well-nigh universal form of land-holding in England. The so-called "burgage" tenure was merely a form of socage which obtained in certain boroughs. The tenures of Borough English and Gavelkind (*qq. v.*) were only local variations of socage tenure.

*Non-free Tenure.*—In addition to the lands held by the king or other territorial lords in demesne and those parceled out by them to be held of them by the free tenures above described, there were other lands granted by them for longer or shorter periods—to be held, perhaps, at the will of the lord, perhaps for the life of the tenant, sometimes even by the tenant and his heirs forever—upon the service and condition of agricultural or other labor to be performed by the tenant at the lord's will. The terms of this tenure—known as "villeinage"—were, for the most part, regulated by the custom of the "manor," or estate, of which the villein tenement formed a part, and the rights of the villein tenant were protected by the court of the manor, but there is no doubt that the quasi-servile character of this tenure was due to the fact that the terms of the tenancy and the enforcement of the tenant's rights were originally largely dependent on the will of the lord. Although it was the unfree man, the villein, who gave his name to this form of land-holding, there was nothing to prevent a freeman, even one who already held lands in the same manor by knight's service or in socage, from being the holder of a villein tenement.

In the course of time this villein tenure lost its arbitrary and indefinite character. The custom of the manor acquired binding force and became enforceable in the king's courts even against the lord of the manor. The condition of labor to be performed by the tenant was commuted into rent, and the copy of the "roll" or record of the lord's court, in which was recorded his accession to the estate, became his muniment of title. He was now a "copyhold" tenant and was said to hold "by copy of court roll." Copyhold tenure still prevails to a considerable extent in England, and presents in the main the same characteristics as it did after the transformation above described. However much it may resemble the prevailing form of freehold tenure—as respects duration of interest, time of enjoyment, mode of descent, etc.—it is nevertheless sharply discriminated from the latter. Land held by copyhold tenure is always parcel of and included in a manor. The lord of the manor has the freehold, the copyholder holds "at the will of the lord according to the custom of the manor." The evidence of the nature and extent of his rights is to be looked for, primarily, in the court rolls of the manor. He has the free right of alienation, but he can alienate only by surrendering the land to the lord who then admits the purchaser.

*Feudal Incidents.*—Occasional reference has been made to the incidental burdens of the feudal relation. As has been pointed out above, these incidents of feudal tenure were, from the very beginnings of the system in England, a grievous burden, and in the course of time, when there was nothing else to distinguish such tenures from one another and from allodial ownership, the legalized exactions of the feudal lords served to keep the old distinctions alive. For more than a hundred years before the abolition of these burdens by the Statute of Military Tenures, they had been the distinctive badge of feudalism as well as the principal cause of complaint against the feudal system of property. The usual incidents of tenure were the following: (*a*) *Relief*: a fine paid to the lord of the fee by the heir upon the death of a tenant of an estate of inheritance. Although the law recognized the right of the heir to succeed to his ancestor's estate, he could enter only at the price of a relief. The amount to be paid was originally indefinite, but in Glarvill's time the relief for a knight's fee is fixed by law at 100*s.*; for socage land it is one year's rent; as to baronies and serjeanties, there is no settled rule; the heir must make the best bargain he can. (*b*) *Aids*: regular or irregular exactions made by the lord to enable him to meet his own pressing necessities. They were regularly and lawfully claimed for the purpose of ransoming the lord from the enemy, for knighting his eldest son, and for marrying off his eldest daughter; but they were sometimes more doubtfully demanded for the purpose of paying the lord's debts, or his relief to his superior lord, etc. It was anciently provided that the aid should be "reasonable," and the amount to be exacted was as early as the year 1275 fixed by statute. (*c*) *Wardship and Marriage*: the right of the lord of a minor tenant, who held by knight's service or military serjeanty, to the custody or wardship both of the land and tenant during the minority of the latter, as well as to dispose of the infant tenant in marriage. These rights were during the latter part of the feudal *régime* the principal source of revenue to the king and the other territorial lords. The lord was entitled to all the rents and profits of the tenement for his own use during the continuance of the wardship (though he was expected to support the heir until the latter came of age), and he might "sell" the young heir, whether boy or girl, in marriage. As has been said before, the lord had in general no rights of wardship or marriage over the heir to socage lands. (*d*) *Escheat*: the lord's right to resume an estate in fee upon failure of the estate. Nothing is more significant of the reality and permanence of the lord's rights in the lands held of him than this notion of the escheating or reverting of the estate to him. Though he has parted with the land in fee, his feudal lordship is a real right of property, which persists through all the changes in title which the land in question may undergo, and which may at any time become once more a full ownership of it. See ESCHEAT.

TENURE IN THE UNITED STATES.—The more burdensome forms of feudal tenure, i. e. the military tenures, never gained a foothold on the American side of the Atlantic. Although these tenures were still in force in England when the earliest colonial charters were granted, these charters invariably provided for socage tenure. The usual provision was that the land should be holden of the king "in free and common socage, by fealty only, for all services, and not *in capite* or by knight's service." Tenure in this form, the lordship of the State being substituted for that of the king, and all feudal incidents being abolished, survives in New Jersey, Pennsylvania, South Carolina, Georgia, and several other States. In New York and most of the remaining States "all feudal tenures, with all their incidents," have been abolished even in name, and all lands are declared by statute "to be allodial, so that, subject only to the liability to escheat, the entire and absolute property is vested in the owners." This is the language of the New York statute (1 Rev. Stat. 717, sec. 3) now embodied in the constitution of the State (Revision of 1894), which has been substantially followed in many other States.

In addition to the *Commentaries* of Blackstone, Kent, and Stephen, the reader is recommended to consult the following modern authorities: Digby's *History of the Law of Real Property*; Leake's *Digest of the Law of Property in Land*; Williams on *Real Property*; Fowler's *History of the Law of Real Property in New York*; and especially Pollock and Maitland's admirable *History of English Law*.

GEORGE W. KIRCHWEY.

**Teocalli**, tā-ō-kaal-lee' [Nahuatl, *teotl*, a god + *calli*, house]: a temple or place of sacrifice of the ancient Mexicans; the name is especially applied to those of Aztec origin. Commonly they were low truncated pyramids, with small buildings on the summit, and an open space where the sacrifices, with their attendant ceremonies, could be carried on in view of the people below. Some of them were very large. The great teocalli of Mexico occupied a space 375 feet long and 300 broad; it was 80 feet high, and the terraced edges were so arranged that it was necessary to pass five times around the whole structure in ascending. On the top were several small buildings, and the sacrificial stone, which is still preserved in the national museum. This pyramid was completed in 1486, and during the first Spanish occupancy of Mexico it was the scene of several fierce battles. After the conquest it was torn down, and its site is now occupied by the cathedral. Remains of true pyramidal teocallis are found in various parts of Southern Mexico. The name has been incorrectly applied to structures of a similar form—for example, the great pyramid or mound of Cholula—which are older than the Aztec period, and, presumably, were not built for religious purposes. HERBERT H. SMITH.

**Te'os** (in Gr. ἡ Τέως): one of the most prominent of the Ionian cities in Asia Minor; situated in Lydia, 25 miles S. W. of Smyrna, between the promontories of Coryceum and Myonnesus, and N. of the island of Samos. It had two good harbors, and carried on a considerable trade. In its vicinity was produced a celebrated wine, and its most prominent public building was a splendid temple of Dionysus. After the Persian conquest most of the inhabitants emigrated to Abdera in Thrace. Teos continued, nevertheless, to be a city of some importance until the time of the Romans, when it gradually fell into decay. Ruins of it, of its walls, theater, and temple, are visible near the present village of *Sighajik*. Anacreon and Hecatæus were born in Teos. Revised by J. R. S. STERRETT.

**Tepic**, tā-peek': a territory of Mexico, separated in 1889 from the northwestern part of Jalisco; surrounded by Sinaloa, Durango, Jalisco, and the Pacific. Area, 11,275 sq. miles. It corresponds in part to the region long called Nayarit, a mountainous tract W. of Zacatecas, included in the Sierra Madre; to this has been added a strip of lower coast-land, including San Blas, which is the principal port. A large proportion of the inhabitants are Indians, who maintain a quasi-independence. The Nayarits number at least 30,000. They are an intelligent race of agriculturists and bold warriors. In their mountain fastnesses they long resisted the Spaniards, and were only conquered after a war of twenty years, in 1722. Subsequently they received missionaries, and were nominally subject to the Government at Mexico, though really obeying their own chiefs. In 1872 they rebelled under one of these chiefs, Manuel Losada, but were subdued after a bloody war. Pop. of the territory (census of 1895) 148,776. Tepic, the capital and principal town, is on a plateau, 18 miles from the Bay of San Blas, and on the railway from Mexico to that port; 2,900 feet above sea-level (see map of Mexico, ref. 6–E). The situation is a fine one, commanding a view of the Pacific, and the climate is very salubrious. The town has manufactures of cotton-cloths, cigars, etc. Pop. about 25,000. H. H. SMITH.

**Teplitz** [derived from Slav. *teplice*, i. e. warm bath; spelled in old documents *Toplic*, from which *Töplitz* till the present time]: one of the most famous watering-places in Europe and a district town of Bohemia, near its northwestern frontier (see map of Austria-Hungary, ref. 2–D). It is beautifully situated in the Biela valley, which separates the Saxon Erzgebirge from the Bohemian Mittelgebirge, is a station of the Aussig-Teplitz and the Dux-Bodenbach railways, and has, with Schönau, 17,526 inhabitants (1890). The castle of Prince Clary, with its fine park and the shady promenades, as well as the numerous arrangements for the comfort and pleasure of the 7,000 to 8,000 people who visit Teplitz annually, make it a delightful abode. It has twelve alkalo-saline springs of 90° to 117° F., whose waters are very effective in cases of rheumatism, gout, paralysis, and gunshot wounds. There is an Austrian military bathing-house in Schönau, and a Prussian and a Saxon bathing-house in Teplitz, which was especially frequented by wounded soldiers of the three wars of 1864, 1866, and 1870–71, so that Teplitz is rightfully called the warriors' bath. The first discovery of Teplitz's thermal springs is said to have been made in 762. The place is historically memorable for the triple alliance concluded there Sept. 9, 1813, between the monarchs of Russia, Austria, and Prussia against Napoleon, and for later conventions of the monarchs. Teplitz in Bohemia must not be confused with other spas of the same name: Teplitz near Trentshin on the Waag, Hungary, with the famous Trentshin sulphur springs, Teplitz or the Warasdin bath (133° F.), and Krapina-Teplitz (35° R.), in Croatia, Teplitz in Carinthia, and Teplitz in Moravia. *Bibl. Gerold* (Vienna, 1886); Delhaes and Baumeister, *Der Badeort Teplitz-Schönau* (Prague, 1886); Hallwich, *Teplitz, eine deutsch-böhmische Stadtgeschichte* (Leipzig, 1886).

HERMANN SCHOENFELD.

**Tequenda'ma**: a waterfall in Colombia. See BOGOTÁ.

**Teramo**, tā'rāā-mō: town; in the province of Teramo, Southern Italy; about 35 miles S. of Fermo (see map of

Italy, ref. 5-E); beautifully situated on an elevated plain between two streams, somewhat above the site of the old *Interamna*, of which the modern name is a corruption. It is an industrious and thriving place, having pottery, household furniture, hat, and licorice factories. Pop. 8,650.

**Ter'aphim** [= Heb. (*terāphīm*), plur. of *terāph*, perhaps meaning "givers of prosperity"]: images or figures, probably used by the ancient Hebrews either as objects of household worship or as religious symbols of some kind. Nothing satisfactory is known of their character, origin, or use. They were found in Jacob's and David's houses as apparently household gods (Gen. xxxi. 30, 32-35; 1 Sam. xix. 13-16); Josiah attempted their suppression (2 Kings xxiii. 24); Hosea (iii. 4) speaks of them as in familiar use.

Revised by S. M. Jackson.

**Tera'shima Munenori**: statesman and diplomatist; b. in the province of Satsuma, Japan, in 1832. Sent as a youth to study medicine in Tokio, he acquired a thorough knowledge of Dutch, and later of English, which brought him into prominence during the negotiations with foreign powers that followed the visit of Commodore Perry to Japan in 1853. Terashima was attached to the embassy that visited the U. S. in 1861, spent two years in England (1865-67), whither he returned in 1872 as minister. Next year he resigned this position, and later became Minister for Foreign Affairs. For two years he served as minister at Washington. When the orders of nobility were created in 1884 he received the title of count. D. June 6, 1893. J. M. Dixon.

**Teratogeny**: See Pathology, Vegetable.

**Teratol'ogy** [from Gr. τέρας, τέρατος, monster, prodigy + λόγος, discourse, reason]: that branch of biological science which treats of monstrous growths in either plants or animals; for example, in botany, of the growth of "double" flowers, flattened or distorted stems, etc. For these, see *Teratogeny* in the article Pathology, Vegetable. Primitive anomalies or congenital malformations in animals, such as have been developed during intra-uterine life, belong to the province of teratology, while acquired deformities, such as have arisen after the birth of the fœtus, are embraced in the field of medical and surgical pathology.

*History.*—All that can be found in any of the ancient authors who have attempted to discourse upon the subject is of very little scientific value. While remarkable malformations among the lower animals were regarded as monsters portending dire calamities, human monstrosities were considered as evidences of divine anger or as the direct result of demoniacal influence, and hence looked upon with apprehension and dread, being interpreted by the augurs of the times as prodigies entailed upon parents as punishments, and frequently as wonders of bad omen to the public, foreshadowing some general calamity. The general belief that monsters had a satanic origin gave rise to the practice of destroying them, either by drowning, strangling, or casting them into the flames, with the hope of thus diminishing or entirely exterminating the progeny of the devil. It was not until the early part of the eighteenth century that painstaking observations of the anatomical structure of monsters were fairly instituted in place of the mere superficial examination and description of the external configuration which had previously constituted the ultimate limit of physical inquiry on this subject.

*Causes of Malformation.*—This inquiry has given rise to much fruitless speculation, but the superstitions and absurd explanations of a former age have chiefly vanished in consequence of the light which modern embryological investigations have shed upon the subject. Certainly, nothing can be more irrational than an attempt to explain the anomalies of organization which occur in man by maternal mental emotions, when corresponding malformations occur among the lower animals, viviparous or oviparous, and also in plants —developments which apparently result from defective or excessive formative power. Such flimsy explanations would certainly fail to account for the fact that deep-seated organs, the existence of which is unknown to the pregnant woman, are frequently malformed, as in congenital malformations of the heart, kidneys, intestinal canal, the abnormal distribution of blood-vessels, etc. External mechanical influences, such as blows, falls, etc., may by shock or by affecting the general health of the mother have power to disturb the normal development of the fœtus in utero. Experiments by Dareste and others in teratogenesis by agitation of the egg and by the establishment of other abnormal conditions, such as the diminution of oxygenation, have demonstrated this possibility beyond a doubt. Original malformation of the germ has been reckoned among the causes of anomalous development. This view of the embryogenesis of at least some of the primitive anomalies receives force from the fact that repetition of the same kind of malformation by the same parents has been observed in a number of cases. It may be ascribed to the mother when the malformation is repeated, and to the father where his children by different wives are malformed in the same manner. An additional evidence of original defect in the germ is the hereditary transmission of certain deformities through several generations, examples of which in an excessive number of digits, hare-lip, hypospadias, and other structural vices, are not very infrequent. Otto maintains that many malformations may be ascribed to diseases of the fœtus, while Vrolik contends that very few are attributable to this cause. Chronic inflammation of the brain may produce dropsy of the ventricles, and thus acrania; the different forms of hydrencephalocele and an arrest in the development of the limbs may occur *in utero* by constriction of amnionic bands, the result of amnionic inflammation. The chief cause of malformation is impeded or retarded development of the fœtus, from whatever cause. Retardation or arrest of development may be confined to one part or extended to others, as seen where several malformations coexist. Wolff, Tiedemann, and J. F. Meckel have elaborated the theory that "most malformations represent certain stages of the development of the embryo and of its organs, at which stages formation has stopped short, or from which ulterior development has ceased to follow the normal type." The deviations from the normal type of a species are never so great as to destroy all semblance to it. There is a limit beyond which abnormalities never pass. In reaching her ultimate anomalies nature observes the law of propriety (*lex proprietatis*, Fleischmann), and makes her approach through a series of transitional gradations. Dissimilar parts and organs are never found fused or united together, nor transpositions of viscera beyond the limits of their natural locality; as, e. g., the brain in the abdomen, or intestinal tube in the cranial cavity.

The following facts have been observed in relation to monsters: That they occur in definite number, the relation being about 1 to 3,000 births; that in the greater part of malformations the sex is female; that certain species of animals are more liable to produce certain forms of monsters than others; the constancy of form in monsters, even among animals of diverse classes (cyclopia, acrania, and double monsters occur in birds, possessing the identical characters as in mammals); and, lastly, the greater predisposition to monstrosity among certain animals, being greater in mammals than in birds and among domestic than wild animals.

Under the head of *Hemiterata* (partial monstrosities) are grouped: I. Anomalies of volume either of stature, as dwarfs or giants, or of volume, *sensu stricto*, affecting regions, systems, or organs. II. Anomalies of form, as of the head. III. Anomalies of color, either deficiency, excess, or alterations, as of the color of the iris. IV. Anomalies of structure, exhibited in the cartilaginous conditions of bones or anomalous ossification. V. Anomalies of disposition: (*a*) by displacement as in clubfoot; (*b*) by change of connection, as in teeth out of line; (*c*) in continuity, as in the union of lips or of digits; (*d*) by closure, as in complete transverse vaginal septum; (*e*) by disjunction, as in persistence of the foramen ovale, or in hare-lip. VI. Anomalies of number and existence, as in defect or excess of digits. Heterotaxis or displacement of organs includes splanchnic and general inversion. There are two divisions of hermaphrodites: true hermaphrodites and pseudo-hermaphrodites, the latter with bisexual external genitals but unisexual reproductive glands.

Monsters proper fall into two classes, single and composite. The former are divided into autositic and omphalositic. I. The autositic include (*a*) ectromelus, with limbs imperfectly developed or differing in size, and symelus, with joined limbs; (*b*) celosoma, in which there is eventration; (*c*) exencephalus, with hydrencephalocele or encephalocele, pseudencephalus, with defective development of brain and cranium, and anencephalus, with brain and cranium absent; (*d*) cyclocephalus, with imperfectly differentiated eyes, and otocephalus, in which the ears are joined under the upper jaw-bones. II. The omphalositic include cases of an imperfectly developed fœtus in twin pregnancy, in the extremest examples reduced to a shapeless mass of flesh. Composite monsters are double autositic or double parasitic.

*Compound monsters* include all cases in which more than belongs to a single being is developed; in its lower degrees the mere addition of an extra finger or toe, and in the highest complete duplication by the union of two well-formed fœtuses. That the genesis of double monsters is not a mere freak of nature, but the result of obedience to laws as invariable as those which govern normal development, will be seen by the following general considerations: (1) *The Law of Unity of Sex.*—Out of over 500 cases of human double monsters, as also of innumerable cases in the lower order of animals, in no instance has this law been violated. The account of a double monster of both sexes, given by a clergyman of Giessen, is very properly rejected by Virchow and all teratologists. The individuals of a double fœtus will always be found to have the same sex, either both males or both females. It is also a fact that in the vast majority of cases they have been found to be females, whether human or animal. (2) *The Law of Homologous Union.*—The union of the two fœtuses of a compound monster obeys the law of homologous union as uniformly as in the union of the two lateral halves of a single fœtus in normal embryogenesis. In other words, there is an equal balancing of parts and organs in each individual. The same muscle of one fœtus unites with the same muscle of the other; bone to bone; the same nerve or blood-vessel to the corresponding parts; and so on until all the parts and organs which are situated adjacent to each other are fused, heart to heart, stomach to stomach, etc. In cases of apparent exception to this law—such as a fœtus by inclusion or of a parasitic monster—it has been found that the union was homologous in the early embryonic periods, but that the growth of one fœtus being arrested or retarded, this blighted one was overlapped and included by its fellow. (3) *The Law of Right and Left Symmetry.*—On examination of the structure and relative position of the internal organs of a double fœtus there will be found a transposition of the viscera of each individual in order to dispose them symmetrically in relation to the common median axis of the compound body. If the double fœtus has two hearts, they will be right and left in position, and their apices will converge toward the line of fusion of the two bodies. This will be found true also of the livers and spleens and of the stomachs. The universality of this law is less positively proven than the two previously stated.

Several theories have been suggested to explain the production of double monsters: (1) The theory of maternal impressions has already been shown to be untenable. (2) The theory that they result from the fecundation of a double egg—i. e. of two distinct yelks inclosed in one capsule—has been proved by repeated experiments to be incorrect. (Prof. Panum, of Kiel, with eighty double eggs of the domestic fowl.) The product of hatching such eggs is twins, separate and of the same or of opposite sexes. (3) A more plausible hypothesis claimed that all double monsters were originally twin conceptions, but that the membranes separating them being absent, imperfect, or absorbed, the two bodies were brought into close contact with each other, and coalesced by reason either of some inflammatory action or of the strong formative power existing at that period of uterine life. This theory fails to explain the law of unity of sex, homologous union, and right and left symmetry. Twins often differ in sex, and one-third of twins are contained in one amniotic sac, the very condition claimed to be most favorable to fusion, and yet in these cases the twins are usually of opposite sexes. Should union occur under these conditions, they would be joined in the most accidental and heterogeneous manner. (4) It has been demonstrated by early embryos in the eggs of birds, and by observations under the microscope of the transparent eggs of fish, that a double monster is the product of a single ovum, whose vitelline membrane develops two primitive traces—i. e. two neural axes—instead of one. In some cases the primitive traces were not entirely separated nor precisely equal in size, while in other cases the neural axis was only partially bifid. The various degrees and the extent to which the primitive trace is cleft, from the slightest amount of duplicity to complete duplication, account satisfactorily for all the forms of duplex development. Thus it is seen that the compound monster proceeds from a single germ, single sexuality, and being governed by identical germinal laws, homologous and symmetrical development and fusion must result. The degree of duplicity and the extent of fusion depend upon the proximity or remoteness of the primitive traces and the relative inclination of their axes. (5) The theory which at present has the strongest support from teratologists is that so strongly supported by Ahlfeld, namely, the fission or splitting of the germinal area. This has been actually observed in the fowl. The cephalic extremity has been observed to divide into two parts, resulting in a two-headed chick, with the duplicity confined entirely to the cephalic extremity. Two authentic cases of triple-headed monsters are recorded, one human and one of a lamb. Their embryogenesis is readily explained by a double splitting of the primitive trace, whereby the cephalic extremity of the neural axis becomes trifid. Limited space forbids going into a detailed account of the numerous forms of double monsters which have occurred, even in the human subject. For particulars, see the essays of George Jackson Fisher on *Diploteratology* in the *Transactions* of the Medical Society of the State of New York for 1865, 1866, 1867, and 1868. The student of teratology will seek the works of Isidore Geoffroy Saint-Hilaire, Otto, Vrolik, Förster, Braune, Ahlfeld, Hirst and Piersol, and many others.

Revised by BARTON COOKE HIRST.

**Ter′bium**: the name given by Mosander to a substance associated with erbium and yttrium in the mineral gadolinite, and supposed by him to be a new element; but the experiments of other careful analysts have failed to discover such a metal, and its existence is consequently a matter of doubt. See ERBIUM and YTTRIUM.

**Terborch**, or **Terburg**, ter′boorkh, GERARD: painter; b. at Zwolle, Holland, about 1617. He first learned drawing of his father, and in 1632 was studying in Amsterdam, but it is not known under what master. Soon after he went to Haarlem and became a pupil of the elder Pieter Molyn. He also was much influenced in his work by Frans and Dirk Hals. In 1635 he matriculated in the Guild of St. Luke at Haarlem and visited England the same year, also Germany, Italy, and France. He remained for some time in Amsterdam, where he studied and learned much from the works of Rembrandt. In 1646 he was in Münster painting the congress then sitting there. His picture the *Ratification of the Treaty of Peace of Münster* is in the National Gallery of London, with the celebrated *Guitar Lesson.* He followed the Spanish plenipotentiary to this congress to Spain, where he became known to Velasquez and studied his work. In 1650 he was again in his native country, and in 1654 he married and settled at Deventer. He became burgomaster of this place, and lived there to the end of his life, which he spent in following his art. D. at Deventer, Dec. 8, 1681. His pictures are in most of the great European galleries. For further information, see *Descriptive Catalogue of the Pictures of the National Gallery* (1889); *The First Painters of Holland*, by Lord R. Gower; C. Lemcke in Dohme, *Kunst und Künstler*, vol. ii., part 1 (1875). W. J. STILLMAN.

**Terceira**, ter-sā′rā̆a: one of the Azores islands (see AZORES); area, 163 sq. miles. The coasts are steep, wild, and, with the exception of a few strongly fortified places which afford good harbors, inaccessible. The interior is much broken up by volcanic agencies, but the soil, mostly consisting of decomposed lava and tufa, is exceedingly fertile, and wine, oranges, and timber are largely exported. Pop. 45,000. Capital, Angra.

**Ter′ebinth, Tiel-tree**, or **Turpentine-tree** [*terebinth* is viâ O. Fr. from Lat. *terebin′thus* = Gr. τερέβινθος, terebinth, turpentine. See TURPENTINE]: the *Pistacia terebinthus*, of the *Anacardiaceæ*. It is some 30 or 40 feet high, and grows in the Levant. It produces the valuable Chian turpentine. The terebinth-tree is noted for its extreme longevity. It was a terebinth in whose branches Absalom was caught (2 Sam. xviii.).

**Terebratu′lidæ** [Mod. Lat.; named from *Terebra′tula*, the typical genus, dimin. of Lat. *terebra′tus*, perf. partic. of *terebra′re*, bore]: a family of BRACHIOPODA (*q. v.*) or lamp-shells. A few species still live in the seas, but the fossil allies are numerous. The shell is pear-shaped in outline, and is anchored by means of a fleshy peduncle which passes through the beak of one of the valves.

**Teredin′idæ** [Mod. Lat., named from *Tere′do*, the typical genus, from Lat. *tere′do, tere′dinis* = Gr. τερηδών, a worm that gnaws wood or clothes, etc., deriv. of τείρειν: Lat. *terere*, rub, grind]: a family of conchiferous or lamellibranchiate molluscs, notable as destructive of timber used as piles, etc., in the ocean. The so-called ship-worms are its chief representatives. The several forms are in nowise related to worms, and the only feature common between the two is the elongation of the body and the tube which they form; they have the true molluscan organization, and the elongation is simply due to the excessive protraction backward of the siphonal tubes and the reduction of the body. The portion of the animal which is covered with shell is comparatively very small and almost globular, and the siphonal

The ship-worm.

portion is in proportion extremely long and worm-like; the siphons are united for the greater part of their length, but free toward their ends, and there armed with two peculiar elongated shelly appendages called styles or siphonal palettes; the mantle is well developed, its lobes united except at the pedal opening, reflected behind over the valves of the shell, and developed above into lobe-like expansions, which are also reflected over the hinges of the shell, and serve to keep the valves in place; the gills are large, and extend far into the siphonal portion; the mouth is provided with palpi, the foot is subcylindrical and sucker-like, with a foliaceous margin, moderately protractile, and well supplied with nerves; the shell is composed of two equal valves of peculiar form; these valves are not united at the hinge, but are only kept in place by the reflections of the mantle above referred to, and are thus susceptible of much independent interaction. The animal forms a long burrow lined with shelly material, in which it conceals itself. Such are the principal characters which distinguish this type. The family has quite a number of representatives, most of which bore in wood, but a few live in the bottom of the water, and the tubes they form in that case serve to protect them from the inflow of mud into their burrows. The members of the several subordinate groups and species are essentially similar, but differ much in details as to form and sculpture of their shells, and still more in modifications of the siphonal palettes. Not far from forty species have been recognized by recent naturalists, most of which belong to *Teredo*. Representatives of the family are found in the seas of almost every country. Great ravages have been committed by species of the genus *Teredo*—especially *Teredo navalis*—and government commissions of inquiry have been instituted to investigate the natural history of the animals with a view to staying their destructive work. The literature concerning the subject is therefore very voluminous. The most noteworthy reports are those made during the years 1860–65 by a commission authorized by the Government of the Netherlands. An account of the American forms is given by A. E. Verrill in *Report of the United States Fish Commission* (1871–72), p. 384. The burrow seems to be made by the foot, not by the shell. It is very small at the surface of the wood, but becomes a quarter of an inch in diameter and as much as 10 inches long. It may penetrate the wood in any direction, but usually runs with the grain, avoiding knots and the burrows of other teredos. The wood is often completely honeycombed with the burrows, and the largest piles may be destroyed in the course of two or three years. The wood thus excavated is not eaten, but the animal feeds on infusoria, etc., obtained from the water. The young are produced in May, and later. They are active free-swimming at first, but later attach themselves to solid objects. The young teredo, when it first settles on the pile, is not larger than the head of a pin. The only remedies are those which prevent the teredo from gaining entrance to the wood, such as sheathing for vessels, painting with coal-tar, etc. Impregnating the timber with creosote and similar means is less effective. Revised by E. A. Birge.

**Teredo**: See Teredinidæ.

**Terence** (*Publius Terentius Afer*): writer of comedy; b. at Carthage, although the date usually given, 185 B. C., is doubtful. He became the slave of a senator, Terentius Lucanus, but on account of talent early evinced he received a careful education, was manumitted, and lived, after the performance of his first comedy, *Andria*, in 166 B. C., in intimate friendship with some of the best men in Rome, such as the younger Scipio and Lælius. He died 159 B. C., on his return from Greece, where he had spent about a year. A daughter survived him. The reports of his death differ very much, some asserting that he was drowned, others that he died in Arcadia. His six comedies are extant—namely, *Andria*, *Hecyra*, *Heauton-timorumenos*, *Eunuchus*, *Phormio*, and *Adelphœ*. They belong to the so-called *fabula palliata*—that is, they represent Greek characters, Greek customs, and Greek life; and they all are borrowed from Greek originals by Menander, Apollodorus, or Diphilus, two Greek comedies being often compounded into one by the Latin author. By the Roman public at large they were not received with any great applause; when the *Hecyra* was first played, people left the theater to see the acrobats; but their purity of language, elegance of diction, and refinement of humor and sentiment—merits which the rivals of Terence ascribed to the co-operation of Scipio and Lælius—made them great favorites with cultivated Romans and subjects of much imitation after the revival of letters in the Middle Ages. Among late editions are those by Parry (London, 1857), Wagner (London, 1869), both with notes, Umpfenbach, critical (Berlin, 1870), and Dziatzko (Leipzig, 1884). There are translations into English by Patrick (1745), Colman (1765; reprinted 1841), and Riley (1853). Annotated editions of separate plays: *Andria* and *Adelphœ*, by Spengel (Berlin, 1888 and 1879); *Phormio* and *Adelphœ*, by Dziatzko (1885 and 1881); *Andria* and *Heauton-timorumenos*, West (New York, 1888); *Hecyra*, Thomas (Paris, 1887). Revised by M. Warren.

**Terentia′nus Maurus**: a Latin writer of the end of the second century A. D., from Mauritania. His treatise in 2,981 verses, *De litteris, syllabis, metris*, addressed to his son Bassinus and stepson Novatus, is still extant. The exposition of meters is especially valuable. The work was edited by Lachmann (Berlin, 1836), and by Keil, *Grammatici Lat.*, vol. vi., pp. 313–413. M. W.

**Teren′tius Scaurus**, Quintus: a celebrated Latin grammarian who flourished under Hadrian, wrote commentaries to Horace, the *Æneid* of Vergil, and Plautus, and grammatical treatises. Excerpts from his *De Orthographia* are printed in Keil's *Grammatici Lat.*, vol. vii. M. W.

**Tereus**: See Philomele.

**Tergouw**: See Gouda.

**Terhune′**, Mary Virginia (*Hawes*): author; known by her pseudonym, *Marion Harland*; b. in Amelia co., Va., about 1835; in 1856 married Rev. Edward P. Terhune, a clergyman in Virginia, who in 1859 became pastor of a Dutch Reformed church in Newark, N. J., and afterward of Dutch Reformed and Congregational churches in Brooklyn, N. Y. In 1888 she became editor of *The Home-maker* magazine. She has published a number of novels, including *The Hidden Path* (1855); *Marion* (1860); *Judith* (1883); *His Great Self* (1892); and several books on domestic housewifery, such as *Common Sense in the Household* (1871). H. A. Beers.

**Terlizzi**, tār-lēet′sē: town; in the province of Bari delle Puglie, Italy; in a fertile plain about 7 miles from the Adriatic, and very near the town of Barletta (see map of Italy, ref. 6–G). Grain, wine, oil, and fruits are exported to some extent. Pop. 20,440.

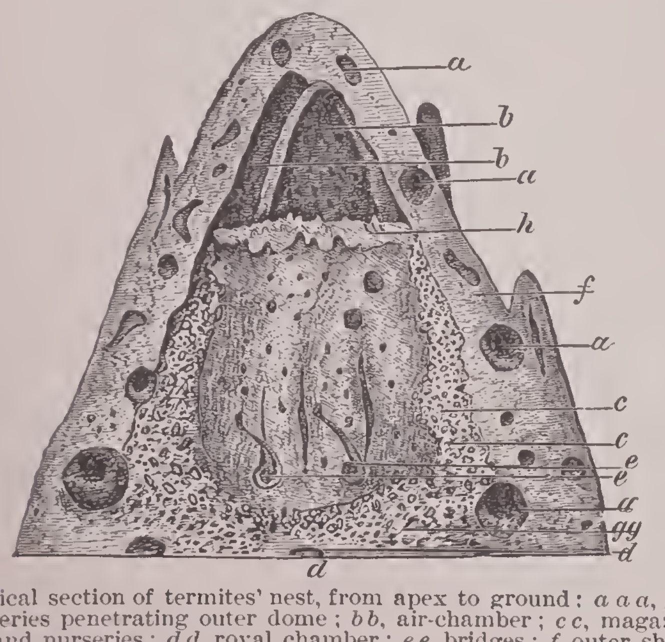
**Termini Imerese**, tār′mē-nē-ee-mā-rā′sā (anc. *Thermæ Himerenses*): town; in the province of Palermo, Sicily; 23 miles E. S. E. of Palermo. It is on a hill on the left bank and near the mouth of the river Termini, which, as well as the town, derives its name from the warm springs in and near this place. The exports are chiefly grain, fruits, sulphur, macaroni, fish, etc. It was under the walls of the ancient *Himera* that Gelon obtained his great victory over the Carthaginians (480 B. C.), and when, seventy years after, the Punic armies destroyed the city, the refugees made the new settlement of *Thermæ Himerenses*, which was a flourishing town in the time of Augustus. Fragments of the ancient ruins are still visible. Pop. 22,730.

**Terminos** (tār′mē-nōs), **Laguna de**: a lagoon on the coast of Campeche, Mexico; separated from the Bay of Campeche (Gulf of Mexico) on the N. by reefs and low islands; these are partly rocky, and between them there are three passages. The lagoon has an area of about 2,600 sq. miles, and over half of it admits vessels of deep draught. It receives a number of small rivers, and several bayous and navigable channels open into it; through some of these, on the W., there is communication with the river Usumacinta. The shores are low and swampy, but abound in cabinet woods and dye-woods, for which the lagoon has long been frequented. At the beginning of the eighteenth century it was a resort of buccaneers. Contemplated improvements would make it one of the best harbors on the Mexican coast. Herbert H. Smith.

**Termites**, tėr′mīts [usually derived from Late Lat. *ter′mes, ter′mitis*, wood-worm; another view is that the name of the principal genus, *Termes*, was given because the book-louse (*Atropos*) was formerly included in it, and this animal was confused with the death-watch (*Anobium*), which insect was supposed to forebode early death; Gr. τέρμα, end]: insects (also called white ants, from the fact that like the ants they are social) which were formerly assigned to the *Neuroptera*, but are now considered as distinct under the name *Isoptera*. The termites form large colonies, and in each colony the individuals are differentiated into different classes or castes, each being fitted by structure for its duties in the colony. Only the king and queen are winged, and these have two pairs of long, narrow, leathery wings, which are similar in structure and are carried flat upon the back when not in use. The mouth-parts are efficient biting organs, and there is an incomplete metamorphosis. The wingless forms are grouped into small-headed workers and soldiers with enormous heads. The king and queen are the sexual members of the colony. At certain seasons of the year they swarm from the nest, take a marriage flight, and then lose the wings, and under favorable circumstances found a new colony. Before egg-laying the abdomen of the female becomes enormously distended with eggs. (For illustrations of termites, see ENTOMOLOGY.) The workers wait upon the royal pair, feed the young, and, besides, do all the excavating for the colony, store away the food, etc. The soldiers are far less numerous, and, as the name indicates, they are the fighters of the colony. Besides their warlike duties, in some species they act as overseers of the workers.

The great home of the termites is in the tropics, but they also extend into colder climates, one species being found in New England. These northern forms do little damage, although one year they seriously threatened libraries in Cambridge. In the tropics, however, they are a formidable pest. The reader is referred to the oft-quoted account of Smeathman, which though published in 1781 still remains the most accurate and detailed description of the habits of these animals.

The termites are dark-loving forms, and the workers and soldiers are blind. They are rarely seen, since they are miners and spend their whole lives in the tunnels which they excavate. When they wish to attack a piece of timber they build a covered approach of earth and saliva, and then when the wood is reached their tunnels run through it in




Vertical section of termites' nest, from apex to ground: *a a a*, galleries penetrating outer dome; *b b*, air-chamber; *c c*, magazine and nurseries; *d d*, royal chamber; *e e*, bridges; *f*, outer shell; *g g*, congeries of royal ante-chambers.

every direction, until at last only the thinnest shell remains, ready to crumble at the slightest touch. In this way they build their mortar approaches up the trunks of the largest trees in order to reach dead branches. They do great good in the tropical forests by removing all dead timber, but when they attack human habitations the results are serious, and the more so since the ravages give no external sign. They will completely riddle every bit of timber in a house, and have even been known to enter a table through its legs and leave nothing but the outside, ready to collapse upon the slightest strain.

The species found in the U. S. lives in decaying wood, but some of the tropical species build conical nests surmounted by numerous pinnacles, and in some cases these nests are 10 to 15 feet in height and 40 to 50 in circumference. They are made of clay solidly packed together and cemented by the saliva of the animal, while in the interior are passages and storerooms for food, nurseries for the young, quarters for the workers and soldiers, and always near the center of the base is the royal chamber where the queen is kept.

See Smeathman, in *Philosophical Transactions*, vol. xvii. (1781); Hagen, monograph in *Linnea Entomologica*, vols. x.–xii.; Fritz Müller, in *American Naturalist*, vol. xxiv., p. 1118 (1890). J. S. KINGSLEY.

**Tern**: any small gull of the sub-family *Sterninæ*, popularly known as sea-swallows. They are characterized by their slender build, remarkably long, pointed wings, rather long, sharp beak, small feet, and, usually, deeply forked tail. They range in size from 2 feet in length down to 9 inches. The general style of plumage is white, with a pearly mantle, and top of head black, but there are exceptions to this, the sooty tern and noddy being almost black. Terns are found over the greater part of the world, and, while typical sea-birds, often occur on bodies of fresh water, especially during the breeding season. They nest on the ground, lay from one to four eggs, feed on fishes and small crustaceans, or even, as in some of the smaller species, on insects. There are some sixty species, about one-fourth of which occur in the U. S., one of the most familiar being the *Sterna hirundo*, a species common to Europe and North America. This bird is 15 inches long, 30 in spread of wing, and the tail is well forked. For the sooty tern see EGG-BIRD. F. A. LUCAS.

**Ternate**: See MOLUCCAS.

**Ternaux-Compans**, tãr′nō′kōṅ′paaṅ′, HENRI: bibliographer; b. in Paris, France, in 1807. He was secretary of the French embassies at Madrid and Lisbon, and *chargé d'affaires* at Rio de Janeiro; resigned and devoted himself to the collection and study of early documents relating to America, traveling extensively in Spain and America for this purpose. For a short time he was a member of the French Assembly. In 1836 he published *Bibliothèque Américaine, ou catalogue des ouvrages relatifs à l'Amérique depuis sa découverte en 1493 jusqu'à l'an 1700.* French translations of a selected series of documents and rare books from his magnificent library were published as *Voyages, relations et mémoires pour servir à l'histoire de la découverte de l'Amérique* (two series, 20 vols., 1836–40), generally known as the Ternaux-Compans collection. This set, which is of great value, is enriched by notes. Subsequently he issued smaller collections or single works of the same character, an historical and bibliographical essay on Guiana, etc. D. in Paris, Dec., 1864. HERBERT H. SMITH.

**Terni**, tãr′nee (anc. *Interamna Umbrica*): town; in the province of Perugia, Italy; near the banks of the Nera, about 10 miles S. S. W. of Spoleto and 55 N. N. E. of Rome (see map of Italy, ref. 5–E). It is chiefly interesting from the antiquities, and remains of a very ancient wall with square towers are to be seen. One of the five gates is called *Tre Monumenti*, from the monuments of the historian Tacitus and of the Emperors Tacitus and Florian, all of whom were born here. The streets open upon a very large square near the center of the town. The cathedral, dating from the seventeenth century, contains many early monuments and inscriptions, but the basilica of San Valentino is still more ancient. The Church of San Salvadore is built on the ruins of a temple of the sun—that of Sant' Alò over a temple of Cybele. The episcopal palace stands, in part, on the site of an amphitheater of the time of Tiberius, which, judging from the foundations, was capable of holding 10,000 spectators. Pop. about 9,420.

Revised by M. W. HARRINGTON.

**Ternstrœmia′ceæ**: See TEA FAMILY.

**Teror**, tā-rōr′: a beautiful town in attractive surroundings on Grand Canary, one of the Canary islands, which has some warm mineral springs, resorted to on account of their curative effects. Pop. 5,800 (in the commune). M. W. H.

**Terpan′der** (Gr. Τέρπανδρος): musician and lyric poet; b. at Antissa, island of Lesbos, in the first half of the seventh century B. C.; settled in Sparta, where, in 676 B. C., he gained the prize in the first musical contest instituted at the feast of Apollo Carneius. He is generally considered the founder of Greek music, as he increased the number of the strings of the lyre from four to seven; was the first to set poetry to music, both his own verses and those of Homer;

established the first regular school of music, and made music a part of education. See Flach, *Geschichte der griechischen Lyrik* (vol. i.). Revised by B. L. GILDERSLEEVE.

**Terpsichore**, térp-sik'ŏ-rē [= Lat. = Gr. Τερψιχόρη, liter., fem. of τερψίχορος, delighting in dancing; τέρπειν, τέρψαι, enjoy + χορός, dance, dancing]: one of the nine Muses. She presided over song and choral dancing, and was represented with lyre and plectrum in her hands, and a wreath of flowers on her head. See MUSES.

**Terrace**: a limited plain, natural or artificial, from which the surface descends on one side and ascends on the other. Artificial terraces are often constructed for the purpose of utilizing the sides of hills, and the steep slopes separating them are protected from the attack of rain by masonry or turf. They have also an extensive use in connection with agriculture, especially in Southern Europe. Gentle slopes, which in the natural condition are covered and protected by vegetation, are sometimes worn into gullies and steep ridges when cultivation exposes them to the action of rain. To prevent this, the land is graded in terraces whose flat surfaces give the rain-water rills no power to erode, and the steep bluffs between the terraces are guarded by turf or a facing of stone. Natural terraces are of various kinds, the most abundant being *terraces of differential degradation*. Where a hill or mountain or the side of a valley is composed of level strata which differ among themselves in texture, these differences usually find expression in the topography. Frost and other agencies that break up rocks act more rapidly on weak rocks, such as shales, than on strong rocks, and reduce them to earth which is washed away by rain. Often a weak rock is in this way eaten back until the strong rock above it is deprived of support and falls away in blocks. By such processes the hillside is carved into a series of terraces separated by bluffs or cliffs. *Stream terraces* are next in abundance. When the volume and grade of a stream are so adjusted to the load of detritus it carries forward that it neither wears down nor builds up its bottom, the stream wears its banks, making a flood-plain, and this gradually becomes broader. If the stream is overloaded, part of the load is deposited and the flood-plain grows higher as well as broader. If then the land is lifted, or the flow of water is increased, or the load is diminished, the stream cuts its channel deeper and ceases to spread over the flood-plain, which then constitutes a terrace on each side of the stream. A repetition of this process produces a series of terraces rising like steps on the valley side, and such series are to be seen in many valleys of the U. S. *Shore terraces* are of several types. Those most frequently seen are carved out by the waves where the sea attacks the land. They are overlooked by cliffs and are usually submerged at high tide. On parts of a coast where drifting sand or shingle accumulates, beach being added to beach, a rather uneven terrace is produced, and this is bounded seaward by a submerged declivity. The deltas accumulated at river mouths are fan-shaped terraces with steep outer slopes. While these features are in process of formation they are partly concealed by the water, but if the region is afterward uplifted their character as terraces becomes conspicuous. *A moraine terrace* is formed where a stream of water flows between a glacier and the side of its valley. The earth and stones of the lateral moraine, together with other material brought by the stream, are built by the running water into a plain; and afterward, when the glacier has disappeared, this plain constitutes a terrace on the valley side. The glaciated districts of the U. S. afford numerous examples. *Fault terraces* are comparatively rare. They are formed where a system of faults traverse a plain, letting it down in steps, and their production is accompanied by earthquakes. American examples occur in the Great Basin, especially at the foot of the Wasatch range. Rain and frost, the great agents of land sculpture, attack and gradually destroy the terraces marking the former activity of streams, glaciers, waves, and the forces of the inner earth, but they perpetually restore the terraces of differential degradation, and it is for this reason that the latter are most abundant. See GEOLOGY, and consult *Lake Bonneville*, Monograph I., U. S. Geological Survey.

G. K. GILBERT.

**Terrace Epoch**: See CHAMPLAIN EPOCH.

**Terra-cotta** [= Ital. < Lat. *terra cocta*, liter., baked earth; *terra*, earth + *cocta*, femin. sing. of perf. partic. of *coquere*, cook, bake]: baked clay, that is to say, pottery. (See *Earthenware, Unglazed*, under POTTERY AND PORCELAIN.) In the language of decorative art the term is used for an object made of baked clay, as a terra-cotta, a collection of terra-cottas; and in this sense it means always an object made of coarse brown or yellow earthenware, and usually unglazed. Greek terra-cottas known to us are TANAGRA FIGURINES (*q. v.*), or figures from Smyrna or Sicily or Tarentum, or antefixes or cymas or anthemions from temples, as from Olympia or Akragas. Greek painted vases are sometimes called terra-cotta vases, but less often, because these are often of soft material. Etruscan terra-cottas are often burial-urns adorned with bas-reliefs of battle-scenes, and having on their covers reclining figures of the dead. Some of these are large, in cases where the body was not burned, and the figures are of life size. Etruscan temples were adorned with pediment figures of terra-cotta, painted in bright colors, and it is established that early Roman architecture depended much upon terra-cotta ornaments. (See ROMAN ARCHÆOLOGY.) None of these is known to exist, but suggestions of what they were like are to be found in the collection of terra-cottas from Pompeii, in the Naples Museum. Terra-cotta figures from China, and more especially from Japan, have been brought to Europe and America, of all degrees of size and importance, from small round boxes made in the semblance of draped figures of men to statuettes and groups of half life size. Many of these are of extraordinary vigor and decorative value, and some even reach a high degree of merit as works of sculpture. Among such figures in baked clay the name *terra-cotta* would not commonly be given to those of light yellow ware, like Satsuma or Kioto figures, nor to those of porcelain; but rather to those of brown clay, sometimes wholly unglazed, sometimes having a thin and fine dark-brown glaze, sometimes wholly or partly glazed with colored and even porcelanous glazes. Such figures often have the flesh left in the brown ware, and the dress and hair put in the glaze, and are then very effective. The Italian Renaissance was very rich in terra-cotta statuary, busts, and bas-reliefs. The museums of Florence, Paris, Berlin, and London have many splendid specimens of this ware. Busts by Donatello, Verrocchio, and other men of their times are among the most interesting and valuable pieces of European sculpture of modern times. The noble enameled terra-cottas of the Renaissance are partly described under ROBBIA, Luca della (*q. v.*); but, besides the work of the Della Robbia family, colored enamels applied to terra-cottas of life size were used by Begarelli, by Mazzoni, and others. Since the sixteenth century terra-cotta has been used for fine and decorative art fitfully and at intervals, as one artist or another took a fancy to it. Thus Clodion (1745–1814) made many small groups of bacchantes and nymphs of great merit in a certain graceful and fantastic way, in reddish-brown terra-cotta, with no glaze whatever. The contemporary French school of sculpture often produces large works in unglazed terra-cotta, especially portrait-busts. In decorative building Italian, Gothic, and Renaissance architecture made a great use of terra-cotta, especially in Lombardy, where good stone was not very accessible. In modern times columns, archivolts, cornices, etc., are made of it, and whole fronts are built of brick and terra-cotta in combination. The taste for it is growing. RUSSELL STURGIS.

**Terra de Fuego**: a corruption of Portuguese *Terra de Fogo*. The Spanish name is TIERRA DEL FUEGO (*q. v.*).

**Terra di Lavoro**: See CASERTA.

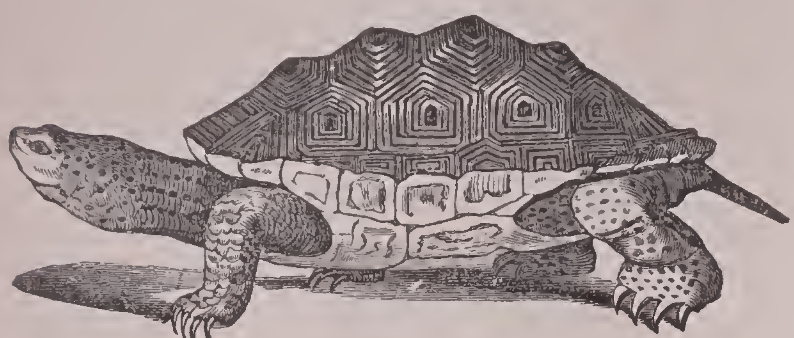
**Terra di Otranto**: See LECCE.

**Terra Firma** [Lat., firm or solid earth]: a term sometimes used to designate the Spanish main or the northwestern portion of South America; also that part of the Italian mainland which formerly acknowledged Venice as mistress. The term designates continental regions as opposed to islands, although also used colloquially to denote land as opposed to water.

**Terra Japon'ica** [Lat., Japanese earth]: an old pharmaceutical designation of CATECHU (*q. v.*), which was formerly regarded as an earthy mineral.

**Terrano'va**: town; in the province of Caltanisetta, Sicily; on the south coast of the island, near the mouth of the Terranova: 60 miles W. of Syracuse (see map of Italy, ref. 10–F). This town occupies the site of an ancient city (probably *Gela*), as is proved by the remains of a Doric temple and by the many old sepulchers found in the neighborhood, whose contents have enriched the museum of Palermo. Pop. 16,440. Revised by M. W. HARRINGTON.

**Ter'rapin** [probably Amer. Ind.]: any one of various small fresh-water turtles of the family *Emydidæ*. The name has no exact scientific meaning, but in the U. S. is usually applied to the salt-water terrapin (*Malaclemmys palustris*), more familiarly known as the diamond-back. This species, held in high estimation for the delicacy of its flesh, is an inhabitant of the salt-water marshes from New York to Texas. It has a large head, covered with a soft naked skin



The salt-water terrapin.

(whence the name *Malaclemmys*), and the alveolar surface of the upper jaw is broad and divided in front by only a slight groove; the neck is short and thick; the shell oval, moderately convex, slightly keeled, and the scales marked with concentric, generally impressed, lines; the skin is gray, spotted, and otherwise marked with black. It rarely much exceeds 8 inches in length, and is generally less than that. It is the most esteemed for the table of any species of the family, and is caught in large numbers for the markets of Baltimore, Philadelphia, New York, and other cities. It commands a price of from $15 to $100 a dozen, according to size, season, and demand. It is active in the water, swimming well, and on land runs with considerable speed. See TORTOISE and TURTLE-FISHERY. Revised by F. A. LUCAS.

**Terrebonne**, tãr'bon': town of Terrebonne County, Quebec; on the north shore of the navigable river Jésus; 16 miles by land N. of Montreal (see map of Quebec, ref. 5–B). It is the seat of Masson College (Roman Catholic), a large and prosperous institution. It has a fine water-power, utilized in a number of manufactories. Its stone-quarries are valuable. Pop. 1,460.

**Terre Haute**, tãr-hōt': city (founded in 1816): capital of Vigo co., Ind.; on the Wabash river, and the Vandalia Line, the Cleve., Cinn., Chi. and St. L., the Chi. and E. Ill., and the Evans. and T. H. railways; 73 miles W. of Indianapolis (see map of Indiana, ref. 7–B). It is on a rolling prairie between the Wabash and a low range of wooded bluffs; has broad streets, paved with macadam, brick, or asphaltum, with brick, limestone, and artificial stone walks; and contains three parks, Union Station, Collett, with 30 acres of grove and lawn; and a driving-park and fair-grounds of 90 acres, with a noted racing-track. The city is surrounded by coal-fields, and has 5 productive oil-wells, 2 artesian wells, supplying sulphur water, 21 miles of electric railway in the city and 11 miles of interurban electric lines, and a garbage crematory. The notable buildings include the county court-house (cost $475,000), U. S. Government building ($150,000), union station ($100,000), State normal school ($250,000), opera-house ($65,000), and St. Benedict's church ($150,000)—the finest in the State. There are 47 churches, viz.: Methodist Episcopal, 13; Baptist, 9; Roman Catholic, 4; Presbyterian, 3; Protestant Episcopal, 3; Congregational, 2; Christian, 3; German Evangelical, 2; Lutheran, 2; United Brethren, 2; and Church of Christ, Jewish, German Reformed, and Salvation Army, 1 each. The public-school system supports a high school and 20 district schools, having 189 teachers and 6,678 pupils, and costing annually over $145,500. Connected with the system is a free public library with over 18,000 volumes. There are also 5 Roman Catholic parochial schools with 23 teachers and nearly 573 pupils, and 1 German Lutheran school with 1 teacher and 48 pupils. The most noted educational institution is the Rose Polytechnic Institute, an advanced school of engineering and chemistry, founded by the late Chauncey Rose, and opened in 1883. It is admirably equipped for its work, and has a productive endowment of $600,000 and an annual income of $47,000. The State normal school has an annual allowance by the State of $65,000, a library of 35,000 volumes, and an average attendance of 800. St. Mary's in the Woods is a Roman Catholic seminary for girls. The charitable institutions include the Rose Ladies' Aid Society for the relief of the poor and the care of a home for old ladies (endowment $90,000), St. Anthony's Hospital, conducted by Sisters of St. Francis (cost $160,000, chiefly gift of H. Hulman, Sr.), Union Hospital (Protestant, endowment $20,000), Rose Dispensary (endowment $90,000), Rose Orphan Home (cost $130,000, endowment $200,000), and St. Ann's Orphan Asylum.

In 1900–01 the city had receipts, $425,067.91; disbursements, $333,014.43; net debt, $365,000; and total assessed valuation, $20,414,090. There are 3 national banks with combined capital and surplus of $1,057,000, savings-bank with deposits of $841,397, a loan and trust company with capital and surplus of $235,000, and a private bank. The city has large manufacturing establishments, including 3 glass-factories, 1 railroad shop, 1 railway-car works, 1 match-factory, 3 rolling-mills, 2 breweries, 4 box-factories, 4 flour and hominy mills, 2 coffee and spice mills, 2 grain-elevators, 1 paving-brick factory, 7 foundries and structural-iron shops, 1 electrical fixture company, 2 carriage-manufactories, 3 boiler-works, 1 candy-factory, 1 casket company, 2 rectifiers and compounding houses, 2 cooperage-factories, 1 gunstock-factory, 1 heading-factory, 5 overall and workingmen's clothing-factories, 1 cracker-factory, 4 distilleries with combined capacities 25,283 bushels of corn daily. The Majestic, largest in the world, capacity 8,533 bushels; 1 shovel and tool works, many wood-working establishments. There are 4 daily, 4 weekly, and 5 monthly newspapers. Pop. (1890) 30,217; (1900) 36,673.

**Terrell**: city; Kaufman co., Tex.; on the Tex. and Pac. and the Tex. Midland railways; 31 miles E. of Dallas (see map of Texas, ref. 2–I). It contains a large high school, a school for colored children, railway-shops, cottonseed-oil mill, creamery, compress, flour-mill, iron-works, a national bank, capital $75,000, a private bank, and two weekly newspapers. Pop. (1890) 2,988; (1900) 6,330.

**Terrestrial Magnetism**: See MAGNETISM, TERRESTRIAL.

**Terrier** [from O. Fr. *terrier* in *chien terrier*, terrier dog; *chien*, dog + *terrier* < Late Lat. *terra'rius*, of the ground, deriv. of *ter'ra* > O. Fr. *terre*, earth, ground; cf. O. Fr. *terrier*, little mound of earth, burrow of a fox or rabbit]: any one of a large number of breeds of small dogs distinguished for vivacity and courage. Among the best known are the English or black-and-tan terrier; the bull-terrier, a miniature bulldog in courage, and often in shape; the fox-terrier, formerly used to unearth foxes; the Scotch or rough-haired terriers, including the Skye, the Dandie Dinmont, and other strains; and the toy-terriers, crosses with some of the small lapdogs. Most of the various breeds of terrier are especially trained to the killing of rats and other vermin. See DOGS. Revised by F. A. LUCAS.

Skye terrier.

**Territory**: a term technically applied in the U. S. and in some Spanish-American republics to certain portions of the public lands which are under the direct control of the national legislature. In the U. S. Territories are organized by congressional enactment. The governor and the administrative and judicial officers are appointed by the President, but a territorial legislature is intrusted with limited powers, subject to the approval of Congress. When a Territory attains a population sufficient to entitle it to one Representative in Congress, it has usually been given permission by a special act to form a State constitution, and then admitted into the Union with rights equal to those of the other States. The rights of Congress over the Territories and respecting their admission as States are based on Art. IV., Sec. 3, of the Constitution. With the exception of Texas, California, West Virginia, and the original thirteen colonies, all the States of the Union have passed through the territorial form of government. At present (1901) there are four organized Territories: Arizona, New Mexico, Oklahoma, and Hawaii. Alaska and Indian Territory also rank in the U. S. as Territories, although they have no organized territorial form of government.

**Terrorite**: See EXPLOSIVES.

**Terry**, Alfred Howe: soldier; b. at Hartford, Conn., Nov. 10, 1827; educated at schools in New Haven and at the law school of Yale College; entered upon the practice of law in 1849, and was clerk of the Superior and Supreme Courts of Connecticut 1854–60. For some years prior to the civil war he had been an active member of the State militia, and since 1854 in command of the Second Connecticut Militia, which regiment was mustered into the service of the U. S. in response to the call for three months' troops, and, with Terry still in command, was engaged in the first battle of Bull Run. Returning at the expiration of the three months, Terry then organized the Seventh Connecticut Volunteers, of which regiment he was appointed colonel Sept., 1861, and which he commanded in the expeditionary corps of Gen. Thomas W. Sherman at the capture of Port Royal, S. C.; was placed in command of Fort Pulaski upon its capture. Promoted to be brigadier-general of volunteers in Apr., 1862, he served in the operations about Charleston, in making a successful demonstration up Stono river during the descent on Morris island, and in the siege operations at Forts Wagner and Sumter. In the Virginia campaign of 1864 he commanded a division in the Army of the James, and was engaged at Drury's Bluff, Bermuda Hundred, and siege of Petersburg, being in command of the corps May–July, 1864. Upon the failure of the first attempt to capture Fort Fisher (*q. v.*), Terry was selected in Jan., 1865, to command the new expedition, which successfully carried that work by assault Jan. 15. For his services on this occasion he was promoted to be a major-general of volunteers and made a brigadier-general in the regular army. In the capture of Wilmington he rendered efficient aid, and in Mar., 1865, was placed in command of the Tenth Corps, which he held during the subsequent operations in North Carolina. In June, 1865, he was placed in command of the department of Virginia; commanded the department of the South 1869–72, and afterward the department of Dakota. He became major-general in the regular army Mar., 1886, and took command of the division of Missouri; retired Apr. 5, 1888. D. at New Haven, Dec. 16, 1890.

Revised by James Mercur.

**Terry**, Ellen Alice: actress; b. at Coventry, England, Feb. 27, 1848; made her first appearance on the stage in 1856 at the Princess's theater, London, under the management of Mrs. Charles Kean, playing Puck, Prince Arthur, etc., and became in 1878 a member of the company of the Lyceum theater under the management of Henry Irving, playing Ophelia, Desdemona, Portia, Juliet, and other characters. Her three sisters—Kate, Florence, and Marion—and her daughter are successful actresses. She visited the U. S. six times in company with Irving, and her acting was much admired for its winning charm, its gracious dignity, and its emotional intensity. Her Portia especially entirely accords with the spirit and poetry of Shakspeare's play.

**Terry**, Luther: See the Appendix.

**Terry**, Milton Spenser, A. M., S. T. D.: minister and educator; b. at Coeymans, Albany co., N. Y., Feb. 22, 1840; educated at Charlotteville Seminary, Troy University, and Yale Theological Seminary; pastor in the Methodist Episcopal Church eighteen years, presiding elder four years; since 1884 has been Professor of Old Testament Exegesis in Garrett Biblical Institute, Evanston, Ill. He has published *Commentary on Judges, Ruth, and Samuel* (1873); *Commentary on Kings, Chronicles, Ezra, Nehemiah, and Esther* (1875); *Biblical Hermeneutics* (1883; rev. ed. 1890); *Commentary on Genesis and Exodus* (1889); *Sibylline Oracles*, translated from the Greek (1890); *The Song of Songs* (1893); *The Prophecies of Daniel Expounded* (1893); and *Rambles in the Old World* (1894). A. Osborn.

**Terschel'ling**: the third of the chain of islands which lie in the North Sea along the northeastern coast of Holland; comprises an area of 45 sq. miles, and consists of low and rich meadow-land protected by downs and dikes against the sea. The inhabitants form a commune numbering about 3,730, and are engaged in ship-building, fishing, and pilotage.

Revised by M. W. Harrington.

**Tertian Fever**: See Fever and Chill.

**Ter'tiaries** [from Eccles. Lat. *tertia'rius*, belonging to the third degree or order < Lat. *tertia'rius*, containing a third part, deriv. of *ter'tius*, third: Eng. *third*]: in some Roman Catholic religious orders, those members who from marriage or secular occupations are not received into the highest membership of the order, but nevertheless take simple vows. The members of the Third Order of St. Francis are the most celebrated class of Tertiarics. They have long, in fact, constituted a separate order in the Church and have a general of their own. The Third Order embraces congregations of both men and women. Other orders have houses of Tertiaries, who are not to be confounded with the lay brethren and sisters of the orders. Revised by J. J. Keane.

**Tertiary Era**: a division of geologic time co-ordinate with the Primary era, and Secondary era, which it follows, and the Quaternary era, which it precedes. In the later and widely adopted classification based on life, the Cenozoic Era (*q. v.*) is made to include the Tertiary and Quaternary. Tertiary time is divided by European geologists into four periods—Eocene, Oligocene, Miocene, and Pliocene. In the chronologic system adopted for the atlas of the U. S. Geological Survey these are represented by two periods named Eocene and Neocene. For accounts of the periods, see the articles under their several names. The flora of this era is treated in the article Plants, Fossil. See also Quaternary Era. G. K. Gilbert.

**Tertre, du**: See Dutertre.

**Tertull'ian** (*Quintus Septimius Florens Tertullianus*): the most eminent Latin ecclesiastical writer of the early Church; b. at Carthage about 160. The son of a Roman military official, he was liberally educated, and became one of the ablest lawyers of the day and professor of rhetoric in his native city. The hollowness of contemporary paganism, the purity of the Christian life, and the courage of the martyrs co-operated to make him a Christian. From his conversion he experienced a profound change of heart, and was soon as noted for the rigidity of his ethical views and conduct as he was formerly for his looseness of life. In fact his severity in this regard led him to break with the regular Church authorities by his excessive insistence on the tenets of Montanism and his want of pity on the fallen. He is said to have founded a sect of Tertullianists which lingered on until the fifth century. He is famous for many works apologetical, doctrinal, and ethico-practical. Among them are the *Apologeticum*, a gem of Christian wit, logic, and erudition; the *De præscriptionibus hæreticorum*, valuable as an evidence of the ecclesiastical mind of his time; the *Adversus Marcionem*, in five books; and works on patience, on chastity, on monogamy, on idolatry, on theaters, etc. He is laconic, pointed, sarcastic, sententious in his utterances. His language is often compressed and obscure, so loaded is it with thought and reference. He created much of the technical ecclesiastical phraseology of the Latin Church. He lived and taught at Rome for some time, and his personal differences with the Roman clergy may have had something to do with his sharp expressions concerning the Roman mildness in treating those who fell away from Christian virtue or faith, but his works contain many expressions and principles that show the theoretical headship and real influence of the Roman Church. D. about 240. See Tillemont, *Mémoires pour servir à l'histoire ecclésiastique*; Freppel, *Tertullien* (Paris, 1864); Cruttwell, *A Literary History of Early Christianity* (London, 1893); the patrologies of Fessler-Jungmann and of Alzog. The best edition of Tertullian is that of Oehler (3 vols., Leipzig, 1851–54).

John J. Keane.

**Terwagne**, Anne Josèphe: See Thérsigne de Méricourt.

**Tesla**, Nikola: electrician; b. at Smiljan, Croatia, Austria-Hungary, in 1857; graduated at the Polytechnic School, Gratz; engaged in electrical work in France; went to the U. S. and was associated with Edison; became electrician of the Tesla Electric Light Company and established the Tesla laboratory in New York for independent electrical research. He has received honorary degrees from Columbia and Yale and the order of St. Sava from the King of Servia, as well as that of the Eagle from Montenegro, and has been vice-president of the American Institute of Electrical Engineers. He is the inventor of the modern principle of the rotating magnetic field embodied in the apparatus used in the transmission of power from Niagara Falls, of new forms of dynamos, transformers, motors, induction coils, condensers, arc and incandescent lamps, and of the oscillator, combining steam-engine and dynamo, etc. His researches in electrical oscillation have opened a new field for scientific investigation. See *The Inventions, Researches, and Writings of Nikola Tesla*, by T. C. Martin (New York, 1894).

**Tessin**: See Ticino.

**Tessin′**, Karl Gustaf: statesman and writer; b. in Sweden, 1695. He filled various important political positions, but he is best remembered as a patron of letters and an orator of force and elegance. While tutor to the crown prince, afterward Gustaf III., he wrote his famous *En gammal mans bref till en ung prins* (An Old Man's Letters to a Young Prince). D. 1770. D. K. D.

**Testament** (Lat. *testamentum*): See Will.

**Testamentary Guardian**: See Guardian.

**Testaments, Old and New**: See Bible.

**Testi**, Fulvio: poet; b. at Ferrara, Italy, Aug. 23, 1597, the son of a pharmacist. Trained at Bologna and Ferrara, he spent his life in the service of the court of Modena; attacked the Spaniards in some early verses, and excited their suspicions; later sought to gain their favor, when ambassador to Madrid (1635–38); was arrested Jan., 1646, for intriguing with French officials, and died in prison at Modena, Aug. 28, 1646. His verse consists chiefly of the *Rime* (1611); a tragedy, *Isola d'Alcina* (1626); the fragments of another drama and two epics; and most pro ably the poem in octaves called the *Pianto d'Italia*. J. D. M. Ford.

**Testicle**: See Histology.

**Testimony** [from Lat. *testimo'nium*, deriv. of *tes'tis*, a witness]: in law, the oral statement of facts made under oath by witnesses upon the trial of a civil or criminal action, or upon the hearing of any other judicial proceeding, as contradistinguished from the evidence furnished by written instruments, or by any other mere physical facts or appearances which can be exhibited to the court or jury. "Evidence" is the generic term, while "testimony" is specific. (See Evidence.) At the common law the witnesses in a legal action must be produced before the jury, unless they are without the kingdom or state, in which case their examination is taken in writing by means of a commission sent to the foreign country. In the English equity, admiralty, probate, and ecclesiastical proceedings the testimony was always taken by deposition and read on the trial. The modern radical changes in procedure have altered most of these ancient rules. Even the testimony in legal actions, both in the U. S. and in England, may now be written if the parties agree to that method; while by the practice of some States and of the U. S. tribunals it may always be in the form of a deposition if the witness lives at a fixed distance from the court or in certain cases in a county other than that in which the trial is held. One important exception to this relaxation is made necessary by the national and State constitutions. In all criminal trials the prisoner must be confronted by the witnesses against him, so that the testimony for the prosecution must be produced and delivered orally before the jury. Generally, wherever the reformed procedure prevails, the testimony in equitable suits is given in the same manner and is governed by the same rules as that in legal actions. In the U. S. courts, however, and in a few States which still retain a separate administration of equity the original form of deposition continues to be used. The reformed English procedure allows the parties a free selection between the written and the oral modes. In respect to the compelling the attendance of witnesses, the administration of the oath or of the affirmation, the examination and cross-examination, and the rules as to the competency of witnesses, see Subpœna, Oath, and Trial.
Revised by George W. Kirchwey.

**Test Oath**: the oath required by the Corporation and the Test Acts (13 Car. II., st. 2, c. 1, a. d. 1661, and 25 Car. II., c. 2, a. d. 1672) to be taken by nearly all civil and military officers. Blackstone describes these statutes as "two bulwarks erected in order the better to secure the Established Church against perils from nonconformists of all denominations, infidels, Turks, Jews, heretics, papists, and sectaries." They made the holding of public office conditional upon the incumbent's taking the oaths of allegiance and supremacy, and subscribing a declaration against transubstantiation and receiving the sacrament of the Lord's Supper according to the usage of the Church of England. After various modifications the statutes were substantially repealed in 1828 (9 Geo. IV., c. 17). During the civil war in the U. S. and after its close, test oaths were imposed by Federal and State legislation. (See U. S. R. S., § 1756, repealed by ch. 46, Laws 1884.) Their validity was soon called in question, and in the famous cases of *Cummings* vs. *Missouri* and *ex parte Garland* (4 Wallace 277 and 333) the U. S. Supreme Court held that any law requiring these oaths to be taken as a condition of holding certain offices and trusts or of pursuing one's ordinary and regular vocation, and thus operating to deprive persons of vested rights, was unconstitutional, as imposing a punishment for an act which was not punishable when it was committed, and hence within the prohibition against *ex post facto* laws; or as inflicting punishment without a judicial trial, and hence under the ban against bills of attainder. Francis M. Burdick.

**Testudina′ta** [Mod. Lat., neut. plur. of Lat. *testudina'tus*, from *testu'do*, tortoise]: an order of reptiles including the turtles, distinguished by having the body protected by a bony case. This is formed above by the ribs and vertebræ, to which are added other expanded bony plates, the whole constituting the carapace; below by a series of bony plates, usually nine, forming the plastron; other bones, called marginals or peripheralia, are usually developed about the edge of the carapace, and in the adults of many species all these bones are immovably connected with one another. The lower jaw, as in other reptiles, is formed of several pieces, but its halves are largely and firmly united at the symphysis by the coalesced dentaries. The jaws are toothless and, like those of a bird, encased in horny sheaths. The dorsal vertebræ are few in number, and immovably connected with one another and with the ribs. The feet have five digits each, and are variously modified for walking and swimming. There is no true sternum, the plastron consisting in part of bones corresponding to the clavicles and interclavicle of other animals, and in part of dermal bones. In most *Testudinata* the carapace is covered with regularly arranged horny plates, which may be quite thin, as in some tortoises (*Testudo*), or thick and overlapping, as in the hawk's-bill turtle. In the trunk-turtle (*Dermochelys*) and the fresh-water *Trionychidæ* the carapace is covered with a thin skin. The heart has two auricles and an imperfectly divided ventricle, and some venous blood enters into the circulation. The digestive apparatus is well developed, although the distinction between gullet and stomach is slight. In the marine turtles, which feed on seaweed, the gullet is armed with long, sharp, backwardly directed papillæ; in other turtles the gullet usually shows longitudinal folds. Including fossil forms the *Testudinata* are divided into four groups: (1) *Amphichelydia*, containing extinct species distinguished among other characters by the separation of the dentary bones. (2) *Pleurodira*, in which the neck is bent sidewise, not in a vertical plane, and the head in consequence can not be drawn within the shell; the pelvis is ankylosed to the carapace and plastron; marginal bones are present. This group contains a small number of tropical species. (3) *Cryptodira*, in which the neck can be bent in a vertical plane, and the neck in most can be drawn within the shell; marginal bones are present. The large majority of turtles belong to this division. (4) *Trionychia*, containing forms in which marginal bones are usually absent, or when present they form an imperfect series and are not connected with the ribs. This group comprises the so-called soft-shelled fresh-water turtles, which have a considerable portion of the outer and posterior part of the carapace cartilaginous and slightly flexible. A fifth group (*Athecæ*) is used by some systematists for the reception of the trunk-turtle (*Dermochelys*) and some fossil forms, in which the carapace consists of numerous small segments and is not united with the vertebræ and ribs. Geological members of the order *Testudinata* are found from the Upper Trias onward. Geographically they are found throughout the tropical and temperate portions of the world, their northernmost limits being about 50° in North America and 54° in Europe. See article *Tortoise* in *Encyclopædia Britannica*, 9th ed.; also Baur *On the Classification of the Testudinata*, *American Naturalist* (June, 1890). See Green Turtle, Hawk's-bill Turtle, Leather-turtle, Lyre-turtle, Tortoise, and Trionychidæ. F. A. Lucas.

**Testudin′idæ** [Mod. Lat., named from *Testu'do*, the typical genus, from Lat. *testu'do*, tortoise]: a family of tortoises (*Testudinata*) distinguished by their club-shaped feet and their special adaptation for terrestrial life. (See Tortoise.) The North American species are *Gopherus polyphemus*, *G. agassizii*, and *G. berlandieri*. The species are long-lived and very tenacious of life, and can live for a long time without food; they subsist upon herbage (grass, vegetables, and roots), and travel, in some cases at least, periodically to watercourses to drink. In temperate climates they hibernate in burrows through the winter.

**Tetá**: See Othoes.

**Tet'anus** [Mod. Lat., from Lat. *te'tanus* = Gr. τέτανος, spasm, tetanus, liter., stretching, tension, deriv. of τείνειν, stretch]: a dangerous spasmodic disease characterized by paroxysms of tonic muscular contraction, succeeding each other with varying frequency for days or weeks. The spasms usually appear first in the muscles of mastication, producing the condition popularly known as "lock-jaw," then involve the large muscles of the trunk, then those of the extremities and those concerned in respiration. In a paroxysm the patient's face is livid or purple, his respiration suspended, his whole body rigid and usually arched backward, owing to the greater power of the muscles of the back. Such a spasm lasts several seconds, and may cause death by arrest of respiration. Fever of varying intensity is present, and extreme exhaustion follows the paroxysms. Death is the more common issue in acute cases, occurring in two or five days. Occasionally, tetanus of less intense type becomes chronic, lasting weeks. Tetanus is universally recognized as an infectious disease due to the bacillus of Nicolaier, which was discovered in 1885. This micro-organism gains access to the system through wounds which are infected with earth or dust. The earth of almost any garden contains them. Jagged wounds, and especially such as involve or injure nerves, are particularly liable to cause the disease. It may begin soon after the injury or not for a long time. Tetanus is more common in hot than in cold climates. As in other infectious diseases the symptoms are largely the result of the action of certain toxines, the products of the bacillus. Tetanus has been successfully treated by chloral hydrate, opium, chloroform, and by timely removal or separation of the nerves which are irritated by the wound. The modern treatment consists in the injection of antitoxines obtained from the blood of animals rendered immune from the disease. This treatment has been highly satisfactory in some cases.

Revised by W. PEPPER.

**Tête de Pont**, tāt'de-pōn̄ [Fr., head of a bridge, bridgehead]: in fortification, a fieldwork, generally open at the gorge, resting its flanks on the banks of a river in order to cover one or more bridges. In spite of their small compass, such works are often of great strength. See FORTIFICATION.

**Tetrabranchia'ta** [Mod. Lat., from Gr. τετρα-, four + βράγχια, gills]: that group of cephalopod Mollusca which includes those forms with two pairs of gills. See CEPHALOPODA, NAUTILIDÆ, and MOLLUSCA.

**Tetrachord**: See HEXACHORD.

**Tetracoral'lia** [Mod. Lat.; from Gr. τετρα-, four + κοράλλιον, coral]: a group of fossil corals, characterized by having the septa arranged in fours. They are simple or colonial, free or fixed. The group is confined to the Paleozoic age, and attained its maximum in the Silurian. About 400 species are known.

**Tetradecap'oda** [Mod. Lat.; Gr. τετρα-, four + δέκα, ten + πούς, ποδός, foot]: a group of malacostracous crustacea, embracing forms the typical members of which have fourteen (seven pairs) feet fitted for locomotion. They have a small head, seven free thoracic body-rings, while more or fewer of the seven abdominal segments are coalesced. The eyes are never on stalks. The group is often known as EDRIOPHTHALMA (*q. v.*) (sessile-eyed) or *Arthrostraca*, in allusion to the jointed thorax. (See MALACOSTRACA.) The group may be divided into four orders: ISOPODA (*q. v.*), AMPHIPODA (*q. v.*), *Læmodipoda*, and *Entoniscidæ*. In the *Læmodipoda*, embracing a few marine forms and including the whale-lice (*Cyamus*) and *Caprella*, the abdomen is greatly reduced, several of the thoracic feet may be lost, while one pair is transferred to the head. The *Entoniscidæ*, with isopodan affinities, are greatly reduced by parasitism, the female being frequently so degenerate that no crustacean relationships are recognizable in the adult. J. S. KINGSLEY.

**Tetradymite**: See TELLURIDES.

**Tetragram'maton** [Mod. Lat., from Gr. τετραγράμματον, a word of four letters; τετρα-, four + γράμμα, letter]: the word of four letters, i. e. the Hebrew YHWH, the holy name of the Deity which the Jews considered "secret" or "inexpressible" (*shēm hammephōrāsh*). Cf. *Zeit. Deutsch. Morgenländ. Gesell.*, xxxv., 162; xxxvi., 410; xxxix., 543. It was written in Hebrew letters in MSS. of the LXX., and then read as Greek ΠΙΠΙ (*Zeit. Deutsch. Morgenl. Gesell.*, xxxii., 465). The real pronunciation, which was given but once—on the Day of Atonement by the high priest—has been lost. In its place the word Adonai (my Lord) was used, and the vowels of that word placed under the consonants YHWH. Since 1520 Christian scholars have wrongly combined the consonants of the one with the vowels of the other, and produced a new word, *Jehovah*. The correct pronunciation is probably *Yahwē*; cf., Ἰάω of the Ophites, Valentinians, Abraxas Gems, and magical papyri; Ἰαουέ of Clemens, Ἰαβέ of Epiphanius and the Samaritans (Theodoret). The word means either "the one who exists" (Ex. iii. 14; Hosea i. 9), or "the one who calls into being" (Clericus, Lagarde, *Bildung der Nomina*, p. 137). For other meanings, see Wellhausen, *Skizzen*, iii., 175; Stade, *Geschichte*, i., 429; Schultze, *Alttest. Theologie*, 4th ed., p. 508; Baudissin, *Studien zur Semit. Religionsgeschichte*, i., 181; *Zeit. Alttest. Wissen.* (1882–83). RICHARD GOTTHEIL.

**Tetrahe'dron** [from Gr. τετρα-, four + ἕδρα, seat, base]; a solid having four bounding planes, four solid angles, and six edges. If regular, its sides are equilateral triangles.

**Tetral'ogy** [Gr. τετραλογία, a quaternion of discourses or dialogues]: the technical name given to a combination of three tragedies (trilogy) and a satyr-drama. The word is also applied to the Platonic dialogues, as grouped in sets of four. B. L. G.

**Tetrameter**: See METRES.

**Tetraon'idæ** [Mod. Lat., named from *Te'trao*, the typical genus; from Lat. *te'trao*, *tetrao'nis* = Gr. τετράων, heath-cock, moor-fowl]: a family of birds comprising the grouse, partridges, quails, etc. The general aspect of the birds is familiar in connection with the kinds just indicated; the bill varies considerably in size, being in some robust and in others rather weak; it is broad at the base, and thence compressed, and the culmen is always arched to the tip, which is obtusely hooked and decurved over the lower mandible; the nostrils are basal and lateral, in some (e. g. *Tetraoninæ*) concealed by feathers, in others partly covered by a hard scale; the wings are short, rounded, and concave; the tail diversiform, but generally short and depressed; the tarsi strong, variously clothed; the toes moderate, the three anterior free, the posterior elevated; the claws stout and adapted for scratching. With these are associated certain osteological characters, contrasting with those exhibited by the nearly allied *Phasianidæ*. (Huxley, *Proc. Zoöl. Soc. London*, 1868, p. 301.) These characters are best expressed in the grouse. As here defined, the family embraces the sub-families *Tetraoninæ*, *Ortyginæ* or *Odontophorinæ*, *Perdicinæ*, *Rollulinæ*, and *Caccabininæ* (in part). The *Turnicinæ* have been isolated by Huxley not only as a distinct family, but as a peculiar super-family or sub-order, under the name *Turnicimorphæ*. By some authorities the family is held to contain only the grouse proper, the partridges and quail being placed in a separate family, *Perdicidæ*, but there seems to be no good reason for this separation. See GROUSE, PARTRIDGE, QUAIL, RUFFED GROUSE, etc.

Revised by F. A. LUCAS.

**Tetrapol'itan Confession** [*Tetrapolitan* (with *t* by analogy of Gr. πολίτης, Eng. *political*, etc.) is from Gr. τετράπολις (sc. χώρα, district, country), a region having four cities, liter., fem. adj., having four cities; τετρα-, four + πόλις, city]: the "confession of the four cities" of Constance, Strassburg, Memmingen, and Lindau. It consists of twenty-three articles and is the oldest confession of the Reformed Church in Germany. It was drawn up by Bucer during the session of the Diet of Augsburg (1530), and presented to the emperor in the name of the four cities, but not read before the diet, nor did it ever receive wider sanction than in the four cities. See Schaff, *Creeds*, i., 526–529. S. M. J.

**Te'trarch** [from Lat. *tetrar'ches* = Gr. τετράρχης, τέτραρχος; τετρα-, four + ἄρχειν, be first, lead, rule]: a name which strictly designated, originally, the viceroy or monarch of the fourth part of a country (Thessaly, etc.), but subsequently became a title bestowed, especially under the Romans, upon the minor tributary princes of the East.

**Tetrodon'tidæ** [Mod. Lat., named from *Te'trodon*, the typical genus; Gr. τετρα-, four + ὀδούς, ὀδόντος, tooth]: a family of plectognath fishes distinguished by the development of the jaw into four tooth-like margins. The form is normally more or less oblong, but the abdomen is capable of much distension, and thus the true form is often disguised; the skin, especially on the belly, is mostly covered with larger or smaller dermal ossifications or spines; the head is oblong and covered with skin, so that the opercular and other bones are concealed; the mouth terminal or subterminal, and with the cleft mostly transverse; the intermaxillary and supramaxillary bones are confluent, but those of the opposite sides are divided by a suture, as is also the dentary bone of the lower jaw; the teeth are represented by the trenchant edges of the jaws and are otherwise wanting; the branchial apertures are narrow slits in front of the pectoral fins; the branchiostegal rays are entirely inclosed within the integuments; the dorsal is chiefly composed of articulated and branched rays, and is generally short and far behind; the anal is like the dorsal, and obliquely opposite, but rather farther behind; the pectorals are narrow and high up; the ventrals are wanting. With these characters are co-ordinated certain osteological features which confirm the isolation of this group as a peculiar family. It is, however, nearly related to the family *Diodontidæ*, which has generally been combined with it. Between sixty and seventy species are known. Representatives of the family are found in all tropical and warm temperate seas. Several are natives of the seacoast of the U. S., two (*Tetrodon lævigatus* and *Chilichthys turgidus*) extending to the eastern coast, and one (*Tetrodon politus*) occurring along the Californian coast. These species are called by the fishermen and others puffers, swell-fish, blowers, etc. The puffing is due to the development of a largely dilatable air-sac, which closely adheres to the peritoneum, and has a valvular communication with the œsophagus, through which the air is received. The species are of no economical importance; indeed some are poisonous. Revised by F. A. LUCAS.

**Tetuan**, tet-oo-aan': town of Morocco; in lat. 35° 34′ N., lon. 5° 18′ W., near the mouth of the river Martil; in an exceedingly fertile and well-cultivated region, especially celebrated for its oranges (see map of Africa, ref. 1–B). The town is fortified and well built, and has several fine mosques and an active trade in woolen and silk stuffs, leather, and fruit. Pop. 20,000 to 25,000, one-quarter Jews. M. W. H.

**Tetzel**, or **Tezel**, tet'sel, JOHANN [*Tetzel* is a diminutive of *Tietze*, his father's name]: seller of indulgences; son of a goldsmith; b. in Leipzig about 1455; studied theology and philosophy at the university of his native city; in 1489 entered the Dominican monastery of St. Paul in Leipzig, and soon became noted as a very impressive popular preacher. In 1502 he was appointed to preach an indulgence in Zwickau and its vicinity, and he was so successful—that is, he made so much money for the papal treasury—that he was steadily employed in the sale of indulgences for fifteen years. His territory was enlarged and his authority increased. It is said that he sold indulgences without requiring previous confession, and that he led an immoral life. At Innspruck in 1512 he was sentenced as an adulterer to be sewn in a sack and thrown into the river, but that sentence was commuted to imprisonment for life, and after being confined for some time at Leipzig he was set free. Roman Catholic writers deny that he sold indulgences without repentance, or indulgences for sins not yet committed: but their argument rests solely on the words of the papal commission, which are vague, and prove nothing with respect to the practice of the man as it had been reported by eye-witnesses. Leo X., having determined to grant a universal indulgence, made Tetzel inquisitor, and commissioned him to preach the indulgence throughout Germany. Tetzel appeared in his highest glory, journeying from town to town and levying his contributions, as has been described by contemporary writers; but when from Brandenburg he approached the Saxon frontier in the middle of 1517, he was unexpectedly met by Luther's theses, nailed to the church-door in Wittenberg Oct. 31. He burned Luther's theses at Jüterbogk, and wrote some theses himself, which the students burned at Wittenberg, while he defended them in a disputation at Frankfort-on-the-Oder, whereby he became a doctor of divinity. This illusion did not last long; and when, in 1518, Karl von Militiz, the papal ambassador, arrived at Leipzig, he not only suspended Tetzel, but spoke so harshly to him that the poor man fell sick of fright and humiliation, and died July 14, 1519. His *Life* has been written by the Protestants F. G. Hofmann (Leipzig, 1844) and F. Körner (Frankenburg, 1880), and by the Roman Catholics V. Gröne (Münster, 1853; 2d ed., Soest, 1860) and K. W. Hermann (Frankfort-on-the-Main, 1882). Cf. J. B. Röhm, *Zur Tetzel Legende* (Hildesheim, 1890). Revised by S. M. JACKSON.

**Teu'cer** (in Gr. Τεῦκρος): (1) the first King of Troy, in honor of whom the Trojans are sometimes called Teucri; but the legends differ with respect to whether he was a native of Troy, giving his daughter, Arisbe, in marriage to Dardanus of Samothrace, or whether he immigrated, together with Scamander, into Troas from Crete. (2) Son of Telamon, King of Salamis, and Hesione of Troy. He accompanied his step-brother, Ajax, to Troy, and was the best archer among the Greeks; but when the Greeks returned after the capture of Troy, Telamon would not receive Teucer in Salamis, because he had not avenged Ajax, and he then sailed to Cyprus, which he received from Belus, King of Sidon, and where he founded the town of Salamis. Revised by J. R. S. STERRETT.

**Teuffel**, toif'fel, WILHELM SIGISMUND: classical scholar; b. at Ludwigsburg, Würtemberg, Germany, Sept. 27, 1820; studied ancient languages in Tübingen, where he became privat docent in 1844; professor extraordinary in 1849; ordinary professor in 1857. D. at Tübingen, Mar. 8, 1878. His most famous work is his *Geschichte der römischen Litteratur* (2 vols., 5th ed., by L. Schwabe, Leipzig, 1890; trans. into English by Warr), the most exhaustive survey of the subject, and absolutely indispensable to every serious student. He is also the author of excellent editions of Aristophanes's *Clouds* and of Æschylus's *Persæ*, and wrote a commentary to the second book of the *Satires* of Horace. His admirable and highly instructive essays on ancient life and thought are collected in his *Studien und Characteristiken* (2d ed., Leipzig, 1889). See S. Teuffel, *W. S. Teuffel* (1889) and Bursian, *Biographische Jahrbücher*, i., 1878, pp. 2 ff. ALFRED GUDEMAN.

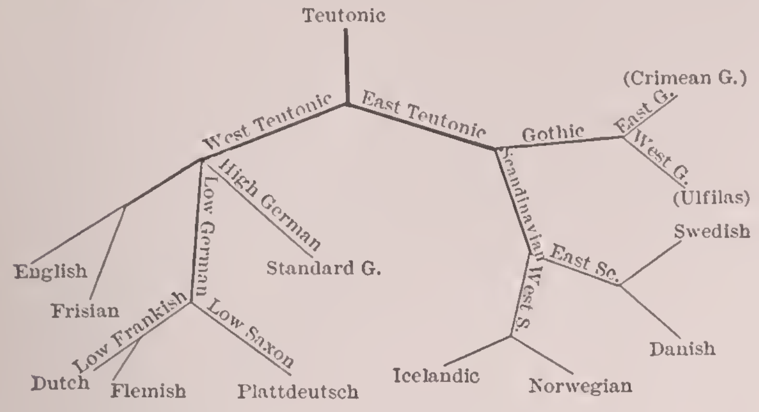
**Teuthid'idæ** [from *Teuthis*, the typical genus]: a family of acanthopterygian fishes, characterized by the peculiar structure of the fins. The body is oblong and compressed, scales small, lateral line continuous. There is a single row of cutting teeth in either jaw, no teeth on the palate. The dorsal fin has thirteen spinous and seven soft rays, the anal seven and nine, a formula common to all the species. Ventral fins thoracic with an outer and inner spine, between which are three soft rays. There are about thirty species, none over 15 inches in length, found in the Indian and Pacific Oceans. F. A. LUCAS.

**Teuton'ic Knights**: a military ecclesiastical order, founded in 1190 by some North German merchants, who had been moved by the sufferings of the crusaders at the siege of Acre. It soon found a patron in Frederick, Duke of Swabia, and secured charters from the emperor and the pope entitling it to all the privileges possessed by the two great rival orders of the Knights Templar and Knights of St. John. The members of the order were required to be Germans of noble birth, but priests and half-brothers, not noble, were admitted. In the early times they took vows of chastity and poverty. In 1230 they entered upon a crusade against the Prussians, and after a century of hard fighting established their rule over Prussia, when they fixed their headquarters at Marienburg. In the meanwhile they had served in the crusades of St. Louis 1248–50, founded Königsberg in 1255, and attacked the heathen Lithuanians in 1283. They were for many years involved in wars with Poland; held at times East and West Prussia, Esthonia, Pomerania, and other neighboring countries. In 1466 they surrendered West Prussia to Poland, and recognized the latter's feudal ownership for East Prussia, when Königsberg became their capital. In 1525 their grand-master, Albert of Brandenburg, converted Prussia into a secular hereditary dukedom, and in 1527 the seat of the order was transferred to Mergentheim in Swabia. In 1561 they lost all their Livonian possessions. In 1805 the Emperor of Austria became grand-master of the order. In 1809 Napoleon declared the order abolished, and gave its lands to various German sovereigns. In 1840 the Austrian emperor reorganized the Teutonic Knights, and in 1865 the order was still further reorganized. F. M. COLBY.

**Teutonic Languages**: a branch of the Indo-European family of languages. For the relationship of Teutonic to the other branches, see article INDO-EUROPEAN LANGUAGES. The term Germanic is also used, especially in Germany, where it is supplanting the older term *Deutsch*. The members of this group may be enumerated and compared with the aid of the following diagram. Each language has been treated in a separate article, under Gothic, Icelandic, German, Dutch, etc.

*Teutonic* is general and theoretical, and represents the one prehistoric language spoken by the Teutonic stock in Central Europe, between the Baltic and the Black Sea. The first divergence in general Teutonic was between East and West Teutonic, first fully treated by Zimmer in *Z'tschrift für d. Altertum*, xix., p. 393, *seq.* See also Kluge in Paul's *Grun-*

*driss der german. Philol.*, i., p. 362, *seq.*, and Sievers in *Encyclopædia Britannica* under *Gothic Language*. East Teutonic is divided into Gothic (see GOTHIC LANGUAGE) and the SCANDINAVIAN LANGUAGES (*q. v.*), but the differences between




the two are more striking than their similarities, and they may as well be kept distinct. See Brugmann's *Grundriss*, i., p. 11, and Noreen in Paul's *Grundriss*, p. 419, *seq.*; also Emerson's *History of the English Language*, chap. ii., and Brandt's *German Grammar*, § 479. The West Teutonic division stands out as more distinct and compact. Applying GRIMM'S LAW (*q. v.*) in its second shifting we get three subdivisions: 1. High German (see GERMAN LANGUAGE), which shifted most of all. 2. LOW GERMAN (*q. v.*), which shifted *th* to *d*. 3. English (see ENGLISH LANGUAGE), which, like Gothic and Scandinavian, shifted only once. The Frisian language stands between English and Low German. Some of its modern dialects have preserved *th*, some shifted it to *d*, and even to *t*. English writers like to place English in the Low German group, but this is hardly justifiable. It is true that when Angles, Saxon, Jutes, and Frisians left the Continent for Britain, their dialects were, roughly speaking, identical with Old Low Saxon, Old Low Frankish, Old Frisian; but the general term Low German should be limited to the non-High German continental dialects, including Modern Dutch, Flemish, Plattdeutsch, and perhaps Frisian, all of which shifted *th* to *d*. The main common characteristics of the Teutonic languages, which constitute at the same time the reason for grouping them together, are as follows: 1. The shifting of consonants according to GRIMM'S LAW and VERNER'S LAW (*qq. v.*). 2. The ACCENT (*q. v.*). In the Indo-European and for a while still in the Teutonic period the accent was "free." Then it became limited to the stem-syllable, which is always the first one in simple words and in "nominal" compounds. In genuine (inseparable) compound verbs it is the second syllable. Cf. Lat. *a'mo—ama'mus, a'mor—amo'ris* with Germ. *ich stand, wir standen, stand'haft, Stand'haftigkeit, verste'hen*; Germ. *Ur'laub—erlau'ben, Bei'schlaf—beschla'fen.* 3. The "strong" and "weak" conjugations. By ABLAUT (*q. v.*) which is not peculiar to the group, however, a regular and full system of verb-inflection called strong has developed; e. g. Eng. *write, wrote, written*; O. H. Germ. *helfan, half—hulfum, giholfan.* The so-called weak conjugation is quite characteristic. It employs a suffix *d* (*t*), of still doubtful origin, to express the simple past tense; e. g. Gothic *nasyan—nasida*; Eng. *love—loved*; Germ. *hausen—hauste.* 4. The double adjective declension: (*a*) The strong, identical with the strong substantive declension, although endings from the pronominal inflection have been mixed with it; (*b*) the weak, whose endings are identical with the weak or *n*-declension of substantives. Mod. H. Germ. has well preserved this twofold inflection and the syntax of the same, e. g. *guter Mann, gutem Manne*; *der gute Mann, dem guten Manne*; *Gutes, das Gute.* There are other minor characteristics of the group, but too technical to enumerate and enlarge upon here.

H. C. G. BRANDT.

**Teutonic** (or **Germanic**) **Mythology**: the body of myths belonging to the Teutonic or Germanic nations; also the system of gods, minor deities, and spirits which these myths commemorate.

*History of the Science.*—The discovery of the *Eddas* (see EDDA) in the sixteenth century dates the beginning of this science, which moved chiefly on lines of interpretation—and that in the main Euhemeristic—until Jacob Grimm (*Deutsche Mythologie*, 1835) put it upon a foundation of philological, historical, and comparative criticism. His main success was in the exhaustive material which he gathered, and in his wonderful, if often misguided, power of combination. Moreover, he not only avoided interpretation, but also insisted that Scandinavian sources are not to be regarded as the foundation, but simply as part of the material, of Teutonic mythology. Then came the great enthusiasm for comparative mythology, with Max Müller and Kuhn as leaders. This has been succeeded by a caution bordering on skepticism in regard to the validity of such processes; but it is interesting to note that rationalists were abroad a century ago, declaring (Adelung, Rühs, and others) that Christian and classical material—that is, mere loans and repetition—lay at the foundation of Norse myth. This view, with concessions to Teutonic and comparative mythology, and put forth with great philological insight, method, and ability, has been revived of late by certain Scandinavian scholars, such as Jessen, and notably by Sophus Bugge, who has succeeded in throwing grave suspicion upon the exclusively heathen character of such myths as the sacrifice of Odin, the death of Balder, and the descriptions of Valhalla. Müllenhoff, who had insisted on the critical methods of Lachmann as check to the more generous combination of J. Grimm, Grundtvig, and others, nevertheless took up the challenge of Bugge and made a manful defense of the essentially heathen character of Scandinavian mythology (*Deutsche Alterthumskunde*, v. i.). Whatever the merits of this particular controversy the vigorous methods of Müllenhoff in the general science deserve all praise. His friend and scholar Mannhardt, who began investigation as an enthusiastic follower of Kuhn, soon developed independent powers of criticism, insisted upon the artistic or poetical element which is sure to master higher forms of myth, abandoned (see his *Mythologische Forschungen*, with valuable introductions by Müllenhoff and Scherer, Strassburg, 1884) much of the old material, and emphasized the importance of traditional rites and superstitions among the peasants. With Mannhardt, as with others, anthropology has exercised a salutary power. Finally, we may mention the tendency of modern critics to exalt the importance of religious rites in general as a far more stable affair than the myth. Extreme in this regard is J. Lippert (*Die Religionen der europäischen Kulturvölker*, 1881), a disciple of Herbert Spencer; according to Lippert myths are mere tales and fancies, accretions upon the religious instinct, and subordinate in every way to ceremonial religion. This is exaggeration; but it is safe to say that while the old problems of Teutonic mythology are still unsolved, a more temperate and reasonable spirit prevails, the material is better understood, and a sounder critical method is accepted on every side.

*Sources.*—Aside from Scandinavian myths (see SCANDINAVIAN MYTHOLOGY), plentiful indeed, but not to be used in their present shape as outright material for the reconstruction of a Teutonic Olympus, the sources are meager and baffling. The line between genuine myth and poetic fancy or allegory is not easy to determine; while the test of a definite cult and a definite locality can be applied successfully to few of the myths which we possess. Names of persons and places—Thor was a favorite for this purpose in Scandinavia—from heathen times are trustworthy, particularly when the name is compounded so as to indicate some phase of worship; and with these sources are to be ranged runic and other inscriptions of ancient date, genealogies, like those of the Anglo-Saxon kings, which go back to such gods as Woden, and even the so-called "kennings" or metaphors of scaldic poetry. Ornaments and other relics from heathen tombs are often incorruptible witnesses to heathen worship. Important, but not always clear, is the evidence of classical writers contemporary with our heathendom; such are Cæsar (*Commentaries on the Gallic War*, vi., 21), Tacitus (*Germania* and parts of the *Annals* and *History*), and Plutarch. With the conversion come the Christian chroniclers—Jordanes, for example—and the lives of saints, particularly of men like Boniface, who were foremost in missionary labor; here too belong renunciations of heathen gods drawn up for the Germanic convert. Critical powers of a high order are needed in the use of such sources as the half-heathen epic (*Beowulf*) and the complicated heroic legend; but poetic fancy is not so rife and contamination not so prevalent in the charms and incantations which more or less clearly show heathen origin. These are a part of religion, as is evident from their purpose and the manner of using them; but popular stories, legends, ballads, and the like, are of little value, having no stay in religious rites and floating easily from one race or community to another.

*Lower Mythology.*—Turning to the actual material we note that the worship of spirits, survival from heathen belief, is found in all Teutonic races, and carries with it a host of stories which belong in part to primitive myth. One example out of many which prove an older worship of the dead is the myth of the Wild Huntsman and his troop of spirits sweeping through a stormy sky. Such a storm is often called *Allerseelenwind*; and the direct cult of these spirits is known still in folk-lore, even adapting itself to Christian purposes in the feast of All Souls. Offerings to the dead, ceremonies at a tomb, give sanction to degenerate myths of this sort, still told by the people, but hopelessly tangled with other elements, native and foreign. Here too belong stories of spirits in guise of bird or beast, or in a form at once human and superhuman—the lore of ghosts. In the popular tales (see BEAST-FABLES) myth is inextricably woven with narrative pure and simple, and migration, especially from the East, may be assumed at every turn; but an exception must be made of charms and incantations, for here we have the sure test of a cult, of ceremonial rites, together with the credentials of immemorial tradition. A charm is often introduced by an epic exordium, setting forth a case similar to the one about to be treated and holding in many cases its shred of myth. Such is the famous Merseburg charm which tells of Phol and Wodan; such is a long incantation in Anglo-Saxon, meant to cure sudden attacks of rheumatism and telling how "mighty women" riding about the air send their spears at the unwary mortal (translated in Gummere's *Germanic Origins*, p. 373). These supernatural women, degenerating into modern witches, or the weird sisters of Macbeth, are of course related to the Norns and the Valkyries of Norse myth, and to those women whom the Germans of Tacitus worshiped as divine.

*Nature-myths.*—Myths of the dead, ghost-lore in general, may be referred to the analogy worked out by primitive man between the world of spirits and the world of his inner consciousness, particularly in dreams. But the world without was as insistent as that within, and there is no good reason for postponing the myths of nature to the late stage assigned them by some modern scholars. Storm and lightning were probably referred to the agency of gigantic spirits, not necessarily ancestral; a vague personality, logical result of what Mr. Tylor calls primitive "animism," was behind the roar of the tempest. Minor phases of natural power, moreover, had their cult and myth; tree-worship and water-worship are cases in point, and exist in manifold survival to this day. Worship of such elemental powers was partly conciliatory and grateful, partly of the banning order, and the myths connected with them have these dualistic types. The forces of nature had higher powers and larger utterance than the serviceable or annoying spirits of the home. The Corn Demon, the good or bad genius of the fields, belonged in this list (see Mannhardt, *Antike Wald- und Feldkulte*); and so, in yet more vague conception, did the giants (see JOTUN), of whom Scandinavia preserved so many myths.

*Gods and Goddesses.*—Through the border-land of demons, dragons, and giants we pass to what E. H. Meyer has called the Pantheon, as opposed to the Pandemonium, of Germanic myth. Here is the higher mythology, where the poet has wrought material, often brutal and always clumsy, into shapes of beauty and majesty. Some of the gods are merely demons or giants promoted, like Loke, god of fire or possibly of lightning; but many of them are far more venerable in origin. They are called *god* (perhaps "he who is invoked") or *ans* (probably "helper"; Anglo-Saxon *Os-* in words such as Oscar), and, as opposed to giants, are the friends of man. They were worshiped in rude temples, despite the denial of Tacitus, and in sacred groves, with dance, song, and sacrifice. Comparative mythology assures the parallel of an old Teutonic god, probably "the bright one," Tiwaz (Scand. Týr), with Sanskrit Dyâus, Greek Zeus, Latin Ju-piter, god of the shining heaven. Originally supreme god, he became the Teutonic Mars (giving the name to Tuesday, *dies Martis*); a few traces of his worship are found, notably an inscription in England. His supremacy was overthrown by Wodan (Ang.-Sax. Woden; Scand. Odin), the god of wind and storm, "Mercurius" in Roman interpretation (hence Wednesday), and then a divinity representing conquest and new arts of life. Wodan became of course monarch of all Teutonic gods; myths about him abound in Scandinavian sources, and traces of his worship are found in all Teutonic nations. Identification of English Woden and the outlaw Robin Hood, however, is made without good reason. (See Child, *Ballads*, 2d ed., iii., p. 47.) The cult of Wodan seems finally to have penetrated peasant life, and is proved by folk-lore; but for Scandinavia at least there is no doubt that Thor (Ang.-Sax. Thunor) was once the favorite; ample material is given by Henry Petersen, *Om Nordboernes Gudedyrkelse og Gudetro i Hedenold*, especially page 46, *seq.* Thor, the thunder-god (Thursday, *dies Jovis*), may have been meant by Cæsar when he ascribes to the Germans a god "Vulcan." There are many myths about this friend of man and sworn foe to the giants, and the converted Scandinavians parted from him unwillingly enough. Occasionally an old god is worshiped under a new name, and Tiwaz probably lives again as the Freyr of Norse myth, a god of fertility, peace, and commerce; his sister Freyja is probably no other than the Nerthus, *terra mater*, mentioned by Tacitus (*Germ.*, 40) as worshiped by Germans along the North Sea with rites that are described in valuable detail. Freyr, moreover, is closely related to, probably identical with, Ing, the father and god of the Tacitean Ingvæones, who dwelt about the Elbe mouth, and later sent conquerors to Britain. Ing is mentioned in the Anglo-Saxon Rune-Lay. Besides Freyja should be mentioned Frigg (Scand. form; Ang.-Sax. Frig), wife of Odin, goddess of love and fecundity; later she appears in folk-lore in humble guise and under many names, such as Holda in Germany.

*Interpretation.*—Occasionally, as has been shown, the meaning of a myth and the origin of a deity are evident enough; such is the case with Wodan and his hunt, with Tiwaz, and others. But the mania for interpretation of myths—whether sun, storm, or a beautiful allegory of human life be the solution—lapsed at one time into a mere guessing-match, and was baffled by nothing. Simrock, in his *Mythologie*, gives after each myth a *hæc fabula docet*, often ingenious to absurdity. Jacob Grimm held himself aloof from all this; and with modern times, as criticism finds more and more difficulty in the mere sifting and valuation of material, and recognizes how many strands are interwoven, what different stages of culture are to be reckoned with, and how hard it is to approach the origins of a myth, interpretation, even with the aid of comparative mythology, has lost much of its ardor. One thing is certain: while myths may yet be traced to personified natural forces, often with convincing proof, the hunt after allegories and fine-spun meanings, such as mars the effect of so able a book as Uhland's *Mythus von Thor*, is now abandoned.

BIBLIOGRAPHY.—Besides the works already named, one should consult J. Grimm, *Deutsche Mythologie*, especially his preface to the second edition (1844; reprinted in fourth edition); Müller, *Geschichte und System der altdeutschen Religion* (1844), despite its age still a useful book; K. Maurer, *Bekehrung des norwegischen Stammes zum Christenthum* (1855, *seq.*); Wuttke, *Der deutsche Volksglaube der Gegenwart* (1869); H. Pfannenschmid, *Germanische Erntefeste* (1878), an excellent book; Tylor, *Primitive Culture*; Kemble, *The Saxons in England*; E. H. Meyer, *Völuspa* and *Germanische Mythologie* (1891); Mogk, *Mythologie*, in Paul's *Grundriss der Germanischen Philologie*.

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**Teutons** [from Lat. *Teu'toni*, *Teu'tones*, from a Teutonic word represented by Goth. *þiuda* : O. H. Germ. *diot* : O. Eng. *þēod*, people; cf. Eng. *Dutch*, from Dutch *Duitsch* : Germ. *Deutsch*. German < O. H. Germ. *diutisk*, popular, national, deriv. of *diot*, people]: the members of the Teutonic branch of the Aryan family.

(1) *The Peoples embraced under the Name.*—Much uncertainty is manifested in the extent of the application. The Greek and Latin authors seem to have used the word to designate only a certain portion of the great race then inhabiting the lands N. of the Alps and E. of the Rhine—viz., that portion with which they first became acquainted—that portion which undertook, in company with the Cimbri, to invade the Roman empire about 113 B. C., and whose original abode had been probably the western coast of Schleswig-Holstein and the territory about the mouth of the Elbe. It was then that Rome first became aware of the existence of a people of untamed might dwelling N. of the Alps, and distinct from the Celtic tribes; and it is quite natural that the Romans, in their ignorance of the extent of the race, should have taken the word which this tribe used, in common with all the other tribes, to designate itself, and have applied it in a Latinized form in particular to this one, and then, upon becoming acquainted with the larger extent of the race, have adopted, as they did, another word, the Belgic-Celtic

word *Germani*, for the name of the entire race. Some of the Latin authors—as Martial and Claudian—used the adjective *Teutonicus* as of like meaning with *Germanicus*, and after the beginning of the tenth century the Latin "Teutonicus" displaces, even in German authorship, the indigenous "Theotiscus" as the comprehensive race-adjective, while in modern times the Latin names, though still used, have been turned wholly about in the extent of their application, the race being designated by the term Teuton, and that portion of the pure or nearly pure stock inhabiting the European continent by the term *German*. In this broadest sense must be included under the name Teuton, in first degree, the Germans of the Continent—viz., the inhabitants of the German empire, of Austria proper, of the northern and northeastern cantons of Switzerland, and of Holland, and the Scandinavians of the two northern peninsulas; in the second degree, the English, the inhabitants of Lower Scotland, and the inhabitants of the U. S.; while in the ethnological composition of almost every truly European nation—that is, every nation W. of Russia proper and Turkey—the Teutonic component enters in a greater or less degree. At the close of the fifth century, when the great movement known in European history as the migration of the peoples ended, the Teutons were the ruling race from Carthage to the Vistula: the Vandals in Africa from Carthage to Gibraltar; the Visigoths from Gibraltar to the banks of the Loire; the Suevi occupying about the present Portugal; Burgundians from the upper course of the Loire to the center of the present Switzerland; the Ostrogoths from the last-mentioned boundary to that of the present Turkish empire on the E., and from the Mediterranean Sea on the S. to the Danube on the N.; the Franks from the lower Loire to Thuringia; Saxon conquerors upon the English coasts; Saxons, Frisii, Thuringians, Marcomanni, Bavarians, and Longobardi still upon the original German soil, the latter moving down a little later (last half of the sixth century) into Italy, and occupying the plain of the upper Po, while the Scandinavic branch not only occupied the two northern peninsulas, but reached round the entire eastern and southeastern shore of the Baltic and far inland. In the far-off lands of Africa, Hispania, Southwestern Gaul, and Middle and Southern Italy the Teutonic element disappeared almost entirely in the amalgamation with the great mass of the Romanic population; while, on the other hand, the inhabitants of Northern and Northeastern France, of Belgium, of Northern Italy, and of Russia's Baltic provinces manifest still most strongly the ethnological characteristics of the Teutons.

(2) *Characteristics of the Teuton.*—(*a*) *Physical.*—Besides the usual Caucasian peculiarities of the "oval head; the lines of eye and mouth dividing the whole face into three nearly equal parts; the large eyes with their axis at right angles with the line of the nose; the 90° facial angle; the full beard, covering to the ears; the white complexion, and the tall, straight, and well-proportioned stature"—which the Teuton possesses in common with all Europeans, he is further somewhat distinguished from these by a larger frame, a whiter and more florid complexion, a bluer eye, and a lighter shade of hair. (*b*) *Mental.*—The distinction between the Teutonic and the Romanic nature is even more manifest in the mental than in the physical constitution. The Græco-Roman world meditated the connection between the ancient civilization and the modern. Its geographical position and historical connections with the Oriental world preserved in the Greek and the Roman the inheritance of the Oriental traits, which the differences of climate and soil, of geography and topography, have indeed modified but not destroyed. The prevailing temperament of the Romanic peoples is still a mixture of the sanguine and the melancholic, the latter element predominating, while fancy and imagination, vacillation, and mysticism, are among the chief traits in their intellectual, moral, and religious character. On the other hand, the Teuton, with more of the phlegm and the choler in his temperament, evinces the deeper insight, the more constant purpose, and the greater *éclaircissement.*

(3) *Institutions.*—These differences of mental constitution are most clearly seen in the fundamental institutions which they have produced. The Roman imperium and the Roman Church may be taken as the great historical products of the Roman spirit. In both of these the sum and substance of all authority is viewed, imaginatively and mystically, as inherent in an office, and all law as proceeding out of it, from above, down, over, and independent of the governed. On the other hand, individual liberty and personal worth were the fundamental principles of the old Teutonic life and polity. In the old assemblies of the village, the hundred, and the tribe it was the will of the freeman which was the authority of law. While in Rome the central power was the strongest, and there existed no local power worth the name, save as an imperial agency, among the Teutons, again, the local power was always the strongest, and centralization always opposed, defied, and overthrown. When Marbodius, the Marcomannic duke, and even the brave Arminius, to whom the German tribes were indebted for the expulsion of the Roman legions from their soil, attempted to retain in time of peace the centralized authority which they had exercised as leaders in war, the one was obliged to flee to Rome in order to save his life, while the other fell a victim to his fatal ambition. Thus is seen enkindled at the very first contact of the Teutonic with the Romanic world the irrepressible conflict between freedom and authority which has shaken Europe from that day to this. Then it was Teutonic liberty against the Roman imperium; in the Middle Ages, after contact and connection with the Roman world had given the Germans kings and emperors, it was the emperor against the pope; in the transition period from the mediæval age to the new time it was German Protestantism against Roman Catholicism; and to-day it is Teutonic science against the syllabus and the Vatican. The Teutonic spirit has given to the modern civilization its freedom of thought and conscience, its estimation of man above institutions, its science, its Protestantism, its doctrine of popular sovereignty, its local self-government, and its national development. It can therefore be truly said to be the spirit of the modern civilization.

SOURCES.—*Vorgeschichte der deutschen Nation*, Wietersheim; *Geschichte der Völkerwanderung*, Wietersheim; *Die Guanchen der canarischen Inseln*, von Löher; *Deutsche Verfassungsgeschichte*, Waitz; *Culturgeschichte des deutschen Volks*, Rückert; *Rom und die Deutschen*, Bluntschli; *De Bello Gallico*, Cæsar; *De Situ, Moribus, et Populis Germaniæ*, Tacitus; *Monumenta Germaniæ historica*, edited by Pertz.

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**Tewfik** (tef-fēēk') **Pasha**, MOHAMMED: Khedive of Egypt; b. Nov. 15, 1852, the eldest son of Ismaïl Pasha. He was educated in Egypt, and declared heir-apparent in 1866 when the Porte granted the right of primogeniture to the Egyptian reigning family. He married Emineh Hamen, and never had any other wives. In 1879 Ismaïl appointed him president of the ministry, which position he resigned after a few weeks. On June 26, 1879, Ismaïl was compelled to abdicate by the British and French Governments, and Tewfik was proclaimed khedive. But he ruled only in name, the dual control having placed the state virtually in the power of the two foreign governments. The result of this was the formation of a national party, with Arabi Pasha at the head. Though he was Minister of War, he quarreled with Tewfik. Great Britain, acting in the interest of the Egyptian bondholders, intervened, and issued an ultimatum July 9, 1882. Alexandria was bombarded on July 11. The insurrection was forcibly put down, and a sort of constitutional monarchy established. On Jan. 18, 1883, a British financial adviser was given a seat in the council. During the Mahdi troubles in 1884 Tewfik was compelled, against his better judgment, to give up the Sudan. He was greatly interested in public works and public instruction. D. at Helwān Palace, Jan. 7, 1892.

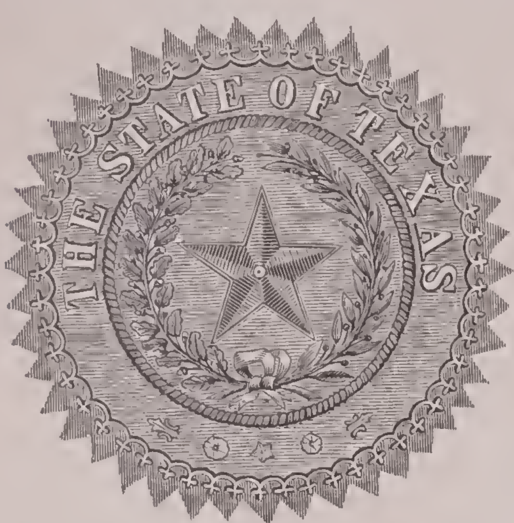
RICHARD GOTTHEIL.

**Tewksbury**: town (incorporated in 1734); Middlesex co., Mass.; between the Merrimack and Concord rivers; on the Boston and Maine Railroad; 5 miles S. E. of Lowell, and 22 miles N. W. of Boston (for location of county, see map of Massachusetts, ref. 2–H). It contains the villages of Wigginville, Gillmanville, Phœnix, and North Tewksbury; has a high school, twelve schools, public library, and the State almshouse; and is principally engaged in agriculture and the manufacture of cotton-machinery. Pop. (1880) 2,179; (1890) 2,515; (1900) 3,683.

**Texarkan'a**: twin city; one part, the capital of Miller co., Ark., the other part in Bowie co., Tex.; separated by the boundary-line between the two States; on the St. L., Iron Mt. and S., the St. L. S. W., the Texark. and Ft. Smith, and the Tex. and Pac. railways; 45 miles S. W. of Little Rock, and 58 miles N. N. E. of Jefferson (for location, see map of Arkansas, ref. 5–B, and of Texas, ref. 2–K). The city is a unit practically, though each part is legally a separate municipality. It is in a pine-lumber region; ships large quantities of cotton; has electric lights, cotton-compresses, machine and boiler works, cottonseed-oil mill, ice-factories, and car-works; and contains 3 national banks with combined capital of $275,000, and 2 daily and 2 weekly newspapers. Pop. (1890), part in Arkansas, 3,528; part in Texas, 2,852; (1900), part in Arkansas, 4,914; part in Texas, 5,256.

**Texas**: one of the U. S. of North America (South Central group); the fifteenth in order of admission into the Union; popularly known as the "Lone Star State."

*Location and Area.*—It is the most westerly of the States bordering on the Gulf of Mexico; is the largest State in the Union: lies between lat. 25° 51′ and 36° 30′ N., lon. 93° 27′ and 106° 43′ W.; bounded N. E. and E. by Oklahoma, Indian Territory, Arkansas, and Louisiana, S. E. by the Gulf of Mexico, S. W. by Mexico, and N. W. by New Mexico; with a rectangular projection, known as the Panhandle, included between Oklahoma on the N. and E., and New Mexico on the W.; area estimated at 268,242 sq. miles, including Greer County on its N. E. boundary, which is also claimed by the U. S. Government.

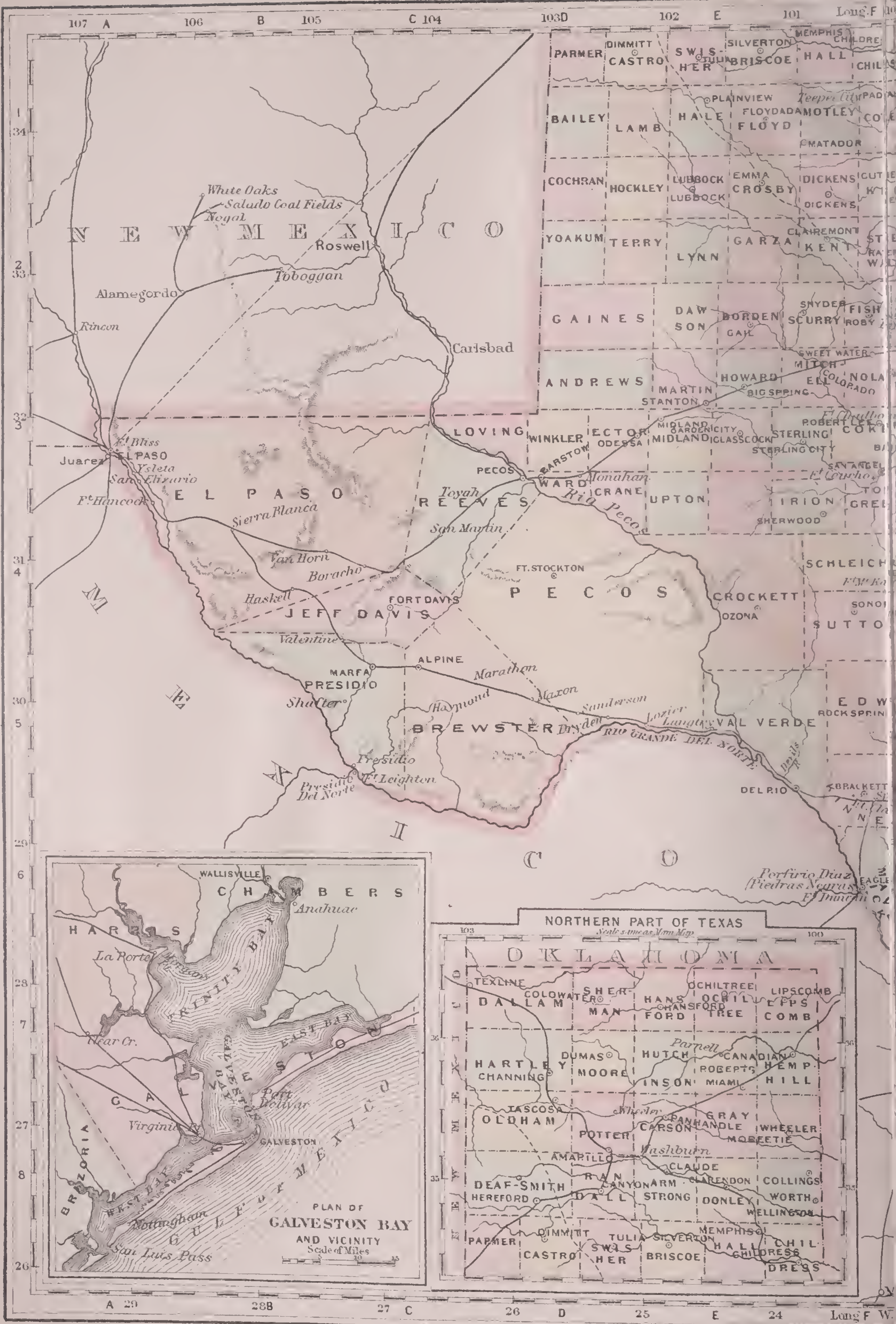


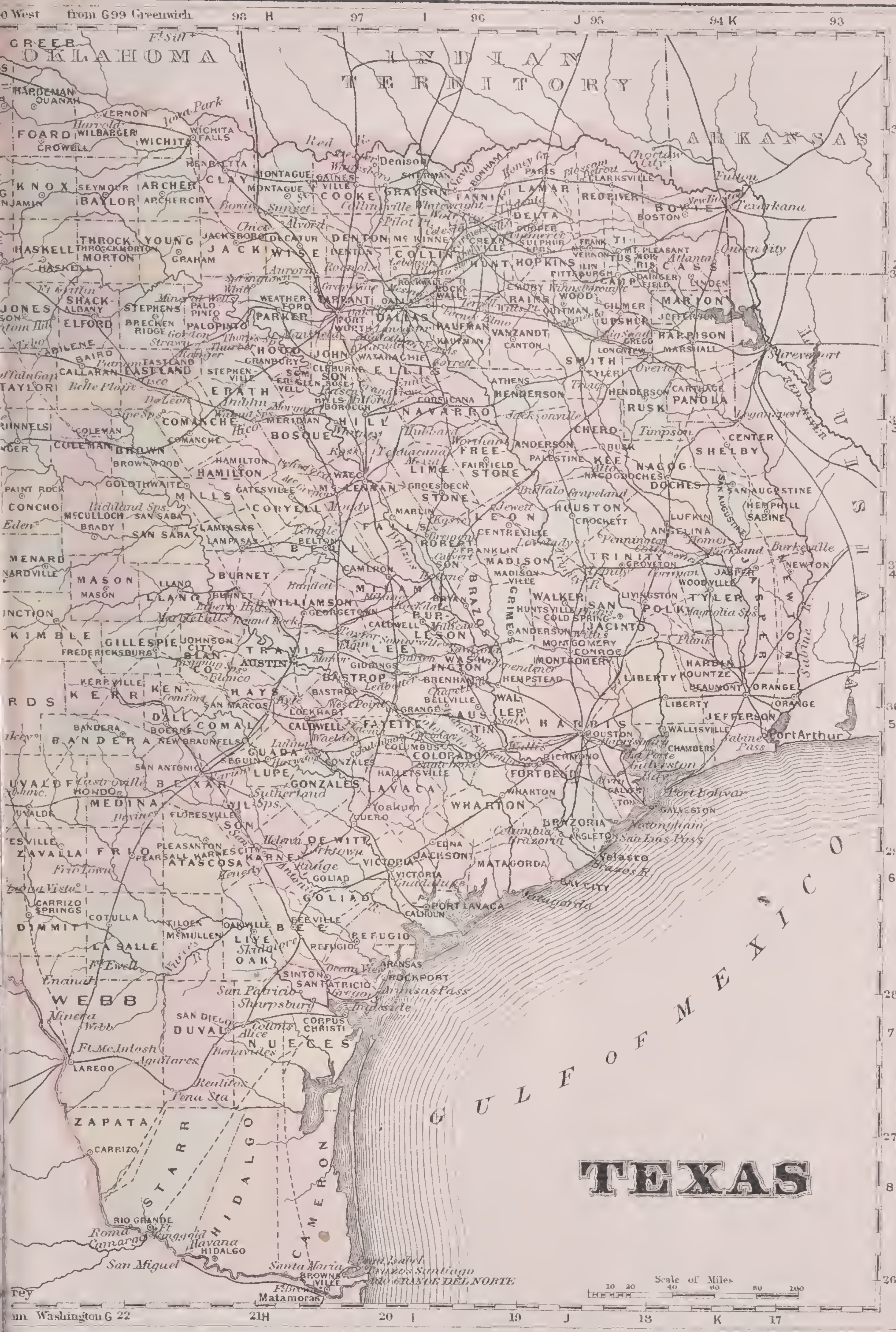
Seal of Texas.

*Physical Features.*—In its geology and topography Texas is composed of areas marked by typical aspects. The northeastern part belongs to the forest-belt extending across the Southern States, the northwestern to an extensive plain reaching downward through several States from the N., and the southwestern, beyond the Pecos river, to the Rocky Mountain system. The surface of the State, omitting the Trans-Pecos region, consists of a series of benches, approximately parallel to the Gulf coast, rising gently toward the N. W. and culminating in the great plateau of the Llano Estacado. Several of these benches are narrowed considerably near their middle portions. The Trans-Pecos country is covered with scattered mountain peaks and ranges having great basins between. The principal benches named in order from the S. E. are the Coast Prairie, the Lignitic Belt, the Black Waxy Prairie, the Grand Prairie, and the Central Denuded Region. Beyond the last lies the Llano Estacado. The Coast Prairie has a width varying from 50 to 100 miles, and the southeast edge, with its long, easy slope, extends a considerable distance out under the waters of the Gulf. The Lignitic Belt has an undulating surface, and is made up of plains, from some of which great basins have been carved out by rivers. The surface of the Black Waxy Prairie rolls gently, and is marked by numerous small hollows or depressions known as hog-wallows. This prairie is about 140 miles wide along Red river, about 85 on the Rio Grande, and only about 10 where the Colorado intersects it. The Grand Prairie is a great plateau, the southwestern part of which is a bed of hard limestone. Its southeast edge is marked by an escarpment reaching from the Colorado river to the Rio Grande, and known as the Balcones. Many springs, remarkable for volume of water and for beauty, burst out along the base of this escarpment. The Central Denuded Region is a basin having a maximum width of about 180 miles. It extends S. into the State for more than three-fourths of the distance across and separates the Grand Prairie from the Llano Estacado. The Grand Prairie, however, sweeps around the southern end of the basin and reaches the Llano Estacado in that quarter. The latter is a vast table-land, sloping gently to the S. E. In Burnet and Llano Counties there is an area of older rocks, notably Archæan, near the junction of the Grand Prairie and the Central Denuded Region. The coast has a line of long narrow islands extending along its front at a distance of 10 to 20 miles from the mainland. From Galveston northeastward these islands sink into shoals. The principal bays are those of Galveston, Matagorda, Espiritu Santo, Aransas, Corpus Christi, and Alazan. While there are districts in North and Central Texas mountainous in geological formation, the only elevations deserving the name of mountains by their altitude are in the Trans-Pecos country. The rivers all have an approximately parallel S. E. direction, except the Canadian and the Red. The former flows N. E. across the Panhandle, and the latter nearly E. along a large part of the northern boundary of the State. The principal remaining rivers named in order toward the S. W. are the Sabine, Neches, Trinity, Brazos, Colorado, Guadalupe, Nueces, and Rio Grande, with its tributary the Pecos. The Canadian, the Red, the Pecos, and the Rio Grande originate beyond the State, and their sources are included in a comparatively small district of upper New Mexico and lower Colorado.

*Soil and Productions.*—The Coast Prairie has a fertile soil of sandy loam with a red or yellow clay subsoil. The alluvial deposits of its river-bottoms are composed largely of materials brought down from the Cretaceous and Permian beds through which the rivers flow in their upper course, and are exceedingly rich. In the Lignitic Belt the pine uplands have a gray sandy soil, usually not very fertile, but the lowlands are better. The Black Waxy Prairie, though somewhat difficult of tillage, is one of the finest agricultural areas of the world. The northeastern half of the Grand Prairie is covered with a chocolate soil of great productive capacity. The southwestern half has a rougher surface, and the soil is shallow, the parts fit for cultivation being mainly the valleys. The Llano Estacado is deeply covered with a brown loam suited especially for wheat and fruit. The mineral resources of Texas are great, but as yet little developed. Salt is obtained from numerous lakes along the Rio Grande border and from salines in East Texas. Extensive beds of rock-salt exist in Van Zandt and Mitchell Counties. In East Texas lignite has been found throughout a large district. In the central and western parts are beds of bituminous coal. The workable area of the Central beds is estimated at 2,300 sq. miles. Sulphur, celestite, strontianite, asphaltum, gypsum, and kaolin are found in various quarters. There are large deposits of iron ore in East Texas, in the Trans-Pecos region, and in the districts adjacent to the town of Llano. Copper ore exists in the last two localities, and also in Northwestern Texas. Lead occurs in the Central Mineral Region and the Trans-Pecos district, and in the latter zinc as well. Gold and silver are found in both these sections. There are, however, few mines of any sort in the parts mentioned as mineral-bearing. There are numerous quarries of good building-limestone in the State, and several of sandstone. Among the most durable and costly varieties of stone are the granites, marbles, and serpentines of Burnet and Llano Counties and the Trans-Pecos region. The principal forests are in East Texas, and the prevailing growth is pine. In the western part of the forest region oak, hickory, and ash are common. In the river-bottoms of the southeast cypress is found in abundance, and in the northeast bois d'arc. Running from Red river S. are two belts of post-oak and blackjacks about 40 miles apart, the eastern being known as the Lower Cross Timbers and the western as the Upper Cross Timbers. They reach about 150 miles into the State, and mark respectively the eastern and the western edges of the Grand Prairie. Toward the S. W. the forests disappear and are replaced by cedar brakes, stretches of mesquite, and similar growths. Along the Rio Grande border are dense thickets of chaparral, mimosa, and various kinds of acacias. The southern part of the district W. from the Black Waxy Prairie is covered with nutritious grasses. Texas ranks first among the cotton-growing States. It produces also large crops of maize, wheat, and oats. Near Alvin in the Coast Prairie, around Tyler, and in the western parts fine fruit is grown.

The animals of Texas, like the vegetables, change in type in passing from the N. and E. toward Mexico. In the forests and along the streams of the eastern part are the red deer, beaver, squirrel, gopher, and badger, with an occasional brown bear, and panther. On the plains and in the more rugged districts of the west are antelopes, black-tailed deer, and big-horn sheep. Only one herd of buffalo is left in the State, and this is in a large pasture in the Panhandle. In different quarters are lobo-wolves and coyotes, red and gray foxes, skunks, wild cats and civet cats. The prairie districts abound in prairie-dogs and Texas hares. Among the birds of the State are wild geese and ducks, which are found mainly in the eastern portions and on the coast; while farther west the plover, curlew, snipe, and Mexican canary prevail. The quail, wild turkey, crow, hawk, owl, and mocking-bird are widely distributed. The commonest


NEW MEXICO
MEXICO
Roswell
Alamegordo
Carlsbad
White Oaks
Toboggan
Rincon
EL PASO
Juarez
Ysleta
Fᵗ Hancock
Sierra Blanca
REEVES
PECOS
JEFF DAVIS
PRESIDIO
BREWSTER
VAL VERDE
CROCKETT
LOVING
WINKLER
ECTOR
MIDLAND
UPTON
CRANE
ANDREWS
MARTIN
HOWARD
GAINES
DAWSON
BORDEN
SCURRY
YOAKUM
TERRY
LYNN
GARZA
KENT
COCHRAN
HOCKLEY
LUBBOCK
CROSBY
DICKENS
BAILEY
LAMB
HALE
FLOYD
MOTLEY
PARMER
CASTRO
SWISHER
BRISCOE
HALL
STERLING
IRION
SCHLEICHER
SUTTON
Fort Davis
Alpine
Marfa
Marathon
Sanderson
Del Rio
Ft. Stockton
Ozona
NORTHERN PART OF TEXAS
OKLAHOMA
DALLAM
SHERMAN
HANSFORD
OCHILTREE
LIPSCOMB
HARTLEY
MOORE
HUTCHINSON
ROBERTS
HEMPHILL
OLDHAM
POTTER
CARSON
GRAY
WHEELER
DEAF-SMITH
RANDALL
ARMSTRONG
DONLEY
COLLINGSWORTH
CHILDRESS
Amarillo
CHAMBERS
HARRIS
GALVESTON
BRAZORIA
GULF OF MEXICO
Trinity Bay
East Bay
West Bay
La Porte
Anahuac
Wallisville
Virginia Pt.
Port Bolivar
San Luis Pass
PLAN OF
GALVESTON BAY
AND VICINITY
Scale of Miles


TEXAS
GULF OF MEXICO
INDIAN TERRITORY
OKLAHOMA
ARKANSAS
LOUISIANA
West from G 99 Greenwich
Washington G 22
Scale of Miles
10 20 40 60 80 100
Austin
Dallas
Houston
Galveston
San Antonio
Fort Worth
Waco
Corpus Christi
Laredo
Brownsville
Matamoras
Port Arthur
Beaumont
Texarkana
Shreveport
Denison
Sherman
Paris
Victoria
Rio Grande del Norte

reptiles are the alligator, horned toad, and snakes of various kinds, the only dangerous ones being the copperhead and rattlesnake. Two hundred and thirty species of fishes have been distinguished, most of them in the rivers of the Coast Prairie. The finest is the black bass. Among the invertebrates are the lobster, shrimp, crab, centipede, and tarantula, while along the coast are found oysters and clams in great abundance.

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 | 174,184 | 228,126 | 31·0 |
| Total acreage of farms | 36,292,219 | 51,406,937 | 41·6 |
| Value of farms, including buildings and fences | $170,468,886 | $399,971,289 | 134·6 |

* Increase.

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

| CROPS. | Acreage. | Yield. | Value. |
|---|---|---|---|
| Corn | 4,553,495 | 81,962,910 bush. | $38,522,568 |
| Wheat | 1,271,517 | 23,395,913 " | 14,973,384 |
| Oats | 744,164 | 28,278,232 " | 8,483,470 |
| Rye | 3,917 | 64,630 " | 43,302 |
| Barley | 2,049 | 50,405 " | 36,292 |
| Potatoes | 14,789 | 916,918 " | 806,888 |
| Hay | 304,933 | 548,879 tons. | 3,732,377 |
| Totals | 6,894,864 | ................ | $66,598,281 |

The cotton production in 1899–1900 was 2,438,555 bales. On Jan. 1, 1900, the farm animals comprised 1,125,645 horses, value $23,507,407; 260,562 mules, value $9,166,041; 693,794 milch cows, value $17,518,298; 4,352,541 oxen and other cattle, value $77,736,384; 2,416,721 sheep, value $4,634,063; and about 3,000,000 swine, value $10,000,000; total head 11,849,263; total value $142,562,193.

*Climate.*—In the northeastern and eastern part there is a fair amount of humidity, but the southwestern and western are too arid for successful agriculture without irrigation. The most marked features of the climate are the Gulf breeze, which blows from the southeast during the warm season, and is quite strong 200 to 300 miles from the coast, and the norther, a cold wind which comes with great velocity and little warning and causes sudden and considerable falls in temperature. The following tables, compiled from U. S. Signal Service observations, show the mean annual and monthly temperature and rainfall of six stations, two in the eastern, two in the central, and two in the western parts:

TEMPERATURE.

| MONTHS, ETC. | New Ulm. | Palestine | San Antonio. | Jacksboro. | Fort Stockton. | Fort Elliott. |
|---|---|---|---|---|---|---|
| Elevation, feet | .... | 495 | 676 | 1,133 | 3,050 | 2,500 |
| January | 50·2° | 42·2° | 50·6° | 42·8° | 43·0° | 30·6° |
| February | 56·4 | 52·1 | 56·0 | 47·4 | 48·8 | 36·0 |
| March | 63·0 | 58·9 | 63·3 | 57·4 | 56·6 | 46·0 |
| April | 68·3 | 65·4 | 69·5 | 67·0 | 63·9 | 55·6 |
| May | 74·6 | 71·2 | 75·3 | 73·2 | 72·2 | 63·8 |
| June | 80·5 | 78·2 | 81·2 | 80·9 | 78·8 | 73·0 |
| July | 82·7 | 81·4 | 82·9 | 83·9 | 80·6 | 77·0 |
| August | 82·6 | 80·2 | 82·3 | 81·8 | 78·0 | 74·7 |
| September | 77·7 | 75·6 | 77·5 | 74·2 | 71·9 | 68·2 |
| October | 69·7 | 66·1 | 69·5 | 66·8 | 63·4 | 56·8 |
| November | 59·2 | 56·6 | 58·7 | 2·7 | 50·6 | 42·5 |
| December | 53·6 | 48·8 | 53·3 | 44·0 | 45·5 | 34·4 |
| Annual | 68·2 | 64·7 | 68·5 | 64·3 | 62·8 | 54·8 |
| Years included in average | 16 | 6 | 9 | 5 | 9 | 8 |

RAINFALL (IN INCHES).

| MONTHS, ETC. | New Ulm. | Palestine. | San Antonio. | Jacksboro. | Fort Stockton. | Fort Elliott. |
|---|---|---|---|---|---|---|
| Elevation, feet | .... | 495 | 676 | 1,133 | 3,050 | 2.500 |
| January | 4·14 | 2·82 | 1·22 | 0·73 | 0·29 | 0·31 |
| February | 4·53 | 3·07 | 2·34 | 1·89 | 0·52 | 0·52 |
| March | 5·07 | 2·88 | 2·39 | 1·23 | 0·86 | 0·61 |
| April | 3·84 | 4·30 | 2·41 | 2·00 | 0·41 | 2·14 |
| May | 5·72 | 5·83 | 3·29 | 3·37 | 1·58 | 5·32 |
| June | 3·48 | 2·80 | 3·13 | 4·10 | 2·23 | 3·79 |
| July | 4·23 | 2·83 | 2·41 | 4·65 | 1·87 | 2·66 |
| August | 3·05 | 2·44 | 3·31 | 2·25 | 2·62 | 3 62 |
| September | 5·68 | 3·70 | 4·09 | 5·79 | 3·88 | 2·00 |
| October | 4·04 | 3·79 | 2·23 | 2·78 | 1·25 | 2·82 |
| November | 5·16 | 4·00 | 2·41 | 1·99 | 0·74 | 0 54 |
| December | 4·62 | 4·01 | 2·08 | 1·61 | 0·85 | 0·81 |
| Annual | 53·56 | 42·47 | 31·31 | 32·39 | 17·10 | 25·14 |

*Divisions.*—For administrative purposes the State is divided into 243 counties, as follows:

COUNTIES AND COUNTY-TOWNS, WITH POPULATION.

| COUNTIES. | * Ref. | Pop. 1890. | Pop. 1900. | COUNTY-TOWNS. | Pop. 1900. |
|---|---|---|---|---|---|
| Anderson | 3–J | 20,923 | 28,015 | Palestine | 8.297 |
| Andrews | 3–D | 24 | 87 | .................. | 1,527 |
| Angelina | 4–J | 6,306 | 13,481 | Lufkin | ..... |
| Aransas | 7–I | 1,824 | 1,716 | Rockport | 1,153 |
| Archer | 2–G | 2,101 | 2,508 | Archer City | ..... |
| Armstrong | 8–E | 944 | 1,205 | Claude | ..... |
| Atascosa | 6–G | 6,459 | 7,143 | Pleasanton | ..... |
| Austin | 5–I | 17,859 | 20,676 | Bellville | ..... |
| Bailey | 1–D | ....... | 4 | .................. | ..... |
| Bandera | 5–G | 3,795 | 5,332 | Bandera | ..... |
| Bastrop | 5–H | 20,736 | 26,845 | Bastrop | 2,145 |
| Baylor | 2–G | 2,595 | 3,052 | Seymour | ..... |
| Bee | 6–H | 3,720 | 7,720 | Beeville | ..... |
| Bell | 4–H | 33,377 | 45,535 | Belton | 3,700 |
| Bexar | 5–G | 49,266 | 69,422 | San Antonio | 53,321 |
| Blanco | 5–G | 4,649 | 4,703 | Johnson City | ..... |
| Borden | 2–E | 222 | 776 | Gail | ..... |
| Bosque | 3–H | 14,224 | 17,390 | Meridian | 923 |
| Bowie | 2–K | 20,267 | 26,676 | Boston | ..... |
| Brazoria | 6–J | 11,506 | 14,861 | Brazoria | ..... |
| Brazos | 4–I | 16,650 | 18,859 | Bryan | 3,589 |
| Brewster | 5–C | 710 | 2.356 | Alpine | ..... |
| Briscoe | 1–E | ....... | 1,253 | Silverton | ..... |
| Brown | 3–G | 11,421 | 16,019 | Brownwood | 3,965 |
| Buchel ‡ | 5–D | 298 | ....... | .................. | ..... |
| Burleson | 4–I | 13,001 | 18,367 | Caldwell | 1,535 |
| Burnet | 4–H | 10,747 | 10,528 | Burnet | 1,203 |
| Caldwell | 5–H | 15,769 | 21,765 | Lockhart | 2,306 |
| Calhoun | 6–I | 815 | 2.395 | Port Lavaca | ..... |
| Callahan | 3–G | 5,457 | 8,768 | Baird | 1,502 |
| Cameron | 8–H | 14,424 | 16,095 | Brownsville | 6,305 |
| Camp | 2–J | 6,624 | 9,146 | Pittsburg | 1,783 |
| Carson | 8–D | 356 | 469 | Panhandle | ..... |
| Cass | 2–K | 22,554 | 22,841 | Linden | ..... |
| Castro | 1–D | 9 | 400 | Dimmitt | ..... |
| Chambers | 5–K | 2,241 | 3,046 | Wallisville | ..... |
| Cherokee | 3–J | 22,975 | 25,154 | Rusk | 527 |
| Childress | 1–F | 1,175 | 2,138 | Childress | 692 |
| Clay | 2–H | 7.503 | 9,231 | Henrietta | 1,641 |
| Cochran | 2–D | ....... | 25 | .................. | ..... |
| Coke | 3–F | 2,059 | 3,430 | Robert Lee | ..... |
| Coleman | 3–G | 6,112 | 10,077 | Coleman | 1,362 |
| Collin | 2–I | 36,736 | 50,087 | McKinney | 4,342 |
| Collingsworth | 8–E | 357 | 1,233 | Wellington | ..... |
| Colorado | 5–I | 19,512 | 22,203 | Columbus | 1,824 |
| Comal | 5–H | 6,398 | 7,008 | New Braunfels | 2,097 |
| Comanche | 3–G | 15,608 | 23,009 | Comanche | 2,070 |
| Concho | 3–F | 1,065 | 1,427 | Paint Rock | ..... |
| Cooke | 2–H | 24,696 | 27.494 | Gainesville | 7,874 |
| Coryell | 3–H | 16,873 | 21,308 | Gatesville | 1,865 |
| Cottle | 1–F | 240 | 1,002 | Paducah | ..... |
| Crane | 4–D | 15 | 51 | .................. | ..... |
| Crockett | 5–E | 194 | 1,591 | Ozona | ..... |
| Crosby | 2–E | 346 | 788 | Emma | ..... |
| Dallam | 7–D | 112 | 146 | Texline | ..... |
| Dallas | 2–I | 67,042 | 82,726 | Dallas | 42,638 |
| Dawson | 2–E | 29 | 37 | .................. | ..... |
| Deaf Smith | 8–D | 179 | 843 | La Plata | ..... |
| Delta | 2–J | 9,117 | 15,249 | Cooper | 1,518 |
| Denton | 2–H | 21,289 | 28,318 | Denton | 4,187 |
| De Witt | 6–H | 14,307 | 21,311 | Cuero | 3,422 |
| Dickens | 2–F | 295 | 1,151 | Dickens | ..... |
| Dimmitt | 6–F | 1,049 | 1,106 | Carrizo Springs | ..... |
| Donley | 8–E | 1,056 | 2,756 | Clarendon | ..... |
| Duval | 7–H | 7,598 | 8,483 | San Diego | ..... |
| Eastland | 3–G | 10,373 | 17,971 | Eastland | 596 |
| Ector | 3–D | 224 | 381 | Odessa | ..... |
| Edwards | 5–F | 1,970 | 3,108 | Rock Springs | ..... |
| Ellis | 3–I | 31,774 | 50,059 | Waxahachie | 4,215 |
| El Paso | 3–B | 15.678 | 24,886 | El Paso | 15,906 |
| Encinal # | 7–G | 2,744 | ....... | .................. | ..... |
| Erath | 3–H | 21,594 | 29,966 | Stephenville | 1,922 |
| Falls | 3–I | 20,706 | 33,342 | Marlin | 3,092 |
| Fannin | 2–I | 38,709 | 51,793 | Bonham | 5,042 |
| Fayette | 5–I | 31,481 | 36,542 | La Grange | 2,392 |
| Fisher | 2–F | 2,996 | 3,708 | Roby | ..... |
| Floyd | 1–E | 529 | 2,020 | Floydada | ..... |
| Foard † | .... | ....... | 1,568 | .................. | ..... |
| Foley ‡ | 5–D | 25 | ....... | .................. | ..... |
| Fort Bend | 5–J | 10,586 | 16,538 | Richmond | ..... |
| Franklin | 2–J | 6,481 | 8,674 | Mt. Vernon | ..... |
| Freestone | 3–I | 15,987 | 18,910 | Fairfield | ..... |
| Frio | 6–G | 3,112 | 4,200 | Pearsall | ..... |
| Gaines | 2–D | 68 | 55 | .................. | ..... |
| Galveston | 6–J | 31,476 | 44,116 | Galveston | 37,789 |
| Garza | 2–E | 14 | 185 | .................. | ..... |
| Gillespie | 5–G | 7,056 | 8,229 | Fredericksburg | ..... |
| Glasscock | 3–E | 208 | 286 | Garden City | ..... |
| Goliad | 6–I | 5,910 | 8,310 | Goliad | ..... |
| Gonzales | 5–H | 18,016 | 28,882 | Gonzales | 4,297 |
| Gray | 8–E | 203 | 480 | .................. | ..... |
| Grayson | 2–I | 53.211 | 63,661 | Sherman | 10,243 |
| Gregg | 2–J | 9,402 | 12,343 | Longview | 3,591 |
| Grimes | 4–I | 21,312 | 26.106 | Anderson | ..... |
| Guadalupe | 5–H | 15,217 | 21.385 | Seguin | 2,421 |
| Hale | 1–E | 721 | 1,680 | Plainview | ..... |
| Hall | 1–F | 703 | 1,670 | Memphis | ..... |
| Hamilton | 3–H | 9.313 | 13,520 | Hamilton | ..... |

* Reference for location of counties, see map of Texas.
† Formed since census of 1890. ‡ Annexed to Brewster in 1897.
\# Annexed to Webb in 1899.

COUNTIES AND COUNTY-TOWNS, WITH POPULATION.

| COUNTIES. | * Ref. | Pop. 1890. | Pop. 1900. | COUNTY-TOWNS. | Pop. 1900. |
|---|---|---|---|---|---|
| Hansford...... | 7-E | 133 | 167 | Hansford......... | .... |
| Hardeman..... | 1-F | 3,904 | 3.634 | Quanah .......... | 1,651 |
| Hardin ........ | 5-K | 3,956 | 5,049 | Kountze.......... | ..... |
| Harris......... | 5-J | 37,249 | 63,786 | Houston.......... | 44,633 |
| Harrison ...... | 2-K | 26,721 | 31,878 | Marshall.......... | 7,855 |
| Hartley........ | 7-D | 252 | 377 | Hartley .......... | ..... |
| Haskell........ | 2-F | 1,665 | 2,637 | Haskell........... | ..... |
| Hays .......... | 5-H | 11,352 | 14,142 | San Marcos ...... | 2,292 |
| Hemphill ...... | 7-E | 519 | 815 | Canadian......... | ..... |
| Henderson..... | 3-J | 12,285 | 19,970 | Athens............ | ..... |
| Hidalgo........ | 8-H | 6,534 | 6,837 | Hidalgo .......... | ..... |
| Hill............ | 3-H | 27.583 | 41,355 | Hillsboro......... | 5,346 |
| Hockley ....... | 2-D | ...... | 44 | .................. | ..... |
| Hood .......... | 3-H | 7,614 | 9.146 | Granbury ........ | 1,410 |
| Hopkins....... | 2-J | 20,572 | 27,950 | Sulphur Springs.. | 3.635 |
| Houston....... | 3-J | 19,360 | 25,452 | Crockett.......... | 2,612 |
| Howard ....... | 3-E | 1,210 | 2,528 | Big Spring ....... | ..... |
| Hunt .......... | 2-I | 31,855 | 47,295 | Greenville........ | 6,860 |
| Hutchiuson.... | 7-E | 58 | 303 | .................. | ..... |
| Irion.......... | 4-F | 870 | 848 | Sherwood ........ | ..... |
| Jack.......... | 2-H | 9,740 | 10,224 | Jacksboro........ | 1,311 |
| Jackson ....... | 6-I | 3,281 | 6,094 | .................. | ..... |
| Jasper......... | 4-K | 5,592 | 7,138 | Jasper............ | ..... |
| Jeff Davis ..... | 4-C | 1,394 | 1,150 | Fort Davis........ | ..... |
| Jefferson ...... | 5-K | 5,857 | 14.239 | Beaumont......... | 9,427 |
| Johuson ....... | 3-H | 22,313 | 33,819 | Cleburne ......... | 7,493 |
| Jones.......... | 2-F | 3,797 | 7,053 | Auson............ | ..... |
| Karnes ........ | 6-H | 3,037 | 8,681 | Karues City....... | ..... |
| Kaufman...... | 2-I | 21,598 | 33,376 | Kaufman......... | 2,378 |
| Kendall........ | 5-G | 3,826 | 4,103 | Boerne............ | ..... |
| Kent........... | 2-F | 324 | 899 | Clairemont....... | ..... |
| Kerr........... | 5-G | 4,462 | 4,980 | Kerrville ......... | ..... |
| Kimble ........ | 5-G | 2,243 | 2,503 | Junctiou ......... | ..... |
| King........... | 2-F | 173 | 490 | Guthrie........... | ..... |
| Kinney ........ | 5-F | 3.781 | 2,447 | Brackettville..... | ..... |
| Knox .......... | 2-G | 1,134 | 2,322 | Benjamin ........ | ..... |
| Lamar......... | 2-J | 37,302 | 48,627 | Paris............. | 9,358 |
| Lamb.......... | 1-D | 4 | 31 | .................. | ..... |
| Lampasas ..... | 4-H | 7,584 | 8,625 | Lampasas........ | 2,107 |
| La Salle ....... | 7-G | 2,139 | 2,303 | Cotulla........... | ..... |
| Lavaca ........ | 5-I | 21,887 | 28,121 | Hallettsville...... | 1,457 |
| Lee............ | 4-I | 11.952 | 14,595 | Giddiugs ......... | ..... |
| Leon........... | 4-I | 13,841 | 18,072 | Centerville ....... | ..... |
| Liberty........ | 5-J | 4,230 | 8,102 | Liberty........... | 865 |
| Limestone..... | 3-I | 21,678 | 32,573 | Groesbeck........ | 1,462 |
| Lipscomb...... | 7-E | 632 | 790 | Lipscomb ........ | ..... |
| Live Oak ...... | 6-H | 2,055 | 2,268 | Oakville.......... | ..... |
| Llano.......... | 4-G | 6,772 | 7,301 | Llano ............ | ..... |
| Loving........ | 3-C | 3 | 33 | Mentone.......... | ..... |
| Lubbock....... | 2-E | 33 | 293 | Lubbock.......... | ..... |
| Lynn .......... | 2-E | 24 | 17 | .................. | ..... |
| McCulloch..... | 3-G | 3,217 | 3,960 | Brady ............ | ..... |
| McLennan..... | 3-H | 39,204 | 59,772 | Waco............. | 20,686 |
| McMullen...... | 7-G | 1,038 | 1,024 | Tilden ............ | ..... |
| Madison........ | 4-J | 8,512 | 10.432 | Madisonville...... | ..... |
| Marion......... | 2-K | 10,862 | 10,754 | Jefferson ......... | 2,850 |
| Martin......... | 3-E | 264 | 332 | Stanton........... | ..... |
| Mason ......... | 4-G | 5,180 | 5,573 | Mason............ | ..... |
| Matagorda .... | 6-J | 3,985 | 6,097 | Matagorda ....... | 1,414 |
| Maverick ...... | 6-F | 3,698 | 4,066 | Eagle Pass ....... | ..... |
| Medina ........ | 5-G | 5,730 | 7,783 | Hondo City....... | ..... |
| Menard........ | 4-F | 1,215 | 2,011 | Menardville ...... | ..... |
| Midland ....... | 3-D | 1,033 | 1,741 | Midland .......... | ..... |
| Milam ......... | 4-I | 24.773 | 39.666 | Cameron ......... | 3,341 |
| Mills .......... | 3-H | 5,493 | 7.851 | Goldthwaite...... | 1,282 |
| Mitchell ....... | 3-F | 2,059 | 2,855 | Colorado ......... | ..... |
| Montague...... | 2-H | 18,863 | 24.800 | Montague ........ | 579 |
| Montgomery... | 5-J | 11,765 | 17,067 | Conroe ........... | ..... |
| Moore ......... | 7-D | 15 | 209 | Dumas ........... | ..... |
| Morris......... | 2-J | 6,580 | 8,220 | Daingerfield...... | ..... |
| Motley......... | 1-F | 139 | 1,257 | Matador.......... | ..... |
| Nacogdoches.. | 3-J | 15,984 | 24,663 | Nacogdoches..... | 1,827 |
| Navarro ....... | 3-I | 26,373 | 43.374 | Corsicana ........ | 9,313 |
| Newton........ | 4-K | 4.650 | 7,282 | Newton........... | ..... |
| Nolan.......... | 3-F | 1,573 | 2,611 | Sweet Water ..... | 670 |
| Nueces ........ | 7-H | 8,093 | 10,439 | Corpus Christi.... | 4,703 |
| Ochiltree ...... | 7-E | 198 | 267 | Ochiltree......... | ..... |
| Oldham........ | 8-D | 270 | 349 | Tascosa .......... | ..... |
| Orange ........ | 5-K | 4,770 | 5,905 | Orange........... | 3,835 |
| Palo Pinto..... | 2-G | 8.320 | 12,291 | Palo Pinto........ | ..... |
| Panola......... | 3-K | 14,328 | 21,404 | Carthage......... | ..... |
| Parker......... | 2-H | 21,682 | 25,823 | Weatherford ..... | 4,786 |
| Parmer........ | 1-D | 7 | 34 | .................. | ..... |
| Pecos.......... | 4-D | 1,326 | 2,360 | Fort Stockton.... | ..... |
| Polk........... | 4-J | 10,332 | 14,447 | Livingston ....... | ..... |
| Potter ......... | 8-D | 849 | 1.820 | Amarillo ......... | 1,442 |
| Presidio ....... | 5-B | 1,698 | 3.673 | Marfa............ | ..... |
| Rains.......... | 2-J | 3.909 | 6,127 | Emory ........... | ..... |
| Randall........ | 8-D | 187 | 963 | Canyon........... | ..... |
| Red River ..... | 2-J | 21,452 | 29.893 | Clarksville ....... | 2,069 |
| Reeves......... | 4-C | 1,247 | 1,847 | Pecos............. | 639 |
| Refugio........ | 6-I | 1,239 | 1,611 | Refugio .......... | ..... |
| Roberts........ | 7-E | 326 | 620 | Parnell.. ........ | ..... |
| Robertson ..... | 4-I | 26,506 | 31,480 | Franklin ......... | ..... |
| Rockwall ...... | 2-I | 5,972 | 8,531 | Rockwall......... | 1,245 |
| Runnels ....... | 3-F | 3,193 | 5,379 | Ballinger......... | 1,128 |
| Rusk .......... | 3-J | 18.559 | 26.099 | Henderson ....... | ..... |
| Sabine......... | 4-K | 4,969 | 6,394 | Hemphill......... | ..... |
| San Augustine. | 4-K | 6.688 | 8,434 | San Augustine ... | 261 |
| San Jacinto.... | 4-J | 7,360 | 10.277 | Cold Spring ...... | ..... |
| San Patricio... | 7-H | 1,312 | 2,372 | Sinton ........... | ..... |
| San Saba ...... | 4-G | 6,641 | 7,569 | San Saba......... | ..... |

* Refereuce for location of counties, see map of Texas.

COUNTIES AND COUNTY-TOWNS, WITH POPULATION.

| COUNTIES. | * Ref. | Pop. 1890. | Pop. 1900. | COUNTY-TOWNS. | Pop. 1900. |
|---|---|---|---|---|---|
| Schleicher..... | 4-F | 155 | 515 | .................. | ..... |
| Scurry..... ... | 2-F | 1,415 | 4,158 | Snyder........... | ..... |
| Shackelford.... | 2-G | 2,012 | 2,461 | Albauy........... | ..... |
| Shelby......... | 3-K | 14,365 | 20,452 | Center............ | ..... |
| Sherman ...... | 7-D | 34 | 104 | Coldwater........ | ..... |
| Smith.......... | 3-J | 28,324 | 37,370 | Tyler............. | 8,069 |
| Somervell ..... | 3-H | 3,419 | 3,498 | Glen Rose........ | ..... |
| Starr ......... | 8-G | 10,749 | 11,469 | Rio Grande City.. | ..... |
| Stephens ...... | 2-G | 4,926 | 6,466 | Breckenridge .... | ..... |
| Sterling †...... | .... | ....... | 1,127 | Sterling City..... | ..... |
| Stonewall...... | 2-F | 1,024 | 2,183 | Rayner........... | ..... |
| Sutton......... | 4-F | 658 | 1,727 | Sonora ........... | ..... |
| Swisher........ | 1-E | 100 | 1,227 | Tulia ............ | ..... |
| Tarraut........ | 2-H | 41,142 | 52,376 | Fort Worth....... | 26.688 |
| Taylor......... | 3-F | 6,957 | 10,499 | Abilene........... | 3,411 |
| Terry.......... | 2-D | 21 | 48 | .................. | ..... |
| Throckmorton. | 2-G | 902 | 1,750 | Throckmorton.... | ..... |
| Titus.......... | 2-J | 8,190 | 12,292 | Mt. Pleasaut...... | ..... |
| Tom Green.... | 3-F | 5.152 | 6,804 | San Angelo....... | ..... |
| Travis ........ | 5-H | 36,322 | 47,386 | Austin........... | 22,258 |
| Trinity......... | 4-J | 7,648 | 10.976 | Groveton......... | ..... |
| Tyler .......... | 4-K | 10,877 | 11,899 | Woodville ........ | ..... |
| Upshur ........ | 2-J | 12,695 | 16.266 | Gilmer ........... | ..... |
| Upton ......... | 4-E | 52 | 48 | .................. | ..... |
| Uvalde ........ | 5-F | 3,804 | 4.647 | Uvalde........... | 1,889 |
| Val Verde ..... | 5-E | 2,874 | 5,263 | Del Rio........... | ..... |
| Van Zandt..... | 2-J | 16,225 | 25,481 | Canton ........... | ..... |
| Victoria ....... | 6-I | 8.737 | 13,678 | Victoria...... ... | 4,010 |
| Walker ........ | 4-J | 12,874 | 15,813 | Huntsville........ | 2,485 |
| Waller......... | 5-I | 10,888 | 14,246 | Hempstead....... | ..... |
| Ward.......... | 3-D | 77 | 1,451 | Barstow.......... | ..... |
| Washington ... | 5-I | 29,161 | 32,931 | Brenham......... | 5,968 |
| Webb ‡........ | 7-G | 14,842 | 21,851 | Laredo ........... | 13,429 |
| Wharton....... | 6-I | 7,584 | 16,942 | Wharton ......... | ..... |
| Wheeler....... | 8-E | 778 | 636 | Mobeetie ......... | ..... |
| Wichita........ | 1-G | 4,831 | 5,806 | Wichita Falls .... | 2,480 |
| Wilbarger...... | 1-G | 7,092 | 5,759 | Vernon........... | 1,993 |
| Williamson.... | 4-H | 25.909 | 38.072 | Georgetown...... | 2.790 |
| Wilson......... | 5-H | 10,655 | 13,961 | Floresville........ | 895 |
| Winkler ....... | 3-D | 18 | 60 | .................. | ..... |
| Wise.......... | 2-H | 24,134 | 27,116 | Decatur.......... | 1,562 |
| Wood.......... | 2-J | 13,932 | 21,048 | Quitman ......... | ..... |
| Yoakum....... | 2-D | 4 | 26 | .................. | ..... |
| Young......... | 2-G | 5,049 | 6,540 | Graham.......... | 878 |
| Zapata ........ | 8-G | 3,562 | 4,760 | Carrizo........... | ..... |
| Zavalla........ | 6-G | 1,097 | 792 | Batesville ........ | ..... |
| Totals ..... | | 2,235,523 | 3,048.710 | | |

* Reference for location of counties, see map of Texas.
† Formed since census of 1890. ‡ Encinal annexed in 1899.

*Principal Cities and Towns, with Population for 1900.*—San Antonio, 53,321; Houston, 44.633; Dallas, 42,638; Galveston, 37,789; Fort Worth, 26,688; Austin, 22,258; Waco, 20,686; El Paso, 15,906; Laredo, 13,429; Denison, 11,807; Sherman, 10,243; Beaumont, 9,427; Paris, 9,358; Corsicana, 9,313; Palestine, 8,297; Tyler, 8,069; Gainesville, 7,874; Marshall, 7,855; Cleburne, 7,493; Temple, 7,065; Greenville, 6.860; Terrell, 6,330; Brownsville, 6,305; Brenham, 5,968; Hillsboro, 5,346; Texarkana, 5.256; Bonham, 5,042.

*Population and Races.*—In 1850, 212,582; 1860, 604,215; 1870, 818,579; 1880, 1,591,749; 1890, 2,235,523 (native, 2,082,567; foreign, 152,956; males, 1,172,553; females, 1,062,970; white, 1,741,190; colored, 494,333, of whom 492,837 were persons of African descent, 727 Chinese, 3 Japanese, and 766 civilized Indians).

*Industries and Business Interests.*—Texas is pre-eminently an agricultural and cattle-raising State, but is rapidly developing manufacturing interests. In 1890 there were reported in the census 5,268 manufacturing establishments, with $46,815,181 capital, employing 39,475 persons, paying $18,586,338 for wages and $36.152,308 for materials, and turning out articles valued at $70,433,551.

*Commerce.*—The foreign trade in the fiscal year 1899–1900, through the customs districts of Brazos de Santiago, Corpus Christi, Galveston, El Paso, and Saluria, aggregated, imports, $5,606,351; exports, $105,985,258.

*Finance.*—In 1898 the State had a bonded debt of $3,992,030, of which $3,254,040 are held by special funds, and $737,990 by individuals. The assessed valuation in 1900 was $946,320.258. The balance of the treasury Sept. 1, 1899, was $1,092,807.94; receipts for fiscal year ending Aug. 31, 1900, $2.859,967.60; disbursements, $2,733,781.60; balance Sept. 1, 1900, $1,159,587.54.

*Banking.*—Sept. 5, 1900, there were 223 national banks, with a combined capital of $19,618,920, surplus and profits of $9,029,138.13, and deposits of $49,749,908.63; on June 30, 41 private banks, capital $1,235,450, surplus and profits $319,179, and deposits $2,276,604; and 2 stock savings-banks, capital $135,000, surplus and profits $148,888, and $584,424 in savings deposits from 2,980 depositors.

*Post-offices and Periodicals.*—On Jan. 1, 1901, there were 3.102 post-offices, of which 164 were presidential (7 first-class, 27 second-class, 130 third-class) and 2,938 fourth-class. Of these, 1,153 were money-order offices and 4 money-order stations. The newspapers and periodicals (1901) comprised 71 daily, 14 semi-weekly, 646 weekly, 1 bi-weekly, 14 semi-monthly, 68 monthly, and 1 quarterly publications; total, 815.

*Means of Communication.*—The total mileage of main railway track in Texas, June 30, 1899, was 9,778·02. The total earnings for the year were $41,102,587.14. The following shows the extent of direct track and the value of property in the State of some of the most important systems, reported Dec. 3, 1894:

| NAME OF CORPORATION. | Mileage. | Total value. |
|---|---|---|
| Austin and Northwestern | 105·96 | $1,753,694 22 |
| Fort Worth and Denver City | 454·13 | 5,771,582 42 |
| Galveston, Harrisburg, and San Antonio | 919·06 | 16,142,297 45 |
| Gulf, Western Texas, and Pacific | 109·67 | 1,318,081 80 |
| Houston and Texas Central | 452·60 | 9,588,903 28 |
| Missouri, Kansas, and Texas of Texas | 837·91 | 13,437,440 80 |
| New York, Texas, and Mexican | 91·52 | 1,093,459 16 |
| Sabine and East Texas | 102·03 | 896,565 73 |
| St. Louis and Southwestern of Texas | 551·78 | 8,862,293 18 |
| San Antonio and Aransas Pass | 687·67 | 8,677,698 37 |
| Texas Central | 175·95 | 2,348,666 47 |
| Texas and Pacific | 1,039·33 | 17,730,689 31 |
| Tyler Southeastern | 88·60 | 914,746 98 |

*Churches.*—The census of 1890 gave the following statistics of the principal religious bodies:

| DENOMINATIONS. | Organizations. | Churches and halls. | Members. | Value of church property. |
|---|---|---|---|---|
| Methodist Episcopal South | 1,701 | 1,632 | 139,347 | $1,647,866 |
| Baptist, Regular, South | 2,318 | 2,302 | 129,734 | 1,384,035 |
| Baptist, Regular, Colored | 1,468 | 1,472 | 111,874 | 667,786 |
| Roman Catholic | 263 | 258 | 105,138 | 1,018,800 |
| Disciples of Christ | 536 | 390 | 41,859 | 467,900 |
| Methodist Episcopal | 407 | 390 | 27,453 | 592,835 |
| Cumberland Presbyterian | 476 | 411 | 22,297 | 436,108 |
| Colored Methodist Episcopal | 222 | 219 | 14,895 | 147,075 |
| Presbyterian in the U. S. | 242 | 216 | 10,774 | 627,806 |
| Lutheran, General Council | 42 | 43 | 7,140 | 128,740 |
| Protestant Episcopal | 139 | 118 | 7,097 | 624,900 |
| African Methodist Episcopal Zion | 47 | 47 | 6,927 | 26,450 |
| African Methodist Episcopal | 138 | 208 | 23,392 | 233,340 |
| Methodist Protestant | 158 | 155 | 5,536 | 16,700 |

*Schools.*—The system of public instruction includes the common schools, the high schools of the cities and towns, the Sam Houston Normal Institute for whites at Huntsville, the Prairie View State Normal School for colored students near Hempstead, the Agricultural and Mechanical College at Bryan, and the State University, which has the departments of literature, science, arts, and law at Austin, and that of medicine at Galveston. In 1899 the total scholastic population of the State was 706,050; and the total expenditure for public instruction in 1898–99 was $4.476.457. One hundred and eighty-eight cities and towns are organized as independent school districts. These may levy special taxes for the support of schools up to 5 mills per $1 for taxable property. Rural districts are allowed to levy 2 mills. The city and town districts levy varying amounts, but many of them go to the limit. Reports for 1898–99 show 10,667 public schools, with 14,989 teachers and 552,503 pupils enrolled, with a daily attendance of 370,055.

*Libraries.*—According to a U. S. Government report on public libraries of 1,000 volumes and upward each in 1891, Texas had 27 libraries, which contained 86,603 bound volumes and 8,401 pamphlets. The libraries were classified as follows: General, 5; school, 5; college, 12; college society, 1; law, 1; and garrison, 3.

*Charitable, Reformatory, and Penal Institutions.*—These comprise a State Asylum for the Blind, State Deaf and Dumb Asylum, Deaf, Dumb, and Blind Institute for Colored Youth, and State Lunatic Asylum, all in or near Austin; North Texas Hospital for the Insane, at Terrell; Southwestern Insane Asylum, near San Antonio; State Orphan Asylum, at Corsicana; State House of Correction and Reformatory, near Gatesville; and State penitentiaries at Huntsville and Rusk. The plan on which the work of the institutes for the blind and the deaf and dumb is based is, first, to educate their inmates as far as the conditions will allow; second, to train them to become self-supporting. The reformatory receives convicts under sixteen years of age, sentenced for not more than five years. Most of the convicts in the penitentiaries are employed in different kinds of manufacturing within the walls, but about one-third are kept at labor under contract, part on railways and part on State and private farms.

*Political Organization.*—The ordinary tenure fixed by the Constitution for officials of the legislative and executive departments is two years. Most of the heads of departments are elected. The judiciary consists of a Supreme Court, a criminal court of appeals, five civil courts of appeals—one for each of five districts into which the State is divided—and the usual district, county, and justice courts. The first two have final jurisdiction respectively of civil and of criminal cases. The judgments of the civil courts of appeals may be reviewed by the Supreme Court under constitutional conditions. There are three judges for each court, and they are elected one for each court every two years, the tenure being six years. Every male citizen twenty-one years of age, who has been one year a resident of the State and six months of the county where he seeks to vote, has the right of suffrage, with the exception of idiots and lunatics, paupers, persons convicted of felony, and soldiers, marines, and seamen in the service of the U. S.

*History.*—It is believed that the coast of Texas was reached in 1528 by Cabeza de Vaca, but the first European settlement within the limits of what is now the State was planted by René Robert Cavelier (see LA SALLE) in Feb., 1685, on the Lavaca river, and was named Fort St. Louis. Previous to this the country had been occupied only by scattered Indian tribes. In 1689 the Viceroy of Mexico sent a small force against the new colony, but the Indians had already stamped it out. In 1691 Don Domingo Teran, governor of Coahuila and Texas, planted several settlements in the latter province, but none survived long. In 1714 Crozat, to whom Louis XIV. had granted Louisiana, sent Huchereau Saint-Denis through Texas to the Rio Grande, mainly to ascertain the possibility of establishing trade with the province. This roused the Spaniards to an effort to secure possession of Texas. In 1715 they established a number of missions in the province, among them that of San Antonio de Valero, which was afterward moved to the famous mission-house known as the Alamo. From this time the hold of Spain on Texas was secure as against France, though the latter continued to assert its claims. In 1729 the Spanish Government tried the policy of colonizing the country instead of holding it by means of missions and military posts, but the attempt failed. In 1730 the Indians began war upon both Spanish and French settlers with the intention of expelling them, but did not succeed in weakening the hold of either. In 1735 the French planted a settlement on the west bank of Red river, and the Spaniards protested; but an official investigation made in Mexico tended to show that the settlement was on French territory. In 1762 France ceded Louisiana to Spain, and in 1800 Spain retroceded it to France. The establishment of the independence of the U. S. was followed by a controversy as to the boundaries between it and the Spanish territory, and the sale of Louisiana to the U. S. in 1803 made it necessary to define the eastern boundary of Mexico. Spain strengthened her forces in Texas, and in 1806 a conflict between the Spanish troops and those of the U. S. in the country E. of the Sabine river was prevented only by an agreement between the opposing generals to recognize the strip between the Sabine and the Arroyo Hondo, a little farther E., as neutral ground. In 1819 the Sabine was agreed on as the eastern limit of Mexico. During 1821–34 Southeastern Texas, except the part adjacent to the Mexican border, was settled by colonists from the U. S. The most important colony was that brought in by Stephen F. Austin. It was located on the lower course of the Colorado and of the Brazos. The Anglo-Americans soon became so numerous in Texas as to excite the jealousy of the Mexicans. The province had been joined to Coahuila, and the whole was governed unsatisfactorily to the colonists. In 1830 further immigration from the U. S. was prohibited by the Mexican congress. In 1833 the Texans sought to obtain a separate state government, but SANTA ANNA (*q. v.*) would not consent. In 1835 Texas revolted. A provisional government was organized, and a war followed, which was ended by the rout of the Mexican army at San Jacinto Apr. 21, 1836. On Mar. 2, 1836, Texas declared its independence, and on. Sept. 2 it adopted a republican constitution. At the same election Sam Houston was chosen president, and an almost unanimous vote was cast in favor of annexation to the U. S. The measure was then checked by President Van Buren's declining the proposition, and it failed again in 1844 because the anti-slavery sentiment and the fact that annexation meant war with Mexico prevented confirmation by the Senate. In 1845, under President Polk, who had been elected on a platform favoring annexation, Texas was annexed, not by treaty, but by a joint resolution of Congress. War with Mexico followed. The treaty of Guadalupe Hidalgo in 1848 established the Texas claim to the strip between the Nueces and the Rio Grande, previously claimed by both Texas and Mexico. In 1861 Texas seceded from the Union and joined the Confederate States. From June, 1865, to Mar., 1867, the State was under a provisional government, and from the latter date to Sept., 1869, under military administration. After this it was restored to its place in the Union.

GOVERNORS OF TEXAS.

*Provisional Governor before the Declaration of Independence of Mexican control.*

Henry Smith, Nov. 12, 1835–Mar. 18, 1836.

*Presidents under the Republic.*

David G. Burnet, Mar. 18, 1836–Oct. 22, 1836.
Sam Houston, Oct. 22, 1836–Dec., 1838.
Mirabeau B. Lamar, Dec., 1838–Dec., 1840.
David G. Burnet (acting), Dec., 1840–Dec., 1841.
Sam Houston, Dec., 1841–Dec., 1844.
Anson Jones, Dec., 1844–Feb. 19, 1846.

*Governors of the State.*

| | |
|---|---|
| J. P. Henderson | 1846–47 |
| George T. Wood | 1847–49 |
| P. Hansborough Bell | 1849–53 |
| Edward M. Pease | 1853–57 |
| H. G. Runnels | 1857–59 |
| Sam Houston | 1859–61 |
| Edward Clark (acting) | 1861 |
| Francis R. Lubbock | 1861–63 |
| Pendleton Murray | 1863–65 |
| Andrew J. Hamilton, prov. | 1865–66 |
| James W. Throckmorton | 1866–67 |
| Edward M. Pease | 1867–70 |
| Edmund J. Davis | 1870–74 |
| Richard Coke | 1874–77 |
| Richard B. Hubbard | 1877–79 |
| Oran M. Roberts | 1879–83 |
| John Ireland | 1883–87 |
| Lawrence S. Ross | 1887–91 |
| James S. Hogg | 1891–95 |
| Charles A. Culberson | 1895–99 |
| Joseph D. Sayers | 1899– |

AUTHORITIES.—Bancroft, *History of North Mexican States and Texas*, 2 vols.; Yoakum, *History of Texas* (2 vols., New York, 1855); Foote, *Texas and the Texans* (2 vols., Philadelphia, 1841); Gouge, *Fiscal History of Texas* (1852); Thrall, *Pictorial History of Texas*; Smith, *Reminiscences of the Texas Republic*; Halley, *Texas*; Brown, *History of Texas*, 2 vols.; Newell, *History of the Revolution in Texas*; Kennedy, *The Rise, Progress, and Prospects of the Republic of Texas* (2 vols., London, 1841); Niles's *Register*; and State publications. GEORGE P. GARRISON.

**Texas, University of**: a coeducational institution comprising departments in Austin, Galveston, and Bryan. The constitution of the republic of Texas made it the duty of the congress of the republic to provide by law a general system of education as soon as circumstances permitted. The congress of 1839 provided for the selection of a site for a university, and when Austin was located as the capital of the State, 40 acres of land, in the center of which the university buildings stand, was designated for the seat of the university. This action of the republic was followed by a grant of 50 leagues (221,400 acres) of land for the "establishment and endowment of two colleges or universities"; and in 1858 the State appropriated to the university $100,000 in U. S. bonds then in the State treasury, confirmed to it the 50 leagues grant of the republic, and further appropriated for its endowment every tenth section of the lands set apart to encourage the construction of railways in Texas. This endowment, which would have amounted to some 3,200,000 acres, was diverted to the free schools by the convention of 1876, which substituted therefor but 1,000,000 acres of far less valuable lands to the university. In 1883 partial restitution was made by the Legislature granting another million acres. The main sources of maintenance are from interest on bonds in which were invested the proceeds of the sale of the 50 leagues, with such appropriations as the Legislature can be induced to make. The bonds amount to $575,840, the interest on which and on land-notes of the university and a few thousand dollars from tuition fees aggregate an annual available fund of from $50,000 to $60,000, which it is proposed to ask the Legislature to supplement with a small tax sufficient to support the institution without the necessity of specific appropriations. The main university establishment, embracing the academic and law departments, was located at Austin in accordance with a vote of the people of the State in 1881, and was opened by the admission of students Sept., 15, 1883, when rooms were provided for the purpose in the temporary Capitol and used till the university building was finished and occupied Jan. 1, 1884. The medical department, which was located at Galveston, also by a vote of the people at the election in 1881, was formally opened in Oct., 1891. The Agricultural and Mechanical College at Bryan, which had been in operation many years before the university was organized, and which, under the Federal grant of 1862 for establishing agricultural colleges in the several States, was a beneficiary, independently of the university, of an endowment from the general Government, was made a branch of the university by the State convention of 1876 in order that it might also have the benefit of appropriations from the university fund. The university has three fine buildings on its grounds at Austin—the main building, costing $135,000; the chemical laboratory, $25,000; and Brackenridge Hall, which is a gift from George W. Brackenridge, of San Antonio, one of the university regents, built at a cost of $17,000 and used for a mess-hall. The medical department at Galveston embraces the Medical College, which cost about $125,000, and the John Sealy Hospital, valued at $70,000, the latter having been originally willed to the city by John Sealy, a citizen of that place, and transferred to the university. All departments of the university so far established are liberally equipped. In Jan., 1900, the number of academic and law students was about 400. Including with these 180 in the medical department at Galveston and those in the Agricultural and Mechanical College at Bryan there were over 900 students. The academic department has over 100 women students. J. J. LANE.

**Texcoco**, or **Tezcuco**, tāth-koo′kō: a town of the republic and state of Mexico; near the eastern side of Texcoco Lake, opposite to and 17 miles E. from Mexico city (see map of Mexico, ref. 7–H). It is celebrated in history. According to the Indian accounts it was founded or occupied about the year 1120 by a tribe of Chichimecs, who called it Acolhuacan or Tenayucan. It became one of the three confederated pueblos of the lake valley, and for a time was the most powerful, subsequently yielding the first place to Tenochtitlan, or Mexico. The inhabitants, called Acolhuas or Texcoeans, claimed a pre-eminence of culture and of purity in the use of the Nahuatl language. The chronicles of their chiefs or kings are preserved by Ixtlilxochitl and others. The last Acolhuan chief became an ally of Cortés in 1520, and at Texcoco the vessels were fitted out which played such an important part in the reduction of Mexico. The modern town is surrounded by farms and gardens. Near it are ruins, supposed to be remains of a country-house of Netzahualcoyotl, with a fountain incorrectly called the Bath of Montezuma. Pop. (1889), with the commune, 15,856. See MEXICAN ANTIQUITIES. H. H. S.

**Texcoco**, or **Tezcuco**, **Lake of**: the largest of the cluster of lakes in the valley of Mexico between Mexico and Texcoco. It is about 12 miles long by 7 miles wide, less than 2 feet deep, and much polluted by the city sewage. Formerly it was larger and deeper, surrounding the capital, which was approached by causeways. There are no true fish, but the axolotl (*Siredon*) is common in it. H. H. S.

**Texel**: the first and largest of the chain of islands which stretches along the northeastern coast of Holland. It contains about 35,000 acres of rich meadow-land.

**Texier**, tes′i-ā′, CHARLES FÉLIX MARIE: archæologist; b. at Versailles, France, Aug. 29, 1802; studied first architecture in the School of Fine Arts in Paris; devoted himself afterward to archæology; undertook under the support of the Government extensive explorations in the East between 1833 and 1843, and after his return was made inspector-general of public buildings in France and Algeria. The results of his explorations he communicated in his two magnificently illustrated works—*Description de l'Arménie, de la Perse et de la Mésopotamie* (2 vols. fol., Paris, 1842–45), and *Description de l'Asie mineure* (4 vols., 1839, *seq.*)—which were put into English by R. P. Pullan. These books have been much criticised for their lack of accuracy, as many plates are alleged to have been drawn and engraved chiefly from unwarranted conclusions of the explorer, and to have been proved inexact by later investigation. D. in Paris, July 1, 1871. Revised by RUSSELL STURGIS.

**Textile-designing**: the originating and producing of designs for textile fabrics. All large mills, making goods which require the combination of colors or weaves to produce patterns, employ a designer of such patterns. A textile design should contain not only the drawings of the figure to be produced, but also a careful arrangement of the calculations and estimates for the work in the different branches of the manufacture. Many of the calculations and explanations, which must be a part of the complete design for a fabric complex in its production, may, however, be dropped from the design for a simple fabric. Besides giving the arrangement of warp and filling, as to colors, and the disposition of warp on the different harness, the textile design should include all the items in the following form, even for the simplest fabric:

| | |
|---|---|
| Name of fabric, | Style number, |
| Number of ends in warp, | Number of picks to the inch, |
| Reed, | Width in loom, |
| Size of warp yarn, | Size of filling yarn, |
| Loom texture, | Finished texture, |
| Loom weight, | Finished weight, |
| Production of the loom a day, | Finished width, |
| Stock, | Weave. |

It is also often necessary to give the amount of each different color of yarn to the yard or in a given number of yards of the fabric in hand.

It will thus be seen that designing is one of the most important of the branches of textile manufacturing. Any mistake in the design may cause much trouble in the mill, if not a loss to the manufacturer. If a fabric is not started properly in the designing-room, the processes through which it passes before being ready for the market will not produce it a perfect fabric. It is not necessary to send a complete design to each department in the mill; only instructions respecting the processes in the department; but this work should be carefully compared by the designer with his record before being sent to the departments. To produce a textile design intelligently a knowledge of manufacturing is required. The designer must become thoroughly conversant with the loom and what can be accomplished by its use, that he may be competent to produce and understand any weave which could be made. The various raw materials must be studied and the methods used to grade the yarns made from them, according to size. To produce a perfect fabric he must study the effect each process in the manufacture has on the raw materials, and, in his conception of the fabric, go over all the processes and then make his design. Only experience, practical mill-work, will show the designer what the construction must be.

*Weaves.*—A knowledge of this division of the textile designs, while more theoretical, is not less important than the practical knowledge of raw materials, yarns, and processes of manufacture. Weaving is the interlacing of two systems of threads, technically known as "warp and filling"; the threads in the length of the fabric are known as the warp, while those with which it interlaces are called the filling; yet very few persons realize the endless varieties of ways, i. e. weaves, which may be employed in the interlacing.

As in the study of color it is found that all the many shades and tints point to three primary colors, so in the study of weaves there are found three primary weaves known to designers as the plain, twill, and satin. It does not follow that every weave resembles either one or all of these primary weaves; yet in innumerable cases the weave is derived directly from one of the three weaves, or is a combination of them.

*Plain Weaves.*—The three primary weaves are illustrated in Fig. 1. The plain weave is shown by the plan A, called a draft, written out on a section of squared design-paper. The warp and filling as interlaced are represented by B. It will be seen that in the weave the movement of every other warp-thread is alike, as shown by the crosses which are used in the draft to represent the raising of the warp-thread at the passing through of the shuttle. To be able to understand the drafts even for the plain weave, the reader will find it necessary to possess a knowledge of the process of weaving. The warp after being wound upon the warp-beam is drawn through the heddles of the different harness. Of these harness there must be as many as there are different movements required for these warp-threads, as shown by the weave. The filling is interlaced with the warp by the shuttle, containing the bobbin of filling, being passed through the shed, formed by the warp being separated into two parts, some of the harness being raised, the others lowered. For description of shed, harness, etc., see LOOM.

Looking for a moment at A in Fig. 1, there will be seen only two movements to the warp-threads. Threads 1, 3, 5, 7, and continuing odd threads, are working alike, and could in consequence be put upon one harness. Threads 2, 4, 6, 8, etc., would be placed on a second harness, as they work alike, and differently from 1, 3, 5, and 7. Thus only two harness are required for this the plain weave, which is the most simple that could be made, the position of the warp-threads changing for each successive pick or shot of the shuttle. Warp-threads 1, 3, 5, etc., are raised on the first pick in the draft A, while their mates are lowered, forming a shed. For

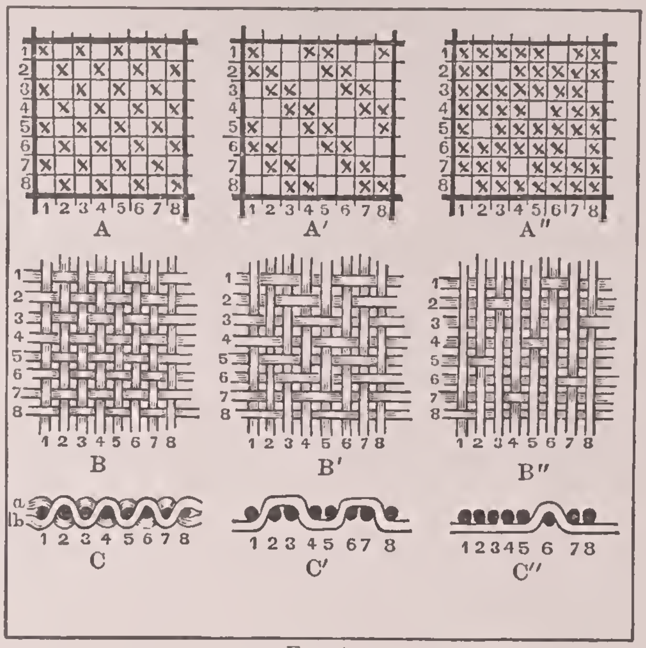



Fig. 1.

the second pick the position of every thread is reversed. The continued changing of position and the passing of the filling through the shed at each change forms the fabric as seen in B, Fig. 1. A sectional view of the plain fabric cut through the warp is given in Fig. 1, C, the warp being represented by the solid black, the filling by *a* and *b*.

*Twills.*—The second primary weave, the twill, could be defined as a weave having the picks alike, except that each pick in turn is stepped one square, that is, one thread to the right or left of the one preceding it, and has at least one float of more than one thread. Beginning at the left and stepping each succeeding pick to the right one thread and toward the bottom would produce a left twill (see A′, Fig. 1); while beginning at the right and stepping to the left toward the bottom would form a right twill. Any twill may be easily written out if one pick is given by starting in the upper left-hand corner of a piece of squared paper, using the crosses when the threads are raised. If the pick given was "the first thread raised the second lowered," and continuing the same, technically "one up and one down," or $\frac{1}{1}$, each pick alike but stepping to right or left, the weave written out would be the plain weave. The twill requires a float of more than one thread and the three-harness twill is the simplest, designated $\frac{1}{2}$ or $\frac{2}{1}$. The first pick of the $\frac{1}{2}$ twill beginning at the left gives *a*, Fig. 2; the next pick must step one space to the right (or left), and is *b*, Fig. 2; the third pick is *c*, Fig. 2; each pick being shown by two repeats of the weave. On this basis all twills may be written out. A′, B′, and C′ in Fig. 1 illustrate the $\frac{2}{2}$ twill weave. This is the four-harness or cassimere twill; with the exception of the plain, it is the most common weave which is used.

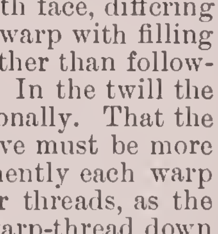



Fig. 2.

*Satin Weaves.*—The satin or satine is a weave extensively used, producing a fabric with a very smooth face, differing from the twill in that the intersections of warp with filling threads are distributed over the surface rather than following closely as in the stepping of the twill. In the twill the fabric presents a rib or wale, running diagonally. That the intersections may not be adjacent the weave must be more than four threads to a repeat, and consequently each warp and filling thread must float at least four threads, as the smooth face is obtained by stitching the warp-thread down for one pick in a repeat, if it is a warp-face, or if a filling-face the warp is carried to the back, and only brought to the face for one pick in each repeat. The simplest satin weave possible, then, is the five-harness, Fig. 3, which is used to illustrate the construction of all satins. A rule to construct any perfect satin weave is to take two numbers, the sum of which is the number of harness to be used, neither of the numbers to be one, or to be contained an even number of times by the number of harness; select one of the numbers as a counter, and begin in the lower left-hand corner of the squared-design paper, having marked off a square with as many sections as there are harness to be used. In the construction of the five-harness satin, A, Fig. 3, take the numbers 2 and 3; selecting 2 as a counter, mark the intersection of warp and filling threads No. 1 as the stitching of the first filling thread; counting off 2 to the right from this intersection gives the warp-thread to which the second pick is stitched. The continued counting off of two threads gives the weave A, Fig. 3. Should the fabric in hand require a warp-face the draft would be written as B, Fig. 3; C, Fig. 3, would be the draft for the filling-face. The eight-harness satin warp-face is given in Fig. 1, A″, B″, C″, and if compared with the plain and twill weaves in the same illustration will further show the construction of the weave and its differences from the other primary weaves.

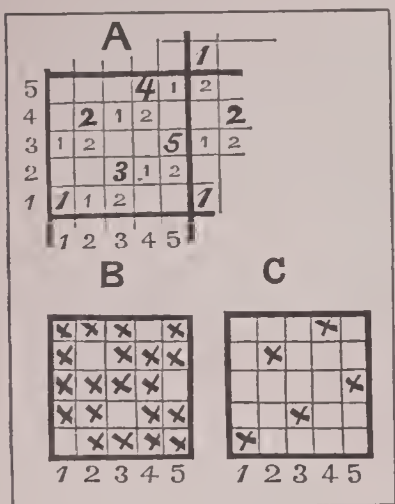



Fig. 3.

*Drawing-in Drafts.*—The object of these drafts is to designate the position of the different warp-threads in each repeat of the pattern, showing which of the harness each shall be placed on. There are various names given to the different forms of drafts, each self-explanatory, as straight draws, skip-draws or cross-draws, point-draws, section-arrangement draws. An examination of Fig. 4 will help the reader to understand the process of drafting for the drawing-in. A represents the weave, B the straight-draw on twelve-harness, and C the reduction of the number of harness to six by the cross-draw, that is, by drawing in all those warp-threads which work alike on one harness; D is the draft showing the harness-movements when reduced to six. The vertical lines marked *v* in C designate how the warp-threads shall be drawn through the reed.

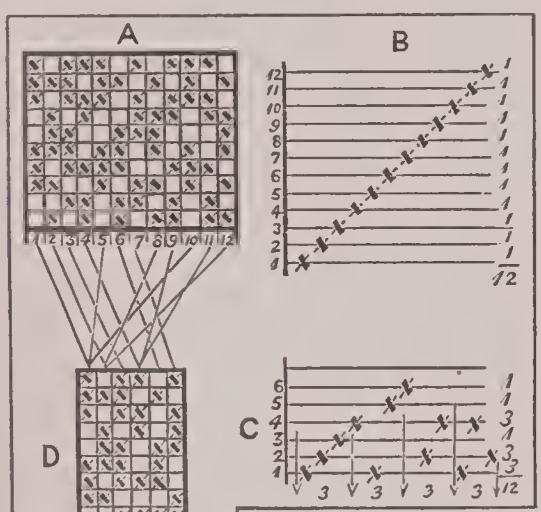



Fig. 4.

*Texture.*—This is the number of threads to the inch in a fabric; the warp-texture means the number of warp-threads, while the texture of the fabrics is the texture of both warp and filling, as 50 × 50, 48 × 48, 40 × 32. In writing out weaves for fabrics of uneven textures it is advisable to use a squared paper which is divided into sections to the square inch in the proportion of the warp and the filling threads.

*Figure-designs.*—Upholstery and carpet-designing and many kinds of silk-designing demand more artistic ability than skill in manufacture so far as the designer is concerned, and the field is so great that explanations of the various systems can not find place here.

LITERATURE.—For books covering not only what has been given in this article, but far more that could not be given, as designing for double-cloth, gauze, and all Jacquard work, the reader will find very valuable Ashton and Ashenhurst on *Design*; Posselt's *Technology of Textile Design* and *Jacquard Machine*; Posselt's *Structure of Fibres, Yarns, and Fabrics* (among the best); Chevreul, Barlow, and Beaumont on *Color*; and a book which is itself a cyclopædia of textile terms, Spitzli's *Manual* (5th ed. 1881). LOUIS CLARK.

**Textile Fabrics**: fabrics made by weaving threads in a loom. (See LOOM and WEAVING.) The threads usually employed are those made by spinning from vegetable fiber, such as that of hemp, flax, cotton, and many plants with fibrous leaves, especially common in tropical countries: of animal fiber, such as wool of sheep, the hair of many varieties of goat, the llama, the camel, the horse, and other beasts: and of the threads spun by the silkworm. A few exceptional fabrics have been woven from *byssus*, or the silky filaments attached to the bivalve shell *pinna flabellum*, the thread of the spider, and other materials capable of being reduced to slender and somewhat pliant strips; thus glass has been spun into threads, and these have been woven into a texture having much beauty of color and luster; the unopened leaves of some plants are woven into hammocks and into the well-known "Panama" hats; and a weaving together of leather thongs has been used as a defensive garment in warfare. Wire, as of silver and silver gilt, has been woven into cloth with other materials, as linen and silk, for ornament, and gilded paper cut into slender strips is used for the same purpose. Feathers also have been woven into fabrics, perhaps only for decorative purposes, a good example being the fabrics of brilliant-colored feathers made by the people of some islands in the Pacific.

As textile fabrics have in all ages been made ornamental, so decorative effect has been sought not only by the color and the luster of the threads composing it, but also by the arrangement of the loom and the passing of the threads so as to produce surfaces of a character very different from that of simply woven stuff like ordinary cotton cloth. Thus a stuff can be woven of silk and cotton, or of silk and wool, in such a way that the whole surface of one side shall be of silk. In like manner a fabric of silk of two colors can be so woven that each surface shall be of one of those colors. Again, the threads can be so interwoven that considerable masses of the thread running in one direction shall be brought to the surface without being visibly broken by threads crossing them. These threads lying closely parallel display whatever natural gloss they have. Again, the threads running in one direction can be thrown up in loops, more or less long, and these loops can either be left to produce by themselves a peculiar surface or, as is more usual, they can be cut or shaved so as to produce the well-known surface of velvet, velveteen, and fustian. Patterns on the surface varied from the background both in the color of the threads and in the direction in which they lie, and patterns also of velvet surface or of uncut velvet or loops, as above mentioned, are also available by way of ornament. Greater thickness, warmth, the power of shedding water from the surface, and similar useful qualities can be got by the same means as are employed for decoration. Hence the varieties of textile fabric are indefinitely numerous, for these different devices are combined together in many different ways. Textile fabrics are colored for decorative purposes, sometimes by dyeing the thread before it is woven into the web. The simplest instance of this is gingham, in which all the threads are colored and the pattern is got by arranging the differently colored threads in stripes and plaids. Glass-cloths and tea-toweling are made in this way. Textiles are often colored after being manufactured, or "in the piece." (See DYEING.) The effect of dyeing is sometimes modified for decorative purposes by gathering up small parts of the surface and tying them tightly. These parts, when the stuff is plunged in the dye, do not absorb the color with any readiness, and undyed spots are left. In some Eastern stuffs, both silk and cotton, undyed figures of definite shape are relieved upon the dyed ground. It is probable that those are produced by painting or printing the surface beforehand with some substance which repels the dye. A somewhat similar effect is produced in European goods, as thin silks, by printing in color the larger part of the surface, leaving spots of the uncolored material. Textile fabrics are ornamented also by the application of color directly to their surface, either by hand-painting, which is unusual, or by printing from engraved blocks. All the great variety of figured calicoes are produced in this way, and thin silks also are printed in patterns. But this manner of decorating, as well as EMBROIDERY (*q. v.*), is separate from the question of textile fabrics, as fabrics are made complete before being decorated in either of these ways.

*Simply woven goods* are those in which one thread of the weft or woof passes across the width of the web, passing alternately above and below the threads of the warp, one at a time. Examples are common linen and cotton goods, such as are used for undergarments, bed-sheets, and the like. Such goods are known by different names often taken from the uses they are put to and often from the place of their original manufacture. Linen cloth or linen is the common name for cloth made from flax. Linen sheeting and linen shirting are so called because of the more common use in modern times of cotton cloth for these purposes. Cambric or linen-cambric is a fine and close-woven material for pocket-handkerchiefs, and at different epochs, according to fashion, for different articles of dress; batiste is a still finer cambric; crash, canvas, duck, and sail-cloth are all stouter cloths, made originally of linen or hemp, although now more commonly of cotton, the names sometimes being used with the prefix, as cotton-duck. Other cotton goods of plain weave, besides cotton-cambric, etc., are the cloth which is called in Great Britain *calico* and in the U. S. more commonly *muslin*, except when printed in colors, and muslin proper, a cloth which is either the fine hand-woven stuff of India or its European imitation. Woolen cloths and those of silk and wool or cotton and wool are also frequently of simple weave. Such are many blankets, the stuff called challis, which is usually printed in colors, the dress material formerly called mousseline de laine and now known by other names, and many light materials, the trade-names of which differ so widely from year to year, as fashions change and manufacturers try to recommend their goods, that it is useless to name them. The patterns in simply woven stuffs must be either plain stripes, or stripes which when crossing each other form plaids, or "polka spots," or other plain figures. A very slight change in the weave allows of a much richer ornamentation. Thus, when the threads are slightly bunched together, so that three parallel threads of the woof which have been separately alternating with those of the web are gathered into one strand and alternate with another similar strand made up of three threads of the warp, there is produced a square of coarser weave, giving a decided pattern to the surface. In like manner, especially in silk-weaving, threads are bunched together for the whole fabric, producing what is sometimes called "basket weave." If the strands are pretty large, thirty-two to an inch or larger, and if several colors are employed in the same web, an appearance of considerable richness may be got by mere crossing lines. In like manner an appearance of silky softness is got by bunching the threads lying in one direction, and holding these together by fine strong threads the other way, as in some silk blankets; but this weave has little strength.

When, however, anything elaborate is proposed, some less simple weave is employed. The one which comes nearest to plain weaving is that where, while the warp is continuous, the threads of the weft stop and return upon themselves, so that each figure of the pattern is of one color and is separated by a complete break in the stuff from the next figure. This is used in some beautiful Chinese silks, where the most elaborate flowers are woven into the uniform thickness of the web, without other separation from the background than this of the breaking off of the weft threads. In the flowers each color is separated from the other colors, as can be seen along the lines of division which run lengthwise of the stuff. A similar texture exists in the thin and hard-finished Eastern rugs without nap, and showing the same pattern on both sides, which rugs are called "Persian cloths" by the dealers. A twill or a twilled fabric is merely one in which a thread of the woof is carried over and then under several threads of the warp at one time. This produces in the simple forms a kind of diagonal striping characteristic of the stuffs ordinarily called twill. Scotch tartan plaids, the beautifully soft India shawls called Rampoor Chuddahs, most linen diaper, tweeds and cheviots and serges, are examples of twilled fabrics. Satin is nothing more than a twill, the threads which lie side by side and form the surface being very soft, with a silky luster. Twilled fabrics are much stronger than those simply woven, and it is much easier in these to produce elaborate patterns on the surface, whether in different colors or by the mere arranging of the threads so as to catch the light. Linen damask, for instance, such as is used for table-cloths, has commonly a pattern, the principal threads of which lie in one direction, while those of the background lie in the contrary direction. It is common to have the pattern finished with a satin-like gloss on the right side; on the reverse side, then, the background will have this gloss and the pattern will be without it, for the two sides of this stuff are the counterparts of each other. Another variety of weaving is that which produces ribbed materials, the ribs running across the fabric. In these the woof is merely a series of bunches or strands of fine threads, or else single stout cords, which lie nearly straight in the fabric, while the warp passes over them, up and down, leaving the ribs showing their rounded surfaces. Such materials are called reps, corded silk, and gros-grain. Sometimes the ribs come in pairs, or ribs of different sizes are alternated. *Crape* is the general name of material made of threads twisted in reverse directions, so that the surface of the stuff is very much crimped and blistered. Ordinary silk crape, a thin and gauzy textile, is dyed black and used for mourning garments in Europe, but is printed in bright colors in the East. *Canton crape* is a thicker and softer silk textile. *Crépon* is a similar fabric made of woolen or other thread much heavier than crape.

Perhaps the most important variety of weave is that which produces goods having a pile, such as velvet, velveteen, and fustian, also corduroy, which is merely velveteen or fustian in lengthwise ribs. In these materials a part of the woof is brought to the surface and forms fine, small loops, which loops cover the whole surface, at least of those parts which are to have the velvet finish. When these loops are not cut in any way the stuff, if of fine silk material, is what is called *uncut velvet*. Much the more common way of finishing the stuff is to cut the loops so that their threads form a uniform surface like the fur of some small animal. The threads standing up in this way are called the pile. Ordinary velvet has a uniform surface, usually of one color, and the name is confined to silk material of considerable value. Velveteen has a similar surface, and is of several kinds: first, a mixture of silk and cotton; second, the material anciently called fustian and made entirely of cotton; third, a material in which the pile is of woolen; but the names change with changing fashions. A material called *velours*, made of linen with a short pile, is also used for furniture-coverings. In goods having a pile the surface is generally uniform, although it may be broken by patterns in color; but a material is also produced in which only a part of the surface has the raised loops, whether cut or uncut, the rest being solid and seeming depressed below the velvety surface. There is, for instance, a Chinese stuff of great beauty in which large parts of the surface are covered or nearly covered with thin strips of gilded paper or silver gilt wire, having upon this an elaborate pattern of flowers, birds, and dragons in velvet pile. There is also a velvet which has the pile of different length or height in different parts, so that a pattern in long or high pile is relieved upon a shorter pile. This is called *pile upon pile* velvet. A greater elaborateness may be reached by having the general surface smooth, with a pattern in short velvet pile relieved and picked out by parts of longer pile. In the sixteenth century a splendid fabric was made which has been reproduced since 1880 in Venice and perhaps elsewhere. In this the ground is more or less satin-like in gloss and finish, and upon this ground a pattern is raised which is partly in uncut velvet with the loops arranged in strongly marked ridges and partly in cut velvet in still higher relief, the pattern being also in three or four different colors.

For another important class of textiles, see CARPETS.

Textile fabrics are of peculiar interest to the student of decorative art, because of the endless variety of effect which may be produced by combining the different methods of weaving, and because of the beauty of the results. In all ages weaving has been one of the first industrial arts which man on emerging from savagery has used for his humblest needs, and which he has then tried to make ornamental; the only exception being the practice of those peoples who have at hand natural substances which replace textiles, such as *tappa* and similar easily prepared materials in the Pacific islands. Elaborate machinery has not been necessary. The most splendid fabrics known, and the most delicate, have been produced on hand-looms of a rudeness hard to imagine—portable frames set up under a tree, as in India, or under a tent, as with the weavers of some of the most beautiful rugs ever made. In fact, the introduction of labor-saving and complicated machinery has been a direct and very positive injury to the textile industry considered as an ornamental art. None of the productions of the power-loom can interest the lover of beautiful fabrics. The making of such beautiful fabrics in the primitive way stops as soon as the machine-made product comes to compete with them, and, although manufacturers sometimes try to imitate the ancient hand-woven stuffs, the imitations have very little of the beauty of the originals. The fine art of weaving belongs to the past and to the few Oriental peoples who still preserve for a little while some of their traditions. Public museums exist in which there are large collections of ancient stuffs, from the fragments of Egyptian and Peruvian mummy-wrappers to the gold-woven kincabs of India and brocades of Japan. The history of textiles is to be studied also in the representations of stuffs of which no fragments remain, as in the sculptures and paintings of Egypt and the art of sculptures in Assyria. The textile art and pottery should be studied together as the most important records of mechanical civilization. R. STURGIS.

**Tezcuco**: See TEXCOCO.

**Thacher**, JOHN BOYD: See the Appendix.

**Thack'eray**, ANNE ISABELLA: author. See RITCHIE.

**Thackeray**, WILLIAM MAKEPEACE: novelist; b. in Calcutta, India, July 18, 1811; son of Richmond Thackeray, secretary to the Calcutta board of revenue, and descended from an ancient Yorkshire family. He was sent to England in 1816; was educated at the Charterhouse School, London, and at Trinity College, Cambridge (1829–30), where he was a contemporary of John M. Kemble and the brothers Tennyson, but left without taking a degree. At Cambridge he edited *The Snob*, a weekly undergraduate paper, in which he printed a parody on Alfred Tennyson's prize poem *Timbuctoo*. He then traveled and studied on the Continent, especially in Italy, with a view to becoming a painter; spent a season (1830–31) in Weimar, enjoying free access to the ducal courts and becoming intimate with the aged Goethe and his brilliant circle. In 1831 he took up his residence in the Temple and began to read law; but in 1832 he went to Paris, in which city he continued to be as much at home as in London for the next ten years of his life. He had inherited a fortune of about £20,000, which he lost in an Indian bank and in journalistic speculations, and by 1837 he began to devote himself seriously to literature. He became a correspondent of *The Times*; wrote humorous papers for *The New Monthly Magazine*, for *Fraser*, and for *Punch* over a variety of signatures, such as Michael Angelo Titmarsh and The Fat Contributor; published collections of his magazine articles with original illustrations, as *The Paris Sketchbook, by Mr. Titmarsh* (1840); *Comic Tales and Sketches* (1841), including the *Yellowplush Papers*; *The Irish Sketchbook* (1843); visited the East in 1845, and published as the result *Notes of a Journey from Cornhill to Grand Cairo* (1846); was first recognized as a literary celebrity upon the publication of his novel *Vanity Fair*, in monthly numbers (Jan., 1847, to July, 1848). He was called to the bar May 26, 1848, but never practiced; availed himself of his recently acquired popularity to issue several small volumes made up from earlier articles, *Our Street* (1847); *The Book of Snobs* (1848); *Dr. Birch and his Young Friends* (1848); and *The History of Samuel Titmarsh and the Great Hoggarty Diamond* (1848); brought out in monthly parts (Nov., 1848, to Oct., 1850) his second novel, *The History of Pendennis*, which confirmed his already high reputation, and made him in popular estimation a rival of Dickens for the first place in modern English fiction; lectured with brilliant success on the *English Humorists of the Eighteenth Century* in London 1851, and in the U. S. 1852; published *The History of Henry Esmond* (1852), *The Newcomes* (1853–55), and *The Virginians* (1857–59), completing the series of his five really great novels; lectured in the U. S. 1855–56, and afterward in England, on *The Four Georges*; presented himself unsuccessfully as a Liberal candidate for the representation of the city of Oxford in Parliament 1857; founded *The Cornhill Magazine* (1859), in which he published his two latest novels, *Lovel the Widower* (1860–61) and *The Adventures of Philip* (1861–62), both admitted to be inferior to his earlier productions, and a series of articles collected as *Roundabout Papers* (1862), and resigned his editorship Apr. 11, 1862. D. in Kensington Palace Gardens, London, Dec. 24, 1863. A marble bust by Marochetti has been erected to his memory in Westminster Abbey. A great part of his life was saddened by the insanity of his wife, who survived till Jan. 11, 1894. Thackeray has been variously described as a realist and a caricaturist, a cynic and a sentimentalist. Beginning with burlesque, satirical character sketches, and all manner of humorous skits and broadly comical drolleries, he gradually widened his field and refined his method until in his great novels he was able to draw a picture of English life, and especially of the life of town, society, and the upper classes, which, while brilliant as satire, included the tragic as well as the comic elements, and in truth to nature was superior to the work of his great rival and counterpart, Charles Dickens. He left an unfinished novel, *Denis Duval*, printed in 1867. Collected editions of his early writings appeared in the U. S. under the title *Miscellanies in Prose and Verse* (4 vols., 1855–57), and rival editions of his complete works are published in Boston, New York, and Philadelphia. A collection of his fugitive articles was issued by James T. Fields as *Early and Late Papers* (Boston, 1867). *The Orphan of Pimlico, and other Sketches, Fragments, and Drawings* (1875) was edited by his daughter. A volume of his inimitable caricatures and marginalia collected under the title of *Thackerayana* was published in 1876. James Hannay, Theodore Taylor, and William B. Reed have published valuable biographical monographs on his life. See also *Thackeray, the Humorist and the Man of Letters*, by J. C. Hotten (1864); *Anecdote Biography of Thackeray*, by Richard H. Stoddard (1874); *Life of Thackeray*, by Anthony Trollope (1879); and *Life of Thackeray*, by Herman Merivale and Frank T. Marzials (1891).

Revised by H. A. BEERS.

**Thadmor**, or **Tadmor**: See PALMYRA.

**Tha'is** (in Gr. Θαΐς): an Athenian courtesan, as celebrated for her wit as for her beauty. She accompanied Alexander the Great on his expedition into Asia, and is said to have instigated him, during a festival at Persepolis, to set fire to the palace of the Persian kings in revenge for the calamities which Xerxes had brought on her native city. After the death of Alexander she entered into a connection with Ptolemy, son of Lagus, King of Egypt, who is said to have married her, and to whom she bore two sons and a daughter. Revised by J. R. S. STERRETT.

**Thalamenceph'alon**: See BRAIN.

**Thalberg**, SIGISMOND: pianist; b. in Geneva, Switzerland, Jan. 7, 1812. He was a natural son of Prince Dietrichstein and the Baroness Wetzlar, who superintended his early education. By the time he was fourteen years of age he was a remarkable pianist. He made many concert tours all over Europe and through the U. S. with the greatest success. He married in 1843 in Paris the daughter of Lablache, the singer, and his daughter, Zare Thalberg, became an opera-singer. Thalberg's compositions are all for the piano. D. in Naples, Apr. 26, 1871. D. E. HERVEY.

**Thaler**, taa'ler [= Germ. : Eng. *dollar*. See DOLLAR]: a coin and money of account in several European countries. The German *Thaler* of silver, till 1871 the monetary unit for Northern Germany, is worth \$0·729. The former Norwegian specie *daler* was equal to \$1·106. Denmark has a gold ten-daler piece worth \$5·532. Since 1873 the monetary unit for Denmark, Norway, and Sweden is the *krona*, two of which form a rigs-daler, equal to \$0·553.

**Tha'les** (Gr. Θαλῆς): the earliest of the Greek philosophers, and with justice called the father of philosophy; b. at Miletus about 640 B. C.; d. about 550. He was of Phœnician descent, and his father's name appears to have been Examyos (perhaps *Samuel*; see *Acta Societat. Philolog. Lipsiensis*, vol. iv., p. 328, *seq.*; but cf. Diels, *Arch. für Gesch. der Philos.*, ii, 165–70). He was the founder of the so-called Ionic or Hylogoic School of Thought, and was also one of the Seven Sages, a practical man, an astronomer, and a mathematician. He was the first man in the Western world who, setting aside the popular mythological or theological explanation of the universe, looked for its first principle in an abstraction of the reason. Philosophical language being then uninvented, he defined his abstract, universal ground of things as *water*, being led to this perhaps by observing that all nourishment contained moisture. (See Aristotle, *Metaph. A*, 3.) He may be said to have been the discoverer of Material Cause, although of course he made no distinction between matter and form, or between being and becoming. Still less had he any notion of efficient or final cause, although, having observed the action of the loadstone, he affirmed (according to Aristotle, *De An.*, i., 5) that all things were full of gods (θεοί). Thales left no writings, and even in Aristotle's time considerable doubt prevailed regarding his opinions. The chief sources of knowledge respecting him are Aristotle and Diogenes Laertius. (Cf. Byk, *Die Vorsokratische Philos. der Griechen*, vol. i., pp. 25–34.) He taught geometry, and studied astronomy. He is said by Herodotus (i., 74) to have predicted an eclipse of the sun, which happened, according to Ottmanns, in B. C. 609; according to Airy (*Philosophical Transactions*, vol. cxliii., p. 179), in 585.

THOMAS DAVIDSON.

**Thali'a** [= Lat. = Gr. Θάλεια, liter., fem. adj., luxuriant, blooming, deriv. of θάλλειν, abound, be luxuriant, bloom]: in Greek mythology, one of the nine MUSES (*q. v.*). She presided over comedy, idyllic and bucolic poetry, and her attributes are the ivy crown, the comic mask, and the shepherd's staff. J. R. S. S.

**Thal'lium** [Mod. Lat., from Gr. θαλλός, green shoot, deriv. of θάλλειν, be luxuriant, flourish, bloom. So called from its green line in the spectrum]: one of the rarer elements, a metal, discovered in 1861 almost simultaneously by Lamy in France and Crookes in England, working independently of each other, by means of the spectroscope. It is found as a small constituent of some iron and copper pyrites in both native and artificial sulphur, in blende and calamine, in lepidolite, in mother-liquors of salt-works at Nauheim, etc. The most productive source of thallium has been from the condensed fume found in the flues of furnaces in which thalliferous pyrites is burned for the manufacture of sulphuric acid. Thallium is nearly as white as silver, with a high luster. It is a very soft metal, easily scratched by the nail, and even softer than lead. It marks paper like lead. Like the latter it is almost or quite destitute of elasticity, and acquires none by hammering or rolling. It is nevertheless crystalline in its internal structure, and gives, when bent, a "cry" almost equal to that of tin. It fuses at about 555° F., expanding considerably. It may be welded perfectly at the ordinary temperature by pressure, like the soft alkali metals. Its spectrum is the simplest one known, and becomes no more complex at intense temperatures in flames, but in sparks from an induction-coil, between thallium-points, five more lines come out, and the photographic spectrum is by no means simple. Thallium has not been recognized in the sun. It is strongly diamagnetic, nearly as much so as bismuth, and conducts electricity about like tin and lead. At a red heat it volatilizes in the air, giving brown oxidized vapor, and boils at a heat below whiteness. Hydrogen passed over the highly heated metal carries it along in vapor, and such hydrogen, even when cool, retains enough thallium to burn with a bright-green flame. Thallium burns brilliantly in oxygen. It is attacked with some difficulty by dilute sulphuric acid, but scarcely at all by hydrochloric acid; by nitric acid with violence. Its salts are highly poisonous, and some of them are sensitive to light, like silver salts, and might be used in photography, though not sensitive enough to possess any advantages. It forms a hard, brittle, white alloy with copper; with lead, a malleable alloy; it combines with platinum very readily, with evolution of great heat; and with tin forms a malleable compound. Mercury readily amalgamates it, forming a crystalline mass.

Revised by IRA REMSEN.

**Thallome**, or **Thallus** [Mod. Lat., from Gr. θαλλός, young shoot or branch]: in botany, a plant-body in which stem and leaf have not been differentiated, as in many of the algæ, some liverworts, the prothallia of ferns, etc. It is often a flat mass, sometimes with a thickened midrib of firmer tissues. Its margins may become lobed and its midrib more distinct, thus passing easily into the leaf-bearing stem. The thallus is thus the homologue of the leafy shoot, and may be regarded as the primitive condition from which it sprang. See MORPHOLOGY, VEGETABLE. CHARLES E. BESSEY.

**Thal'lophytes**, or **Thalloph'yta** [from Gr. θαλλός, young shoot + φυτόν, a plant]: a general term applied in botany to the plants below the MOSSWORTS (*q. v.*), and including those described in the articles on PROTOPHYTES, PHYCOPHYTES, and CARPOPHYTES (*qq. v.*). Originally the group of the thallophytes was made co-ordinate with the cormophytes ("stemmed plants"), the two including the whole vegetable kingdom, but in recent years it has been made the lowest of the four branches, anthophytes (flowering plants), pteridophytes (fernworts), bryophytes (mossworts), thallophytes (thallus-plants). While the term is a convenient one to use it does not represent a natural group of plants, but rather an aggregation of groups. See PLANTS, FOSSIL.

CHARLES E. BESSEY.

**Thames**, temz [anc. *Tamesis*, appar. from *Thame* + *Isis*, names of the two rivers uniting to form the Thames]: the principal river of England. It rises on the southeast side of the Cotswold Hills near Cirencester, at an elevation of 376 feet above the level of the sea, and flows in an eastern direction to the North Sea, passing Oxford, Reading, Henley, Windsor, Eton, and Richmond on its way to London. It is called the Isis up to its junction with the Thame. The tide ascends as far as Teddington, between Eton and Richmond, and from this point up to Oxford there are thirty-three locks. At London Bridge its width is 290 yards; at Woolwich, 490 yards; at Gravesend, 800 yards; 3 miles below Gravesend it expands into a large estuary, 6 miles broad at its mouth, at the Nore Light. Its entire course is about 250 miles, and it is navigable for vessels of 1,400 tons burden up to Blackwall, 6 miles below London Bridge, and barges may ascend as far as 200 miles from the mouth. It owes its importance as a waterway to its tidal estuary and to the fact that it has no delta. Its principal affluents are the Coln, Leach, Windrush, Cherwell, Thame, Colne, Lea, and Roding on the left bank, and on the right the Kennet, Loddon, Darent, Mole, and Medway. The area of its basin is 6,100 sq. miles. Above London the scenery is interesting, and the river is studded with numerous islands. Through a vast system of canals it communicates with the southern and western coasts.

**Thames**: a river of the province of Ontario, Canada. It flows in a southwest course for 160 miles, and then enters Lake St. Clair. The towns of London, Chatham, and Oxford are on this river. It is navigable by vessels of 8 or 10 feet draught to Chatham, 18 miles, but there is a troublesome bar at its mouth.

**Thames**: a river in Connecticut, formed at Norwich by the junction of Yantic, Shetucket, and Quinebaug rivers. It is a navigable tidal channel 14 miles long, and reaches Long Island Sound at New London.

**Thane**, or **Thegn** [M. Eng. *thein* < O. Eng. *þegen*, soldier, attendant, minister, nobleman: O. H. Germ. *degan*, boy, follower, warrior; cf. Gr. τέκνον, child]: in English history, the title among the Anglo-Saxons and early Normans of certain military tenants and freeholders in the king's service. They were originally the servants of the king, and as the royal power increased they became a new nobility, supplanting the older nobility of birth, the nobility of the earls. Very early in the history of the Anglo-Saxons in Britain thanehood was fully established. As a nobility of office it made it possible for the simple freeman to rise to noble rank. The churl who owned five hides of land or had taken three sea-voyages was eligible to thanehood. After the Norman conquest the thanes were gradually merged in the barons, and the principle of personal service to the king gave place to that of the tenure of land from the king as the basis of nobility. In Scotland the thanes were a class of non-military tenants of the crown, and the title was in use till the end of the fifteenth century.

F. M. COLBY.

**Than'et**, OCTAVE (pseudonym of ALICE FRENCH): writer; b. at Andover, Mass., about 1860. She was educated at the academy in her native place, and early removed to Davenport, Ia., where she has since chiefly resided. Her short stories contributed to the *Atlantic*, the *Century*, and other monthlies attracted much attention, and were collected into a volume entitled *Knitters in the Sun* (New York, 1884). She has also published *Expiation*, a novel (1890); *Otto the Knight and other Trans-Mississippi Stories* (1891); *We All* (1891); *Stories of a Western Town* (1893); and *An Adventure in Photography* (1893). M. B.

**Thanet, Isle of**: the northeastern extremity of the county of Kent, England, separated from the mainland by the river Stour and the Nethergong rivulet. Area, 26,180 acres. The surface is level and the soil fertile, though light. Pop. (1891) 57,821. It contains the watering-places Ramsgate, Margate, Westgate, and Broadstairs.

**Thanksgiving Day**: an annual religious festival in the U. S., celebrated in New England from the first settlement by the Pilgrims. It originated in 1621, when Gov. Bradford of the Plymouth colony appointed a day for public praise and prayer after the first harvest, and the practice was observed by the other New England colonies and during the Revolution was introduced in several of the Middle States. Since then it has extended to nearly all the States, and has become a national institution since 1863. The day, which is usually the fourth Thursday of November, is designated by a proclamation signed by the Governor or the President. F. M. COLBY.

**Tha'sos**: island; in the Ægean Sea; 5 miles S. of the mainland; since 1462 belonging to Turkey. Area, 85 sq. miles. The island has gold mines not worked since antiquity; is the most fertile and least visited by foreigners of all the Greek islands; and in dress and customs its inhabitants have been the least affected by modern innovations. The painter Polygnotus was a Thasian. Ruins of ancient and mediæval monuments abound. Pop. 4,500, all Greeks, simple, unambitious, and prosperous, living in nine villages.

E. A. GROSVENOR.

**Thatcher**, HENRY KNOX: rear-admiral U. S. navy; b. at Thomaston, Me., May 26, 1806; entered the navy as a midshipman Mar. 4, 1823, and in 1855 attained the rank of commodore. During the civil war he commanded the first division of Porter's fleet in both the Fort Fisher fights, and the West Gulf squadron during the bombardment of Fort Alexis and Spanish Fort in Apr., 1865, just prior to their being stormed and carried by the Union army, their surrender being immediately followed by that of Mobile. After the war he commanded the Gulf Squadron and the Pacific Squadron; was promoted rear-admiral in 1866, and retired in 1868. D. in Boston, Mass., Apr. 5, 1880.

**Thaumatrope**: See STROBOSCOPE.

**Thaumaturgus, St. Gregory**: See GREGORY THAUMATURGUS.

**Thaxter**, CELIA (*Laighton*): poet; b. at Portsmouth, N. H., June 29, 1836. She was a daughter of Thomas B. Laighton, an editor and politician who, disappointed in his political aspirations, became keeper of the White Island light, on the Isles of Shoals, and her writings, both prose and verse, were largely inspired by the sea. She was married in 1851 to Levi L. Thaxter, of Watertown, Mass. Among her books are *Among the Isles of Shoals* (1873); *Poems* (1874); *Driftweed* (1878); *The Cruise of the Mystery and other Poems* (1886); and *An Island Garden* (1894). D. on the island of Appledore, Isles of Shoals, Aug. 26, 1894. H. A. B.

**Thayer**, ABBOTT HANDERSON: portrait, figure, and flower painter; b. in Boston, Mass., Aug. 12, 1849; pupil of Gérôme and Lehmann in Paris; third-class medal, Paris Exposition, 1889; Temple silver medal, Pennsylvania Academy, Philadelphia, 1891; member Society American Artists 1879. His portraits are notable for expression and character and his studies of roses for beautiful color. His most important work is *Virgin Enthroned*, owned by J. M. Sears, Boston. Studio in New York. W. A. C.

**Thayer**, ALEXANDER WHEELOCK: music critic, biographer, and historian; b. at South Natick, Mass., Oct. 22, 1817; graduated at Harvard in 1843, and at the law school 1848; in 1849 went to Europe and began collecting materials for a *Life of Beethoven*. He made frequent visits to Europe, and after 1862 remained there, being U. S. consul in Trieste during 1859–82. His great work was left incomplete. Three volumes have been published, vol. i. (1770–92) in 1866, vol. ii. (1792–1806) in 1872, and vol. iii. (1807–16) in 1879, and the concluding volume was nearly completed at the time of his death, in Trieste, July 15, 1897. It was written in English and translated into German by Herman Deiters, of Bonn, and published in Berlin. It has not appeared in English.

**Thayer**, ELI: See the Appendix.

**Thayer**, EUGENE: organist and composer; b. in Mendon, Mass., Dec. 11, 1838; settled in Boston, where he remained for nearly twenty years; in 1862 was one of the performers at the opening of the great organ in Music Hall, Boston; visited Europe in 1865 and 1866 for additional study; gave the first free organ recital in the U. S. in Boston, Apr. 10, 1869; in 1881 removed to New York to be organist of the Fifth Avenue Presbyterian church; received the degree Mus. Doc. from Oxford; composed much organ and vocal music, including a mass in E flat and a festival cantata. D. at Burlington, Vt., June 27, 1888. D. E. HERVEY.

**Thayer**, JOHN MILTON: lawyer, soldier, and governor; b. at Bellingham, Mass., Jan. 24, 1820; graduated at Brown University; studied law and came to the bar; went to Nebraska, where he became brigadier-general of militia and member of the Territorial Legislature; he was colonel of the First Nebraska regiment, and commanded it at Shiloh; was appointed brigadier-general of volunteers for services at Fort Donelson and Shiloh; Senator from Nebraska 1867–71; was Governor of Wyoming 1875–78, and of Nebraska 1887–91. He was the department commander of the Grand Army of the Republic in Nebraska in 1886.

**Thayer**, JOSEPH HENRY, D. D.: biblical scholar; b. in Boston, Mass., Nov. 7, 1828; graduated at Harvard in 1850, and at Andover Theological Seminary in 1857; preached for the Evangelical Congregational church in Quincy, Mass., one year; was settled over the Crombie Street church in Salem, Mass., Dec. 29, 1859; was chaplain of the Fortieth Massachusetts Volunteers nine months from Sept., 1862; relinquished his pastorate in Feb., 1864, to become Associate Professor of Sacred Literature in Andover Theological Seminary, which place he resigned in 1882, removing to Cambridge, where, in 1884, he was chosen Professor of New Testament Criticism in the Divinity School, and became *emeritus* in 1901. Secretary of the New Testament Company of the American Committee for the Revision of the English Bible. Besides occasional sermons, review articles, and contributions to the *Journal of Biblical Literature*, the American edition of Smith's *Bible Dictionary*, Hastings's *Dictionary of the Bible*, etc., he has published a biographical sketch of Ezra Abbot (1884), whose *Critical Essays* he edited (1888), and *Notes on Scrivener's Plain Introduction*, etc. (1885), *The Change of Attitude toward the Bible* (1891), *Books and their Use* (1893), a translation of the 7th German ed. of Winer's *New Testament Grammar* (1869), and a translation of Alex. Buttmann's *New Testament Grammar* (1873). He has also published *A Greek-English Lexicon of the New Testament* (1886), a monument of great labor and erudition. He edited an edition of Sophocles's *Greek Lexicon* (1888).

**Thayer**, SYLVANUS, LL. D.: soldier; b. at Braintree, Mass., June 9, 1785; graduated at Dartmouth College 1807, and at the U. S. Military Academy 1808. After service in the defenses of the eastern coast and of New York harbor, he was called to the field in 1812, and was chief engineer on the Niagara frontier; of the right division of the Northern army on the Lake Champlain line of operations in 1813; and in the defense of Norfolk, Va., in 1814, receiving the brevet of major Feb. 20, 1815. In 1815 he was sent to Europe to examine military works and schools and to witness the operations of the allied armies before Paris. From 1819 to 1833 he was superintendent of the Military Academy, during which time that institution was organized upon its present basis. (See MILITARY ACADEMIES.) On being relieved from the superintendency July 1, 1833, he was charged with the construction of the fortifications of Boston harbor, upon which, in union with his duties as president of the board of engineers for permanent fortifications, he was engaged during the remainder of his active service. During parts of 1857 and 1858 he commanded the Corps of Engineers, and was chief engineer of the U. S.; declined to transfer his headquarters to Washington, and on his own application was placed on leave of absence; was retired with the rank of colonel July 1, 1863. He gave $70,000 to found the Thayer School of Civil Engineering at Dartmouth College, $10,000 for a public library in Braintree, and bequeathed about $300,000 in trust for an academy in Braintree. He published *Papers on Practical Engineering* (1844). D. at South Braintree, Sept. 7, 1872. His body was reinterred in 1877 at West Point, where a statue was raised in his honor.

**Thayer**, WILLIAM MAKEPEACE: See the Appendix.

**Theater** [viâ O. Fr. from Lat. *thea'trum* = Gr. θέατρον, place for seeing shows, theater, deriv. of θεᾶσθαι, view, behold, deriv. of θέα, view, sight]: specifically, any structure erected for dramatic or operatic performances, the present form being a modification of the model first established by the Greeks more than 500 years before the Christian era.

*The Greek Theater.*—In the very earliest days the Athenian dramas were performed upon temporary wooden scaffoldings, prototypes of the booths of mediæval times, which were put up for the festivals of Dionysus and then taken down and laid aside for future use. It was upon such a scaffolding that the first acted drama of Æschylus was produced, and the collapse of the structure during the performance, an accident regarded as an evil omen, suggested the construction of a more durable edifice.

The first stone theater was begun soon afterward on the southeastern slope of the Acropolis, and it is a noteworthy fact that the plans were drawn with such skill and foresight, such exact appreciation of acoustic and spectacular requirements, that none of the architects of succeeding generations was able to suggest any important improvement upon them. In all the ruins of theaters extant in Greece, Asia Minor, and Sicily, the same general arrangement and proportions are observable. Here it may be noted that all Greek theaters were built either upon eminences or on the side of a hill, and that in every case the spectators occupied the upper or northwestern and the stage the lower or southeastern part of the structure. As the performances occurred at comparatively long intervals, and were originally in the nature of religious festivals, it was necessary to provide accommodation for great crowds, and it is probable that some of the largest theaters were capable of holding as many as 70,000 or 80,000 people. The acoustic qualities of the auditorium were thus the last to receive attention, and the actors, to reach the ears of so vast a multitude, were compelled to adopt a slow method of elocution, and to use mechanical devices in their masks in order to increase the volume of the voice.

Originally, the most important part of the Greek theater was the orchestra (ὀρχήστρα), the central space devoted to the movements of the chorus, out of which the drama ultimately grew. This space was exactly circular, except that a narrow segment of it was occupied by the stage. It was a little lower than the lowest row of seats or benches surrounding it, and was boarded over. In the center of it, equidistant from the rear of the stage and from all other points of its circumference, stood the altar of Dionysus (θυμέλη), which was square, made of wood, and elevated on a platform approached by steps. It was used for various purposes in different plays, sometimes as an altar, sometimes as a monument, etc. Occasionally it was occupied by the flute-player, or the leader of the chorus, which generally was grouped between it and the stage. Around the orchestra the seats were ranged in rows forming three-fourths of the circumferences of a series of concentric circles arranged like stairs. When the theater was on the side of a hill these seats were hewn out of the rock. In other cases they were supported by elaborate sub-structures. The ascending series of these concentric circles was interrupted by one or more broad level spaces, or circular aisles (called by the Greeks διαζώματα, or κατατομαί, and by the Romans *præcinctiones*), in which spectators were allowed to stand if there were no seats for them elsewhere. The benches themselves were intersected at frequent and regular intervals by flights of steps running from one aisle to another, but not in unbroken straight lines, by which the spectators could ascend or descend at will. These steps divided the benches into blocks or wedges, known in Greece as κερκίδες and in Rome as *cunei*. The approaches to the seats were mainly through underground passages to the lower benches, but in some cases there were galleries and stairways communicating with the upper rows. All the space devoted to the spectators, the *theatrum* proper, was often denominated the κοῖλον, or in Latin the *cavea*, or pit, in allusion to its being an excavation. Behind and above the highest row of seats there was a covered portico which is supposed to have had some relation to the acoustics of the structure, but with this exception the audience was unprotected by any sort of roof, although at a later period awnings were introduced.

*The Stage.*—The stage, as has been mentioned, occupied a small segment of the orchestra circle, and in height was level probaby with the top of the altar. At each end it was connected with the orchestra by a flight of steps by which the chorus ascended when required to take part in the action of the play. The back of the stage was inclosed by a wall called the scene (σκηνή, *scena*), having two extensions, or wings, entitled side-scenes (παρασκήνιον, *parascena*). The stage itself was called the προσκήνιον (*proscenium*), and the front part of it nearest the orchestra, where the actors generally took their places, was known as the λογεῖον (*logeum*), and in the Roman theater the *pulpitum*. The *scena* represented a suitable background for the play, and, before the performance, was covered by a curtain (παραπέτασμα, αὐλαία, *aulæum* and *siparium*), which was let down, not rolled up as with us. As to the description and quantity of the scenery employed, the information is rather meager, but it is known that there were different scenes for different plays, and that they were susceptible of change or modification. In the great tragedies the scene consisted of the front of a palace, with a door in the center, and two projecting wings, also with doors. The center door was known as the royal entrance, and was used by the πρωταγονιστής or leading man. The wings were often supposed to represent the abodes of guests or strangers. Frequently the palace possessed an upper story, from which actors described what was supposed to be going on at a distance. There is little doubt that elaborate scenery was in use before the days of Sophocles, and it certainly was needed in the plays of Euripides. Woods and hills were represented in the satiric drama, and private dwellings and the houses of slaves in comedies. There was also a certain amount of machinery, including one device for bringing a god down from the sky or up from the infernal regions.

*Actors and Audience.*—There is some dispute among the authorities as to whether or not women were admitted to the theater in the earlier days of the drama, but the probability is that they were permitted to witness tragedies but not comedies. Later on all restrictions as to sex were removed, although the coarseness of the dialogue in comic plays became worse and worse as the drama degenerated. This, perhaps, was one reason why all female characters were taken by youths. Another, possibly, was the fact that a bad actor was occasionally subject to the penalty of corporal punishment. In the modern sense of the word, the old Greek stage-performers were not actors at all. To add to their stature they wore high-heeled boots (*cothurnus*); they were padded so extravagantly that free movement was not to be thought of; their faces were hidden behind masks of various material, and they chanted their lines through some sort of metal contrivance which had an effect akin to that of a speaking-trumpet. The performances, which always included a series of plays, often lasted from sunrise until sunset. The places of honor were in the lowest rows of benches, where the magistrates and military and social magnates and illustrious strangers sat. Above them were the senators, then the *ephebi*, then the general public. The best seats cost the highest price, the average rate of admission being about 2 obols, or 6 cents. Pericles passed a law which conferred the right of free admission upon the poor. The expenses of the representations were defrayed by wealthy citizens and by state subvention.

*The Roman Theater.*—From the ruins of some of the most ancient Roman theaters, like those at Tusculum and Fæsulæ, which were excavated out of the sides of hills, it is quite plain that the Romans borrowed their theatrical ideas in the first place from the Greeks, but it was a long time before a stone theater was erected in Rome itself, owing to a notion that anything so elaborate and costly was not in accord with the simplicity of the republic. Dramatic representations were popular at an early period, but the theaters used were wooden structures put up for temporary use, and then taken down. It was in buildings of this kind that the comedies of Plautus and Terence received their first interpretations. During the later days of the republic wooden theaters of vast size and elaborate ornamentation were built in Rome, but Pompey was the first man who dared to depart from precedent and construct a magnificent stone theater near the Campus Martius. The plan of this as of all other important Roman theaters differed from the Greek model, chiefly in the fact that the rows of benches around the orchestra formed only a semicircle, and that the orchestra itself was a semicircle, of which the diameter was the front of the stage. In the Roman orchestra there was no altar, and no provision for any chorus, the orchestral space being set aside for distinguished persons. The fourteen lowest rows of benches were appropriated to the Equites. Pompey's theater was a copy of that at Mytilene, and had a capacity of 40,000. The Romans erected more theaters upon level ground than the Greeks did, their use of the arch and of concrete cheapening the cost of sub-structure. It may be noted that although there was no religious idea in the Roman theater, Pompey, to escape a charge of impiety, put a statue of Venus Victrix at the top of the cavea. The best-known remains of ancient theaters are at Rome, Nîmes, Ephesus, Miletus, Cnidus, Tauromenium, and Syracuse.

*The Modern Theater.*—The exact process of the evolution of the modern theater from the early structures erected in England and on the Continent in the sixteenth and seventeenth centuries can not now be traced, but the whole history of the stage, as we know it, dates from the days of the old miracle-plays or mysteries, which were performed by itinerant performers in churches, in temporary booths, or in the court-yards of inns. In the last-mentioned case the stage was erected in the center of the yard, with its back toward the door, which afforded means of ingress and egress to the actors. The galleries of the inn served as boxes for the more distinguished spectators, while the common folk stood on the ground. Sometimes the stage was roofed, in which case the ends of it were appropriated to the use of such fashionable folk as might be present. . This arrangement suggested the models of the earliest London theaters, which were practically inclosed yards, octagonal or nearly circular in shape and roofless, except over the stage, which continued to give shelter to the fashionable theater-goers until Voltaire in France set the example of driving them into the boxes. At the rear of the stage was a raised platform, surmounted by a balcony, from which a movable curtain depended. This corresponded to the door in the inn-yard, and no other provision for scenery or decoration appears to have been made. The green-room, or "tireynge-house," was on one side of the stage, and the roof of it was often surrendered to the audience. The first playhouse in London was the theater erected by James Burbage in 1576–77, and the next the Curtain theater, in Shoreditch (so named from a plot of ground called the Curten). Burbage built the Globe, of Shakspearean fame, in 1598, and in the same decade Henslowe opened the Rose and the Swan. Among other contemporary houses were the Blackfriars, the Red Bull, the Hope, the Whitefriars, and the more famous Fortune of Edward Alleyn, which lasted from 1600 to 1819.

Meanwhile (about 1550) Palladio had begun building theaters in Italy, modeled largely upon the old classic rules, in which the stage was provided with a solid structure, with doors and balconies made to do duty for all kinds of scenery. This example, a little later, was followed in France in the Palais Royal, founded by Richelieu in 1639, where the tragedies of Corneille were first performed. The invention of movable scenery, by Bibbiena, and of the drop-curtain, is ascribed to the latter half of the century. Thereafter the development of theatrical architecture and literature proceeded apace, and a gradual combination of the mediæval and classical ideas resulted in the prototype of the luxurious theater of the present era, with its boxes (intended originally for the persons who otherwise would have sat upon the stage), its orchestral stalls, which gradually have usurped the place of the old pit (the floor of the inn-yard), and its rows of semicircular galleries, which represent the benches of the ancient Greeks.

*The Modern Stage.*—The theater, properly so called, has changed but little in essentials (except the addition of a roof) since the Greeks devised it 2,000 years and more ago, but as it now is the stage is a modern creation. The word stage is generally applied only to that part of it visible to the spectators through the proscenium arch, and inclosed by the scenery. The spaces on either side are known technically as the wings, and these originally contained all the scenery (flats), which was pushed forward as required, running in grooves. Nowadays there is a space above the stage as high again as the proscenium arch, which is known as the flies, while below the stage there is an excavation of almost equal capacity, which is called the dock. This latter is divided into several floors, in which there is storage-room for scenery and much complicated machinery for raising and lowering it at will, through trenches cut in the stage, and also for working the traps through which demons, harlequins, etc., appear and disappear. Scenery therefore can be manipulated in three ways, from above, below, or the sides, while set pieces (such as castles, cottages, reversible exteriors, etc.) are constructed upon collapsible frames, which can be moved upon wheels in any direction and packed away with wonderful celerity. The double stage (of which the first example was constructed in the Madison Square theater of New York) was an invention of Steele Mackaye, and is extremely useful when a succession of elaborate interiors is to be presented, but it occupies much space, and has other disadvantages which have prevented its general adoption.

*Scenery, Lighting, etc.*—The recent advance in the art of stage illusion has been very great. In the mere painting it would be difficult to improve much upon the work of such artists as Watteau and Boucher in France, Raphael in Italy, and Clarkson Stanfield, Beverley, and Telbin in England, but the new mechanism accomplishes marvels. Thunder is counterfeited by iron balls or sheets of tin. The introduction of electricity has made real lightning possible in storms, and the noise of rain and wind is simulated wonderfully by the use of a cogged cylinder revolving against tightly stretched cloth. Formerly lightning was simulated by flashes of lycopodium, and the noise of rain by parched peas in a metal cylinder. Wagner, at Bayreuth, first used steam for the production of magical and other effects, and water is most faithfully represented by huge mirrors in which sylvan scenery is reflected. Until 1720 dip-candles were used for footlights. Then the French substituted moulded candles, which in time were replaced by lamps with Argand burners. Gas followed in 1822 and now yields to electricity.

*Stage Directions.*—For purposes of directions to actors, scene-shifters, etc., the stage is divided into five lateral strips, which, beginning from the left-hand side as the spectator faces it, are denominated the "prompt-side" (from the position of the prompter, who no longer occupies a box in the very center of the footlights, except in opera and in Continental theaters), "prompt-center," "center," "opposite prompt-center," "opposite prompt-side." These titles are abbreviated into "P.-S.," "P.-C.," "C.," "O. P.-C.," and "O. P.-S." The various entrances for actors in the wings, counting from the front of the stage, are called the first, second, and third entrances, left or right, as the case may be. Doors in the rear of the stage are described as center and left or right center (back), according to position. The position of the dressing-rooms for the performers depends largely upon the amount of space available. In the older theaters these chambers were often little better than underground cells, stowed away in all sorts of dark and unwholesome recesses, but in the best modern houses the quarters of the actors are well lighted, well ventilated, and moderately comfortable. Special conveniences, of course, are provided for "star" performers.

The danger from fire in a well-equipped modern theater is inconsiderable. It is possible, indeed, to build and furnish a theater wholly with incombustible materials, and to exclude all fire from the structure. The dynamos for lighting, and the furnaces for heating and supplying power, can be placed in a separate building. All scenery, ropes, draperies, and woodwork (of which little is needed in these days of light steel manufactures) can be rendered fire-proof by the aid of various cheap chemicals. The use of gas, once a source of continual danger, is on the point of being discontinued altogether. The largest theaters in Europe are La Scala in Milan and the San Carlo in Naples, each of which can hold nearly 5,000 persons. The opera-house in Vienna and the Grand Opéra in Paris are perhaps the most notable houses architecturally. The first theater in the U. S. was opened in Williamsburg, Va., in 1752, the second in Nassau Street, New York, in 1753.

LITERATURE.—An immense body of literature is at the disposal of students of the ancient and modern theater. Some of the best authorities on the early English stage are Wilkinson's *Londina illustrata* (1819); Collier's *History of Dramatic Poetry* (1879); Halliwell-Phillips's *Life of Shakespeare* (1883); Malone's *History of the Stage* (1790; republished by Boswell in 1821); the publications of the New Shakespeare Society, and a series of articles on early London theaters by F. F. Ordish in *The Antiquary*, vols. xi., xii., xiv. (1885–86). Other writers on the general topic are Coleridge, Hazlitt, Leigh Hunt, Charles Lamb, Edward Dowden, Dr. Doran, and Walter Thornbury. Of the continental authorities may be mentioned Donnet's *Théâtres de Paris* (1821); Salomon's *Construction des Théâtres* (Paris, 1871); Coutant's *Principaux Théâtres Modernes* (Paris, 1870); Moynet's *L'Envers du Théâtre* (Paris, 1874); Pougin's *Dictionnaire du Théâtre* (Paris, 1885). The student of the ancient theater may consult Dr. Smith's *Dictionary of Antiquities*, Prof. Becker's *Charicles*, and the works of Schlegel, Böttiger, Böckh, Schneider, Geppert, and others in the long list of German commentators.

J. RANKEN TOWSE.

**Theaters, Law of**: Unlicensed or improperly conducted playhouses are nuisances. In Great Britain the license is granted by letters-patent from the crown, or by the lord chamberlain (to whom all new plays must be submitted also), or by justices of the peace, or by the county council. In the U. S. the authority to license, regulate, and tax theaters is commonly delegated to the municipalities. The English courts seem disposed to give to the term "theatrical entertainments" a broader meaning than is attached to it by U. S. decisions. (Cf. *Shelley* vs. *Bethell*, 12 Q. B. D., and *Queen* vs. *Tucker*, 2 Q. B. D. 417, with *Harris* vs. *Com.*, 81 Va. 240, and *Re Theatrical Licenses*, 3 Pa. Dist. R. 191, A. D. 1894.) The proprietor of a theater is not engaged in a business "affected with a public interest." He may therefore fix his own prices, and he may refuse admission to whomsoever he pleases, unless a statute imposes the duty of providing like accommodation for all persons without regard to race or color. (*People* vs. *King*, 110 N. Y. 418.) If he sell tickets for an entertainment he must provide seats for the purchasers or refund the money. The purchaser, however, has no right to take a seat not called for by his ticket, and if he does he may be lawfully ejected. Moreover, as a ticket is at most a personal license to enter the theater, it may be revoked at any time, whereupon the holder is bound to leave the house, although he is entitled to damages for breach of the contract for admission. (*Purcell* vs. *Daly*, 19 Abb. N. Cas. (N. Y.) 301.) Auditors have the right to express their honest likes or dislikes of the play or the players or the management, by applause, by hisses, or by other demonstrations which do not tend to excite terror or to break the peace. If two or more, however, go to the theater with the preconcerted design to howl down an actor or to damn a play, their demonstrations in carrying out such designs are unlawful, and their conduct amounts to actionable conspiracy. (*Gregory* vs. *Brunswick*, 1 C. and K. 24.) See Hamlyn, *Manual of Theatrical Law* (London, 1891); Wandell, *Law of the Theatre* (Albany, 1891).

FRANCIS M. BURDICK.

**The'atines** [named from the Bishop of Theate, afterward Pope Paul IV.]: a Roman Catholic order of regular clerks and nuns, founded in 1524 by the Bishop of Theate and several of his friends. They spread into various countries, opposed Protestantism, and labored for the reform of the clergy and the extension of the Oriental missions. They are now found chiefly in Italy. Revised by J. J. KEANE.

**The'baïs**, or the **Thebaïd** [Gr. Θηβαΐς, the region of Thebes]: the district of Upper Egypt, extending from Siut (Asyut, Lycopolis, about 27° 20′ N. lat.) to Syene at the first Nile cataract (24° N. lat.), which with the HEPTANOMIS (*q. v.*) constituted the "land of Upper Egypt" in the ancient texts. It probably was equivalent to the Hebrew Pathros, and it was originally of like extent with the Coptic and Arabic grand division of Upper Egypt. The Romans subdivided the Delta region into four parts, created the Heptanomis, and at one time divided the Thebaïs into two portions.

CHARLES R. GILLETT.

**Thebes**, theebz [Gr. Θῆβαι, and later Διόσπολις; Lat. *Thebæ, Diospolis Magna*; Egypt. *Pa-Amon*, dwelling of Amon-Zeus, *Uast, Nu-Amon, Nu*, city of Amon, or city *par excellence*; Heb. *No-Amon*]: a city of Egypt on both sides of the Nile (at about 25° 50′ N. lat.). After the desertion of Memphis by the princes of the seventh to the tenth Egyptian dynasties, due possibly to a foreign invasion similar to that of the Hyksos at a later period, Thebes became the capital of Egypt, and so continued during the middle and new kingdoms. (See EGYPT, ANCIENT). The city proper was on the east side of the Nile, and is now represented by the ruins of several temples, those of KARNAK (*q. v.*) and LUXOR (*q. v.*) being the chief. The west side of the river was occupied by the Theban necropolis and various temples, most of which were memnonia dedicated to the manes of their founders. The temples, beginning toward the N., were those of GURNAH (*q. v.*), Dêr el-Bahri, built by Hatasu, the Ramesseum (built by Ramses II.), Dêr el-Medîneh (founded by Ptolemy IV. and continued down to the time of Augustus, dedicated to Hathor), and MEDÎNET HABU (*q. v.*). There was also formerly a temple of Amenhotep III. (the MEMNON (*q. v.*) of the Greeks) adjacent to the Colossi of Memnon, but it has almost entirely disappeared. Another temple, built by Thothmes III., just N. of the Ramesseum has also disappeared. The cemeteries in the same region are those of Drah Abu'l Neggah (eleventh and twelfth dynasties), just W. of Gurnah, Asasif and Abd el-Gurnah, respectively E. and S. of Dêr el-Bahri, and Gurnai Murraï, N. of Medînet Habu. Besides these there were also the Tombs of the Kings, in a valley W. of Dêr el-Bahri, and the Tombs of the Queens, W. of Medînet Habu. It was in the hills W. of Dêr el-Bahri that the mummies of the Pharaohs of the seventeenth to the twentieth dynasties were discovered in 1881. See HER-HOR.

The hills bordering on the strip of land fertilized by the Nile at Thebes recede farther from the river than elsewhere, but they are more distant on the E. than on the W. The Libyan hills are honeycombed with tombs. The residence portion of Thebes was to the E. of the temple of Karnak, though it is estimated that about a quarter of the total population, consisting of priests and artisans whose employments were of a funerary character, dwelt in the necropolis on the W.

The foundation of the city goes back probably to the Old Kingdom, though at that time it was of insignificant size. Its prominence dates from the eleventh and twelfth dynasties, when more extensive building operations were begun. During the Hyksos period it was the seat of native princes tributary to the invaders, and it so continued till the seventeenth dynasty, when a revolt occurred, occasioned by religious demands made upon Seqen-Ra, King of Thebes, by Apepi the Hyksos ruler. War was waged during several reigns, till at last the Egyptian armies were victorious. Thebes became the national capital again and Amon-Ra, the tutelary deity of Thebes, became the supreme god in the Egyptian pantheon. The kings of the eighteenth and nineteenth dynasties, especially THOTHMES III. and RAMSES II. (*qq. v.*), were exceedingly active in building at Thebes, and the history of the city is largely a history of these dynasties. During the reign of Amenophis IV., the "heretic king" (see KHUNATEN), the capital was temporarily removed to TELL EL-AMARNA (*q. v.*), but the power of the priests of Amon was too great for the innovator, and the old *régime* was speedily restored. After the close of the twentieth dynasty the seat of government was removed to the Delta and Thebes gradually lost its power, though it was twice the source of insurrections, which were subdued only by the aid of the Romans. (See PTOLEMY.) Its final destruction as a political power occurred in 85 B. C.

The sanctity of Thebes, the "On of the South" as contrasted with On-Heliopolis at the apex of the Delta, arose from the fact that it was reputed to have been the birthplace of Osiris, but it was inferior to Abydos (see MEMNONIUM), the burial-place of Osiris, and Heliopolis, the city of the Sun, in the religious estimation of the people. Its wealth and power were due to the spoils of war taken thither by the warlike Pharaohs of the eighteenth and nineteenth dynasties. The epithet "hundred-gated" applied by the Greeks to Thebes had reference to the multitude of pylons which marked the entrances to its numerous temples. The origin of the Greek name is uncertain, though several conjectures have been ventured. CHARLES R. GILLETT.

**Thebes**: the capital city of Bœotia; founded by Cadmus in a fertile, well-watered, and undulating plain. The city was very prominent in mythical times, for many of the most important and most extensive myths were located there. (See CADMUS, HARMONIA, SEMELE, INO, AMPHITRYON, ALCMENE, AMPHION, NIOBE, and ŒDIPUS.) Its walls and their seven gates were built by Amphion, and were taken but twice, once in mythical times by the EPIGONI (*q. v.*) of the Seven and then by Alexander the Great. In historical times Thebes was the leading city of Bœotia and was usually hostile to Athens, but she never fought with success or rose to first-rate importance until after the battle of Leuctra, when she assumed the hegemony of Greece, though she maintained it only during the lifetime of Epaminondas. She was unfortunate in her wars with Philip of Macedon, who placed a garrison within her citadel. On the death of Philip she expelled this garrison, but was punished severely therefor by Alexander, who razed the city, sparing only the temples and the house of Pindar, and sold the inhabitants into slavery, with the exception of the descendants of Pindar and those who had opposed the rebellion. PHRYNE (*q. v.*) offered to rebuild the walls of Thebes, but her offer was declined. The city was rebuilt by Cassander with the help of the Athenians, but it did not prosper. The modern town has about 5,000 inhabitants. It was virtually destroyed by an earthquake in 1893. An excellent topographical account of Thebes is by Fabricius, *Theben*, etc. (Freiburg, Baden, 1890). J. R. S. STERRETT.

**The Brill**: See BRIEL.

**Thecla**, SAINT: according to the famous story, a virgin of Antioch, enthusiastically attached to the apostle Paul, by whom she was converted to Christianity and strict celibacy. She maintained her faith in Christ amid persecutions, public and private, and was miraculously delivered from assaults upon her virtue. *The Acts of Paul and Thecla* is a widely circulated Christian romance of the second or third century, designed to exalt celibacy and to emphasize the comfort the doctrine of the resurrection gave. It is probable, however, that the tale has an historical basis. See the chapter upon it in W. M. Ramsay's *The Church in the Roman Empire* (London and New York, 1893). S. M. J.

**Thecoso'mata** [Mod. Lat., from Gr. θήκη, case + σῶμα, σώματος, body]: a subdivision of the pteropod *Mollusca* (see PTEROPODA) in which a shell is present.

**Theft**: See LARCENY.

**Thegn**: See THANE.

**The'ine**: the alkaloid of tea and coffee; its formula is $C_8H_{10}N_4O_2.H_2O$. See CAFFEINE and TEA, PHYSIOLOGICAL EFFECTS OF.

**Theiner**, tī'ner, AUGUSTIN: historian, critic, and polemical writer; b. at Breslau, Prussian Silesia, Apr. 11, 1804; studied theology, philosophy, and jurisprudence at the university of his native city; obtained the degree of *doctor juris* at the University of Halle for his *Commentatio de Romanorum Pontificum Epistolarum Decretalium Collectionibus antiquis* (1829); traveled with the support of the Prussian Government to Vienna, Paris, and London; settled in 1831 in Rome, and was in 1851 appointed keeper of the secret archives of the Vatican, from which office he was removed in Aug., 1870, accused by the Jesuits of having during the Council of the Vatican furnished the bishops of the opposition with the documents necessary to combat the dogma of infallibility. D. at Cività Vecchia, Italy, Aug. 10, 1874. He originally held liberal views of the relation between the papal see and the Roman Catholic Church; he assisted his brother, Johann Anton, in the publication of *Die Einführung der* *erzwungenen Ehelosigkeit bei den christlichen Geistlichen und ihre Folgen* (2 vols., Altenburg, 1828; n. e. Barmen, 1893), a book which was first upon the index; but during his residence in Rome he attached himself more and more closely to the Ultramontane party, and developed an astonishing literary activity in its service. Besides a number of minor essays and pamphlets, he wrote *Geschichte der geistlichen Bildungsanstalten* (Mentz, 1835); *Disquisitiones in præcipuas Canonum et Decretalium Collectiones* (Rome, 1836); *Versuche und Bemühungen des Heiligen Stuhls in den letzten drei Jahrhunderten, die durch Ketzerei und Schisma von ihm getrennten Völker des Nordens wiederum mit der Kirche zu vereinen; nach geheimen Staatspapieren* (Augsburg, 1837); *Die neuesten Zustände der katholischen Kirche beider Ritus in Polen und Russland seit Katharina II.* (1841); *Geschichte der Zurückkehr der regierenden Häuser zu Braunschweig und Sachsen in den Schoss der katholischen Kirche* (Einsiedeln, 1843); *Die Staatskirche Russlands im Jahre 1839* (1844); *Le cinque Piaghe della S. Chiesa* (1849); *Zustände der katholischen Kirche in Schlesien von 1740–58* (2 vols., Regensburg, 1852); *Geschichte des Pontificats Clemens XIV.* (2 vols., Paris, 1852); *La Souveraineté temporelle du Saint-Siège* (1861), etc. His principal works are his new edition and continuation of Baronius's *Annales Ecclesiastici*, and his publications of documents relating to the history of the Church among various nations—*Documents inédits retatifs aux affaires religieuses de la France 1750–1800* (2 vols., 1858); *Vetera Monumenta Hungariam sacram illustrantia* (2 vols., 1859); *Monuments historiques relatifs aux règnes d'Alexis Michaélowitsch, Théodore III. et Pierre le Grand de Russie* (1859); *Vetera Monumenta Poloniæ Gentiumque Finitimarum Historiam illustrantia* (4 vols., 1860–64); *Codex diplomaticus Dominii temporalis Sanctæ Sedis* (3 vols., 1862); *Vetera Monumenta Slavorum meridionalium Historiam illustrantia* (1863); *Vetera Monumenta Hibernorum et Scotorum Historiam illustrantia* (1864); and *Acta genuina ss. oecumenici concilii Tridentini* (2 vols., 1874).—His elder brother, JOHANN ANTON THEINER, b. at Breslau, Dec. 15, 1799, became Professor of Scriptural Exegesis in 1824 in Breslau; became a pastor in 1830; resigned his office in 1845, and joined the German Catholics; lived as a private teacher in Breslau, and was appointed secretary of the library of the university in 1855. He wrote, besides the above-mentioned work on celibacy, *Die reformatorischen Bestrebungen in der katholischen Kirche* (Altenburg, 1845); *Das Seligkeitsdogma der römisch-katholischen Kirche* (Breslau, 1847); *Enthüllungen über Lehren und Leben der katholischen Geistlichkeit* (Leipzig, 1862). D. at Breslau, May 15, 1860. Revised by S. M. JACKSON.

**The′ism** [from Gr. Θεός, God]: in the widest acceptation of the term, the doctrine of a Divine Being. As such it may be deistic or pantheistic or polytheistic, while atheism and agnosticism are its opposing terms. More narrowly considered, theism is synonymous with monotheism, and in this sense it may be deistic or pantheistic. Lord Shaftesbury used indifferently the terms theism and deism. John Fiske in his *Outlines of Cosmic Philosophy* and elsewhere develops a "Cosmic Theism" which is essentially pantheistic. He is not singular in this, and a pantheistic theism may be said to be the general result of modern scientific and philosophic thought. In later usage theism has been, as with Frances Power Cobbe, a term indicating a belief in God not derived from supernatural revelation and not specifically Christian. While the derivative force of the words theist and deist is precisely the same, the only difference being that in one case we have a Greek and in the other a Latin root, they have been used very generally for some time past as differentiating terms. Deism has designated the historical movement in theology which is described in the article DEISTS. From that movement the theism of the nineteenth century has differed, as less mechanical and more spiritual. The god of deism was a god outside the world, a mechanical creator, apart from the world, and leaving it to go alone, or governing it by natural laws. The god of theism has been a principle of life and order, never ceasing from his operations, his laws not delegated forces, but the constant habits of his activity. On the physical side theism has allied itself naturally with the doctrine of evolution. During the transcendental period in the U. S. deism was contemned as resting on the argument from design, while theism was glorified as the doctrine of conscience and direct intuition. There has been much confusion, however, in the use of these terms, Kant using them in a manner directly opposite to that of the New England transcendentalists. By deism he indicated the exclusive belief in a transcendental theology; by theism the belief in natural theology as a possible, if not the only, way to God. Prof. Robert Flint's *Theism* is a classic treatment of the matter, and another is Martineau's *Study of Religion*. See NATURAL THEOLOGY. JOHN W. CHADWICK.

**Theiss**, tīs: a river of Hungary; formed by the junction of the Black and White Theiss, both of which rise in the Carpathian Mountains; flows with a winding southern course to the Danube, which it joins 22 miles E. of Peterwardein. Its entire length is 828 miles, for the greatest part of which it is navigable even for large vessels. After entering the Hungarian plain its breadth is from 400 to 800 feet, its shores are low and marshy, and its current is sluggish. It is rich in fish, especially sturgeon.

Revised by M. W. HARRINGTON.

**The′mis** [= Lat. = Gr. Θέμις, personification of θέμις, custom, divine sanction, law, right, deriv. of τιθέναι, θεῖναι, put, set]: a daughter of Uranus and Gæa, and the second wife of Zeus, by whom she became the mother of the Horæ and the Mœræ. She is the personification of law and order as established by custom and equity. She presides over the assemblies of men, and sees to it that their deliberations make for order and justice. She is also a goddess of prophecy, and declares to mankind the decrees of Zeus. She presided over the oracle at Delphi before Apollo became the mouthpiece of Zeus at that place. She was worshiped at many places in Greece. As represented in art her features resemble those of Athene, but she carries a cornucopia and a pair of scales, to typify the blessings that result from law and order.

J. R. S. STERRETT.

**Themis′tius** (in Gr. Θεμίστιος) **of Paphlagonia**: Greek philosopher and orator; flourished in the second half of the fourth century A. D. As a teacher of philosophy and oratory he had a long and successful career at the Byzantine court, being especially honored by the Emperor Theodosius. Though he shows great tolerance in religious matters, his spirit and his style are steeped in the thought and language of the great pagan authors. His extant works consist of orations, edited by W. Dindorf, 1832, and paraphrases of Aristotle, which maintained their popularity through the Middle Ages, edited by L. Spengel (1866). B. L. G.

**Themistocles**, the-mis′tō-klēez (Gr. Θεμιστοκλῆς): general and statesman; b. at Athens about 514 B. C.; the son of Neocles and a Carian or Thracian woman; became the political leader of Athens after the expulsion of Aristides by ostracism in 483. He was impetuous and shrewd; sagacious in his judgment of actual circumstances and their probable consequences; swift in arriving at a resolution; inexhaustible in devices for the realization of his plans; possessed of a most impressive eloquence; energetic, cunning, and unscrupulous. His actions show a blending of rank ambition and lofty statesmanship; of egotism sometimes even sordid, and an elevation of mind truly noble, which becomes the more inexplicable the better known his ways and means become. Nevertheless, in a most decisive crisis he was the saviour of Athens and of Greece. After the battle of Marathon (490) people generally believed that the Persian war was ended. Themistocles, however, felt that a still heavier storm was coming, and he understood that a strong fleet would be the most effective means of victory, and the only safe means of rescue in case of defeat. Thus the development of the Athenian navy became the goal of his policy. He induced his countrymen to spend the income of the silver mines of Laurium, which had hitherto been distributed among the citizens, in the organization of a powerful fleet. He secured the passage of a law that twenty triremes should be built every year. When the armament of Xerxes was heard of, and Greece became alarmed, he procured an oracle from Delphi saying that Athens should defend herself by wooden walls—that is, by her fleet; and when, finally, the pass of Thermopylæ was forced, when the battle off Artemisium, in which he consented to fight under the Spartan commander, though the number of the Athenian ships was the greatest, had proved ineffective, and the Persian hosts streamed down over Bœotia and Attica, he persuaded the Athenians to leave their city to the protection of its tutelary deities, to bring their women and children in safety to the island of Salamis, and to go on board the fleet. In the Bay of Salamis the entire Greek fleet lay assembled; but various opinions prevailed in the council—whether to give battle here or at the isthmus, whether to give battle at all, or to separate, etc. It was Themistocles who held the fleet together by declaring that if the Greeks now separated the Athenians would leave Greece for ever, take their women and children, and set sail for Italy—a plan as sound as grand, and one which he no doubt was able to carry out. It was also he who finally compelled the Greeks to give battle by entering into negotiations with the Persian commander and hastening the approach of the Persian fleet. The Greeks were surrounded without knowing it, escape was impossible; fight had become a necessity. During the night Themistocles rowed from the Athenian division of the fleet to the Spartan, from the Spartan to the Corinthian, etc., busy to the last. In Salamis the women and children of Athens watched in prayer; on the opposite coast of the mainland carpenters were raising a throne from which Xerxes would look at the battle. In the morning (Sept. 20, 480) the Persian fleet stood up the narrow sound; the battle began, and it terminated in a most glorious victory for the Greeks. Themistocles was now the first man, not only in Athens but in Greece; when visiting Sparta, he was presented with the best chariot the nation possessed, and accompanied to the borders of Tegea by a guard of 300 horsemen—honors unheard of hitherto. To his native city he did one more great service. When, after the battle of Salamis, the Athenians began to rebuild their city, Sparta, through jealousy, dissuaded them from rebuilding the fortifications, and even threatened them with an armed interference. Themistocles hastened to Sparta, bribed the ephori, deluded the assembly of the elders by lies and dissimulations, deceived the whole community, and kept the question floating and undecided until it became superfluous, the walls not only of Athens, but also of Piræus, having reached a sufficient height to be defended with effect. Then he returned home, loaded with the hatred of all Spartans. Soon after this event he disappeared from public life. The last part of his history, that which follows the rebuilding of Athens, is as obscure and confused as the first, that which precedes the expulsion of Aristides. He was accused of treasonable connections with the Persians, but acquitted; then ostracised in 471, exiled to Argos, and again accused of treason by the Spartans; an order to arrest him was issued, and he fled from Argos to Corcyra, Thrace, Ephesus, and arrived finally at Susa, the residence of the Persian king, in a covered carriage, such as was generally used to convey women to the royal harem. At the Persian court there was a party, headed by the widow of Xerxes, which demanded his execution immediately; but Themistocles understood how to impress the reigning monarch, Artaxerxes, so favorably that he was not only left unmolested, but received rich dotations and acquired considerable influence. Deeply implicated in the Persian plans for the subjugation of Greece, he died suddenly at Magnesia in Asia Minor in 449 B. C.

Revised by J. R. S. STERRETT.

**Thenard's Blue**: See BLUE and COBALT.

**The'obald**, LEWIS: author; b. at Sittingbourne, Kent, England, about 1690; educated at Isleworth, and became a lawyer, but devoted himself chiefly to literature; published *Electra, a Tragedy* (1714); *A Critical Discourse on Homer's Iliad* (1714); *A Translation of the First Book of the Odyssey* (1716); *The Censor*, a periodical (1717); *Memoirs of Sir Walter Raleigh* (1719); *The Double Falsehood* (1720), a play which he attributed to Shakspeare; and some twenty other plays, none of which had much success or are now remembered. He is chiefly known as a Shakspearean editor, having published *Shakespear Restored, or Specimens of Blunders committed and unamended in Pope's Edition of this Poet* (1726), which brought upon him the wrath of Pope, and procured him the post of hero of the first edition of the *Dunciad* (1729). In 1733 he issued an edition of Shakspeare (7 vols.) which completely superseded that of Pope. His emendations were few, executed with great care, and are acknowledged to possess great merit, having been reproduced without acknowledgment by many subsequent editors. D. in Sept., 1744. Revised by H. A. BEERS.

**Theobroma**: See CACAO and THEOBROMINE.

**Theobro'mine** [deriv. of Mod. Lat. *theobro'ma*; Gr. θεός, god + βρῶμα, food]: an organic base present in cacao-beans, and therefore in chocolate; formula $C_7H_8N_4O_2$. It is prepared by treating the beans with warm water, adding neutral plumbic acetate to the strained solution, conducting a current of hydrogen sulphide through the filtrate from the lead precipitate, evaporating the second filtrate, and crystallizing from alcohol. It may be further purified by heating between two watch-glasses, when it is obtained as a dazzling white sublimate. Theobromine is a colorless crystalline powder, but sparingly soluble in boiling water, and still less so in alcohol and in ether. It has a bitter taste, and gives crystalline salts with several of the acids.

Revised by IRA REMSEN.

**Theocracy**: See RELIGION, COMPARATIVE.

**Theoc'ritus** (in Gr. Θεόκριτος): earliest and chiefest of bucolic poets; commonly set down as a native of Syracuse, though Cos also has claims on him. He flourished in the first half of the third century B. C., at the court of Ptolemy Philadelphus in Alexandria, and the court of Hiero II. in Syracuse, but the chronological order of his poems in honor of those potentates is much disputed, so that it is not certain how his career is to be distributed. Nor is anything known as to the time and manner of his death, though it has been inferred from a line of Ovid, *Ibis*, 549, that his end was the halter. We have under the name of Theocritus thirty-one poems, besides a number of epigrams. Of these poems, commonly called idyls (Gr. εἰδύλλια), ten are strictly bucolic, three are imitations of the mimes of SOPHRON (*q. v.*), the rest vary in sphere and poetic value, and a few are spurious, or at all events fall below the poet's art and tone. Theocritus occupies a unique position in literature. No one has so blended in his verse the artistic and the popular, and all who have attempted to emulate him have failed to reproduce his wonderful charm. His language is Syracusan Doric, and yet it is not the peasant language pure and simple. It has notes that have been learned from the predecessors of Theocritus, from Epicharmus and Sophron; and his Æolic poems, among the most attractive of all, are clearly artificial. His peasants are peasants, his shepherds smell of the sheepcote, his reapers of the harvest-field, his fishermen of fins and scales; their jests are as broad as the sky under which they live, and yet we can not but suspect allusion here and allegory there. His measures, as a rule, are epic, and belong to the recitative order, and yet the arrangement in strophes mimics song and the dialogue gives dramatic character, so that the three great forms of poetic composition are all present in his works. He is a conscious artist to the minutest points of workmanship; he is the child of a period when the scholar held the poet bound; and yet through all the limitations and artificialities of the period and the province there breathes an intimate love of nature that makes Theocritus a poet for all time, as he is the last true poet of the Greek tongue. Noteworthy editions are by Ahrens, 2 vols. (1855), by Meineke, 3d ed. (1856), by Wordsworth (1872), by Fritzsche-Hiller with German notes (1881). There is a *Lexicon Theocriteum*, by Rumpel (1879). For the bibliography, see Cipollini, *Gli Idilli di Teocrito* (1887). Of the translations into English the most interesting are the verse rendering by Calverley (1869) and the prose version by Andrew Lang (1880), with an introductory essay, *Theocritus and his Age*.

B. L. GILDERSLEEVE.

**Theodec'tes** (in Gr. Θεοδέκτης) **of Phase'lis**, in Lycia: pupil of Plato and Isocrates; distinguished alike as tragic poet and orator. The scant fragments of his tragedies which are collected in Nauck's *Fragmenta Tragicorum Græcorum* (2d ed., pp. 801–807) hardly bear out his reputation, which was doubtless enhanced by his versatility. B. L. G.

**Theod'olite** [probably for *the alidade*; Arab. *al 'idāda*, rule]: an instrument used by surveyors for measuring horizontal and vertical angles, similar to an engineer's transit in all respects, except that the telescope is not usually reversible. See HYPSOMETRY.

**Theodo'ra**: Byzantine empress; b. about 508, either at Cyprus or more probably at Constantinople; the daughter of Acacius, master of bears to the Green Faction. By the death of her father her mother was left destitute with three daughters, Comito, Theodora, and Anastasia, none of whom was over seven years of age. The three successively appeared on the stage as pantomimic dancers, an occupation held in general contempt. In the *Anecdota*, attributed to PROCOPIUS (*q. v.*), scandalous stories are narrated of Theodora's youth, which it is impossible to verify or wholly refute. In 525, when she married the consul Justinian, she was, if the commonly accepted date of her birth be correct, but seventeen years old; hence some of the charges against her can not possibly be true. Justinian had obtained from his uncle Justin I. abrogation of the law which forbade marriage between a senator and a woman of servile origin or who had appeared on the stage. In 527 Justinian succeeded to the throne. He required public functionaries to swear allegiance to Theodora as well as to himself, caused her effigy to appear on the coins with his own, and cited both their names in public decrees as joint rulers. During twenty-three years of married life she showed herself his worthy consort. Her courage and judicious counsels prevented his deposition at the revolt of the Nika in 532, and in all questions of administration she took a notable share. No female sovereign manifested larger interest in the unfortunate and destitute of her own sex or strove more earnestly to alleviate their condition. It has been supposed that thus she sought to atone for the possible faults of her own youth. She retained her ascendency over the mind of Justinian to the last. Her only child by him was a daughter. Theodora was of small stature, pale, delicate, vivacious, graceful rather than beautiful, had expressive eyes, and was fascinating in manner. She died of cancer in 548 at Pythia, near Broussa, whither she had gone for the baths. EDWIN A. GROSVENOR.

**Theodore**, King of Abyssinia: See ABYSSINIA.

**Theodore of Mopsues'tia**, also called, from his place of birth and early life, THEODORE OF ANTIOCH, and whose epithet among the Nestorians is "The Interpreter": bishop and exegete; b. in Antioch about 350. His parents were wealthy and gave him every advantage, but under the urging of John Chrysostom, his life-long friend, he entered an ascetic brotherhood which Chrysostom had established. Shortly afterward he repented of the step and left the brotherhood, as he desired to marry. To him Chrysostom then addressed two eloquent and affectionate letters which bear the title *An Exhortation to Theodore after his Fall*, and which had the desired effect of determining him to renounce his matrimonial intentions and saving him for the Church. He was not yet twenty years of age when his "fall" and recovery occurred. He continued his studies and was ordained priest in Antioch 383. Somewhat later he removed to Tarsus. He essayed authorship with brilliant success and in 392 became Bishop of Mopsuestia, the modern Messis, 40 miles W. from Tarsus, where he died 428. He is the most prominent representative of the "middle" Antiochian school of Bible interpreters. He commented on nearly the whole Bible in the grammatical and historical manner of the Antiochian school, and in constant protest against the allegorizers. He also appeared as a controversialist and as a practical theologian. Much of his writings has been lost—particularly to be regretted are his letters, which were so highly admired that they were called the Book of Pearls. His fame in the West is due to his alleged heresy. Dying in the odor of sanctity and passionately defended, it was soon afterward openly said and was proved that he was the virtual author of Nestorianism. The Council of Ephesus in 431 condemned his "creed"—although his name was not mentioned—and the Council of Constantinople in 553 anathematized him, by request of the Emperor Justinian. So the West wanted to learn who the man was about whom the East was so much excited, and a Latin translation of portions of his works was the result. Curiously enough his commentary on Paul's Epistles was circulated under the name of Ambrose. It was highly popular, and the heretic of the East "supplied the Middle Ages [in the West] with an accepted interpretation of an important part of Holy Scripture." Much of this Latin translation was first published in 1880–82 in Cambridge. See Migne's *Patrologia Græca*, lxvi., for a general collection of the remains. Cf. H. Kihn, *Theodor von Mopsuestia u. Junilius Africanus* (Freiburg im Breisgau, 1880). SAMUEL MACAULEY JACKSON.

**Theod'oret**: bishop and author; b. about A. D. 393 at Antioch, Syria, the only son of rich and influential parents; received a good education under religious influences; at twenty-three, his parents being dead, distributed all his property and retired to a monastery at Nicerte, 75 miles from Antioch; in 423 became Bishop of Cyrus or Cyrrhus, the modern Koros, on a branch of the river Aphreen, in the district of Syria called Cyrestica, which is a fertile plain lying between Alma Dagh and the Euphrates. D. probably in 457. In the discharge of his diocesan duties he was eminently successful, bringing back by his eloquence and power of persuasion numbers of heretics to the Catholic Church. At last, however, he himself was accused of heresy. He had a strong sympathy for Nestorius, and in 449 he was even deposed from his see by the synod of Ephesus, though he was reinstated by the synod of Chalcedon in 451. Of his works, comprising a history of heresies, a dialogue against Eutychianism, commentaries, etc., the *History of the Church from 325 to 429* is the most important. The best edition of his works, which comprise commentaries on Paul's Epistles and large parts of the Old Testament, discourses, controversial works, histories, and letters, appeared in Halle, 1769–74, in five volumes, edited by Schulze and Nösselt, reprinted by Migne, in *Patrologia Græca*, lxxx.–lxxxiv. (Paris, 1860); English translation by Bloomfield Jackson of the *Ecclesiastical History, Dialogues, and Letters*, in *The Nicene and Post-Nicene Fathers*, 2d series, iii. (New York, 1892); Gaisford's translation of the history is in Bohn's Ecclesiastical Series. Revised by S. M. JACKSON.

**Theod'oric** [a Teutonic name; cf. Goth. *þiuda*, people, and *reiks*, king]: founder of the Ostrogothic kingdom of Italy; b. about 454, the son of Theudemir, who with his two brothers ruled over the Ostrogoths in Pannonia under the authority of the East Roman emperor; was educated at the Byzantine court, whither he was sent as a hostage at eight years of age, and where he spent about eleven years. In 474 he succeeded his father as king of his nation, and for some time was a true ally of Zeno, the Eastern emperor, but, dissensions soon arising, Theodoric invaded the Roman provinces of Macedonia and Epirus, and for several years harassed the empire by marauding expeditions. At last, in 488, he and the emperor agreed upon a plan for the employment of the Ostrogoths in Italy against Odoacer. Late in the fall the whole nation, numbering over 200,000, of whom 40,000 were soldiers, broke up its settlements, and advanced slowly into Italy, defeating the Gepidæ on the way. Odoacer was defeated in three battles—at the Isonzo, near Aquileia, Aug. 28, 489; at Verona, Sept. 30, 489; and on the Adda, Aug. 11, 490. He then shut himself up in Ravenna, was besieged there for over two years, and was finally assassinated Mar. 15, 493, at a banquet shortly after he had surrendered himself. After his victories Theodoric naturally considered the soil of Italy as belonging to himself, and a part of it, one-third, it is said he partitioned out among his warriors, thus covering Italy with a network of Gothic military colonies. In other respects he retained the administrative machinery of the empire, and he understood how to work it. He governed Goths and Romans as if they were one people, and, though himself an Arian, refrained from persecuting the Catholics till the last two years of his reign. Under him the country enjoyed peace and prosperity to a greater degree than fell to its lot for several centuries. In commerce and industry, in science and art, damages were repaired, and new undertakings started. Cassiodorus, Boethius, Symmachus, and other literary men of eminence lived at his court in Verona as his intimate friends. In his foreign policy he was also wise and successful, and among the German tribes he became a hero (*Dietrich von Bern*), around whose name legends grew thick during the Middle Ages. The last days of his life were embittered by a controversy with the emperor and the pope over the persecution of the Arians, and stained by deeds of violence and cruelty. He alienated the minds of his Roman subjects by the judicial murder of Boethius and Symmachus, and he angered the Catholics by his treatment of Pope John I., who died in prison. He died at Ravenna, Aug. 30, 526, just after he had issued an edict giving over the Catholic churches of Italy to the Arians. See Hodgkin, *Theodoric the Goth* (1891). F. M. COLBY.

**Theodosia**, or **Feodosia**: See KAFFA.

**Theodo'sius**: an eminent Roman general from whom a line of emperors descended. Sent to Britain by Valentinian I. in 367 A. D., he drove out the Picts and Scots, strengthened the military positions on the frontiers, and restored security and order in the country. After his return he was for some time stationed on the upper Danube, where he defeated the Alemanni. In 372 he took command in Africa, and succeeded, after an obstinate struggle, in putting down a revolt led by the Moorish chieftain Firmus. Theodosius was executed in 376 by order of Valens.—His son, THEODOSIUS I., THE GREAT, Roman emperor from 379 to 395, was born in Spain, probably at Cauca, in Galicia, about the year 346, and educated in his father's camp. He early received an independent command in Mœsia, and distinguished himself by victories over the Sarmatians, but after the execution of his father, in 376, he retired from public life, and returned to his native place. After the defeat and death of Valens in the battle of Adrianople (in 378), Gratian recalled him to the court, made him commander-in-chief against the Goths, and declared him Augustus (Jan. 19, 379), placing Egypt, Asia, Thrace, Macedonia, and Dacia under his scepter. Theodosius pursued a skillful policy in his campaigns against the Goths, and a peace was concluded by which they received lands within the empire and became allies of Rome. In 383 Gratian was defeated and killed by Maximus at Lyons, and Theodosius acknowledged the usurper as Emperor of Britain, Spain, and Gaul, but secured Africa, Italy, and Illyricum for Gratian's brother, Valentinian II. In 387, however, Maximus broke from Gaul into Italy, and the weak Valentinian II. and his mother Justina, who was the true regent of the empire, fled for safety to Theodosius. Theodosius became so infatuated with Valentinian's beautiful sister, Galla, that he promised to restore him to the throne in order to obtain her hand. Maximus was defeated and put to death in 388, and Valentinian II. was reinstated as Emperor of the West, but in 392 was killed by Arbogastes, who, not venturing to assume the purple himself, raised the rhetorician Eugenius to the throne. Theodosius hesitated long before he entered on a new war, but in 394 he marched against Eugenius and Arbogastes, and defeated them at Aquileia, thereby uniting the whole Roman empire under his scepter. He died shortly after, however (Jan. 17, 395), at Milan, leaving the empire to his sons Arcadius and Honorius. Theodosius was a zealous upholder of orthodox Christianity, and took active measures for the suppression of pagan rites and heretical opinions. His obedience to the Church was exemplified in his submission to the penance imposed by Ambrose after the cruel massacre of Thessalonica (390).—His grandson, THEODOSIUS II. (408–450), b. in 401, succeeded his father, Arcadius, as emperor in the East. He was a weak ruler, controlled largely by his sister, Pulcheria, and his wife, Eudocia. He is chiefly known for the Theodosian code, a collection of the imperial constitutions issued since the time of Constantine. Revised by CHARLES H. HASKINS.

**Theog'nis of Megara**, in Greece: elegiac poet who flourished in the latter half of the sixth century B. C., and lived to see the on-coming of the Persian war. His life fell in a period of feuds and factions; the oligarchical party to which he belonged was overborne by the democracy, and Theognis, stripped of his estate, suffered the pangs of poverty and exile. In the verses that have been preserved under his name, 1,389 in number, we have the creed of a Doric oligarch set forth for the instruction of a young favorite who belonged to the same order. The fragments vary in length, and as the sententious character of the poetry of Theognis lends itself readily to interpolations, his genuine work is largely mixed with passages from other poets, such as Solon, Mimnermus, Tyrtæus, and Evenus. But for all these foreign ingredients the character of the poet and the bitterness of his spirit are manifest enough, and the remains of Theognis are of prime importance in enabling us to understand the state of parties and the problems of society in the Greece of the sixth century. Ed. by Welcker (1826), by Ziegler (2d ed. 1880), by Sitzler (1880), and by Bergk, *Poetæ Lyrici Græci*, vol. ii., pp. 177–236 (4th ed.). Translated by Frere (1842)—see Frere's *Works*, vol. iii., ed. of 1874—with a clever but hopeless attempt to work all the disparate fragments into a mosaic of the poet's life and character. For more recent studies, see Sittl, *Geschichte der griechischen Literatur*, vol. i., p. 261, foll. B. L. GILDERSLEEVE.

**Theological Schools**: See SCHOOLS.

**Theology** [from Gr. Θεός, God + λόγος, discourse, reason]: literally, discourse concerning God. The term has come down to us from the Greek philosophers, who used it in the sense of "account of the gods." Plato so used it in speaking of what Homer and Hesiod in their poems have said of the gods, though he also employs the word mythology, which by common consent has been adopted by Christian writers as the more appropriate term. The word theology seems to have first come distinctly into Christian use during the great controversies in the fourth century respecting the divinity of Christ and his relation to the Godhead, the term then meaning sometimes the doctrine of the divine nature of Christ as distinguished from his human nature (οἰκονομία), and sometimes the doctrine of the Trinity. Theodoret in the fifth century appears to have been the first to use the term in the sense of "doctrine of God." He proposes and discusses the question, Why did not Moses preface his account of the creation with (θεολογία) the doctrine of God—i. e. with some explicit teaching respecting the nature and attributes of God? It was not until the twelfth century that theology assumed something like the comprehensiveness of its modern meaning. Abelard having prepared a compend of his lectures on some of the most prominent doctrines of faith, entitled it "Christian Theology" (*Christiana Theologia*). From the time of Abelard the term rapidly widened in meaning till it came to include all that is now comprehended under it. Theology now denotes not merely the doctrine of God, or theology proper, but also the doctrine of the world in its relations to God, or cosmology; the doctrine of man in his relations to God, or anthropology; the doctrine of the salvation of man through the person and work of Christ, or soteriology; the doctrine of the final states of all men, or eschatology; and the doctrine of the Church, its constitution and government, or ecclesiology. Theology may therefore be defined as the science which treats of God and the universe in all their known relations to each other. It has sometimes been defined as "the science of the supernatural," and very commonly as "the science of religion." These definitions, however, are vague and inexact; both, with any definiteness of meaning, would necessarily include much that does not properly belong to theology, and omit still more that does. The last named, "the science of religion," from its apparent simplicity and comprehensiveness has gained great popular currency, which has also been promoted by indefinite notions as to the nature of both religion and theology.

Religion exists as an inward state of feeling—a sense of duty toward a Being or beings regarded as divine and supreme—and also as an outward expression of that feeling in acts of worship and service. The science of religion, therefore, should analyze and classify the religions of the world—both the religious convictions and feelings of men, and the forms of worship and service in which these convictions and feelings find their natural expression. Theology, on the other hand, deals exclusively with the facts, whether of consciousness or of revelation, from which religion, both subjective and objective, proceeds, and, educing the truths and principles which the facts embody, it formulates and groups them into the doctrines which constitute theology.

The right of theology to be called a science, which in late years has been warmly disputed, can be determined only by answering the following questions: first, Can the facts with which it has to do be proved to be indubitably real, and what are they supposed to be? and second, Can the methods which it adopts in dealing with its facts be shown to be in accordance with the acknowledged laws of mind? In its broad sense as a science it must gather its facts from the wide fields of nature, consciousness, and the sacred Scriptures. In a narrower and commoner sense of the term its facts, according to one class of theologians, are to be found only in the sacred Scriptures, and are strictly historical; according to another class, even in the narrower sense of the term, the facts of the moral consciousness should not be overlooked; this latter class holding that the ultimate and decisive appeal must ever be to the Scriptures, yet maintaining that the facts of the moral consciousness when properly scrutinized will be found to be explanatory, supplemental, and corroborative of those of the Scriptures. As to the facts, so far as they are historical they are amenable to the bar of criticism, like the facts of any other history, and must vindicate their trustworthiness by precisely the same kind of evidence; and so far as they are from the moral consciousness, they are open to inspection, and may be subjected to the same kind of analyses and tests as any other facts of mind. As to methods, there is the same liability to error in theology as in any other science; but out of various possible methods in dealing with the phenomena of nature, some one is of course admitted to be scientific, and that one, with such insignificant modification as may be necessary to fit it to its service, must be equally scientific in dealing with the phenomena of revelation; so that, if a science of astronomy, and still more if a science of ethics, be possible there may also be a science of theology. Science differs from mere knowledge in the degree of its certitude and exactness. It would be difficult to show that the essential principles of theology are less certain or less capable of exact statement than those of any other science. Science also differs from mere knowledge in the extent to which its material is classified and organized. The facts of theology can be classified and organized, and precisely to the extent in which this is accomplished can theology be called a science. The chief ground for denial of the right of theology to be called a science is found in its liability to resort to theory when facts are wanting, and to hypothesis in the absence of evidence. Its danger of becoming in this way unscientific is, however, no greater than that of most other sciences. The facts of revelation on which the science of theology rests presuppose and imply those fundamental facts of being which it is the office of metaphysical philosophy to interpret: of these facts some kind of explanation is to every enlightened mind a necessity. The theologian must have his explanation, and it is to him the source of his greatest danger of becoming unscientific. His metaphysic is perpetually suggesting to him its method of rounding his theology into the completeness of a system. To what is strictly scientific in his theology he is continually tempted to add what is purely theoretic. It is because theology has been so encumbered by what is purely theoretic—by theories of the Trinity, theories of sin, and theories of the divine providence, of the atonement, of regeneration, etc.—that its right to be entitled a science has been disputed; but to any one who looks impartially at the materials with which theology builds, and at the inductive method which it may justly adopt, its right to be called a science would seem to be as clear as that of any other species of knowledge.

Theology has been divided into two kinds, which have been designated according to the supposed sources of their materials. Thus we have Natural Theology (*q. v.*) and revealed theology. By the first is meant that knowledge of God, his existence, attributes, and government of the world, which may be gathered from nature—i. e. from the external world and from the mental and moral constitution of man; and by the second is meant that knowledge of God and the universe, and of their mutual relations, which may be gathered from the Bible alone, or at least that knowledge alone which the Bible sanctions. It may be doubted, however, if the line of separation between the two is so clearly marked as is commonly supposed. The Bible assumes and incorporates into itself no small portion of what must be regarded as fundamental in natural theology, and few, if any, of the sources of natural theology have failed to be irradiated by the light of revelation. It is now well-nigh impossible to distinguish between what is taught by nature and what by revelation.

Revealed theology has been distributed into a variety of species, each of which has received its designation either from its special aim or from its special method of treatment. Thus, to particularize, we have systematic theology, the aim of which is to reduce all revealed truths to a series of statements that together shall constitute an organized whole; dogmatic, which aims pre-eminently to state what is authoritatively taught, whether by the Scriptures, the councils, or the creeds; philosophical, in which the formal statements of truth are more or less directly determined either by the postulates or by the conclusions of some special system of philosophy; metaphysical, in which the aim is to substantiate the teachings of the Bible by an appeal to those primitive cognitions and primary beliefs which the Bible always assumes; speculative, in which theory predominates over Scripture and all other authority; rational, which gives to human reason the highest authority in determining what is theological truth; biblical, which, indifferent alike to philosophy and dogma, and, making system but a secondary consideration, aims simply to state the teachings of the Bible; doctrinal, which contents itself with simply formulating its statements of truth with a view to their being understood and accepted; and practical, which, on the other hand, seeks so to shape its statements of truth as to secure conformity of life with what is stated; polemical, which is quite as intent on overthrowing the positions of other systems as in defending its own; and historical, which traces doctrines through the controversies amid which they were enunciated, and under the influence of which they were formulated. Moral theology is a designation which has among Protestants fallen into general disuse, but once denoted a discussion of moral law and human duty as laid down in the Ten Commandments and the Sermon on the Mount, and covered ground which is occupied by moral philosophy or Christian ethics. The term theology, unaccompanied by an epithet, commonly denotes a completed series of the classified doctrines of Christianity. Doctrines are formal statements of Christian truth, and scientific theology consists of the whole circle of doctrines arranged according to some determinate plan.

Theology as a science has had a clearly marked history—a history covering special controversies under which specific doctrines took form, and those broader and less violent discussions in which all doctrines, under the influence of metaphysical philosophies, were adjusted into the various systems which, taken together, constitute the science as a whole. This history, beginning with the time immediately succeeding that of the apostles, naturally divides itself into three great periods, the first extending to A. D. 730, the second from 730 to 1517, and the third from 1517 to our own time.

During the first period, theology was in its formative state. The hints given by Scripture in the formula of baptism (Matt. xxviii. 19) and the apostolic benedictions (2 Cor. xiii. 14), in the grouping of the facts of sin and salvation about the two persons, Adam and Christ (Rom. v. 12–19), in the poetical summary of the truths of redemption quoted by Paul (1 Tim. iii. 16), seem first to have suggested the possibility of combining these facts and truths into a system. Ignatius (d. 115) gives the first distinct statement of the faith drawn up in a series of propositions, and his systematizing formed the basis of all later efforts. No complete treatise of theology, however, was written during this first period. The nearest approach to one was by Isidore, of Seville, who died in 636. He wrote what he styled Three Books of Sentences (*Tres Libri Sententiarum*), but it was, as its title indicated, a mere collection of extracts from the Church Fathers. The period, however, was not unproductive of results. It gave to the Church universal that admirable digest of Christian faith called the Apostles' Creed. Among the churches of the East were elaborated the great doctrines of the Trinity and of the person of Christ, which were formulated in the creeds adopted by the Council of Nice in 325, of Constantinople in 381, of Ephesus in 431, and of Chalcedon in 451. Within the same period also—that is, during the first quarter of the fifth century—the equally important doctrines of anthropology (specifically of the fall of Adam and its effects on the human race) were discussed, chiefly among the churches of the West under the leadership of Augustine and Pelagius. Augustine maintained that all men sinned in Adam; that by his fall all were physically and morally corrupted (original sin), and incapacitated to will or to do aught but evil; that all there is of good in any one is by sovereign grace in fulfillment of a predestinating purpose. Pelagius, on the other hand, maintained that Adam alone was injured by the fall; that every one of his descendants begins life with a nature as pure as his was, and with a will as free to choose good as evil; that grace simply assists natural power, and is bestowed on those who by right use of natural power deserve it. Augustinism was adopted as the orthodox doctrine of the Church by the Council of Ephesus in 431. Semi-Pelagianism denied the positions of Augustine and softened the statements of Pelagius. Wiggers in his history of the three views says aptly that "Pelagianism makes man to be morally *well*; Semi-Pelagianism makes him to be morally *sick*; Augustinism makes him to be morally *dead*."

The second period (from 730 to 1517) produced three great writers on theology—viz., John of Damascus, Peter the Lombard, and Thomas Aquinas. John (d. 754) wrote what he styled An Accurate Summary of the Orthodox Faith (Ἔκδοσις ἀκριβὴς τῆς ὀρθοδόξου Πίστεως, or *De Orthodoxa Fide*). He is the only writer of note on systematic theology which the Greek Church has ever produced. He drew his materials from the earlier Fathers, and chiefly from the three great Cappadocian teachers, Gregory Nazianzen, Gregory of Nyssa, and Basil the Great. He was the first to apply the formulas of Aristotle to theological investigation, and thus to introduce the dialectic or scholastic method. His views of the moral state and ability of man, like those of all the Greek Fathers, are much less rigid than those of Augustine. His work is chiefly of value to one who would understand the history of the doctrine of the person of Christ. Peter the Lombard (d. 1164) compiled from the Latin Fathers, chiefly from Augustine and Gregory the Great, what he styled Four Books of Sentences (*Quatuor Libri Sententiarum*). His method is formal and dialectic, but he shows great acuteness and skill in his aim at reconciling the opposing views of the authors whom he quotes—an aim the opposite of that of Abelard (d. 1142), who had sought in his "Yes and No" (*Sic et Non*) to array the Fathers against one another. The work of Peter became the great authority in the Roman Church, the ablest theologians for a long time contenting themselves with simply commenting on it. The greatest of mediæval theologians, however, perhaps one of the ablest of any age, was Thomas Aquinas (d. 1274). He wrote, according to the fashion of his time, elaborate commentaries on the *Sentences* of the Lombard, to which he also gave the alternative title of Sum of Theology (*Summa Theologiæ*). He is pre-eminently scholastic in method, but transparent in thought and exhaustive in treatment. The Lombard simply recognized the rising controversy between the Realists and the Nominalists; Aquinas was a pronounced and earnest Realist. He was also more Augustinian in his anthropology than Lombard, and, setting aside the mythical theory of the atonement, which Lombard had accepted from the Fathers, and which made the death of Christ to have been a ransom paid to Satan, he maintained, and established for all time since, the Anselmic theory, that the death of Christ was a satisfaction for sin to the justice of God. The mythical theory had prevailed until the beginning of the twelfth century, when Anselm, Archbishop of Canterbury (d. 1109), elaborated the theory which bears his name, and the final acceptance of which made as distinctly, though less violently, an epoch in the progress of theological science as had been made more than seven centuries before by the adoption of the Augustinian views of human nature. The *Summa* of Aquinas is one of the highest authorities in the Roman Catholic Church.

The third great period, from 1517 to the present, has been more fruitful of treatises on scientific theology, and has contributed more to its progress than all the Christian centuries preceding. Until the sixteenth century only two great doctrines or groups of doctrines—viz., of God, including the Trinity, Christology, etc., and of man, including sin, free will, sovereign grace, etc.—had been comprehensively discussed. The Reformation under Luther turned on controversies over the doctrines of soteriology, or of the divine method of making the work of Christ available for men. The Roman Church, under guidance of mediæval theologians, had come to make the process of salvation to be a mere external work (an *opus operatum*) wrought by the efficacy of the sacraments. Luther maintained that it could be wrought only through a personal faith (a *fides justificans*). In prosecution of the controversy the Reformers, cutting loose from scholastic theology, entered at once on the study of the Bible and the Christian truth for themselves. The first Protestant treatise on scientific theology, the *Common Places* (*Loci Communes*) of Melanchthon, had its origin in a course of lectures on the Epistle to the Romans, the chief object of which was to collate and expound such passages of the Epistle as bore directly on the question in dispute. Out of the biblical studies of the Reformers, German, Swiss, and French alike, grew those statements of soteriological doctrines now found in all systems of Protestant theology.

From the middle of the sixteenth century theology presents itself under three clearly defined types—the Lutheran, the Reformed (the Calvinistic), and the Roman Catholic. At the beginning of Protestantism the Lutherans and the Calvinists were essentially one in doctrine. Both adopted the Augustinian views of sin and grace, and both held firmly to the Nicene and Chalcedon creeds. Luther was himself pre-eminently Augustinian, and even wrote a book (*De Servo Arbitrio*) to prove that the will of man is enslaved; and Melanchthon, when he wrote the first edition of his *Loci*, as well as the Augsburg Confession (*Confessio Augustana*) and the apology for it (*Apologia Confessionis*), was no less Augustinian. Luther, however, propounded and defended a doctrine of the real presence of the body and blood in the Lord's Supper under the title of consubstantiation; and Melanchthon, gradually swerving from the Augustinian views of sin and irresistible grace (monergism), maintained the existence of a co-operative power of the human will in regeneration (synergism), and favored the Reformed view of the Supper rather than the Lutheran; the Reformed, under the lead of Calvin, adhered to Augustine's views of human nature, and maintained that in the Supper the Lord is present, not in the bread and wine, but in the heart of the communicant through partaking of the consecrated elements; the differences between the Lutheran and Reformed, slight at first, rapidly widened into complete separation. The historical progress of dogmatic theology may be traced under the three above-mentioned types—the Roman, the Lutheran, and the Reformed or Calvinistic.

*The Roman.*—The Roman Catholic Church, in which theological studies had fallen into neglect, was roused into immediate activity by the outbreak of the Reformation; but in the canons of the Council of Trent (1545–93) it reaffirmed the theology of its mediæval writers, particularly of Aquinas, and authorized the preparation of the Roman Catechism (*Catechismus Romanus*), which popularizes and reiterates the decrees of the council. Its great writers, such as Bellarmine and Petavius, contented themselves with acting on the defensive, simply reaffirming the dogmas of the Church and the interpretations which priestly authority had put upon them. There has been no dearth of modern theological treatises in the Roman Church, but the most able and complete of them all is that of Cardinal Perrone (*Praelectiones Theologicæ*), which first appeared in 1835, and of which very many editions have been since published. It is specially able in its presentation of the Roman theory of the Church and its sacraments. Moehler's *Symbolism* skillfully states and minimizes the points of difference between Roman Catholicism and Protestantism; while Hurter's *Compendium Theologiæ Dogmaticæ* is a recent and extended exposition of the Roman doctrine.

*The Lutheran.*—The *Loci* of Melanchthon, first published in 1521, became at once the great Lutheran authority, and was the first in a series of learned and able treatises. It was clear in thought, admirable in style, and entirely free in language and method from scholasticism. Sixty editions in Latin and a large number (estimated at more than twenty) of translations into German were published during its author's lifetime. The later editions were so changed from the earlier as to make it almost another work. Theologians immediately succeeding Melanchthon contented themselves with writing commentaries on the *Loci*; but during the 200 years following his death (1561) the Lutheran Church abounded in great writers on theology, many of whom were noted for their learning as well as for their extraordinary grasp and acuteness of intellect. Among others may be mentioned Chemnitz, Gerhard, Calixtus, Calovius, and Quenstedt. Of these authors, some sided in their anthropology with Luther, but the majority with Melanchthon, while almost unanimously they went with Luther in his views of the sacrament of the Supper. The simultaneous appearance, however, of Rationalism and Pietism about the middle of the eighteenth century interrupted the sluggish flow of Lutheran theology, few or no treatises of any special value for a half a century or more from that date having made their appearance. The Rationalists were too intent on their work of destruction to construct a scientific theology; and the Pietists, regarding religion as much more a matter of the heart than of the intellect, were indifferent to doctrinal discussions. The only strictly rationalist treatise on systematic theology worthy of note was that of Wegscheider (*Institutiones Theologiæ Christianæ Dogmaticæ*); the Pietists produced no dogmatic treatise; but Pietism and Rationalism have, one or the other, largely determined the methods and conclusions of subsequent treatises. The union of the Lutheran and the Reformed Churches in Germany, since 1817, has rendered increasingly indistinct the line of separation between the two theologies, and for this reason the later developments of Lutheran doctrine will be mentioned in connection with the Reformed theology after the time of Schleiermacher.

*The Reformed* (*Calvinist*).—At the head of all the Reformed theologians, and, in the estimation of some, of all Protestant as well, stands John Calvin. He was eleven years old when Melanchthon published the first edition of his *Loci*, and was but twenty-seven when he published the first edition of his own *Institutes of Theology* (*Christianæ Religionis Institutio*). Few if any writers on theology have surpassed him in transparency of thought, in depth or breadth of view, in strength of grasp, or in logical force and consistency. The Reformed theology has gained wide currency among different nations. Its adherents had so multiplied and organized themselves into Churches under Calvinistic creeds among different nations as to admit, with varying degrees of accuracy, of national designations. Thus we have the Swiss-French or Genevan Church, founded by Calvin (he published at Geneva the revised edition of his *Catechism*, 1541: the *Creeds*, *Consensus Tigurinus*, 1549; *Consensus Genevensis*, 1552; and the revised and standard edition of his *Institutes*, 1559); the Anglican, which through Cranmer and Ridley expressed itself in the Thirty-nine Articles, 1552; the German Reformed Church, which crystallized around the Heidelberg Catechism, 1562; the Dutch (Netherlands), which culminated in the Synod of Dort, 1618, and afterward signalized itself by the origin of the federal theory or covenant system, 1648; the Anglo-Scotch, which proclaimed itself in the Westminster Confession and Catechism, 1646–48: and, finally, we have the American type of theology, which, having begun under the Westminster Symbols (the Congregationalists adopting them 1648, and the Presbyterians 1729, while the Dutch brought with them the Heidelberg Catechism, and the Episcopalians the Thirty-nine Articles), now presents itself under new and ever-increasing variations.

Calvinistic theology, unlike the Lutheran, has been subject to many modifications, and has subdivided itself into a variety of schools. Some of these modifications have had their origin in reactions against extremes of view or of method, and others have resulted from the influence of special schools of speculative philosophy, to which the Reformed theology has always been much more sensitive than the Lutheran. Thus near the middle of the seventeenth century the Calvinist writers of the Netherlands had become excessively scholastic and formal. In opposition to their method, Cocceius (in German *Koch*, and English *Cook*) conceived the federal method or the system of covenants—a covenant of works between God and man, and a covenant of grace between God and Christ—a method which he regarded as founded on the historical order of the Scriptures. Francis Burman at Utrecht and Herman Witsius at Leyden adopted the federal theory. The Cartesian philosophy, just then engaging the attention of Europe, was accepted by the Federalists, who adopted it so far as it taught the capacity of the unaided reason of man to know God and his character; the Scholastics assailed it. Voetius and Van Mastricht (who styled it the gangrene of theology) being specially bitter in their denunciations. While the Netherlands were agitated with controversies about scholasticism, federalism, and Cartesianism, the Calvinists of France were equally moved by disputes over the two distinctively Calvinistic doctrines of predestination and imputation. The professors at Saumur persisted in modifications of the current statements of both these doctrines. Amyraldus (Amyraut) rejected absolute predestination, but propounded in its stead a predestination conditioned by a hypothetic or ideal universalism. Associated with Amyraut at Saumur was Placæus (La Place), who denied the doctrine of immediate imputation—i. e. the notion of a direct imputation of Adam's guilt to his innocent descendants—and affirmed the doctrine of mediate imputation—i. e. the imputation of Adam's guilt to his descendants as made guilty by an inherited evil nature. The views of both Amyraut and Placeus were opposed by Rivetus in France, by Francis Turretin at Geneva, and by J. H. Heidegger at Zurich. Against them, Heidegger was apppointed by the Swiss to draw up a symbolical book, the *Consensus Helveticus*, which was much discussed, but could never be lifted into a position of authority. Turretin, a sympathizing friend of Heidegger, in his important treatise on theology (*Institutio Theologiæ Elencticæ*) adopted the covenant theory of Cocceius and affirmed immediate imputation and absolute predestination. Again, during the first half of the eighteenth century the philosophy of Leibnitz having been adopted and adjusted to theological inquiries by Wolff, some of the Swiss theologians followed the Wolffian method. Wolff had maintained, and attempted to show by a most elaborate treatise, that the truths of natural theology were capable of demonstration, and that revealed theology, resting on natural, could thus be made to stand on a basis of science and certainty. But Wolff had also resolved all theological truths, whether of revealed or of natural religion, into mere abstract principles and definitions; and the theologians who constructed their systems after his method, while making a great show of logic, reduced theology to a mere system of formal and arid propositions. Notably of this class were Daniel Wyttenbach and J. F. Stapfer, of Berne. Schleiermacher, under the double influence of a pantheistic philosophy and of the Moravian teaching of his youth, gave to the German Reformed theology, during the first quarter of the nineteenth century, a tendency and a modification which continue. He mediated, however, between the Lutheran and the Reformed systems, thus influencing to some extent the methods and results of both. Schleiermacher based his system of theology upon the inner certainties of Christian feeling, and his writings constituted a transition from the rationalism of the preceding century to the more scriptural and evangelical faith represented by Neander and Tholuck, Twesten and Nitzsch, Müller and Dorner, Ebrard and Lange, Thomasius and Philippi, Luthardt and Kahnis. Two new forms of rationalism, however, have appeared in Germany, the one based upon the philosophy of Hegel, and numbering among its adherents Strauss and Baur, Biedermann, Lipsius, and Pfleiderer; the other based upon the philosophy of Kant, and advocated by Ritschl and his followers, Harnack, Hermann, and Kaftan; the former emphasizing the ideal Christ, the latter emphasizing the historical Christ, but neither of the two fully recognizing the living Christ present in every believer. The Swiss Reformed Church has produced an able conservative theologian in the person of Gretillat, of Montauban.

*Theologies in Antagonism with the Reformed.—Socinianism.*—At a very early period in the history of Protestant theology there was opposition to the doctrine of the Trinity. This opposition culminated in the person of Servetus, and he was put to death by burning. The opponents of trinitarianism gathered in Transylvania, and finally, organized by Faustus Socinus (d. 1604), became known as Socinians. Socinus wrote a brief treatise on theology, and a catechism which comprehended only the points in dispute between him and the trinitarians. The views of the Socinians are found in the *Racovian Catechism* and in the *Bibliotheca Fratrum Polonorum*. Socinianism has been represented by the Unitarians Samuel Clarke and James Martineau in England, and William Ellery Channing and James Freeman Clarke in the U. S. Unitarianism, however, has at no time produced a systematic theology. For a more extended account, see SOCINIANS AND SOCINIANISM.

*Arminianism.*—In reaction against the rigid high Calvinism of the Netherlands, Arminius denied the doctrine of absolute predestination, and propounded in its stead the doctrine of a predestination founded on the foreknowledge of God. Violent controversies ensued; the followers and successors of Arminius addressed a remonstrance to the state authorities; the Synod of Dort was convened, and the Remonstrants were excluded from the Reformed Church. Episcopius and Limborch elaborated the Arminian theology into a self-consistent system, while Hugo Grotius constructed the governmental theory of the atonement. The Methodists, who have inherited the theology of the Arminians, have for their systematic theologians in England Watson and Pope, in the U. S. Raymond, Foster, and Miley. English Methodists hold in general to the modified Arminianism of John Wesley, and regard man's ability to co-operate with God to be a matter of grace, while Arminius regarded the bestowal of this ability to be a matter of justice, man without it not being accountable. American Methodists, in general, hold more closely to original Arminianism, and maintain the almost unlimited self-determining power of the human will. See also ARMINIUS AND ARMINIANISM.

The Anglican Church and the Protestant Episcopal Church of the U. S. have taken little or no interest in the cultivation of systematic or scientific theology, in large part because, until recently, specifically theological schools have been lacking in England, and because questions of missions and of ritual have absorbed attention in the U. S. Pearson on *The Creed* and the popular expositions of the Thirty-nine Articles by Bishop Burnet, and more recently by Browne, Bishop of Winchester, are not in any proper sense scientific treatises on theology, although they are common English text-books. The "judicious" Hooker is still the greatest theological writer of the English Church, although his work is only on *Ecclesiastical Polity*. Yet there are signs of awakening interest in theology. Litton's *Compendium of Dogmatic Theology* and Moule's *Outlines of Christian Doctrine* show a tendency to return from the usual Arminianism of the Anglican Church to the old Augustinism; while Kedney's *Christian Doctrine* is a recent American work in which the speculative element is prominent.

The Baptists have been represented in theology by John Bunyan's *Gospel Truths Opened*, John Gill's *Body of Practical Divinity*, and Andrew Fuller's *Letters on Systematic Divinity*. It is in the U. S., however, that the Baptists have shown greatest activity both in theology and in missions. Within a few years have been published Ezekiel G. Robinson's *Christian Theology*, Augustus H. Strong's *Systematic Theology*, Alvah Hovey's *Manual of Theology and Ethics*, James P. Boyce's *Systematic Theology*, E. H. Johnson's *Outlines of Systematic Theology*, Ebenezer Dodge's *Christian Theology*, and W. N. Clarke's *Christian Theology*. The ablest exposition of the views of the Quakers is Robert Barclay's *Apology for the True Christian Divinity*.

*American theology* in general, aside from the writers already mentioned, has run in two lines: 1. The Reformed system of Jonathan Edwards, modified successively by Joseph Bellamy, Samuel Hopkins, Timothy Dwight, Nathaniel Emmons, Leonard Woods, Charles G. Finney, and Nathaniel W. Taylor. Jonathan Edwards, one of the greatest of metaphysicians and theologians, thought too little of nature, and tended to a thoroughgoing idealism. He regarded the chief good as happiness—a form of sensibility. Virtue was voluntary choice of this good. Hence union with Adam in acts and exercises was sufficient. This God's will made identity of being with Adam. There naturally followed the exercise-system of Hopkins and Emmons, on the one hand, and Bellamy's and Dwight's denial of any imputation of Adam's sin or of inborn depravity, on the other—which last denial was also made by many other New England theologians who rejected the exercise-scheme, as, for example, Strong, Tyler, Smalley, Burton, Woods, and Park. Dr. Nathaniel W. Taylor added a more distinctly Arminian element, the power of contrary choice—and with this tenet of the New Haven theology, Charles G. Finney, of Oberlin, substantially agreed. Thus from certain principles admitted by Edwards, who held in the main to an Old School theology, the New School theology has been gradually developed. Calvinism, as thus modified, is often called the New England theology. Through Horace Bushnell, and the influence of Andover professors who, in their turn, have followed the German Dorner, the New England or New School theology has developed a tendency to the doctrine of probation after death for those who have had no opportunity in this life to accept Christ; and, as thus modified, the New School theology is often called the New Theology. 2. The older Calvinism, represented by Charles Hodge the father, and A. A. Hodge the son, together with Robert J. Breckinridge, Samuel J. Baird, and William G. T. Shedd. All these, though with minor differences, hold to views of human depravity and divine grace more nearly conformed to the doctrine of Augustine and Calvin, and they are for this reason distinguished from the New School theologians and their followers by the popular title of Old School. Old School theology has for its characteristic tenet the guilt of inborn depravity; but among those who hold this view, some are federalists and creationists, and justify God's condemnation of all men upon the ground that Adam represented his posterity. Such are the Princeton theologians generally, including Charles Hodge, Archibald A. Hodge, and the brothers Alexander. Among those who hold to the Old School doctrine of the guilt of inborn depravity, however, there are others who are traducianists, and who explain the imputation of Adam's sin to his posterity upon the ground of the natural union between him and them. Baird's *Elohim Revealed* and Shedd's essay on *Original Sin* (Sin a Nature and that Nature Guilt) represent this realistic conception of the relation of the race to its first father. R. J. Breckinridge, Robert L. Dabney, and James H. Thornwell assert the fact of inherent corruption and guilt, but refuse to assign any rationale for it, though they tend to realism. Henry B. Smith holds guardedly to the theory of mediate imputation: but while ranked with the Old School he may be regarded as mediating between the Old School and the New. As a learned, acute, and philosophical theologian, he deserves to be placed next to Jonathan Edwards.

*Relation of Theology to Metaphysical and Physical Science.*—The rise and progress of systems of theology have always been coincident with the rise and progress of systems of philosophy. Mediæval theology is intelligible only by understanding the realistic or nominalistic philosophies of its authors; and the modern systems of Protestant theology can be fully understood only by understanding the systems of philosophy which underlie them. It is remarkable that while the great theological writers anterior to the sixteenth century, who are appealed to as common authorities by Roman and Protestant writers alike, were philosophical realists, the chief theological systems of the Protestant Churches rest either upon avowed and unadulterated nominalism or upon nominalism in the disguised form of conceptualism; but with the traditional influence of metaphysical systems the natural sciences have in our day been rapidly coming into collision. It is the office of these sciences to ascertain what is really knowable of the processes of nature, and to reduce this knowledge to exact forms of statement. In fulfillment of this office, these sciences, in their manifold departments, are not only rendering an invaluable service to the science of mind, by bringing metaphysicians to observe its actual phenomena rather than to build on definitions of its processes, but are doing a work of equal value to theology, by requiring theologians to deal with law, government, sin, righteousness, character, heredity, and other fundamental truths, not as mere names or conceptions, but as the most real of realities. Both in Europe and in the U. S. the most recent theology has been greatly influenced by the monistic tendencies of modern science, in some instances to the denial of the freedom of man and of the transcendence of God, in other cases with a strenuous affirmation of these ethical postulates. The so-called higher criticism has applied the principles of historical development to the Old Testament, with the result in some cases of denying any specifically divine element, but in general with the only result of inducing a somewhat broader view of divine inspiration as possibly consistent with error in matters not affecting the moral or religious teaching of the Scriptures. The theology of the future, which is to stand the test of criticism and control the consciences of men, must, like the teachings of the New Testament, rest on a basis of reality, and find in the consciousness of mankind an unequivocal testimony to its truth.

LITERATURE.—Petavius, *Opus de Theologicis Dogmatibus*; Bellarmine, *Disputationes de Controversiis Fidei*; Möhler, *Symbolism*; Gass, *Geschichte der protestantischen Dogmatik*; Polenz, *Geschichte des Calvinismus*; Heppe, *Dogmatik des deutschen Protestantismus*; Hase, *Hutterus Redivivus*; Schweizer, *Die Glaubenslehre der evangelischen Reform-Kirche.* The church histories of Neander, Gieseler, Hase, and Guericke; Neander, *Christliche Dogmengeschichte* (History of Christian Dogmas, translated by J. E. Ryland); Hagenbach, *History of Doctrines* (the translation revised and enlarged by H. B. Smith); Winer, *Comparative Darstellung des Lehrbegriffs der verschiedenen christlichen Kirchenparteien*; Schneckenburger, *Vergleichende Darstellung des Lutherischen und reformirten Lehrbegriffs*; Schaff, *Creeds of Christendom*; Dorner, *History of Protestant Theology*; and the *History of Theology* in Gretillat's *Théologie Systématique.* Dictionaries of theology, which give definitions of theological terms and articles upon theologians and their systems, exist in different languages. Of them the best are known as Herzog's *Real-Encyklopädie*, the great thesaurus of Protestant learning (2d ed. Leipzig, 1877–88, 18 vols.); Wetzer and Welte's *Kirchenlexicon*, the great thesaurus of Roman Catholic learning (2d ed. Freiburg im Breisgau, 1882, *seq.*); McClintock and Strong, *Cyclopædia of Sacred Literature* (New York, 1867–81, 10 vols., with 2 supplementary vols. and supplements 1887, *seq.*); less extensive is the *Schaff-Herzog Encyclopedia* (New York, 3 vols., 1884; rev. ed. 1887); in one volume are W. F. Hook's *Church Dictionary* (London, 1842; 14th ed. 1887); J. H. Blunt's *Dictionary of Theology* (1870); W. E. Addis and T. Arnold's [Roman] *Catholic Dictionary* (London and New York, 1883; 4th ed. 1893). See also ANTHROPOLOGY, ATONEMENT, CALVINISM, CHURCH HISTORY, FUTURE STATE, GERMAN THEOLOGY, and GOD. Revised by AUGUSTUS H. STRONG.

**Theopaschites**: the Greek name for PATRIPASSIANS (*q. v.*).

**Theoph'ilus**: Bishop of Antioch (171–185); probably of heathen parentage; famous for his *Apologia ad Autolycum*, an elaborate apology for Christianity. He is the first Christian writer to mention a Trinity in the Divine Nature (*Apol.*, ii., 15). A commentary on the Gospels is ascribed to him, but probably inaccurately. The *Apology* was best edited by Otto (Jena, 1861), and has been translated in the *Ante-Nicene Fathers*, ii., 89–121. S. M. J.

**Theophilus**: Byzantine emperor (829–842). A brave and skillful soldier, he waged generally successful wars in Sicily and against the Saracens, and led his armies in person as far as the Euphrates. He enforced justice, rewarded merit, and his reign was glorious. The iconoclastic controversy which had convulsed the empire over a hundred years was terminated at his death. E. A. G.

**Theophras'tus** (Gr. Θεόφραστος) **of Eresus**, in Lesbos: Greek philosopher; became the head of the Peripatetic School after the death of its founder, ARISTOTLE (*q. v.*), and presided over its fortunes, which prospered under his guidance for thirty-five years (322–287 B. C.). This prosperity was due to the character and ability of the head of the school, who enjoyed the highest esteem both at home and abroad. His lectures had the same themes and the same titles as those of his great predecessor. Especially attractive were his discourses on ethical topics, in which he showed the indulgent temper of a man of the world; and in the province of science he eclipsed the botanical work of Aristotle. His treatises on *Practical Botany* (περὶ φυτῶν ἱστορίας) in nine books and *Theoretical Botany* (περὶ φυτῶν αἰτιῶν) in six books are still extant, besides fragments of works on mineralogy (περὶ λίθων), on the senses, and on metaphysics. But the work by which he is best known is his treatise called *Characters* (χαρακτῆρες). These sketches of character by Theophrastus, who was a friend of MENANDER (*q. v.*), are taken not from real life, but from the mimic life of the stage, and are of great importance for the study of the New Comedy. The book has enjoyed unbounded popularity, and has been imitated scores of times. Especially famous are La Bruyère's companion pieces in French, and George Eliot's *Theophrastus Such.*

Unfortunately only the vicious and ludicrous characters have been preserved, and the book has come down to us in a condition which shows serious interference with the original form. There is an edition of all the works by J. G. Schneider (Leipzig, 1818); a critical edition by Wimmer (Leipzig, 1862); of the *Characters* by Casaubon (Leyden, 1592), and one by Jebb (1870). B. L. GILDERSLEEVE.

**Theoph'ylact** (surnamed SIMOCATTA): author; b. at Locri, of Egyptian descent; went to Constantinople in 610 A. D., held various offices during the reign of Heraclius, and died there about 629. His extant works comprise *Historiæ Mauricii Tiberii Imperatoris Libri VIII.* (first edited with a Latin translation in 1604, latest ed. by Immanuel Bekker, Bonn, 1834), which gives a minute account of the Emperor Maurice's wars from 582 to 602; eighty-five letters divided into *morales. rusticæ et amatoriæ* (Venice, 1499); and *Questiones Physicæ*, edited by J. F. Boissonade (Paris, 1835).
Revised by S. M. JACKSON.

**Theophylact**: archbishop; b. at Euripus, on the island of Eubœa: seems to have gone early to Constantinople, where he obtained great reputation for learning, and was appointed teacher to Constantinus Porphyrogenitus. In 1078 he was make Archbishop of Achrida, in Bulgaria, and took up his residence at Achrida, where he died after 1107. He was a prolific writer, and his collected works were published in a splendid edition by Maria de Rubeis (4 vols. fol., Venet., 1754–63, reprinted in Migne's *Patrologia Græca*, lxiii., lxiv.). His commentaries are really catenas derived mostly from Chrysostom and not original, but they are remarkably well done, and may be consulted with advantage. This remark applies especially to his commentary on the four Gospels, which was translated into Latin by Œcolampadius (Basel, 1524). SAMUEL MACAULEY JACKSON.

**Theopom'pus** (Gr. Θεόπομπος) **of Chios**: Greek historian; b. about 380 B. C.; was banished from his native island in early life and took refuge in Athens, where he became a pupil of Isocrates, who said of him that he needed the bit as his fellow-pupil Ephorus needed the spur. Theopompus had great success as a composer of show speeches, especially with his panegyric on Mausolus, King of Caria, but, like EPHORUS (*q. v.*), he is known chiefly as an historian. In his *History of Greece* (Ἑλληνικά), twelve books, he took up the thread of narrative where Thucydides dropped it, and told the story of Greece from 410 to 394, the date of the battle of Cnidus. In his *History of Philip* (Φιλιππικά), fifty-eight books, he made the reign of Philip of Macedon the center. Besides these works an epitome of Herodotus in two books was attributed to him, and Anaximenes the rhetorician forged under his name a famous invective, *Three-headed* (Τρικάρανος), in which Athens, Sparta, and Thebes were represented as the triple monster that had ruled and ruined Greece. Of all his work nothing is left save extracts and fragments; but an epitome of the Latin translation of his *Philippica* by Trogus Pompeius survives in the work of Justin. He was a vigorous writer, but first and foremost a rhetorician rather than an historian, and he may be set down as a bitter partisan and a propagator of scandalous stories, which later gossips were only too glad to repeat. Fragments in Müller's *Fragmenta Historicorum Græcorum*, vol. i., pp. 278–333.
B. L. GILDERSLEEVE.

**Theos'ophy** [from Gr. θεοσοφία, knowledge of divine things, deriv. of θεόσοφος, wise about God; Θεός, God + σοφός, wise]: a name which, as specifying a religious philosophy, was originated by Ammonius Saccas in the third century of our era. The body of ethical, philosophic, and scientific doctrines to which that title applies is, however, as old as humanity itself, and contains everything that is true in all other and later systems. Esoterically preserved and transmitted in its entirety by adepts and initiates, from time immemorial, their messengers—known to the world as "great teachers" and "saviours"—have, at periodic intervals determined by cyclic law, exoterically taught as much of it as could safely be given out and which any considerable portion of our race could at such times receive and assimilate.

Theosophy teaches a knowledge of the laws governing the evolution of the universe. It is not based upon assumed divine revelation, but upon consciousness. It sees no unsolvable mystery anywhere, throws the words coincidence and chance out of its vocabulary, and affirms the omnipresence and omnipotence of law and perfect justice. Theosophy postulates an Eternal Principle, unknowable except in its manifestations, which is in and is all things, and which, periodically and eternally, manifests itself and recedes from manifestation—evolution and involution. Its opposite poles in the manifested universe are spirit and matter, which are coexistent and inseparable. In manifesting itself the spirit-matter differentiates on seven planes, which are of progressive density down to that within our sensuous perception, the substance in all being the same, but differing in the proportions of its two compound elements. Through all thrill ceaselessly vibrations which are the inexhaustible impulse from the First Cause. These vibrations are distinct, each from all the others, and each always the same in mode upon every plane, but differing in rate according to the rarity or density of the substance of the plane. By means of these vibrations are brought about all forces—phenomena in nature, specialized differentiations and effects of creation, preservation, and mutation—in the world of forms as well as upon the ethereal planes. Thus every atom of the universe is infused with spirit, which is life in one of its phases of manifestation, and endowed with qualities of consciousness and intelligence—likewise phases of the spirit—in conformity to the requirements of its differentiation. On the lowest material plane, which is that of humanity, the spirit focalizes itself in all human beings who permit it to do so. Its rejection is the cause of ignorance, from which flow all sin, suffering, and sorrow; by its conscious acceptance man becomes partaker of the Divine Wisdom, "one with the gods," entering into possession of an ever-increasing power of consciousness, and attains oneness with the Absolute. This is the ultimate destiny of all beings; hence Theosophy affirms the perfectibility of the race and rejects the concept of innate unregenerable wickedness. From the theosophic point of view the world is compounded of the Egos or individual spirits, for whom it emanates from the Divine Will; and its evolution is due to the impulse imparted by its spiritual element, that force manifesting itself from the beginning in the primary conditions of life—far below the sentient stage—and having in the evolvement of higher forms, including man, the guidance and direction of intelligent, perfected beings from other and older evolutions. Hence man is deemed a conscious spirit, the flower of evolution; while below him, in the lower kingdoms, are other less-advanced classes of egos, all, however, on the way of ascent to the human stage, which they will eventually reach when man has gone on still higher. The perfecting of self-consciousness is the object of evolution. By this man is enabled to reach more exalted stages of existence. And his conditioned mortal life is for the purpose of affording him experience by which that self-consciousness may be developed and cognition of the spirit attained.

Man is a spirit and requires vehicles with which to come in touch with all the planes of nature included in evolution, and it is these vehicles that make of him an intricate, composite being, liable to error, but at the same time able to rise above all delusions. He is in miniature the universe, for he is, as spirit, manifesting himself to himself by means of seven differentiations. Therefore he is characterized in Theosophy as a septenate or sevenfold being. His immortal being comprises a trinity, spirit (*Atman*), the spiritual soul or discernment (*Buddhi*), and mind (*Manas*). This triad requires as vehicles or instruments through which to operate and gain cognition in matter four lower mortal principles. These are: The animal passions and desires, unintelligent and productive of ignorance through delusion (*Kama*); the life-energy (*Jiva*); the astral body (*Linga Sarira*), which is the connecting link between the ethereal principles and the corporeality; and, finally, the physical body (*Sthula Sarira*). The principle designated as *Jiva* is a special differentiation for the energizing of the human being from the great *pranic* ocean of the life-principle, which is one of the distinctive vibrations already spoken of, and a phase of manifestation of the spirit. It does not cease when the collective entity called man dies, but simply continues its vibrations in the myriad of lives that make up the cells of the body without animating them in harmonious aggregate action. The *Linga Sarira* belongs to the astral plane of matter, which, being next above that of our tangible world in refinement of its substance, is just beyond our normal sensuous perception. As the physical body is at death reabsorbed into the material elements whence it was drawn, so the astral body is eventually dissipated in and absorbed by the substance of its plane; but its permanence is much greater than that of the gross body. During life it is from the earliest moment until the last the model upon which are moulded the physical molecules of which the body is composed, and through it the life-principle is enabled to animate the aggregate mass as a collective entity. These lower four principles or sheaths are the transitory, perishable part of man—not himself, but in every sense the instruments he uses—given up at the hour of death and rebuilt at every new birth. The trinity is the real man, the thinker, the individuality that passes from house to house, gaining experience at each rebirth, while it suffers and enjoys according to its deeds. In each successive earth-life he is known to others as a new personality, but in the whole stretch of eternity he is one individual, conscious of an identity not dependent on name, form, or recollections of personalities. This doctrine of reincarnation is the very base of Theosophy, for it explains life and nature as no other hypothesis can; and it is an essential to the scheme of evolution, for without such re-embodiment on the plane of experiences and atonements there could be no evolution of the human soul. The Ego returning to mortal life only goes into the family which either completely answers to its whole nature, gives an opportunity for its evolutionary progress, or is connected with it by reason of events in past incarnations and causes mutually created. Inseparable from the doctrine of reincarnation is that of *Karma*, or justice, sometimes called the "ethical law of causation." Mere entry into life is no fit foundation for just reward or punishment, which must be the deserts for prior conduct. But such consequent awards determine entry into life, and with unerring equity establish the sequence of good and evil happenings in requital of the past. Effect is always in cause, and thus the body, brain, and intellectual faculties furnished by reincarnation being products of one's own deserving, become the field from which must be gleaned the harvest planted by acts in the past. The law of Karma applies in physical nature as well as in ethics to solar systems, planets, races, nations, families, and individuals. With reincarnation the doctrine of Karma explains the misery and suffering of the world, and no room is left to accuse nature of injustice. The misery of any nation or race is the direct result of the thoughts and acts of the Egos who make up the race or nation. If they did wickedly in the past, they must suffer the inevitable consequences. To this end they must go on incarnating and reincarnating until the effects they caused have been exhausted. Though the nation thus suffering chastisement should for a time disappear, the Egos belonging to it could not leave the world, but would reappear as the founders of some new nation in which they would continue to receive their karmic due.

With reference to *post-mortem* conditions, Theosophy teaches two states of existence somewhat analogous to the Christian "purgatory" and "heaven." The first, immediately subsequent to earth-life, is *Kama-loka*, where the immortal triad takes leave of the lower principles remaining after separation from the body. Thence the Ego passes into *Devachan*. The former is, as its name indicates, a place —the astral plane penetrating and surrounding the earth— the latter a state of being, or rather of consciousness. In Kama-loka all the hidden passions and desires are let loose, and enough mentality is retained to make them tortures. When the astral body in which they cohere is disintegrated, as it is in time, they remain a sort of entity in the *Kama-Rupa*, a form of still less materiality than the *Linga Sarira*. Eventually this too is said to fade out, leaving only their essence, the *Skandhas*, fateful germs of karmic consequence, which, when the Ego emerges from the devachanic state, are by the law of attraction drawn to the new being in which it incarnates. Owing to the law of cohesion between the principles, which prevents their separation before a given time, the untimely dead must pass in Kama-loka a period almost equal to the length life would have been but for the sudden termination. Losing the body has not killed them. They still consciously exist in the astral body, and in the case of very wicked and forceful persons—some executed criminals, for instance—may be even more harmful on the astral plane than they were in life. Prolonged kama-lokic existence is no injustice to the victims of accident, since death, like everything else, is a karmic consequence. Finally, it may be said of Kama-loka that it is the last conscious state of the thoroughly evil human souls bereft of the spiritual tie and doomed to annihilation (*Avitchī*). Having in life centered the consciousness in the *kamic* principle, preserved intellect and rejected the spirit, leading persistent lives of evil for its own sake, they are the only damned beings we know. Pure souls speedily pass from Kama-loka to the devachanic state. It is a period of rest; a real existence, no more illusionary than earth-life, where the essence of the thoughts of life that were as high as character permitted expands and is garnered by the soul and mind. When the force of these thoughts is fully exhausted the soul is once more drawn back to earth, to that environment which will best promote its further evolution.

No new ethics are presented by Theosophy, as it is held that right ethics are forever the same. But in the doctrines of Theosophy are to be found the philosophical and reasonable basis of ethics and the natural enforcement of them in practice. The present worldwide interest in Theosophy dates from 1875, when Helena P. Blavatsky, a messenger of the adepts, appeared in New York, initiated the theosophic movement, and, with Henry S. Olcott, William Q. Judge, and several other persons, formed the Theosophical Society. Other revivals of the ancient doctrine, occurring in the last quarter of each century during several hundred years past, are matters of historic record; but, as their times were not propitious, they amounted to little in their effect upon humanity at large compared with the importance this one has attained. The Theosophical Society, though its members generally, no doubt, subscribe to theosophic doctrine, is not dogmatic, but admits to membership all who can conscientiously accept its three avowed objects: 1. "To form the nucleus of a Universal Brotherhood of Humanity without any distinctions whatever. 2. To promote the study of ancient and modern religions, philosophies, and sciences. 3. To investigate unexplained laws of nature and the psychical powers of man." Starting with a membership of fifteen persons in 1875, it has spread all over the globe, until now it has hundreds of branches scattered through all the civilized and even the semi-civilized countries, and counts its members by thousands. Beyond its organization in importance, however, is the wonderful influence of theosophic teachings in coloring the literature, thought, ethics, and even scientific progress and religious expression of the world. The size of the society gives but a very imperfect idea of the extent of its work.

The best books conveying instruction in detail concerning theosophic doctrine—but a meager skeleton of which has been offered in the foregoing—are the following: H. P. Blavatsky, *The Secret Doctrine* (1888); *Isis Unveiled* (1877); *The Key to Theosophy* (1889); William Q. Judge, *The Ocean of Theosophy* (1893); A. P. Sinnett, *Esoteric Buddhism* (1883); *Five Years of Theosophy*, selections from *The Theosophist* (1885); Rama Prasad, *Nature's Finer Forces* (1890); *Patanjali* (Judge's version) *Yoga Aphorisms* (1889). A score of theosophic magazines are issued in half as many languages. The leading one of the Theosophical Society in America is *The Path*, published in New York. WILLIAM Q. JUDGE.

**Thera**: See SANTORIN.

**Theramenes**, the-răm'ē-nēez (in Gr. Θηραμένης): an Athenian politician whose name figures in all political transactions during the last years of the Peloponnesian war, now on the side of the demagogues, now on the side of the oligarchs, and always in the character of a traitor. After the battle of Arginusæ (406 B. C.), in which he held a subordinate command in the right wing of the Athenian fleet, he was ordered to return to the scene of action and save as many as possible of the disabled galleys and their crews. A heavy storm set in, which made the execution of the order impracticable, and a great number of Athenian citizens were drowned. In order to escape the odium of this incident, Theramenes speedily repaired to Athens and accused the commanders-in-chief of having taken no measures in the case. In 404 B. C. he was sent first to Lysander, who besieged Athens, and afterward to Sparta, to negotiate a peace, but he postponed the final conclusion of a treaty until the Athenians were reduced to such a degree that they were compelled to accept any conditions whatever. After the peace he was elected one of the thirty tyrants, but as he opposed the violent measures of that body, he became suspected by Critias, was accused by him as an enemy of the state, and finally forced to drink poison. He was a man of eloquence, and, according to Diodorus, a disciple of Socrates.

Revised by J. R. S. STERRETT.

**Therapeu'tæ** [= Lat. = Gr. Θεραπευταί, liter., servants, deriv. of θεραπεύειν, minister to, serve, deriv. of θεράπων, attendant, servant]: a sect of Jewish contemplative ascetics, kindred to, though distinct from, the Essenes. Their chief seat was on Lake Mareotis, the body of water immediately S. of Alexandria, in Egypt. They were of both sexes, strictly observed the Sabbath and other Jewish festivals, were ardent students of the Mosaic law, and claimed to have secret religious knowledge. Philo describes them in his treatise *On a Contemplative Life, or on the Virtues of Suppliants* (Yonge's Eng. trans. of Philo, Bohn's Series, iv., 1–20). Philo is the only writer to mention them—a fact which has led some to deny their existence and to attribute to a Christian forger of the fourth century the mention of them by Philo. See the exhaustive treatise by Fred. C. Conybeare, *Philo about the Contemplative Life* (Oxford, 1895). SAMUEL MACAULEY JACKSON.

**Therapic Acid**: See COD-LIVER OIL.

**Theresa**, tā-rā'sā̆ă, or **Teresa de Jesus**, SAINT: b. at Avila, Spain, Mar. 28, 1515, her full name being TERESA SANCHEZ DE CEPEDA; entered (Nov. 2, 1536) the Carmelite monastery at Avila, and in 1562 founded a reformed branch of Carmelite nuns. She made a prolonged study of theology and wrote several mystical and ascetic treatises, which are accounted among the Spanish classics, and obtained her a great reputation. Among them are *Discurso ó Relacion de su Vida* (1562), an autobiography giving an account of her interior conflicts and visions; *El Camino de la Perfeccion* (1563); *El Libro de las Fundaciones; El Castillo interior, ó las Moradas* (1577), a mystic description of the heavenly life; and *Santos Conceptos de Amor de Dios.* D. at Alba, Oct. 4, 1582. She was canonized by Gregory XV. in 1621. Revised by J. J. KEANE.

**Theresi'na**: capital of the state of Piauhy, Brazil; on the right bank of the Parnahyba river, 220 miles above its mouth in the Atlantic (see map of South America, ref. 4–G). It was founded in 1852, the capital being removed from Oeiras. The town is regularly laid out, but has no buildings of note and the trade is inconsiderable. The climate is somewhat insalubrious, though less so than that of Parnahyba. Pop. about 8,000. H. H. S.

**Theresiopel**, or **Maria-Theresiopel**: See SZABADKA.

**Theresop'olis**: town of the state of Rio de Janeiro, Brazil; in a high valley of the Organ Mountains; 38 miles by railway from Nictheroy on the Bay of Rio (see map of South America, ref. 7–G). It was originally a German colony, named in honor of the Empress Theresa. On account of its delightful climate and magnificent mountain scenery it is a favorite summer resort, and no place near the capital better merits a visit of the tourist. In 1892 it was selected as the state capital, but subsequently this was changed to Petropolis. Pop. 6,000. H. H. S.

**Thereza Christina Maria**: Empress of Brazil; b. in Naples, Mar. 14, 1822. She was a daughter of Francis I., King of the Sicilies, by his marriage with Maria Isabella, Infanta of Spain. In 1843 she married Pedro II., Emperor of Brazil. Her unassuming goodness caused her to be generally beloved. The Brazilian revolution and the abdication of the emperor were the probable causes of her death at Oporto, Portugal, Dec. 28, 1889. Of her children only one, Isabel of Bragança, survives. See PEDRO II. H. H. S.

**Thermæ** [Lat., warm springs, warm baths = Gr. θέρμαι, warm springs]: essentially, structures of the Roman imperial epoch consisting in general of large establishments in which baths of all sorts were provided, including large tanks for swimming, together with grounds for running, ball-play, etc., halls for similar exercises, porticoes for promenade and conversation, lecture-rooms, libraries, and probably rooms for eating and festivity. Public baths existed before the time of Augustus in Rome and in other cities, but the earliest thermæ erected was that of Marcus Agrippa. For the architecture of these structures, see ARCHITECTURE. The service of these gigantic places of resort was performed by slaves in great numbers, and carried on by means of underground passages elaborately planned and systematized. Some of the underground structures of the baths of Diocletian in Rome have been explored, but it is probable that much remains to be known of them. Admission to the thermæ was by means of a small fee, but at times the generosity of the emperor or some public man opened some one thermæ gratuitously for a time. The regulations about the hours of opening and closing, the separation of the sexes, the charge for admission and other details of management were frequently varied, and many edicts concerning them are on record. There also remains much that is unknown in the matter of the arrangement of the buildings and the use of different parts; nor is it certain whether the admission fee was payable for the use of the buildings, the porticoes, etc., or for bathing only. See ROMAN ARCHÆOLOGY. RUSSELL STURGIS.

**Thermal Springs** [*thermal* is from Gr. θερμός, hot]: in general, springs which have a mean annual temperature higher than that of the region in which they are found. Many springs which maintain an even temperature throughout the year appear warm in winter and cold in summer, owing to changes in the temperature of the air.

In most instances the designation thermal is restricted to springs where the temperature stands from 10° to 15° F. above that of the surrounding atmosphere. All observations lead to the opinion that the cause of these high temperatures must be found in the heated rocks below the surface. It does not follow that the waters themselves are necessarily derived from any deep-seated source. On the contrary, the waters of hot springs are mainly meteoric waters that have penetrated downward a sufficient distance to attain increased temperature by contact with heated rocks. In other words, the higher temperature is due to internal heat which is known to increase with depth.

Nearly all thermal springs are found either in regions of orographic disturbance, where the rocks have undergone great displacement through faulting and folding, or else in regions that have been subjected to volcanic eruptions. As lavas have been forced to the surface along lines of least resistance, it not infrequently happens that profound disturbance of strata and volcanic eruptions occur together in the same locality. All regions where hot springs are on a grand scale appear to have been at one time or another centers of eruptive energy. This has been shown to be the case in so many instances that thermal activity and volcanic manifestations may be regarded as closely associated phenomena. In areas of eruptive rocks where the pouring out of lavas long since ceased, the occurrence of thermal springs is looked upon as evidence of the dying out of volcanic energy. Such heated waters testify to the slow cooling of underground lavas through long periods of time. In many localities eruptions have not taken place since Tertiary time, yet connected with them are boiling springs still active and discharging vast quantities of water. The amount of internal heat dissipated by this continuous action of hot springs and steam-vents must be very great.

*Distribution of Thermal Springs.*—Thermal springs occur in all parts of the world, and not one of the great continental divisions is without them. Many of the larger islands of the world have hot springs, which are usually recognized even by primitive inhabitants as possessing curative properties for many forms of human ailment. In Europe hot springs are numbered by thousands; in France alone over 900 have been described, mostly in the Auvergne, a region of extinct volcanoes. In England, where all volcanic action ceased before the historic period, two hot springs have been noted for centuries. The spring at Bath is known to have remained nearly in its present condition ever since the occupation of England by the Romans. It maintains a temperature of 120° F., and according to the best estimates discharges daily 180,000 gal. of water carrying mineral matter in solution. At Buxton the temperature stands at 82° F. Hot springs extend along the Cordillera from the southern end of South America, through Central America, Mexico, the U. S., and well up into British Columbia. They are distributed over the Appalachians—North Carolina and Virginia being noted for hot springs. In Virginia they are connected with the anticlinal axes and displacements in sedimentary strata. The regions where thermal activity is displayed on the grandest scale, with the most extensive outflows of hot water, are Iceland, New Zealand, and the Yellowstone National Park. Within the restricted area of the Yellowstone Park there are between 3,500 and 4,000 hot springs, without counting innumerable steam-vents and fumaroles. The cauldron of Excelsior geyser discharges 4,400 gal. of boiling water a minute. Geysers are intermittent hot springs. See YELLOWSTONE PARK.

Notwithstanding the wide distribution of thermal springs, there are extensive areas in which none exist. They are wanting in the Mississippi valley and over the Great Plains, and none are known along the coastal plain of the South Atlantic States. Over large areas in Russia they appear to be absent. Their absence in these localities is accounted for by the fact that the sedimentary rocks lie nearly horizontal and show little disturbance. Hot waters fail to reach the surface, and if any exist they flow off underground. Proximity to the seacoast and elevation above sea-level apparently exercise no influence upon the distribution of thermal waters. In the elevated portions of the Andes, notably in Chili and on the high plateau of Tibet, hot waters flowing from fissures in the rocks have been recorded by scientific travelers at elevations from 10,000 to 16,000 feet above sea-level. In the Yellowstone Park they are found over 8,000 feet above the ocean.

*Temperature.*—At the surface the temperature of thermal springs varies from a few degrees above that of the air, up to the boiling-point. As a large number of springs are situated less than 1,000 feet above sea-level, many of the boiling waters show a temperature but a little below 212° F. On higher plateaus and elevated mountain regions the boiling-point is reached at much lower temperature. In the geyser basins of the Yellowstone Park water boils at 198° F. Careful observations made by lowering self-registering thermometers into hot pools and geyser-vents gave some clew to increased underground heat. In the Upper Geyser Basin, at only 70 feet below the surface, the thermometer recorded 253° F., a rise in temperature due to the pressure of a superincumbent column of water.

*Solvent Power.*—In general, the solvent power of thermal waters may be said to increase with temperature. Pressure also increases the power of hot waters to take up mineral matter in solution. Many of the relatively cool springs may have acquired their mineral contents at lower depths and consequently higher temperatures. Thermal waters which hold alkaline carbonates in solution have greatly augmented their solvent power for other mineral substances, notably silica, a common ingredient of boiling water in volcanic regions. The mineral ingredients of thermal springs are varied and embrace all substances found in what are usually designated natural mineral waters. Owing to their great solvent power nearly all thermal waters may be considered as mineral waters. In general, any classification of mineral waters based upon chemical composition would apply equally well to thermal waters. ARNOLD HAGUE.

**Thermic Fever**, or **Sunstroke**: fever due to excessive heat, but most commonly due to exposure to the direct heat of the sun; indirect solar heat or artificial heat may have the same effect. There is another form of disease which results from excessive heat quite distinct in its characteristics from thermic fever in that the temperature of the body is depressed. This is generally called *heat exhaustion.* In its mildest form it is represented by the weakness of feeble persons subjected to heat while under exertion. In severe cases there is profound depression, pallor, and in the most severe forms collapse and unconsciousness. The temperature of the body is lowered sometimes to 95° F. Thermic fever, on the other hand, is characterized by high fever, the thermometer in severe cases registering as much as 112° and 115° F. The onset of the symptoms is usually abrupt, though vague distress or weakness may precede their development. The patient rapidly sinks into unconsciousness, is extremely restless, even delirious or maniacal, the surface of the body is red and covered with sweat, the eyes are suffused with blood, and vomiting and purging are frequently present. Unless the patient is promptly treated death ensues from paralysis of the controlling mechanism of respiration and circulation in the brain. The causes of heat exhaustion and thermic fever have been the subject of much speculation, but it is now recognized that the important factor is the immediate effect of heat upon the nervous centers at the base of the brain. Whatever lowers the vitality and resisting power of the system, such as ill health or fatigue, contributes to the development of these diseases, but the immediate cause is the heat itself.

The treatment is different in the two forms. In heat exhaustion the temperature of the body must be promptly elevated by the use of external heat, and stimulants, such as digitalis, atropine, and strychnine, are demanded imperatively. In the case of thermic fever, on the other hand, reduction of the excessive fever is the first requisite. For this purpose cold bathing, effusions of ice-water over the chest and body, or rubbing with ice must be resorted to, and should not be delayed a moment beyond necessity. Antipyrine is a remedy useful for the reduction of fever, but is not in the least comparable with cold water. Where the circulation is failing digitalis should be given hypodermatically; and, on the other hand, in cases of great excitement of the circulation, venesection is used with advantage.

After recovery from sunstroke or heat exhaustion there is often an abnormal susceptibility to the effects of heat, and meningitis or other diseases may follow in consequence of the attack or of the greater susceptibility resulting from the attack. WILLIAM PEPPER.

**Thermidor**, Fr. pron. tār'mēē'dōr' [= Fr. from Gr. θερμός, hot]: the eleventh month of the French republican calendar. It began on July 19 and ended with Aug. 18.

**Thermo-æsthesiometer**: See RECORDING APPARATUS, PSYCHOLOGICAL, in the Appendix.

**Thermo-chemistry** [from Gr. θέρμη, heat + Eng. *chemistry*]: that branch of chemistry which deals with the investigation of the evolution and absorption of heat in chemical reactions. Whenever a chemical change takes place there is either an evolution or absorption of heat, and a complete study of the change necessarily involves an estimation of the quantity of heat evolved or absorbed. In 1840 Hess, of St. Petersburg, announced the fundamental law of constant heat summation, according to which the amount of heat developed in a reaction is the same no matter what the intermediate stages may be. Another fundamental law is this: The amount of heat required to decompose a compound into its constituents is the same as the amount evolved in its formation. An immense number of determinations have been made, particularly by Julius Thomsen, of Copenhagen, and by M. Berthelot, of Paris, and the laws referred to have been shown to hold good. While work of this kind is of undoubted value, it has had a comparatively slight effect upon the advance of chemical science. See CHEMISTRY. IRA REMSEN.

**Thermody'namics** [from Gr. θέρμη, heat + δύναμις, power]: the science which deals with physical phenomena involving either the development of heat or the transformation of heat into other forms of energy. The development of the science has been most rapid since the middle of the nineteenth century, and its applications, which were at first confined to the problems of mass mechanics, now extend to such fields as electro-chemistry, thermo-electricity, and the various branches of physical chemistry. The following may be cited as examples of cases where the principles of thermodynamics are involved: The expansion of bodies when heated; the development of heat by compression; the transformation of heat into mechanical energy in the steam-engine and other heat-engines; the dissociation of gases and of substances in solution; the flow of gases; fusion and evaporation; the influence of temperature changes upon the electromotive force of a voltaic cell. The fundamental principles of the science are usually stated in the form of the two laws of thermodynamics which are explained below.

*First Law.*—The first law, although capable of expression in a variety of forms, is at bottom only a statement of the principle of the conservation of energy as applied to cases where heat is transformed or developed. Heat being a form of energy may be measured in ordinary mechanical units. (See ENERGY.) Thus 1 British thermal unit is developed by the expenditure of 778 foot-pounds of energy, or 1 minor calorie $= 4{\cdot}197 \times 10^7$ ergs. Similarly, when one calorie of heat is transformed, $4{\cdot}197 \times 10^7$ ergs are obtained in some other form of energy. The first law merely states that heat is a form of energy capable of transformation, and that the mechanical equivalent of heat is constant. The first law is often put into the following form: If a quantity of heat $dQ$ is imparted to a body, this energy is expended (1) in increasing the internal energy of the body by raising its temperature or changing its state; (2) by causing the body to expand and so do external work. If $dU$ represents the change in the internal energy and $dW$ the work done against external forces during expansion, then the law of energy requires that

$$dQ = dU + dW, \qquad (1)$$

where $dQ$ is supposed to be measured in mechanical units. If $p$ and $v$ represent the pressure and volume of the body, we have $dW = pdv$, and the equation may be written in the more usual form

$$dQ = dU + pdv. \qquad (2)$$

Many thermodynamic problems may be solved by a direct application of the energy relations expressed by the first law. Among such may be cited those problems of hydromechanics and PNEUMATICS (*q. v.*), which involve heat transformations as well as ordinary mechanical considerations.

The pressure, volume, and absolute temperature of a perfect gas are found to be related by the equation

$$pv = RT, \qquad (3)$$

in which $R$ is a constant depending upon the chemical constitution of the gas, $v$ refers to the volume of unit mass, and $T$ is the absolute temperature. The fixed gases obey this law with great accuracy, while the relation is also approximately satisfied in the case of most vapors, provided they are at a temperature not too near the boiling-point of their liquid.

If a gas is allowed to expand or contract under such conditions that the temperature is maintained constant, we have

$$pv = RT = \text{const.} \tag{4}$$

In this case the expansion is *isothermal*. The first law makes possible the computation of the amount of heat which must be supplied to the gas during expansion in order to keep the temperature the same. We have from (2)

$$dQ = dU + pdv.$$

For a gas $dU = c_v dT$, $c_v$ being the specific heat for constant volume,

$$\therefore\ dQ = c_v dT + pdv.$$

In the case of isothermal expansion, however, $T$ is constant, i. e. $dT = 0$. Therefore $dQ = pdv$, and if the gas expands from $v_1$ to $v_2$ we have $\left(\text{remembering that } p = \frac{RT}{v}\right)$

$$Q = \int dQ = \int_{v_1}^{v_2} pdv = \int_{v_1}^{v_2} RT\frac{dv}{v} = RT \log_e \frac{v_2}{v_1}. \tag{5}$$

The expression $\int_{v_1}^{v_2} pdv$ represents the work done by the gas in overcoming the external pressure. Equation (5) states therefore that energy equivalent to the work done must be supplied in the form of heat.

When no heat is supplied to the gas during expansion its behavior is different. Work is then done at the expense of the internal energy of the gas, and the temperature falls. Under these circumstances the expansion is *adiabatic.* The condition that no heat is lost or gained during expansion leads to the equation

$$dQ = 0 = dU + pdv = c_v dT + pdv.$$

This is equivalent to

$$c_v dT + RT\frac{dv}{v} = 0. \tag{6}$$

If the gas expands from $v_1$ to $v_2$, the corresponding temperatures being $T_1$ and $T_2$, we therefore have

$$c_v \log_e \frac{T_1}{T_2} = R \log_e \frac{v_2}{v_1}. \tag{7}$$

The constant $R$ is equal to the difference (expressed in mechanical units) between the two specific heats of the gas; that is to say, $R = c_p - c_v$ where $c_p$ is the specific heat at constant pressure. The relation between volume and temperature during the process of adiabatic expansion may therefore be put in the form

$$\frac{T_1}{T_2}\left(\frac{v_1}{v_2}\right)^{\gamma - 1} = 1, \tag{8}$$

or, making use of the relation given in (4),

$$p_2 = p_1\left(\frac{v_1}{v_2}\right)^{\gamma}, \tag{9}$$

where $\gamma$ represents the ratio $\frac{c_p}{c_v}$.

As an example of the application of these equations we may consider the case of the adiabatic expansion of air. The numerical value of $\gamma$ has been found by experiment to be 1·405 for air as well as for other gases in which the molecule is supposed to consist of two atoms. If expansion continues until the air occupies three times its original volume, we have from (8)

$$\frac{T_2}{T_1} = (\tfrac{1}{3})^{0 \cdot 405}.$$

Assuming that the air was originally at the ordinary atmospheric temperature, say 20° C., its absolute temperature was $T_1 = 273° + 20° = 293°$. The temperature $T_2$ after expansion is therefore

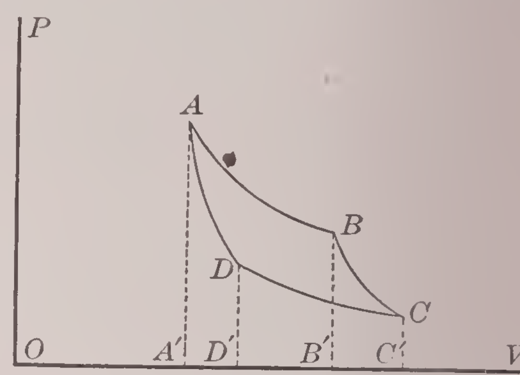
$$T_2 = 294(\tfrac{1}{3})^{0 \cdot 405} = 148° \text{ (absolute)},$$

or − 25° C. The air is therefore cooled by expansion from 20° C. (68° F.) to − 25° C. (− 13° F.). In cases where power is transmitted by compressed air the expansion is often approximately adiabatic, and the cooling effect is a source of some trouble. See Pneumatic Transmission.

For other cases in which the first law may be directly applied (e. g. the flow of gases through pipes, velocity of sound in gases, etc.), the reader is referred to treatises on hydromechanics.

*Second Law.*—While mechanical energy can be completely transformed into heat, the transformation of all the heat in a body into other forms of energy is in no case possible. In general only a small fraction is capable of such transformation. The second law of thermodynamics affords a means of determining the *availability* of heat. The fundamental principle upon which it rests is the experimental fact that heat can not of itself pass from a colder to a warmer body. The consequences of this principle are more far-reaching than is at first apparent. The following example will afford an illustration of its application:

*Carnot's Cycle.*—A perfect gas may be utilized as a working fluid in transforming heat into mechanical energy in the following cyclic process: Let the initial pressure and volume of the gas be represented by the co-ordinates $AA'$ and $OA'$ of the point $A$ in the diagram. The gas is allowed to expand isothermally until its pressure has been reduced to $BB'$ and its volume has increased to $OB'$.




During expansion the gas may be made to do work by driving a piston, while an amount of heat, $Q_1$, must be supplied from a "source" in order to keep the temperature constant. When the condition represented by the point $B$ has been reached, the source of heat is removed, and the gas allowed to expand adiabatically to $C$. If the absolute temperature was originally $T_1$, it will have fallen between $B$ and $C$ to some lower temperature, $T_2$. Let the gas now be compressed isothermally at this temperature to $D$. During this process the heat $Q_2$ developed by compression must be removed by a "refrigerator." The gas is finally compressed adiabatically to the original condition $A$, when its temperature will be $T_1$ as before.

During the complete cycle the heat $Q_1$ has been given to the gas, while the quantity $Q_2$ has been taken from it. The difference $Q_1 - Q_2$ represents the amount of heat that has been transformed into mechanical energy. It may be mentioned in passing that the graphical representation here used affords an excellent means of following the various steps in such a process. Thus the area $ABB'A'$, being equal to $\int_A^B pdv$, represents the work done during the first expansion. Similarly the areas $BCC'B'$, $CDD'C'$, and $DAA'D'$ represent the amounts of work done, either *upon* the piston or *by* the piston, during the corresponding expansions or compressions. The area of the figure $ABCD$ is a measure of the net work done by the gas in the course of the complete cycle. Graphical methods similar to this are frequently employed in thermodynamic problems.

A consideration of the laws of perfect gases shows that under these circumstances

$$\frac{Q_1}{T_1} - \frac{Q_2}{T_2} = 0, \text{ or } \frac{Q_1 - Q_2}{Q_1} = \frac{T_1 - T_2}{T_1}.$$

The expression $\frac{Q_1 - Q_2}{Q_1}$ is the ratio of the work utilized in driving the piston to the total heat energy supplied, i. e. the efficiency of the engine.

Such a process is a reversible one. For if the expansions and compressions are made to occur in the reverse direction, a quantity of work, $Q_1 - Q_2$, will be done *by* the piston and will result in taking the heat $Q_2$ from the refrigerator and giving up $Q_1$ to the source. It is clear that no heat-engine working between the temperatures $T_1$ and $T_2$ can be more efficient than one that is reversible. For if this were possible, such an engine might be employed to drive a reversible engine, using the same source and refrigerator, backward, and there would result a continual transfer of heat from the refrigerator to the source, i. e. from a colder to a warmer body. But this is contrary to universal experience.

The greatest possible efficiency which can be obtained in any heat transformation is thus determined by the range of temperatures that can be used, and does not depend upon the working substance. For example, if heat is supplied at

200° C. while the temperature of the refrigerator is 100° C., the highest possible efficiency is given by the expression

$$\frac{T_1 - T_2}{T_1} \text{ or } \frac{100}{200 + 273} = 21{\cdot}1 \text{ per cent.}$$

If steam is used as the working fluid this case would correspond to that of an engine receiving steam at a pressure of about 200 lb. and exhausting at atmospheric pressure. The efficiency practically attainable would of course be much less than that computed for the ideal case. In the case of any reversible cycle of operations in which the quantities $Q_1$ $Q_2$, . . . etc., of heat are supplied at temperatures $T_1$, $T_2$, etc., it is found (remembering that $Q$ is sometimes negative) that

$$\frac{Q_1}{T_1} + \frac{Q_2}{T_2} + \ldots = 0. \qquad (10)$$

By a reversible cycle is meant any series of operations which finally bring the whole system back into its original condition, and which can be performed in the opposite direction with all quantities reversed. If the temperature changes are continuous, equation (10) may be written

$$\int \frac{dQ}{T} = 0 \qquad (11)$$

for a reversible cycle. Considerations which can not be discussed here show that $\frac{dQ}{T}$ is a complete differential, i. e. the differential of some quantity whose value is completely determined by the physical condition of a body, and independent of the manner by which the body was brought into that condition. This quantity is called the *entropy* of the body, and may be denoted by $S\left[\frac{dQ}{T} = dS\right]$. The entropy of a perfect gas may, for example, be found as follows: From (1)

$$dQ = dU + pdv,$$

but $dU = c_v dT$, and since for a perfect gas $pv = RT$, we have $pdv = RT\frac{dv}{v}$,

$$\therefore\ dS = \frac{dQ}{T} = C_v\frac{dT}{T} + R\frac{dv}{v} \qquad (12)$$

$$S = c_v \log_e T + R \log_e v + \text{const.} \qquad (13)$$

In other cases the determination of $S$ presents greater difficulties. But the principle stated below may often be applied without a knowledge of the actual numerical value of $S$.

By using the conception of entropy, the second law of thermodynamics may be stated in a very useful form as follows: In the case of any reversible process the *total* entropy remains constant; if the process is not reversible, the entropy of the system must increase. In estimating the total entropy, all bodies whose condition is in any manner altered during the process in question must be considered. As examples of non-reversible processes may be mentioned the development of heat by friction, or the expansion of a gas without overcoming outside pressure.

In accordance with the second law, as stated above, the entropy of a system can never diminish. When the physical conditions of a system are such that its entropy is a maximum, the system must therefore be in equilibrium. It is this condition that enables the solubility of a salt, the dissociation of a vapor, the vapor tension of liquids or solutions, etc., to be determined by the application of the second law; for these are all cases of physical and chemical equilibrium. In the case of evaporation, for example, the development of vapor at the surface of a liquid continues until a certain definite vapor pressure, whose value depends upon the temperature, has been reached. The vapor is then saturated, and there is no tendency either for further evaporation or for condensation. Under these circumstances the liquid and its vapor are in equilibrium with one another. The conditions necessary for such equilibrium may be investigated by remembering that the entropy of the system must be at a maximum. Various laws in regard to the dependence of vapor tension upon temperature, substances in solution, etc., have been developed in this manner.

The application of thermodynamics has been greatly extended during the last few years, and it seems probable that this science will be a most valuable aid in the further development of physics and chemistry. ERNEST MERRITT.

**Thermo-electricity**: the direct production of electric currents by means of heat. The process was discovered by Seebeck about 1821 or 1822 (Pogg. *Ann.*, vi., 1826). Strictly, the phenomenon consists in the generation of electromotive force at the unequally heated junctions of two substances which are in some way dissimilar. Thus if a circuit be formed of an iron and a copper wire, and if the temperature of one junction be raised above that of the other, a current will flow across the warmer junction from copper to iron. The heated junction is the seat of an electromotive force of such direction that the iron is at a higher potential than the copper. A current, therefore, flows around through the circuit from the warmer iron across the cooler junction back to the warmer copper. For thermo-electric series, see *Electricity from Heat* under ELECTRICITY.

The electromotive force of a thermal element is small, and depends not only upon the temperature difference of the two contacts, but upon the absolute values of their temperatures. Every combination of two metals has what is called a neutral temperature. At this temperature the electromotive forces at the two junctions are equal and in opposite directions; hence there is no current. Thus for silver and iron the neutral temperature is 223·5° C.; for copper and iron it is 274·5° C. When the mean temperature of the two junctions is above the neutral temperature, the current is reversed. There is no current when $t_1$ equals $t_2$ and when $\frac{1}{2}(t_1 + t_2)$ equals the neutral temperature.

With most pairs of metals, if differences of temperature be plotted as abscissas and electromotive forces as ordinates, a parabola will be obtained with its axis vertical. (See *Electricity from Heat*, under ELECTRICITY.) Therefore, from the properties of the parabola,

$$E - e = b\,(T - t)^2, \qquad (1)$$

where $E$ and $T$ are the electromotive force and temperature corresponding to the vertex of the parabola, and $b$ is a constant. In a few cases the parabola becomes a straight line, and in others the curve consists of portions of parabolas with their axes parallel and their vertices turned alternately in opposite directions.

This relation between electromotive force and temperature led Lord Kelvin and P. G. Tait to adopt an elegant method of constructing a thermo-electric diagram. The differential coefficient of $e$ with respect to $t$ is, from equation (1),

$$\frac{de}{dt} = 2b(T - t). \qquad (2)$$

Now $\frac{de}{dt}$, or the rate of change of the electromotive force with temperature, is the *thermo-electric power*, and, if this be taken as an ordinate, (2) is the equation of a straight line. If, then, this line for some standard metal be made to coincide with the axis of temperature, the lines obtained from observations on circuits of other metals with it will, in general, be straight lines also; and taken together they will

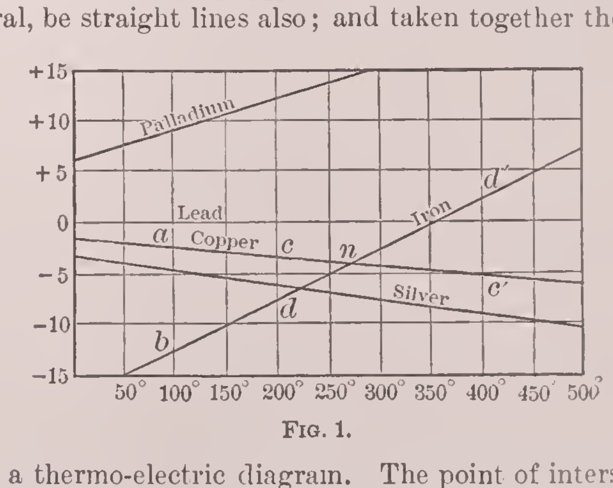



FIG. 1.

form a thermo-electric diagram. The point of intersection of any pair of lines corresponds with the temperature of maximum electromotive force for this pair of metals. Thus the copper-iron lines cross at 274·5°. This is therefore the temperature at which the thermo-electric power of this pair becomes zero. It is also the point, therefore, corresponding to the neutral temperature for this pair. At a mean temperature a little below 274·5° a small difference of temperature between the two junctions causes a current to flow across the warmer one from copper to iron; if the mean temperature is above 274·5°, the current flows across the warmer junction from iron to copper. This phenomenon is known as *thermo-electric inversion*. Fig. 1 is the thermo-electric diagram for several metals compared with lead.

From the manner in which this diagram is constructed it follows that, if the cooler junction of a copper-iron couple be at 100° and the warmer at 200°, the electromotive force in the circuit will be represented by the area *a b c d*; but if the warmer junction be at 400°, the electromotive force will be numerically equal to the difference of the areas *a b n* and *c′ d′ n*. The intersections of some of these lines, palladium-copper, for example, lie beyond the limits of Tait's experimental diagram. The palladium-copper lines, if produced, would intersect at − 170° C. Dewar and Fleming have found, by means of the low temperature obtained with liquid oxygen, that thermo-electric inversion for this couple occurs at about − 170° C.

In 1834 Peltier discovered the phenomenon converse to the production of electromotive force by the application of heat. If a bismuth-antimony junction, for example, be heated, a current flows across from bismuth to antimony, or bismuth is positive to antimony. Peltier discovered that if a current be sent across such a junction from B to A, Fig. 2, where B is bismuth and A antimony, the junction is cooled; but if it goes from A to B, the junction is heated. The long arrow in the figure shows the direction in which the current is sent through from an outside source; the arrows at *a* and *b* show the direction of the electromotive force at the junctions. At *a* this electromotive force is in the same direction as the current; hence at this point work is done on the current, and the heat of the junction is converted into the energy of a current. At *b* the electromotive force is negative, and the current does work on the junction and heats it. This accords with the general principle that the current gives up energy wherever it encounters a back electromotive force. This generation of heat is entirely distinct from that due to the resistance of a conductor, since the heat due to the Peltier effect is proportional to the first power of the current, while that due to ohmic resistance varies as the square of the current. Moreover, the former is a reversible phenomenon, while the latter is not.

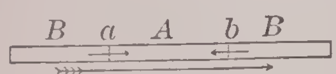



Fig. 2.

In order to explain the fact of electric inversion in such couples as copper and iron, Lord Kelvin assumed that the Peltier effect becomes zero at the neutral temperature. No heat is then absorbed or developed at a junction at this temperature, while heat is generated at the other junction, since the current there meets a counter-electromotive force. There is, therefore, no thermal energy at the junctions which can be converted into electrical energy; but since there is no other possible source of the energy of the current, Lord Kelvin was led to predict that heat is absorbed at parts of the circuit other than the junctions. This prediction he subsequently verified. In copper heat is absorbed when the current passes from cold parts to hot parts; in iron it is absorbed when the current passes from hot parts to cold parts.

Consider a metallic bar, A B C, Fig. 3, which is heated at the middle, B, and cooled at the ends, A and C. Then the distribution of heat may be represented by the curve *a b c*. But if a current be passed from A to C, then, in metals like copper, the curve of the distribution of heat becomes somewhat like *a′ b c′*. Since a current in copper absorbs heat as a liquid does in flowing from the cold parts to the hot parts of a tube, electricity is sometimes said to have *specific heat*. It is positive in metals like copper and negative in metals like iron.

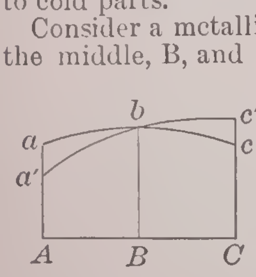



Fig. 3.

Thermal electromotive forces have their origin also at the contacts of solids with liquids and of liquids with liquids.

The thermo-electric power of Zn–$ZnSO_4$ is 0·00076 for a mean temperature of 18·5° C.; that of Cu–$CuSO_4$ is 0·00069 for about the same temperature. Since the liquid is positive to the metal in both cases, and there is no appreciable electromotive force at the contact of the two, the temperature coefficient of the electromotive force of a Daniell cell, which is composed of zinc in zinc sulphate and copper in copper sulphate, is the difference of the above two thermo-electric powers, or 0·00007. This conclusion is verified by experiment. Similar results with other cells show that the temperature coefficient in general is determined by the superposition of the several electromotive forces at the contacts of the dissimilar substances in the cell.

Henry S. Carhart.

**Thermom′eter**: any instrument for the measurement of temperature. The effect generally used for the purpose is the relative expansion of a liquid or a gas. The distortion of solids by heat is also sometimes used. In the earliest thermometer (Galileo, 1592, and Debbel, 1621) a glass bulb containing air was used, a bead of liquid in the stem separating the contained gas from the outer atmosphere. The movement of this bead along an arbitrary scale indicated the change of temperature. In the eighteenth century liquid thermometers came into use, among others the mercury-thermometer, which, in the hands of Fahrenheit (1714), of Réaumur (1730), and of Celsius (1742), reached a considerable degree of perfection. The scales of these three makers are related to each other as shown in the following formula and graphically in Fig. 1:

$$n°\ C. = \tfrac{4}{5}\ n°\ R. = \tfrac{9}{5}\ n°\ F. + 32°\ F.$$

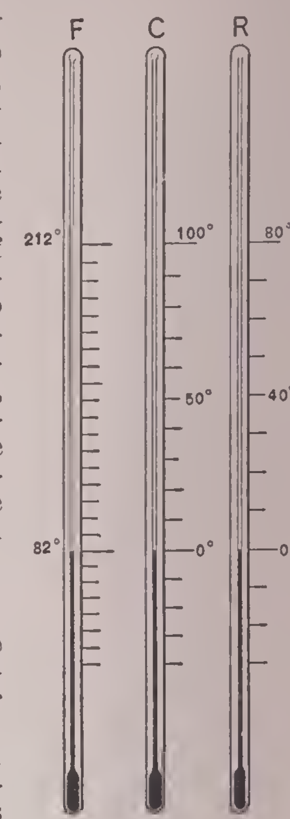



Fig. 1.

The only other scale which need be mentioned is the absolute scale, sometimes used in scientific work, for which see Thermometry.

All thermometers are based upon the same principle of scale-making—viz., the selection of two fixed points which are capable of accurate experimental determination and the division of the intervening portion of the bore into equal parts called degrees. Parts of the tube lying above and below the fixed points are divided into degrees of the same size. The fixed points used in the construction of all ordinary thermometers are the temperatures of melting ice and of the steam within a vessel of boiling water when the pressure is 76 cm. of mercury. The scale of Fahrenheit appears to have been arranged with reference to the uses of the physician, the attempt having been to make 100° correspond with the temperature of the human body; but it is always fixed by the use of the two points already mentioned.

*The form of the mercury-thermometer*, which is the result of nearly 200 years of experience, is briefly as follows: (1) An elongated bulb containing pure mercury (B, Fig. 2), with walls of glass as thin as is compatible with safety, and a diameter somewhat less than that of the stem (S), in order to admit of its passage without pressure through any hole which snugly fits the tube of the thermometer. (2) An elongated stem of glass with a capillary bore, sometimes flattened to show the height of the mercury, but in the better forms cylindrical. The stem is sometimes of clear glass, sometimes of glass with a strip of milk-glass at the back. In all thermometers for scientific purposes it carries the scale, etched upon the glass. The bore should terminate above in a small bulb (*b*), which serves to receive any mercury which may be driven to the upper end of the bore. This minor bulb is also useful in the calibration of the thermometer.

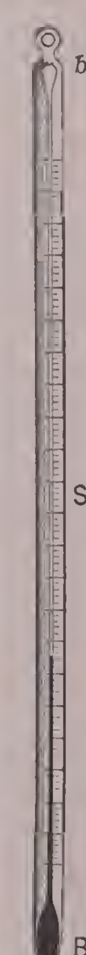



Fig. 2.

*Establishment of the Fixed Points.*—To find the melting-point of a thermometer, after the same has been filled with mercury, exclude the air by boiling the mercury within the bulb, seal the tube, and insert the bulb in broken ice, as shown in Fig. 3; then, after a sufficient interval (about twenty minutes to thirty minutes) has elapsed, mark on the stem the position of the mercury; this gives the melting-point of ice. To find the boiling-point, the apparatus shown in Fig. 4 is used. It consists of a bath in which the thermometer bulb and a portion of the stem are surrounded by steam at the proper pressure. After adequate exposure, the height of the mercury is again noted.

*The scale of the mercury-thermometer* is based upon the assumption that equal movements of the mercury along the stem indicate equal differences of temperature. As is pointed out in the article on Thermometry (*q. v.*), this assumption fails of strict fulfillment from two distinct causes.

The first of these is the irregularity of the bore, a source of error, which can be overcome by calibration and by making the divisions with equal cubic contents of bore, instead of making them of linear equality. The other difficulty arises from the fact that glass expands with increasing rapidity as the temperature rises, so that the relative coefficient of expansion of the liquid with which the bulb is filled, even though that liquid possesses a perfectly constant coefficient, will vary with the temperature. This source of error, although it may be neglected in many of the uses to which the mercury-thermometer is put, is so serious in its bearings upon experiments of precision as to have led to the abandonment of that instrument as a primary standard in favor of the air-thermometer.

FIG. 3.

*Shifting of the Zero-point.*—A very troublesome error of the mercury-thermometer is the gradual rise of the zero-point with age. This effect, which often amounts in the aggregate to more than a degree of the centigrade thermometer, is due to the continued contraction of the glass of the bulb after fusion. This change, which is rapid at first, continues, although with diminishing intensity, for a very long time. It has been traced for at least twenty years. A similar shrinkage, through much smaller range, follows every subsequent heating of the thermometer; so that an instrument which, after the determination of its zero, is placed in boiling water suffers a shifting of the zero from which it recovers only after a long time.

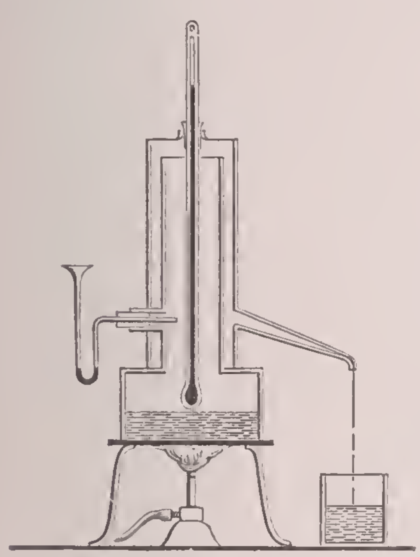


FIG. 4.

*Air-thermometers*, on account of their comparative freedom from the influence of the variations in the coefficient of expansion of the bulb, have been universally adopted as standards of comparison. They depend upon the laws of Charles and Mariotte (see PNEUMATICS), which express the well-established fact that the volume of a gas is directly proportional to the absolute temperature, with a constant coefficient of ·003668, and inversely proportional to the pressure.

The essential parts of the air-thermometer are the bulb (B, Fig. 5) and the manometer (M), by means of which the pressure may be regulated and measured. The usual procedure consists in holding the air within the bulb at constant volume, the mercury within the manometer tube being brought always to the same level ($n$). The temperature of the air within the bulb is computed from the pressure necessary to give it the volume in question.

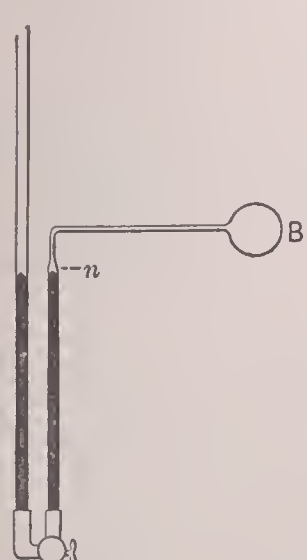



FIG. 5.

At very high temperatures this process has to be abandoned for fear of distending the bulb and changing its volume permanently. For such experiments the pressure is maintained constant and the volume is allowed to vary. In the measurement of temperatures above 400°, porcelain is substituted for glass on account of its greater refrangibility. Fig. 6 shows the form of bulb used by Barus in the calibration of thermo-elements for the measurement of high temperatures. It is of porcelain, with a neck 40 cm. long and only 0·1 cm. of internal diameter. A re-entrant tube is introduced for the purpose of admitting the junction to be calibrated to a position near the center of the bulb.

*Special Forms of Thermometers.*—The thermometers described in the preceding paragraphs are standard forms. These are modified to adapt the instrument to special purposes, and sometimes new principles are introduced.

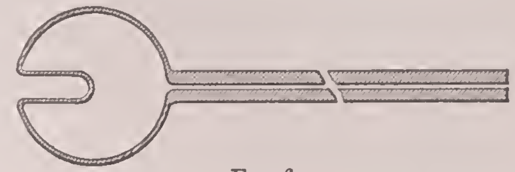


FIG. 6.

Among the numerous special forms of mercury-thermometers it is possible to mention here only one or two of the best known. One such is the clinical thermometer, in which the stem is shortened between the zero and the range with which one has to do in determining the temperature of the human body, by means of a small subsidiary bulb, as shown in Fig. 7. Other well-known special forms are the various maximum and minimum thermometers, of which one of the most widely used (Rutherford's) is shown in Fig. 8. The maximum recording device consists simply of a steel marker, which is pushed along the wide bore in front of the mercury column, and is left by the latter when it recedes. The minimum is recorded by means of an alcohol-thermometer containing a minute dumb-bell-shaped marker of glass, which fits the tube loosely, so that when the thermometer rises the liquid flows past. Upon the return the surface film catches the marker, which is thus compelled to follow the receding column to its lowest point.

FIG. 7.

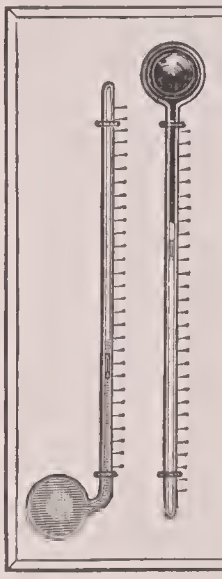


FIG. 8.

Where it is desired to indicate temperatures in such a way that the scale may be easily read from a distance, distortion thermometers are sometimes used. They are analogous to the aneroid barometer in principle, the same multiplying devices being used to carry a hand along a circular scale. Fig. 9 shows a familiar form. It consists of a strip of copper and one of steel fastened side by side and bent so as to form nearly a complete ring. The copper is on the inside. Difference in the coefficients of expansion of the two metals distorts the double piece which is fastened at one end, and the slight movement of the free end is magnified by the simple device shown in the figure. The spiral spring secures a prompt return of the pointer. See CENTIGRADE THERMOMETER.

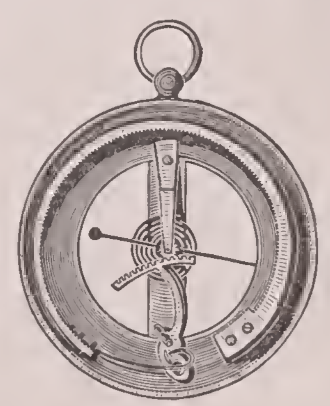


FIG. 9.

E. L. NICHOLS.

**Thermom′etry** [deriv. of *thermometer*; Gr. θέρμη, heat + μέτρον, measure]: the process of measuring temperature. The phenomena which are commonly utilized in thermometry are the change in length or volume under the action of heat, distortion of form from the same cause, the electromotive force due to difference of temperature between the junctions of a thermo-element or thermopile, and the change of electrical resistance which occurs in a metal when the same is subjected to variations of temperature.

*Expansion thermometers*, on account of their simplicity, are the most widely used. They are also the earliest, Galileo having made air-thermometers with arbitrary scales in 1592. A nearly ideal substance for thermometry at ordinary temperatures is mercury. That liquid possesses a very low freezing-point (— 39·4° C.) and a higher boiling-point than any other available liquid (357° C.). It has a sufficiently large coefficient of expansion (0·000181), as compared with glass (0·000025), to afford ample sensitiveness; it is opaque and an excellent conductor of heat. These properties have led to the adoption of mercury for all excepting a few special purposes, in spite of the fact that it does not possess the one essential characteristic of a perfect thermometric medium, viz., an absolutely constant coefficient of expansion. Only the permanent gases possess such a coefficient, and these, while they are likely always to be used for purposes of reference and comparison, are ill adapted in almost every other respect for the purposes of practical thermometry. Since, moreover, the performance of any liquid or gas thermometer depends not only upon the coefficient of the contents but also upon that of the bulb itself, the accuracy of the instrument is limited by the lack of uniformity in the expansion of glass. The error due to variations in the coefficient of the bulb are less important in the case of air thermometers, where the gas expands 140 to 150 times as fast as glass, than with mercury, where the ratio is only about 7 : 1. That mercury is a sufficiently good material to use in bulbs of ordinary glass is seen on comparing its coefficient at different ranges with that of the latter substance. See Table I. :

TABLE I.—COEFFICIENTS OF EXPANSION OF MERCURY AND OF GLASS.

| MERCURY (ACCORDING TO LEONARDT). | | ORDINARY GLASS (ACCORDING TO RECKNAGEL). | |
|---|---|---|---|
| Range of temp. | Mean coeff. (cubic). | Range of temp. | Mean coeff. (linear). |
| 0° to 100° | 0·00018092 | 0° to 10° | 0·00000851 |
| 100 " 200 | 0·00018094 | 0 " 50 | 0·00000882 |
| 200 " 300 | 0·00018129 | 0 " 100 | 0·00000920 |
| | | 0 " 150 | 0·00000959 |
| | | 0 " 200 | 0·00000997 |

Happily glass is an artificial mixture, and its properties are to a great extent within the control of the manufacturer. Under the guidance of Abbe, of Jena, and other investigators, it has been found possible to adapt glass, by varying its composition, to the varying needs of the optician, and also to reduce the changes in its coefficient of expansion. How marked the improvement is may be seen from Table II., in which are indicated the errors of two mercury-thermometers, the zero-points and boiling-points of which are correct and the bores of which between those points are divided into 100 parts of equal volume. One of these is a thermometer of Thuringian glass of the composition used in 1830–40, the other is a modern thermometer of the Jena normal glass. Both are compared with the hydrogen thermometers :

TABLE II.

| TEMPERATURES. | CORRECTION OF A THERMOMETER OF | |
|---|---|---|
| Hydrogen thermometer. | Thuringian glass. | Jena normal glass. |
| 0° | 0·000° | 0·000° |
| 10 | −0·086 | −0·056 |
| 20 | −0·149 | −0·091 |
| 30 | −0·191 | −0·109 |
| 40 | −0·213 | −0·111 |
| 50 | −0·206 | −0·103 |
| 60 | −0·201 | −0·086 |
| 70 | −0·171 | −0·071 |
| 80 | −0·127 | −0·041 |
| 90 | −0·069 | −0·018 |
| 100 | 0·000 | 0·000 |

*Thermometric Scales.*—Many proposals have been made to establish thermometric scales based upon some absolute system, thermodynamic or other. In practice, however, it is found convenient to adopt an arbitrary scale with two points fixed ; these fixed points being that of melting ice and of the saturated vapor above water which boils at a pressure of 76 cm. The familiar scale of Fahrenheit has this interval divided into 180 parts [+ 32° to + 212°], that of Réaumur into 80 parts [0° to + 80°], while the scale of Celsius, the "centigrade" scale of science, contains 100 divisions. The ratio of the three is therefore

$$1\ F. = \tfrac{5}{9}\ C. = \tfrac{4}{9}\ R.$$

To consider the case of the centigrade scale only, it is evident that the 100 equal divisions between melting and boiling might be—

(1) Linearly equal divisions,
(2) Divisions of equal content of bore,
(3) True degrees of the centigrade scale.

In a thermometer of truly cylindrical bore, filled with a thermometric substance with uniform coefficient, and having a bulb which likewise expands uniformly, the three methods of dividing the stem would be identical. Actual thermometers, however, do not possess truly cylindrical bores. Calibration of the same by means of a detached thread of mercury shows in general a conical form, more or less irregular. The character of the bore can be shown graphically by means of a curve in which ordinates are reciprocals of the lengths of the thread and abscissas are distances of the middle of the thread from the zero-point of the thermometer. Fig. 1 is such a curve, platted from measurements upon an unusually good thermometer. It is evident that a scale made by dividing the bore between the melting and boiling points into 100 parts linearly equal will be inaccurate. All fine thermometers have the bore calibrated for the purpose of determining the lengths of divisions, embracing everywhere equal cubic contents of bore. Such a scale is subject only to errors arising from variations in the coefficient of apparent expansion of the mercury. The size of this error, which depends upon the character of the glass, is given in Table II. For the work of the highest precision, in which the errors of expansion can not be neglected, a direct comparison is made with the air-thermometer. For other errors of the mercury thermometer and for details of its construction, etc., see THERMOMETER.

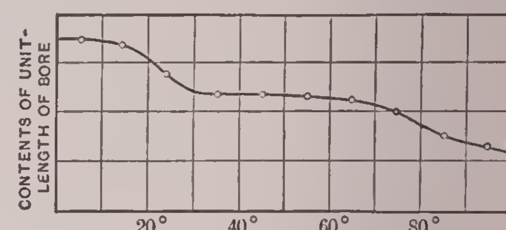


FIG. 1.

The so-called *absolute scale of temperature* is based upon the following consideration : Given a thermometer containing a perfect gas. Suppose the form of the thermometer to be cylindrical (Fig. 2). If this cylinder be placed in ice and in steam and the two fixed points noted, it will be found that the interval contains $\frac{100}{273}$ of the contents of the tube. If now the tube be graduated in centigrade degrees (all of equal length) and the graduation be carried downward past the zero, the 273d division below zero will coincide with the bottom of the tube. From this −273° is called *the absolute zero.* It is a point lying considerably below the experimental range, which at present extends only to the temperature of oxygen boiling under reduced pressure, or to about − 200° C. See, further, the article ZERO.

The use of the expansion of solids in thermometry is chiefly confined to the measurement of high temperatures or pyrometry (see PYROMETER), the coefficient being too small to afford sufficient delicacy at ordinary temperatures, but the distortion of properly constructed composite solids consisting of two or more solids with different coefficients is used with excellent results. Such instruments, for a description of which see THERMOMETER, are adapted for indicating temperature changes rather than for precise measurement. They bear much the same relation to the mercury-thermometer that aneroid barometers do to the standard mercury-barometer.

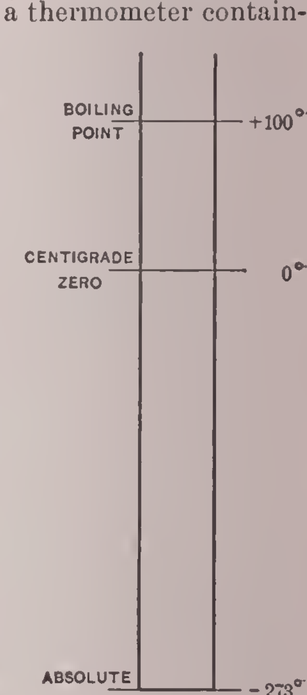


FIG. 2.

It may be seen from the foregoing that the standard process in thermometry is that in which the expansion of a gas is used. The manipulation of the air-thermometer, whether by the method of constant pressure or of constant volume, is, however, so complicated a matter that that instrument is used only for purposes of reference and calibration.

*Electrical thermometry,* as indicated in ELECTRICITY (*q. v.*), consists in the utilization of the electromotive force of a thermo-element for the determination of differences of temperature or of the change in resistance in a wire for the same purpose. These two methods are incomparably the most sensitive of known processes for the detection of minute differences, and it is in the measurement of the almost infinitesimal heat quantities with which the student of radiant energy has to deal that they have chiefly been employed.

Both methods, however, furnish likewise the most trustworthy means of extending accurate and quantitative measurements to very low and to very high temperatures. Throughout both these extreme ranges, which lie beyond that of the mercury-thermometer, a properly calibrated thermo-element or resistance-coil affords quite as manageable a substitute for the air-thermometer as the mercury-thermometer does between 0° and 100°. For temperatures of 0° to —200° C. the most serviceable apparatus consists either of a coil of pure copper wire or of a thermo-element of platinum — platinum-iridium. Where the coil is used resistances are measured either with the Wheatstone bridge, of which the other three arms are known and are maintained at constant temperature, or by fall of potential. In the latter method, which has certain advantages, the arrangement of the apparatus is that shown in Fig. 3, in which diagram B is a battery in closed circuit with the temperature coil, R, and compensated comparison-coil, C. The sensitive galvanometer, G, can be placed in shunt with R or C at will, and it is the ratio of the deflections thus obtained which measures the temperature of R. The change in the resistance of copper with the temperature, which amounts to ·40 to ·42 for 100°, is ample for the purposes of such measurements, and determinations of the coefficient for a wide range have shown a degree of constancy in that factor which leaves little to be desired. Thus Kennelly and Fessenden found for a copper wire a mean coefficient 0·004065 between 27·8° and 255·26°, with no deviation from that value comparable with the errors of observation. The researches of Dewar and Fleming led to a precisely similar result for the range of temperatures —200° C. . . . +100° C. The specimen of copper with which they performed their experiments gave a higher temperature coefficient (0·00424), but the coefficient was found to be nearly constant throughout the entire range covered by their investigations. Fig. 4 shows the resistance curve for copper, the observations being made at the temperatures of boiling oxygen, boiling ethylene, ice, and steam. It appears as the result of the study of that metal, therefore, that while different specimens of copper possess different coefficients, it is quite safe to assume that the coefficient remains unchanged between —200° C. and +250° C. Since the coefficient is readily determined at ordinary temperatures, say between 0° and 100°, copper is one of the most satisfactory of materials for the electric determination of temperature.

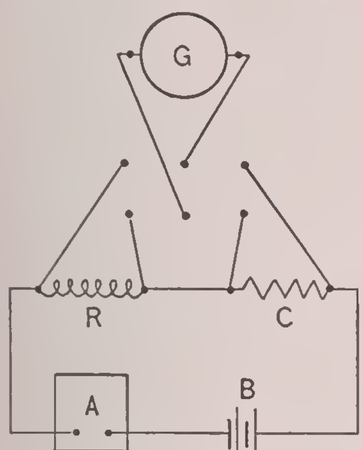



Fig. 3.

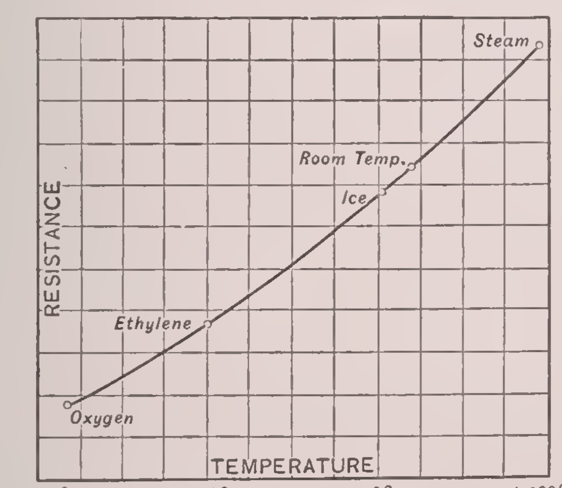



Fig. 4.

Comparisons of thermo-elements with the hydrogen-thermometer have been made, extending downward to the very lowest temperatures that can be produced by artificial means. By these experiments it appears that the electromotive force of a couple, consisting of pure platinum and of an alloy of platinum with iridium (10 per cent.), one junction of which is cooled, is very strictly proportional to the difference of temperature. This is the combination to be selected when the circumstances make it better to use a thermo-element. The difficulty of obtaining platinum of sufficient purity, however, makes it desirable to use the method of the resistance coil whenever practicable.

For the electrical measurement of very high temperatures the same two methods are used. Since, however, the only metals which are sufficiently refractory to admit of their employment are platinum and the metals of the platinum group, the choice of materials is confined to them and their alloys. Barus has shown that the thermo-couple already described (platinum and an alloy of platinum and iridium), when the metals are of the utmost purity, gives an electromotive force very nearly proportional to the temperature almost up to the melting-point of platinum. Fig. 5 shows his curve of calibration up to 1,600°. The performance of thermo-elements in which commercial platinum is used is, however, altogether untrustworthy. Attempts have been made by Siemens, Matthiesen, Benoit, and others to utilize the change of electrical resistance of platinum for the measurement of high temperatures, but the results are most unsatisfactory. See Pyrometer.

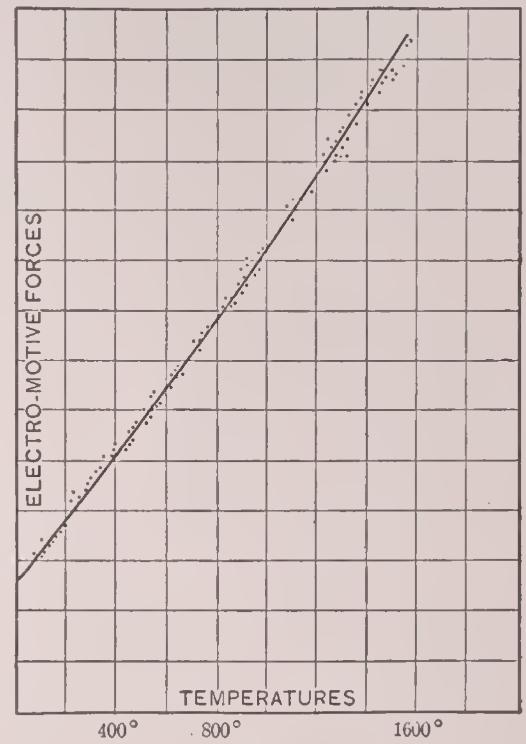



Fig. 5.

When the thermo-electric couple is to be used for the measurement of temperature through whatever range, the arrangement of apparatus shown in Fig. 6 is an advantageous one. It is based upon the same principle as the method given above for the use of the resistance coil—viz., the comparison of the electromotive force to be determined with one constant and known. The thermo-element, *c*, V, has the junction, *c*, packed in melting ice, while V is exposed to the temperature to be measured. It is in circuit with a suitable galvanometer, *G*, through the switch, *S*. The points *a* and *b* in any circuit have a constant difference of potential. The galvanometer may be brought into shunt around *a* and *b* at will by means of *S*. The ratio of the deflections due to differences of potential between *a* and *b* and between *c* and V affords a measure of the difference of temperature between junctions of the latter couple. The points *a* and *b* may be the terminals of a standard cell, the junctions of a thermo-element maintained in ice and boiling water, or two points upon a closed metallic circuit through which a constant current is flowing.

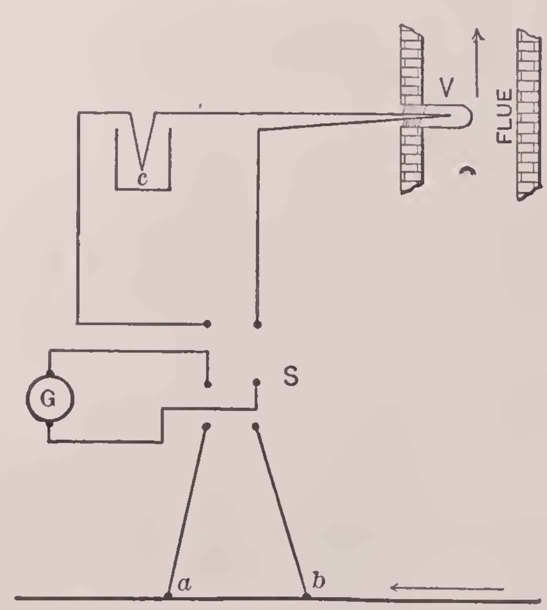



Fig. 6.

It should be noted that none of these electrical methods affords any direct or absolute measurement of temperature. They all depend upon calibration of the apparatus, that is to say, directly or indirectly, like all other thermometric processes, upon comparison with the air-thermometer. See, further, Guillaume, *Thermométrie de Précision*; Barus, *Measurement of High Temperatures*; Preston, *Heat*; Larden, *Heat*; and the chapters on thermometry in the treatises of Jamin, Wüllner, Müller-Pouillet, Violle, and Winkelmann.
E. L. NICHOLS.

**Ther'mopile**: an instrument for the production of electric currents by means of the added electromotive forces of a series of thermo-elements. The action of a thermopile depends upon a principle which is elucidated in ELECTRICITY (*q. v.*). Whenever a closed circuit consists of more than one metal, and there is a difference of temperature between the junctions or points of transition from one metal to another, a current will flow through the circuit as if generated by a difference of potential between the hot and the cold junction. By having several hot and several cold junctions in a circuit it is possible, by a proper arrangement, to sum up the differences of potential thus produced. Such a device is a thermopile. Thermopiles are of two classes: (1) for the study of radiation or of minute differences of temperatures; (2) for the production of considerable current.

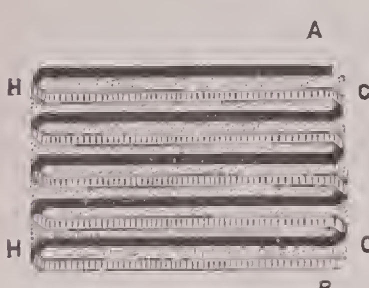


FIG. 1.

In the first class large electromotive forces are desired. These are obtained by selecting metals situated at as great a distance from one another in the thermo-electric series as possible. Bismuth and antimony form the couple usually chosen. These metals are worked into tiny slabs, and soldered together alternately with intervening strips of insulating material, as shown in Fig. 1. In such a series of thermo-elements, alternate junctions of which at H H, for example, can be heated while the other set lying between C C remain cool, a difference of potential equal to the sum of those generated in all the single elements will be found to exist between the terminals A and B. Such an arrangement constitutes a linear thermopile, and a number of these are frequently gathered together into a cubical block, as shown in Fig. 2.

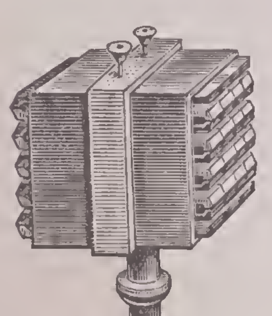


FIG. 2.

This was the form of pile used by Melloni in his famous researches upon radiant heat. The cubical pile was incased in a metal tube with flaring ends, by means of which, when desired, rays from a source of radiation could be gathered upon one face of the pile. Fig. 3 shows the cubical pile of Melloni, mounted in the customary manner. One face is furnished with the funnel-shaped tube which is closed in the illustration. The other face is exposed to the radiation from a Leslie cube.

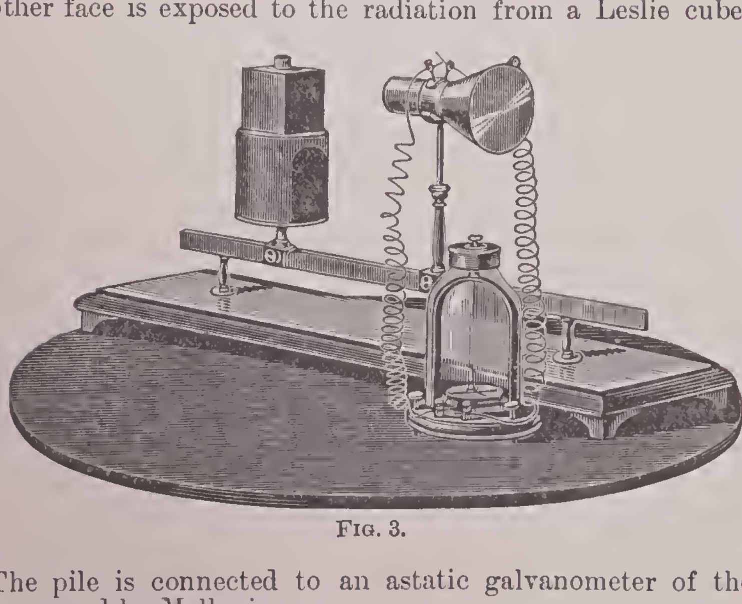


FIG. 3.

The pile is connected to an astatic galvanometer of the type used by Melloni.

The requirements to be met in the construction of a thermopile of the second class are entirely different from those of an instrument of the kind just described. The materials must be capable of withstanding a high temperature, and the electrical resistance must be low. Instead of antimony and bismuth, two more refractory metals are therefore selected, generally iron and German silver. These are connected in couples so as to form a flat ring, with the junctions to be heated within and the cold junctions outside, as shown in Fig. 4. A number of such layers, one above another, all connected in series and forming a hollow cylinder, constitutes the pile or battery. A burner of the Bunsen type placed beneath the axis of the cylinder heats the inner junctions.

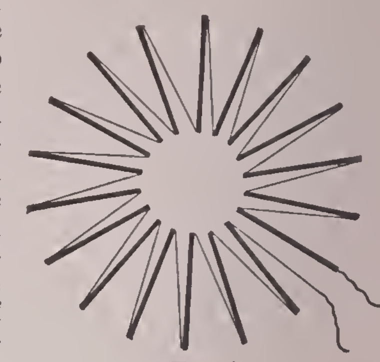


FIG. 4.

With such thermo-batteries very considerable currents may be generated in circuits of low resistance—sufficient, for example, to perform electrolysis or to drive small motors. It has been shown, however, that this method of converting heat energy into electrical energy is of necessity a wasteful one, and that the thermopile considered as a thermal engine must always be of very low efficiency. E. L. NICHOLS.

**Thermop'ylæ** [= Lat. = Gr. Θερμοπύλαι, liter., Hot Gates; θερμός, hot + πύλαι, gates]: a narrow defile between Mt. Œta and the Maliac Gulf, leading from Thessaly into Locris. It was the only way by which an enemy could enter from Northern Greece into Hellas, and became celebrated as the scene of the heroic death of Leonidas and his 300 Spartans in their attempt to prevent the Persian hordes from passing through the defile. The locality is no longer a pass, as it has been widened by natural causes into a swampy plain.
Revised by J. R. S. STERRETT.

**Thêroigne de Méricourt**, tā'rwaăñ-de-mā'rē'koor', assumed name of ANNE JOSÈPHE TERWAGNE: revolutionist; b. at Marcourt, Luxemburg, Aug. 13, 1762; was educated in a convent, but went in 1789 to Paris, where she lived as a courtesan. On the outbreak of the Revolution she acquired influence over the mob, was conspicuous at the fall of the Bastile, and from her fiery speeches and boldness became known as the Amazon of the Revolution. Driven from Paris by an order for her arrest, she fell into the hands of the Austrians at Liège, and was imprisoned in Vienna for nearly a year. Restored to liberty, she returned to Paris, and became still more popular; but her fidelity to the Girondists angered the partisans of the Mountain, whose violence she strove to check. On May 13, 1793, she was seized by a rabble of infuriated women in the garden of the Tuileries, stripped naked, and whipped. This drove her mad, and she spent the rest of her life in La Salpêtrière, where she died June 9, 1817. See Fuss, *Théroigne de Méricourt* (1854).
F. M. COLBY.

**Theromor'pha**, or **Theromora** [*theromorpha* is from Gr. θηρίον, mammal + μορφή, form]: a group (order) of fossil reptiles which combines in a remarkable way the characters of both Batrachia and monotreme mammals. It appears in Carboniferous time and dies out in the Triassic. These fossils are found in America, Europe, and South Africa.

**Thesau'rus**: See LEXICOGRAPHY and DICTIONARY.

**The'seus** (Gr. Θησεύς): in Grecian mythology, the national hero of Attica and the founder of the city of Athens; a son of Ægeus and Æthra. He was married first to Antiope, the queen of the Amazons, and afterward to Phædra. He took part in the campaign of the Argonauts, in the Calydonian hunt, in the battle with the Centaurs, etc., but his most famous exploit was the slaying of the Minotaur. Attica was bound to send annually a tribute of youths to Crete to be sacrificed to this monster. In order to put an end to this misery, Theseus repaired to Crete and won the affection of Ariadne, the daughter of King Minos, who provided him with a clew to the labyrinth and a sword to kill Minotaur; he slew the monster and carried off ARIADNE (*q. v.*), whom he afterward left on Naxos. During a revolution in Athens he fled to Scyros, where he perished by the treachery of King Lycomedes, but in 469 B. C. Cimon conquered Scyros and brought his bones back to Athens, where they were interred in the celebrated temple of Theseus. By the sculptors Theseus was sometimes represented as resembling Hercules, with a lion's skin and a club, though of a lighter and fleeter form and of a more elevated expression; sometimes as resembling Hermes, with chlamys (a short cloak) and petasos (a cap). Revised by J. R. S. STERRETT.

**Thesiger**: See CHELMSFORD, FREDERICK AUGUSTUS THESIGER.

**Thesis**: See ARSIS AND THESES.

**Thes'pis**: a native of Icaria in Attica and a contemporary of Pisistratus; became the inventor of the Greek tragedy by introducing between the dithyrambic chorals at the festival of Dionysus an interlocutor, or manner of actor, who now in monologues, now in dialogues with the leaders of the chorus, narrated, or gave a mimetic representation of, the incidents to which the songs referred. Nothing of his writings, if he wrote anything, has come down to us, but he seems to have been a serious person, and the curious picture of Thespis strolling about from place to place and entertaining people with shows from his wagon is due to Horace (*Ars Poetica*, 276), whose perspective of the history of literature is very faulty. Revised by B. L. GILDERSLEEVE.

**Thessalo'nians, First and Second Epistle of St. Paul to the**: See PAULINE EPISTLES.

**Thessalonica**: See SALONICA.

**Thes'saly**, or **Thessa'lia** [= Lat. = Gr. Θεσσαλία, Θετταλία]: a large division of ancient Greece, bounded E. by the Ægean Sea, N. by Macedonia, and W. by Epirus. The surface is a plain, inclosed on all sides by mountains—Pelion and Ossa on the E., Olympus and the Cambunian Mountains on the N., Pindus on the W., and Othrys on the S. The soil is very fertile, and the land was in ancient times famous for its wheat and its fine breed of horses. The inhabitants were Æolians, but very early the Epirotes invaded and conquered the country, and made the inhabitants their slaves. The government was oligarchical, but very often disturbed by internal wars, which was the reason why Thessalia never exercised any influence on the affairs of Greece. It was conquered by Philip of Macedon, and passed from Macedonia into the hands of the Romans. After long subjection to Turkey, Thessaly was added to the kingdom of Greece in 1881 through the recommendation of the powers after the Russo-Turkish war. It consists of the nomarchies of Arta, Trikalla, and Larissa; total area, 5,073 sq. miles. Pop. (1896) 397,459. See the articles on GREECE.

**The'tis** (in Gr. Θέτις): in Greek mythology, a daughter of Nereus and Doris. She lived with her sisters, the Nereides, in the depths of the sea, and was a gentle and kindly goddess, ever ready to assist gods in trouble. So she cared for Dionysus when he was fleeing before King Lycomedes, for Hephæstus when he had been hurled from heaven by Zeus, and she called Briareus to the assistance of Zeus when he was endangered by the machinations of Hera, Athene, and Poseidon. Both Zeus and Poseidon sued for her hand, but Themis foretold that she was destined to bear a son greater than his father. For this reason she was forced, to her great sorrow, to marry Peleus, a mortal man, but king of the Myrmidons in Thessaly. The gods attended the wedding in a body and brought gifts. Eris, enraged because she had not been bidden to the marriage, threw the apple inscribed "To the Fairest" among the wedding guests, and therefore to this wedding may be traced the origin of the Trojan war. Thetis was prevented by Peleus from fully carrying out her plan to make her only son Achilles immortal. In anger thereat she abandoned Peleus and returned to her home in the sea, but she ever followed the fortunes of her son with passionate sympathy. J. R. S. STERRETT.

**Theuriet**, tö'ree'ā', ANDRÉ: poet and novelist; b. at Marly-le-Roi, France, Oct. 8, 1833; studied law in Paris, and received his licentiate in 1857; soon entered the office of the ministry of finances, and at the same time began his literary work with the verses *In Memoriam* (1857). Subsequent poems are *Le chemin des bois* (1867); *Les paysans de l'Argonne, 1792* (1871); *Le bleu et le noir* (1873); *Les nids* (1879); *Le livre de la payse* (1882); *Nos oiseaux* (1886); *La ronde des saisons el des mois* (1891). His novels are numerous, beginning with the *Nouvelles intimes* (1870) and *Mlle. Guignon* (1874), and comprising among the latest the *Charme dangereaux* (1891); *Jeunes et vieilles barbes* (1892); and the *Chanoinesse* (1893). Dramatic productions are *Jean-Marie* (1871); *La maison des deux Barbeaux* (1885); *Raymonde* (1887), the two latter being drawn from his like-named novels. He has also contributed to various periodicals, and, as an art-critic, written *Jules Baslien-Lepage, l'homme et l'arliste* (1885). J. D. M. FORD.

**Thian-Shan**: another spelling of TIEN- (or T'IEN-) SHAN (*q. v.*).

**Thibaudeau**, tēē'bō'dō', ANTOIN CLAIRE: statesman and historian; b. at Poitiers, France, Mar. 23, 1765, where he subsequently practiced as an advocate; was elected a deputy to the Convention in 1792; voted for the execution of the king without appeal to the people, but fell out, nevertheless, with the Terrorists; was chosen president of the Council of Five Hundred in 1796; became a member of the council of state under the consulate and empire, and was made a count in 1803, but was banished from France by the ordinance of July 26, 1815, and lived in Prague, engaged in mercantile business, till 1830, when he returned to France; was made a senator by Napoleon in 1852. D. Mar. 8, 1854. Among other works, he wrote *Mémoires sur la Convention el le Direcloire* (2 vols., 1824); *Hisloire générale de Napoléon Bonaparte* (1827–28); *Mémoires sur le Consulal el l'Empire* (10 vols., 1835); and *Ma biographie; mes mémoires* (published after his death, 1875).

**Thibaut**, or **Thiband**, tēē'bō': King of Navarre; b. at Troyes in 1201; a posthumous son of Count Thibaut of Champagne, and Blanche, daughter of King Sancho the Wise of Navarre; was educated at the court of Philip Augustus; took an active part in the political entanglements after the death of Louis VIII.; became King of Navarre in 1234; made an utterly unsuccessful crusade in 1239; persecuted the Albigenses in his territories, which in other respects he governed well. D. at Pamplona, July 10, 1253. Among the *trouvères* he occupies a high rank; sixty-six poems by him were published in 1742 by Lévesque de la Ravallière, and eighty-one are found in Tarbé's *Collection des Poètes champenois* (1851). See Delban, *Vie de Thibaul* (1850).

**Thibaut**, ANTON FRIEDRICH JUSTUS: jurist; b. at Hameln, Hanover, of French descent, Jan. 4, 1774; studied law at Kiel, and in 1798 was appointed Professor of Civil Law, teaching there until called to Jena in 1803; in 1806 he was made Professor of Civil Law in the University of Heidelberg, and remained there till his death, having some political offices conferred upon him without his seeking. He was a man of striking personality, and, in addition to his great legal attainments, was a finished scholar and student of music. D. at Heidelberg, Mar. 29, 1840. His works have left a deep impress on German jurisprudence, the most important of them being *Theorie der logischen Auslegung des römischen Rechts* (1799); *Ueber Besitz und Verjährung* (1802); and *Syslem des Pandeklenrechls* (1803), besides numerous essays, and a book dealing with music. F. STURGES ALLEN.

**Thibet**: another spelling of TIBET (*q. v.*).

**Thibodeaux**, tib'ō-dō': town; capital of Lafourche parish, La.; on the Bayou Lafourche and the S. Pac. Railroad; 3 miles N. of Terre Bonne, and 55 W. by S. of New Orleans (for location, see map of Louisiana, ref. 11–F). It is in an agricultural and a rice and sugar-cane growing region; contains Thibodeaux College (Roman Catholic, chartered in 1859), Mt. Carmel convent, a State bank with a capital of $25,000, and two weekly newspapers; and has a number of important mechanical industries. Pop. (1880) 1,515; (1890) 2,078; (1900) 3,253.

**Thick-knee**: any bird of the genus *Œdicnemus*, family *Charadriidæ* or plovers. The thick-knees are distinguished by the moderately long and straight bill (a little longer than the head), which is compressed and wedge-shaped at the terminal half, the linear open nostrils, some distance from the base of the bill, and the elongated tarsi (three or four times as long as the middle toe) covered with hexagonal scales. One species (*Œ. superciliaris*) is a native of Peru; all the others are peculiar to the Old World. They are migratory, and resort to the temperate regions to rear their young. They frequent mostly open inland plains. The common European species is *Œdicnemus crepilans*, which attains a length of about 17 inches. Revised by F. A. LUCAS.

**Thierry**, ti-ā'ree', JACQUES NICOLAS AUGUSTIN: a brilliant historian of the "picturesque" school; b. at Blois, France, May 10, 1795; educated at the college of his native town and the normal school of Paris; attached himself in 1814 with great enthusiasm to Saint-Simon, whom he assisted in his literary labors; became in 1817 a contributor to *Le Censeur européen*, edited by Comte, and afterward to the *Courrier français*, in which he first published in 1820 his remarkable *Lettres sur l'Histoire de la France*, but concentrated himself more and more on the study of history, especially that of France and England, and published in 1825 his *Histoire de la Conquête de l'Angleterre par les Normands* (4 vols., 1860), which attracted great attention, and has been often republished, and translated twice into English (1825 and 1847). In 1826 he became nearly blind, and could continue his studies only by the aid of secretaries and of his friends, among whom were Armand Carrel and Fauriel, above all of his wife, Julie de Quérangal, known from several spirited essays in the *Revue des Deux Mondes*; they were married in 1831, but she died in 1844. Subsequently he lived mostly in his brother's house, and died in Paris, May 22, 1856. He became a member of the Academy in 1830. To the latter period of his life belong *Dix Ans d'Études historiques* (1834), a collection of minor essays, and *Récits des Temps mérovingiens* (1840), both translated into English. By Guizot he was appointed to edit one part of the *Collection des Monuments inédits de l'Histoire de France*—namely, the *Recueil des Monuments inédits de l'Histoire du Tiers État* (3 vols., 1849–56), which led him to write his *Essai sur l'Histoire de la Formation et des Progrès du Tiers État* (1853; translated into English by Francis B. Wells, 1855). His *Œuvres complètes* were collected in 10 vols. (1856–60).—His brother, AMÉDÉE SIMON DOMINIQUE THIERRY, D. C. L., b. at Blois, Aug. 2, 1797, was appointed Professor of History in Besançon in 1828, prefect of the department of Haute-Saône in 1830, member of the council of state in 1838, senator in 1860. D. in Paris, Mar. 27, 1873. His writings, advocating the same principles as those of his brother, but less brilliant in execution, comprise *Histoire des Gaulois jusqu'à la Domination romaine* (3 vols., 1828); *Histoire de la Gaule sous l'Administration romaine* (3 vols., 1840–47); *Histoire d'Attila* (2 vols., 1856); *Récits de l'Histoire romaine* (1860); *Tableau de l'Empire romain* (1862); *Saint Jérôme* (2 vols., 1867); *Saint Chrysostome* (1872).

Revised by A. G. CANFIELD.

**Thiers**, ti-ār': town; in the department of Puy-de-Dôme, France; on the Durolle; 23 miles E. N. E. of Clermont by rail (see map of France, ref. 6–G). It contains the Church of Le Moutier, portions of which date back to the seventh and eighth centuries. Among its manufactures are paper, including stamps and playing-cards, candles, and, most important of all, the making of cutlery. Pop. (1891) 11,993.

**Thiers**, LOUIS ADOLPHE: statesman and author; b. in Marseilles, France, Apr. 16, 1797; studied law at Aix; was admitted to the bar in 1818, and began to practice as an advocate, but was drawn by his ambition as well as by his talents to politics and literature, and removed in 1821 to Paris. Here he became a contributor to the *Constitutionnel*, and his articles attracted wide attention. In the meanwhile he made the acquaintance of Laffitte, and became prominent in liberal circles. In 1823 he began to publish his *Histoire de la Révolution française*, finished in 1827 in 10 vols., and this book at once made his name popular throughout France. In 1830 he founded the *National* in connection with Mignet and Armand Carrel, drew up the protest against the *ordonnances* of July 26, and took an active part in the revolution which effected the change of dynasty in France. He was elected a member of the Chamber of Deputies, held office in the ministry of Finance, and in 1832 became Minister of the Interior. For the next four years he virtually directed the policy of the cabinet, though he was not made Prime Minister till 1836. He withdrew altogether from the Government in August of that year on account of the king's opposition to his plan of an armed intervention in the affairs of Spain. On Mar. 1, 1840, he was again made Prime Minister. In the controversy between Mehemet Ali and the Porte, France supported the former, in the hope of reviving Napoleon's policy in the East, and gaining the supremacy in Egypt and Syria, while Russia, Great Britain, Austria, and Prussia were bent on maintaining the integrity of the Ottoman empire. Thiers assumed a menacing attitude, and for a time it seemed as if France might go to war on behalf of her ally, but the king refused to countenance extreme measures, and Thiers resigned Oct. 21, 1840. He retired from public life for several years; visited England, Spain, Italy, and Germany, making preparations for his great work, *Histoire du Consulat et de l'Empire* (20 vols., 1845–62); but in the last years of the reign of Louis Philippe he resumed his work in the Chamber of Deputies, and made vehement opposition to the government of Guizot, especially to its foreign policy. In the banquets which preceded the revolution of Feb., 1848, he took no part, but the popularity which he had partly lost during his own administration he fully regained when he came into opposition. As a member of the Constituent and Legislative Assemblies he accepted the republic, but advocated very restrictive measures. He voted for the presidency of Louis Napoleon, and fought a duel with a fellow deputy named Bixio, who had criticised him for his vote. Nevertheless, when the empire began to develop from the policy of the president, Thiers immediately went into opposition, and on Dec. 2, 1851, he was arrested, and shortly after banished from France. He returned, however, in August, but lived in retirement until 1863, when he was elected a member of the Representative Assembly by Paris. His criticism of the policy of the emperor, the Italian and Mexican wars, the rebuilding of Paris, etc., was often very severel though generally not very effective; he was almost the only member of the Assembly who opposed and condemned the declaration of war against Prussia, but after the downfall of the empire he developed an astonishing energy to save his country from utter ruin. On Sept. 17, 1870, he started on a tour to London, St. Petersburg, Vienna, and Florence in order to procure foreign intervention, and on his return in the last days of October he opened negotiations with Bismarck concerning an armistice. After the capitulation of Paris and the conclusion of the armistice, he was elected a member of the National Assembly by twenty-six departments, Feb. 8, 1871, and on Feb. 17 the Assembly chose him chief of the executive. On Aug. 31 his term of office was fixed at three years, and he received the title of "president of the republic." He was very successful in negotiating the peace; he saved Belfort and one milliard for France. He was still more successful in procuring the means of fulfilling the conditions of peace; the payment of the indemnification and the liberation of French soil from German occupation were effected in a surprisingly short time. The insurrection of the Commune was promptly put down, but his attempt at consolidating the "conservative republic" by legislative enactment failed, and on May 24, 1873, he resigned. He continued a member of the Assembly, and in 1876 was elected senator for Belfort. D. at St.-Germain, Sept. 3, 1877. Among his other works are *Histoire de Law* (1826; Eng. trans., New York, 1859); *De la Propriété* (1848); *L'Homme et la Matière* (1875).

Revised by F. M. COLBY.

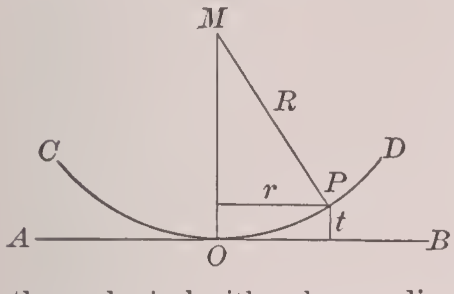
**Thiersch**, teersh, FRIEDRICH WILHELM: classical scholar and educator; b. at Kirchscheidungen, in Prussian Saxony, June 17, 1784; studied theology and philology at Leipzig and Göttingen; privat docent in the latter university in 1809; professor of the Lyceum at Munich, and on the transference of the University of Landshut to the Bavarian capital in 1812 was called to the chair of Ancient Languages, which he held with great distinction till his death in Munich, Feb. 25, 1860. Thiersch has the credit of reviving classical studies in Bavaria by his masterly reorganization of the entire school system of the state. He founded the Philological Institute (*Acta Philologorum Monacensium*, 4 vols.), published a once highly esteemed *Greek Grammar*, and numerous works on archæological and pedagogical subjects, among which may be mentioned *Ueber gelehrte Schulen* (3 vols.); *Ueber den gegenwärtigen Stand des öffentlichen Unterrichts in Deutschland, Holland, Frankreich und Belgien* (3 vols., 1838); *Ueber die Epochen der bildenden Kunst unter den Griechen* (2 vols., 2d ed. 1820). See his *Life and Works*, written by his son Heinrich (2 vols., Leipzig, 1867).

A. GUDEMAN.

**Thinocor'idæ** [Mod. Lat., named from *Thino'corus*, the typical genus; Gr. θίς, θινός, heap of sand, sandy shore or bottom + κόρυς, the crested lark]: a family of birds of uncertain affinities peculiar to South America. The general aspect is somewhat quail-like; the bill rather short, somewhat slender, broad at the base, and compressed forward, and with the upper mandible slightly decurved over the lower; nostrils basal and lateral, and partly curved by a horny membrane; wings long and pointed; tail moderate and produced straight backward; tarsi stout or moderate, and with the investing scales more or less small; toes four, the three anterior moderately long and free, the posterior small and elevated. The family name was proposed (by Prince Bonaparte in 1850) and has been adopted (by Kaup, Gray, etc.) for a group of birds confined to the temperate and colder regions of South America. They are generally supposed to be most nearly related to the sheathbills (*Chionididæ*), but this remains to be verified. They go about generally in pairs or small coveys. Their flight somewhat resembles that of grouse. Open plains seem to be their chief resorts. Eight species are known, belonging to the genera *Thinocorus* and *Attagen*.

Revised by F. A. LUCAS.

**Thin Plates, Colors of**: the colors produced by interference of light at the surfaces of thin layers of media differing in density. When light falls upon a soap-bubble, or a thin floating film of oil, iridescent hues are seen, which owe their existence to interference of light reflected from the upper and lower surfaces of the film. The same is observed when a thin crevice is produced in a transparent body like ice or glass. The film of soap-solution, or oil, or air, is optically a plate whose thickness determines the tint observed.




These phenomena were first studied by Newton, who investigated a film of air between two surfaces of glass, one of which was plane and the other spherical with a long radius of curvature. Let $AB$ be the plane surface, touched at $O$ by the curved surface $COD$, whose radius of curvature, $OM$ or $PM$, is $R$. Let $t$ be the thickness of the film at any point, $P$, whose distance from a perpendicular at $O$ is $r$. Then by geometry

$$r^2 = (2R - t)t = 2Rt - t^2.$$

Since $t^2$ is exceedingly small in comparison with $R$, the formula may be written simply

$$r^2 = 2Rt. \qquad (1)$$

Now suppose yellow light to be incident vertically from above at $P$. Some of it is transmitted through the film to the lower surface, and there reflected to join what is directly reflected at $P$. The difference of path of the two portions is obviously $2t$. If this retardation be such that the two portions become united with a difference of phase of a half wave-length, or any odd number of half wave-lengths, the resulting interference produces extinction (see INTERFERENCE); but if this difference be a whole wave-length, or any even number of half wave-lengths, they conjoin to produce brightness. This is true for all points where the thickness of the air-film is $t$, and these form a circle around $O$ as center with radius $r$.

It can be shown that when light is reflected at the boundary between two media of different density, if the reflection occur in the less dense medium there is change of phase, which has the same effect as if there were a retardation of half a wave-length. This occurs in the film of air at its lower surface. At the center, $O$, where the glass-surfaces are in optical contact, there is hence a black spot due to interference. Around this is a succession of alternately bright and dark rings, according as the interference is with an even or odd number of half wave-lengths of retardation, including that due to change of phase. If the symbol $\lambda$ be used for wave-length, the successive values of $2t$ for the dark points will be 0, $\lambda$, $2\lambda$, $3\lambda$. $4\lambda$, etc., while for the bright points they will be $\frac{1}{2}\lambda$, $\frac{3}{2}\lambda$, $\frac{5}{2}\lambda$, etc. Substituting these values of $2t$ in the fundamental equation, $r^2 = 2tR$, we have the means of calculating the wave-length of light, since $R$ is known and $r$ may be measured easily. If blue light be employed instead of yellow light, the diameter of any given ring is found to be smaller. The wave-length for blue is hence less than for yellow. If white light be employed there will be a succession of rainbow-rings with the full succession of colors, each tint being due to the extinction of its complementary tint; but these spectra become wider and overlap each other with increasing distance from the center, becoming mixed, so that only a few remain visible. If these Newton's rings are viewed by transmitted rather than reflected light, as there is no change of phase by transmission, the central spot is bright. The presence of the film causes interference as before, but the ratio of reflected to transmitted light is small, so that the rings are wanting in clearness of definition. If the incident light be oblique instead of perpendicular to the surface of the film the rings are larger, and the formula is a little less simple than that just deduced. W. LE CONTE STEVENS.

**Thionville**, ti-ōn̄'vēel' (Germ. *Diedenhofen*, anc. *Theodonis Villa*): town of the present German province of Alsace-Lorraine; on the Moselle, 19 miles N. of Metz, and in the midst of a broad level plain (see map of German Empire, ref. 6–B). It is a walled city of the old school of fortification, ranking under that system as a third-class fortress. After the investment of Metz by the Germans in 1870, Thionville proved of annoyance to the besieging force, and after two days' bombardment capitulated Nov. 24, 1870, with large stores of supplies. Although many buildings were destroyed, the defences were left almost intact. Pop. (1890) 8,928.

Revised by M. W. HARRINGTON.

**Third Estate**: See ESTATES, THE THREE; and FRANCE, HISTORY OF.

**Third Orders**: See TERTIARIES.

**Thirion**, tēe'rēe'ōn̄', EUGÈNE ROMAIN: historical painter; b. in Paris, May 19, 1839; pupil of Picot, Fromentin, and Cabanel; medals, Salons, 1866, 1868, and 1869: second-class medal, Paris Exposition, 1878; Legion of Honor 1872. His *Moses* (1885) is in the Luxembourg Gallery. Works in the museums in Bordeaux, Perpignan, Tours, and Lisieux; frescoes in La Trinité, Paris. Studio in Paris. W. A. C.

**Thirl'wall**, CONNOP, D. D.: historian; b. at Stepney, London, England, Jan. 11, 1797; displayed such extraordinary precocity that at the age of eleven years his father, who was a clergyman, printed a volume of his compositions under the title *Primitiæ, or Essays and Poems on Various Subjects*, etc. (1809); entered Trinity College, Cambridge, 1814, and in 1815 took the Craven and Bell scholarships; took the senior chancellor's classical medal and graduated in 1818; became fellow and tutor of Trinity College; studied law, and was called to the bar at Lincoln's Inn 1825; published a translation of Schleiermacher's *Critical Essay on the Gospel of St. Luke* (1825); took orders in the Church of England 1828; became rector of Kirby Underdale, Yorkshire; associated with Rev. Julius Charles Hare in translating Niebuhr's *History of Rome* (2 vols., 1828); and as one of the editors of the Cambridge *Philological Museum* was for several years examiner for the classical tripos at Cambridge, and classical examiner in the University of London; wrote for Lardner's *Cabinet Cyclopædia* a popular *History of Greece* (8 vols., 1835–40), afterward revised and enlarged in a library edition (8 vols., 1845–52); and became Bishop of St. Davids 1840, which post he resigned May, 1874. D. at Bath, July 27, 1875. He was chairman of the Old Testament company on Bible revision. He published a number of sermons, charges, letters, addresses, and essays, which, with other writings, were issued under the title *Literary and Theological Remains* (3 vols., 1876–77), edited by Canon J. J. S. Perowne. His *Letters* were published in 1881 (2 vols.), and his *Letters to a Friend*, edited by Dean Stanley, in 1882. Revised by S. M. JACKSON.

**Thirst** [O. Eng. *þyrst*, *þurst* : O. H. Germ. (> Germ.) *durst* : Icel. *þorsti* : Goth. *þaúrstei*, thirst, deriv. of *þaúrsus*, dry, withered, deriv. of *gaþíarsan*, wither; cf. Lat. *torre're*, parch : Gr. τέρσεσθαι, become dry : Sanskr. *tṛṣ*, thirst]: a sensation normally caused by the need of water in the animal system, and consequently relieved by drinking. The great thirst of cholera is also caused by a deficiency of water. But thirst also accompanies febrile excitement. This is only temporarily relieved by drinking, and unless contra-indicated by the symptoms small lumps of ice will usually relieve the thirst, and reduce the excessive heat with efficiency and without danger. The use of too much salt is another familiar cause, the explanation being in this case the excessive salinity of the blood. The great thirst of diabetes is similarly induced. Revised by W. PEPPER.

**Thirty-nine Articles of Religion**: doctrinal formulas of the Reformation period. When the Reformation was fairly introduced into England under Edward VI. (1547–53), Archbishop Cranmer at first entertained the noble but premature project of framing an evangelical catholic creed in which all the Reformed Churches could agree in opposition to the Church of Rome, then holding the Council of Trent, and invited the surviving continental Reformers, Melanchthon, Calvin, and Bullinger, to London for the purpose. Failing in this scheme, he framed, with the aid of his fellow Reformers, Ridley and Latimer, the royal chaplains, and the foreign divines, Bucer, Peter Martyr, and John à Lasco, whom he had drawn to England, the *Forty-two Articles of Religion* for the English Reformed Church. After passing through several revisions they were completed in Nov., 1552, and published in June, 1553, by royal authority and with the approval of convocation. The reestablishment of the papacy under the short but bloody reign of Mary (1553–58) set them aside, together with the Edwardian Book of Common Prayer. Under Elizabeth (1558–1603) the Articles were revised and permanently restored. They were reduced to thirty-nine, and brought into that shape and form which they have ever retained since in the Church of England. The Latin edition was prepared under the supervision of Archbishop Parker, with the aid of Bishop Cox, of Ely (one of the Marian exiles), and Bishop Guest, of Rochester, and approved by convocation 1562. The English edition, which is of equal authority, though slightly differing from the Latin, was adopted by convocation in 1571, and issued under the editorial care of Bishop Jewel, of Salisbury, 1571. They were made binding on all ministers and teachers of religion and students in the universities, but subscription was not always enforced with equal rigor, and they were bitterly complained of by Nonconformists, who had scrupulous objections to the political articles. The Act of Uniformity under Charles II. imposed greater stringency than ever; but the Toleration Act of William and Mary gave some relief by exempting dissenting ministers from subscribing Articles XXXIV. to XXXVI. and a portion of Article XXVII. Subsequent attempts to relax or abolish subscription resulted at last in the University Tests Act of 1871, which exempts all students and graduates in the Universities of Oxford, Cambridge, and Durham, except divinity students and the holders of offices with clerical functions, from subscription, and throws these institutions open to persons of all religious denominations.

The Thirty-nine Articles cover nearly all the heads of the Christian faith, especially those which at the time of their framing were under dispute with the Roman Catholics. They affirm the old orthodox doctrines of the Trinity and incarnation, the Augustinian views on free will, total depravity, divine grace, faith, good works, election, and the Protestant doctrines on the Church, purgatory, and the sacraments of baptism and the Lord's Supper. They are borrowed in part from Lutheran standards—namely, the Augsburg Confession of Melanchthon (1530) and the Würtemberg Confession of Brentius (1552), but on the sacraments, especially the much-disputed doctrine of the real presence in the Eucharist, they follow the Swiss Reformers, Bullinger and Calvin. In the political sections they are purely English, and teach the Erastian doctrine of the spiritual as well as temporal supremacy of the sovereign as the supreme governor of the Church of England. They have therefore an eclectic and comprehensive character, which distinguishes the Anglican Church from the Lutheran and the strictly Calvinistic churches of the Continent and Scotland, and from the dissenting denominations of England. They have often been interpreted and misinterpreted in the interest of particular schools and parties, while all claim them as favoring themselves. They must be understood in their plain grammatical sense; and when this is doubtful, the Prayer-book, the two books of Homilies, the Catechism, and the private writings of the English Reformers and the Elizabethan divines must be called to aid. The doctrinal decisions in the Gorham (1848–50), Bennet (1870–72), and other controversies favor great latitude in their interpretation.

The Protestant Episcopal Church in the U. S., after effecting an independent organization and episcopate in consequence of the American Revolution, formally adopted the Thirty-nine Articles of the mother Church at the General Convention held in Trenton, N. J., Sept. 12, 1801, but with sundry alterations and omissions in the political articles (Art. XXI. and XXXVII.), which the separation of Church and state made necessary. The only doctrinal difference is the omission of all allusion to the Athanasian Creed (Art. VIII.), which is also excluded from the American editions of the Prayer-book. The Twenty-five Articles of the Methodist Episcopal Church and the Thirty-five of the Reformed Episcopal Church are based upon the Thirty-nine Articles.

LITERATURE.—C. Hardwick, *History of the Articles of Religion* (Cambridge, 1851; 3d ed. 1876); Thomas Rogers, *Exposition of the Thirty-nine Articles* (London, 1579; new ed. Cambridge, 1854); G. Burnet, *History of the English Reformation* (many eds.) and *Exposition of the Thirty-nine Articles* (Oxford, 1845 and other eds.); Laurence, *Bampton Lectures* for 1834 (Oxford, 3d ed. 1838); E. H. Browne, *Exposition of the Thirty-nine Articles* (London, 1850; ed. by J. Williams, 1887, the best book); A. P. Forbes, *An Explanation of the Thirty-nine Articles* (1867; 3d ed. 1887); Schaff, *Creeds* (vols. i., p. 292, and iii., pp. 485–522).

Revised by S. M. JACKSON.

THE THIRTY-NINE ARTICLES as revised by the Protestant Episcopal Church in the U. S. are as follows:

ART. I. *Of Faith in the Holy Trinity.*—There is but one living and true God, everlasting, without body, parts, or passions; of infinite power, wisdom, and goodness; the Maker and Preserver of all things both visible and invisible. And in unity of this Godhead there be three Persons of one substance, power, and eternity—the Father, the Son, and the Holy Ghost.

ART. II. *Of the Word or Son of God, which was made very Man.*—The Son, which is the Word of the Father, begotten from everlasting of the Father, the very and eternal God, and of one substance with the Father, took man's nature in the womb of the blessed Virgin, of her substance; so that two whole and perfect natures, that is to say, the Godhead and manhood, were joined together in one person, never to be divided, whereof is one Christ, very God, and very man; who truly suffered, was crucified, dead, and buried, to reconcile his Father to us, and to be a sacrifice, not only for original guilt, but also for actual sins of men.

ART. III. *Of the going down of Christ into Hell.*—As Christ died for us, and was buried; so also is it to be believed, that he went down into hell.

ART. IV. *Of the Resurrection of Christ.*—Christ did truly rise again from death, and took again his body, with flesh, bones, and all things appertaining to the perfection of man's nature; wherewith he ascended into heaven, and there sitteth, until he return to judge all men at the last day.

ART. V. *Of the Holy Ghost.*—The Holy Ghost, proceeding from the Father and the Son, is of one substance, majesty, and glory, with the Father and the Son, very and eternal God.

ART. VI. *Of the Sufficiency of the Holy Scriptures for Salvation.*—Holy Scripture containeth all things necessary to salvation; so that whatsoever is not read therein, nor may be proved thereby, is not to be required of any man that it should be believed as an article of the faith, or be thought requisite or necessary to salvation. In the name of the holy Scripture we do understand those canonical books of the Old and New Testament, of whose authority was never any doubt in the Church. *Of the Names and Number of the Canonical Books.*—Genesis, Exodus, Leviticus, Numbers, Deuteronomy, Joshua, Judges, Ruth, The First Book of Samuel, The Second Book of Samuel, The First Book of Kings, The Second Book of Kings, The First Book of Chronicles, The Second Book of Chronicles, The First Book of Esdras, The Second Book of Esdras, the Book of Esther, The Book of Job, The Psalms, The Proverbs, Ecclesiastes or Preacher, Cantica or Songs of Solomon, Four Prophets the greater, Twelve Prophets the less. And the other books (as *Hierome* saith) the Church doth read for example of life and instruction of manners; but yet doth it not apply them to establish any doctrine; such are these following: The Third Book of Esdras, The Fourth Book of Esdras, The Book of Tobias, The Book of Judith, The rest of the Book of Esther, The Book of Wisdom, Jesus the Son of Sirach, Baruch the Prophet, The Song of the Three Children, The Story of Susanna, Of Bel and the Dragon, The Prayer of Manasses, The First Book of Maccabees, The Second Book of Maccabees. All the books of the New Testament, as they are commonly received, we do receive, and account them canonical.

ART. VII. *Of the Old Testament.*—The Old Testament is not contrary to the New; for both in the Old and New Testament everlasting life is offered to mankind by Christ, who is the only Mediator between God and man, being both God and man. Wherefore they are not to be heard, which feign that the old fathers did look only for transitory promises. Although the law given from God by Moses, as touching ceremonies and rites, do not bind Christian men, nor the civil precepts thereof ought of necessity to be received in any commonwealth; yet notwithstanding, no Christian man whatsoever is free from the obedience of the Commandments which are called moral.

ART. VIII. *Of the Creeds.*—The *Nicene* Creed, and that which is commonly called the *Apostles'* Creed, ought thoroughly to be received and believed; for they may be proved by most certain warrants of holy Scripture.

ART. IX. *Of Original or Birth-sin.*—Original sin standeth not in the following of *Adam* (as the *Pelagians* do vainly talk); but it is the fault and corruption of the nature of every man, that naturally is engendered of the offspring of *Adam*; whereby man is very far gone from original righteousness, and is of his own nature inclined to evil, so that the flesh lusteth always contrary to the Spirit; and therefore in every person born into this world it deserveth God's wrath and damnation. And this infection of nature doth remain, yea, in them that are regenerated; whereby the lust of the flesh, called in Greek φρόνημα σαρκός (which some do expound the wisdom, some sensuality, some the affection, some the desire, of the flesh), is not subject to the Law of God. And although there is no condemnation for them that believe and are baptized; yet the Apostle doth confess, that concupiscence and lust hath of itself the nature of sin.

ART. X. *Of Free Will.*—The condition of man after the fall of *Adam* is such that he can not turn and prepare himself, by his own natural strength and good works, to faith, and calling upon God. Wherefore we have no power to do good works pleasant and acceptable to God, without the grace of God by Christ preventing us, that we may have a good will, and working with us, when we have that good will.

ART. XI. *Of the Justification of Man.*—We are accounted righteous before God, only for the merit of our Lord and Saviour Jesus Christ by faith, and not for our own works or deservings. Wherefore, that we are justified by faith only, is a most wholesome doctrine, and very full of comfort, as more largely is expressed in the Homily of Justification.

ART. XII. *Of Good Works.*—Albeit that good works, which are the fruits of faith, and follow after justification, can not put away our sins, and endure the severity of God's judgment; yet are they pleasing and acceptable to God in Christ, and do spring out necessarily of a true and lively faith; insomuch that by them a lively faith may be as evidently known as a tree discerned by the fruit.

ART. XIII. *Of Works before Justification.*—Works done before the grace of Christ, and the inspiration of his Spirit, are not pleasant to God, forasmuch as they spring not of faith in Jesus Christ; neither do they make men meet to receive grace, or (as the school-authors say) deserve grace of congruity: yea rather, for that they are not done as God hath willed and commanded them to be done, we doubt not but they have the nature of sin.

ART. XIV. *Of Works of Supererogation*—Voluntary works besides, over and above, God's commandments, which they call works of supererogation, can not be taught without arrogancy and impiety: for by them men do declare, that they do not only render unto God as much as they are bound to do, but that they do more for his sake, than of bounden duty is required: whereas Christ saith plainly, When ye have done all that are commanded to you, say, We are unprofitable servants.

ART. XV. *Of Christ alone without Sin.*—Christ in the truth of our nature was made like unto us in all things, sin only except, from which he was clearly void, both in his flesh, and in his spirit. He came to be the Lamb without spot, who, by sacrifice of himself once made, should take away the sins of the world; and sin (as Saint *John* saith) was not in him. But all we the rest, although baptized, and born again in Christ, yet offend in many things; and if we say we have no sin, we deceive ourselves, and the truth is not in us.

ART. XVI. *Of Sin after Baptism.*—Not every deadly sin willingly committed after baptism is sin against the Holy Ghost, and unpardonable. Wherefore the grant of repentance is not to be denied to such as fall into sin after baptism. After we have received the Holy Ghost, we may depart from grace given, and fall into sin, and by the grace of God we may arise again, and amend our lives. And therefore they are to be condemned, which say, they can no more sin as long as they live here, or deny the place of forgiveness to such as truly repent.

ART. XVII. *Of Predestination and Election.*—Predestination to life is the everlasting purpose of God, whereby (before the foundations of the world were laid) he hath constantly decreed by his counsel secret to us, to deliver from curse and damnation those whom he hath chosen in Christ out of mankind, and to bring them by Christ to everlasting salvation, as vessels made to honor. Wherefore, they which be endued with so excellent a benefit of God, be called according to God's purpose by his Spirit working in due season: they through grace obey the calling: they be justified freely: they be made sons of God by adoption: they be made like the image of his only-begotten Son Jesus Christ: they walk religiously in good works, and at length, by God's mercy, they attain to everlasting felicity.

As the godly consideration of predestination, and our election in Christ, is full of sweet, pleasant, and unspeakable comfort to godly persons, and such as feel in themselves the working of the Spirit of Christ, mortifying the works of the flesh, and their earthly members, and drawing up their mind to high and heavenly things, as well because it doth greatly establish and confirm their faith of eternal salvation to be enjoyed through Christ, as because it doth fervently kindle their love towards God: So, for curious and carnal persons, lacking the Spirit of Christ, to have continually before their eyes the sentence of God's predestination, is a most dangerous downfall, whereby the devil dost thrust them either into desperation, or into wretchedness of most unclean living, no less perilous than desperation.

Furthermore, we must receive God's promises in such wise, as they be generally set forth to us in holy Scripture: and, in our doings, that will of God is to be followed, which we have expressly declared unto us in the Word of God.

ART. XVIII. *Of obtaining Eternal Salvation only by the Name of Christ.*—They also are to be had accursed that presume to say, That every man shall be saved by the law or sect which he professeth, so that he be diligent to frame his life according to that law, and the light of nature. For holy Scripture doth set out unto us only the name of Jesus Christ, whereby men must be saved.

ART. XIX. *Of the Church.*—The visible Church of Christ is a congregation of faithful men, in the which the pure Word of God is preached, and the sacraments be duly ministered according to Christ's ordinance, in all those things that of necessity are requisite to the same.

As the Church of *Jerusalem*, *Alexandria*, and *Antioch*, have erred; so also the Church of *Rome* hath erred, not only in their living and manner of ceremonies, but also in matters of faith.

ART. XX. *Of the Authority of the Church.*—The Church hath power to decree rites or ceremonies, and authority in controversies of faith: and yet it is not lawful for the Church to ordain anything that is contrary to God's Word written, neither may it so expound one place of Scripture, that it be repugnant to another. Wherefore, although the Church be a witness and a keeper of Holy Writ, yet, as it ought not to decree anything against the same, so besides the same ought it not to enforce anything to be believed for necessity of salvation.

ART. XXI. *Of the Authority of General Councils.*—[This article (which is given at foot *) was omitted, because it is partly of a local and civil nature, and because the remaining parts are provided for in other articles.]

ART. XXII. *Of Purgatory.*—The Romish doctrine concerning purgatory, pardons, worshiping and adoration, as well of images as of relics, and also invocation of saints, is a fond thing, vainly invented, and grounded upon no warranty of Scripture, but rather repugnant to the Word of God.

ART. XXIII. *Of Ministering in the Congregation.*—It is not lawful for any man to take upon him the office of public preaching, or ministering the sacraments in the congregation, before he be lawfully called, and sent to execute the same. And those we ought to judge lawfully called and sent, which be chosen and called to this work by men who have public authority given unto them in the congregation, to call and send ministers into the Lord's vineyard.

ART. XXIV. *Of Speaking in the Congregation in such a Tongue as the People understandeth.*—It is a thing plainly repugnant to the Word of God, and the custom of the primitive Church, to have public prayer in the church, or to minister the sacraments, in a tongue not understanded of the people.

ART. XXV. *Of the Sacraments.*—Sacraments ordained of Christ be not only badges or tokens of Christian men's profession, but rather they be certain sure witnesses, and effectual signs of grace, and God's good will toward us, by the which he doth work invisibly in us, and doth not only quicken, but also strengthen and confirm our faith in him.

There are two sacraments ordained of Christ our Lord in the Gospel, that is to say, baptism and the supper of the Lord.

Those five commonly called sacraments, that is to say, confirmation, penance, orders, matrimony, and extreme unction, are not to be counted for sacraments of the Gospel, being such as have grown partly of the corrupt following of the Apostles, partly are states of life allowed in the Scrip-

* XXI. *Of the Authority of General Councils.*—General councils may not be gathered together without the commandment and will of princes; and when they be gathered together (forasmuch as they be an assembly of men, whereof all be not governed with the Spirit and Word of God), they may err, and sometimes have erred, even in things pertaining unto God. Wherefore things ordained by them as necessary to salvation have neither strength nor authority, unless it may be declared that they be taken out of holy Scripture.

tures; but yet have not like nature of sacraments with baptism, and the Lord's Supper, for that they have not any visible sign or ceremony ordained of God.

The sacraments were not ordained of Christ to be gazed upon, or to be carried about, but that we should duly use them. And in such only as worthily receive the same, they have a wholesome effect or operation; but they that receive them unworthily, purchase to themselves damnation, as Saint *Paul* saith.

ART. XXVI. *Of the Unworthiness of the Ministers, which hinders not the Effect of the Sacraments.*—Although in the visible Church the evil be ever mingled with the good, and sometimes the evil have chief authority in the administration of the Word and sacraments, yet forasmuch as they do not the same in their own name, but in Christ's, and do minister by his commission and authority, we may use their ministry, both in hearing the Word of God, and in receiving the sacraments. Neither is the effect of Christ's ordinance taken away by their wickedness, nor the grace of God's gifts diminished from such as by faith, and rightly, do receive the sacraments ministered unto them; which be effectual, because of Christ's institution and promise, although they be ministered by evil men.

Nevertheless, it appertaineth to the discipline of the Church that inquiry be made of evil ministers, and that they be accused by those that have knowledge of their offenses; and finally, being found guilty, by just judgment be deposed.

ART. XXVII. *Of Baptism.*—Baptism is not only a sign of profession, and mark of difference, whereby Christian men are discerned from others that be not christened, but it is also a sign of regeneration or new-birth, whereby, as by an instrument, they that receive baptism rightly are grafted into the Church; the promises of the forgiveness of sin, and of our adoption to be the sons of God by the Holy Ghost, are visibly signed and sealed; faith is confirmed, and grace increased by virtue of prayer unto God.

The baptism of young children is in anywise to be retained in the Church, as most agreeable with the institution of Christ.

ART. XXVIII. *Of the Lord's Supper.*—The supper of the Lord is not only a sign of the love that Christians ought to have among themselves one to another; but rather it is a sacrament of our redemption by Christ's death; insomuch that to such as rightly, worthily, and with faith, receive the same, the bread which we break is a partaking of the body of Christ; and likewise the cup of blessing is a partaking of the blood of Christ.

Transubstantiation (or the change of the substance of bread and wine) in the supper of the Lord, can not be proved by holy Writ; but is repugnant to the plain words of Scripture, overthroweth the nature of a sacrament, and hath given occasion to many superstitions.

The body of Christ is given, taken, and eaten, in the Supper, only after an heavenly and spiritual manner. And the mean whereby the body of Christ is received and eaten in the Supper is faith.

The sacrament of the Lord's Supper was not by Christ's ordinance reserved, carried about, lifted up, or worshiped.

ART. XXIX. *Of the Wicked, which eat not the Body of Christ in the Use of the Lord's Supper.*—The wicked, and such as be void of a lively faith, although they do carnally and visibly press with their teeth (as Saint *Augustine* saith) the sacrament of the body and blood of Christ; yet in nowise are they partakers of Christ; but rather, to their condemnation, do eat and drink the sign or sacrament of so great a thing.

ART. XXX. *Of both Kinds.*—The cup of the Lord is not to be denied to the lay people; for both the parts of the Lord's sacrament, by Christ's ordinance and commandment, ought to be administered to all Christian men alike.

ART. XXXI. *Of the One Oblation of Christ finished upon the Cross.*—The offering of Christ once made is that perfect redemption, propitiation, and satisfaction, for all the sins of the whole world, both original and actual; and there is none other satisfaction for sin, but that alone. Wherefore the sacrifices of masses, in the which it was commonly said, that the priest did offer Christ for the quick and the dead, to have remission of pain or guilt, were blasphemous fables, and dangerous deceits.

ART. XXXII. *Of the Marriage of Priests.*—Bishops, priests, and deacons are not commanded by God's law, either to vow the estate of single life, or to abstain from marriage: therefore it is lawful for them, as for all other Christian men, to marry at their own discretion, as they shall judge the same to serve better to godliness.

ART. XXXIII. *Of Excommunicate Persons, how they are to be avoided.*—That person which by open denunciation of the Church is rightly cut off from the unity of the Church, and excommunicated, ought to be taken of the whole multitude of the faithful, as an heathen and publican, until he be openly reconciled by penance and received into the Church by a judge that hath authority thereunto.

ART. XXXIV. *Of the Traditions of the Church.*—It is not necessary that traditions and ceremonies be in all places one, or utterly like; for at all times they have been divers, and may be changed according to the diversity of countries, times, and men's manners, so that nothing be ordained against God's Word. Whosoever, through his private judgment, willingly and purposely, doth openly break the traditions and ceremonies of the Church, which be not repugnant to the Word of God, and be ordained and approved by common authority, ought to be rebuked openly (that others may fear to do the like), as he that offendeth against the common order of the Church, and hurteth the authority of the magistrate, and woundeth the consciences of the weak brethren.

Every particular or national church hath authority to ordain, change, and abolish ceremonies or rites of the Church ordained only by man's authority, so that all things be done to edifying.

ART. XXXV. *Of the Homilies.*—The Second Book of Homilies, the several titles whereof we have joined under this article, doth contain a godly and wholesome doctrine, and necessary for these times, as doth the former Book of Homilies, which were set forth in the time of *Edward the Sixth*; and therefore we judge them to be read in churches by the ministers, diligently, and distinctly, that they may be understanded of the people.

*Of the Names of the Homilies.*—1. Of the right use of the church. 2. Against peril of idolatry. 3. Of repairing and keeping clean of churches. 4. Of good works: first of fasting. 5. Against gluttony and drunkenness. 6. Against excess of apparel. 7. Of prayer. 8. Of the place and time of prayer. 9. That common prayers and sacraments ought to be ministered in a known tongue. 10. Of the reverend estimation of God's Word. 11. Of alms-doing. 12. Of the nativity of Christ. 13. Of the passion of Christ. 14. Of the resurrection of Christ. 15. Of the worthy receiving of the sacrament of the body and blood of Christ. 16. Of the gifts of the Holy Ghost. 17. For the rogation-days. 18. Of the state of matrimony. 19. Of repentance. 20. Against idleness. 21. Against rebellion.

[This article is received in this Church, so far as it declares the Books of Homilies to be an explication of Christian doctrine, and instructive in piety and morals. But all references to the constitution and laws of England are considered as inapplicable to the circumstances of this Church; which also suspends the order for the reading of said homilies in churches, until a revision of them may be conveniently made, for the clearing of them, as well from obsolete words and phrases, as from the local references.]

ART. XXXVI. *Of Consecration of Bishops and Ministers.*—The Book of Consecration of Bishops, and Ordering of Priests and Deacons, as set forth by the General Convention of this Church in 1792, doth contain all things necessary to such consecration and ordering; neither hath it any thing that, of itself, is superstitious and ungodly. And, therefore, whosoever are consecrated or ordered according to said form, we decree all such to be rightly, orderly, and lawfully consecrated and ordered.

ART. XXXVII. *Of the Power of the Civil Magistrates.*—The power of the civil magistrate extendeth to all men, as well clergy as laity, in all things temporal; but hath no authority in things purely spiritual. And we hold it to be the duty of all men who are professors of the Gospel, to pay respectful obedience to the civil authority, regularly and legitimately constituted.

ART. XXXVIII. *Of Christian Men's Goods, which are not common.*—The riches and goods of Christians are not common, as touching the right, title, and possession of the same; as certain Anabaptists do falsely boast. Notwithstanding, every man ought, of such things as he possesseth, liberally to give alms to the poor, according to his ability.

ART. XXXIX. *Of a Christian Man's Oath.*—As we confess that vain and rash swearing is forbidden Christian men by our Lord Jesus Christ, and *James* his Apostle, so we judge, that Christian religion doth not prohibit, but that a man may swear when the magistrate requireth, in a cause of faith and charity, so it be done according to the prophet's teaching, in justice, judgment, and truth.

**Thirty Tyrants**: a body of thirty magistrates in Athens (404–403 B. C.). They were appointed from the aristocratic party by the Spartans, victorious in the Peloponnesian war. The tyrants were guilty of the most cruel and shameless acts, and after one year were expelled by Thrasybulus.

**Thirty Years' War**: the name given to a succession of wars (1618–48) begun as a struggle between Roman Catholics and Protestants, carried on as an attempt to establish the authority of the German emperor over the religious interests of Germany, and concluded as a struggle of the house of Austria to maintain its imperial power over domestic and foreign affairs.

*Causes of the War.*—By the Treaty of Augsburg (1555), which temporarily brought the strifes of the Reformation to an end, each of the German states was permitted to determine the nature of its national religion. All subjects were permitted to remove from states in which their religion was forbidden to states in which it was officially sanctioned. But the inconveniences imposed on dissent by these provisions made disagreements inevitable. Protestantism continued in Catholic states and Catholicity continued where it was under governmental prohibition. Protestantism throve, especially in Bohemia and Austria; but under Rudolf II. (1576–1612) a strong reaction, largely under the influence of the Jesuits, set in. In 1608 the Evangelical Union and in 1609 the Catholic League were formed to protect their respective interests. The Emperor Matthias (1612–19) gave certain guarantees of liberty, but in 1617 Ferdinand of Styria, who had been educated by the Jesuits, was crowned King of Bohemia. Persecutions at once began. Protestant churches were closed in Braunau and pulled down in Klostergrab. The Protestant estates met in Prague Mar. 5, 1618, and petitioned the Emperor Matthias, who sent messengers to declare their meeting illegal and to defend his own acts. The reply of the emperor was borne by Slawata and Martinitz, and received in the assembly-room of the castle. At the end of the altercation which ensued Slawata and Martinitz, with their secretary, Fabricius, were hurled from the castle window about 70 feet from the ground. The fact that all escaped with only slight injuries tended to increase the faith of the Catholics in the divine protection of their cause. Protestants and Catholics alike in all parts of Southern Germany took up arms.

*The Bohemian War* (1618–20).—After the events just described the concessions made to Protestants in Bohemia were withdrawn, and an insurrection followed. Frederick V., the Elector Palatine and a Protestant, was chosen King of Bohemia in 1619. Count Thurn repeatedly defeated the Catholic forces, but Frederick V. was a courtier rather than a soldier, and his motley army was totally routed by the army of Maximilian of Bavaria at Weissemberg Nov. 8, 1620. The same autumn and winter the Lower Palatinate was ravaged by an army of Spaniards under Spinola. The Protestants, utterly defeated in Bohemia, were given over to persecution.

*War in the Palatinate* (1621–23).—Count Mansfeld and Duke Christian of Brunswick at the head of the Protestant forces showed great skill and energy in opposition to the Catholic armies on the Rhine. They ravaged the territories of the Catholic League, and everywhere retaliated with energy for the tyranny shown by Ferdinand II. in his dealings with the Protestants. Both sides fought with desperation. The imperial commander TILLY (*q. v.*) defeated the Margrave of Baden at Wimpfen (May 6, 1622); also Christian of Brunswick at Höchst (June 30, 1622) and at Stadtlohn (Aug. 6, 1623). These victories might have ended the war but for two reasons. The Protestant princes in the north were beginning to be aroused, and Mansfeld and Christian, though dismissed by Frederick (July, 1623), refused to lay down their arms or leave the field. They fought desperately on their own account in Alsace, in Lorraine, in Holland, and in Saxony, supporting their armies as they went, and everywhere leaving desolation.

*The Danish-Saxon War* (1624–29).—The Danish king Christian IV. resented injuries inflicted on him by the emperor, and, supported by a British subsidy, joined the Protestant cause in 1624. With the forces of Mansfeld and Christian of Brunswick, he marched into Lower Saxony. Meantime the Emperor Ferdinand had called for the help of WALLENSTEIN (*q. v.*), who, with the army of Leaguers under Tilly, now marched to the north. The Danes were routed in 1626 by Tilly at Lutter and Mansfeld by Wallenstein at Dessau. The hopes of the Protestants would have perished but for the fact that Mansfeld, after an apparently overwhelming defeat, gathered together forces enough to conduct a victorious raid or campaign through Silesia, Moravia, and Hungary. Meanwhile, however, the forces of Wallenstein and Tilly overran North Germany and Denmark, and compelled Christian IV. to sign a treaty of peace at Lubeck May 12, 1629.

*The Swedish-German War* (1630–36).—In 1629 Ferdinand issued the famous Edict of Restitution, according to which all estates that had been secularized since 1552 were ordered to be restored to the Catholic Church. The edict, unpopular with many Catholics, gave the greatest offense to the Protestants. Not content with this, Ferdinand fomented a revolt of the Poles against Sweden, thus intensifying the deep indignation that was already at the point of war. On July 4, 1630, GUSTAVUS ADOLPHUS (*q. v.*) landed with a Swedish army at Usedom, drove the imperialists out of Mecklenburg and Pomerania, and formed alliances with Hesse, Saxe-Weimar, Magdeburg, Brandenburg, and Saxony. Tilly advanced against the new alliance, and stormed and sacked Magdeburg May 20, 1631, after a desperate siege. The city was given up to plunder, and the slaughter of the inhabitants became memorable. On Sept. 17, 1631, the armies met at Breitenfeld, near Leipzig, and the army of Tilly was nearly annihilated. Gustavus now advanced to the W., to the S., and to the E., traversing the Rhine and ascending the valley of the Main, defeating his enemy on the Lech Apr. 15, 1632, where Tilly was slain, and entering Munich May 17, after having established organizers and supporters in every important city along his route. The brilliancy of this march startled Europe and laid the basis for a new Evangelical Union, with Sweden at the head. Ferdinand saw that the case was desperate, and thereupon recalled Wallenstein, whom he had previously disgraced, giving him practically unreserved powers. Wallenstein rapidly collected an army, overran Bohemia, and marched N. into Saxony. Gustavus was obliged to follow. In the desperate battle of Lützen (Nov. 16, 1632) Wallenstein was defeated, but the cause of the Protestants, while overthrowing the enemy, suffered an irreparable loss in the death of Gustavus Adolphus at the moment of victory. The Swedes, under Oxenstierna, preserved their advantages until at Nördlingen, Sept. 6, 1634, the Protestants, under Bernard of Weimar, were totally defeated. The cause of the emperor was thus reinstated, and Saxony signed a treaty of peace at Prague May 30, 1635.

*The French-Swedish War* (1636–48).—RICHELIEU (*q. v.*), having broken the political power of the Huguenots and of the nobles in France, was now ready to advance to the third great object of his policy—the defeat of the ambitions of Austria. To secure the hearty alliance of France, Oxenstierna yielded to Richelieu the direction of the war. The contest then became political rather than religious. While France united with Sweden, Denmark and Saxony united with the Emperor Ferdinand. Another set of generals then came into prominence. The Swedes under Banér held Northern Germany, and, after penetrating Silesia and Bohemia, defeated the Austrians and Saxons in a great battle at Wittstock in 1636. The same army under Torstensson and Königsmark gained further victories at Breitenfeld (1642) and Jankau (1645). Meantime Turenne and Condé devastated the regions of the Rhine, and, by repeated victories, drove back the imperial forces from the Palatinate and from Bavaria. These successes prepared the way for an invasion of Austria, which was about to take place when, after many preliminaries, the terrible struggle was brought to an end by the Peace of WESTPHALIA (*q. v.*) Oct. 24, 1648. As the fruit of this most terrible of modern wars, Protestantism was saved, but at a cost which it is difficult even to estimate. The population was greatly decreased; intellectually and morally the people suffered a great decline. Germany was disintegrated, and the material losses were such that a complete recovery had hardly taken place at the end of two centuries.

AUTHORITIES.—Gardiner, *Thirty Years' War* (1874); Ward, *The House of Austria in the Thirty Years' War*; Schiller, *Geschichte des Dreissigjährigen Kriegs* (Leipzig, 1793); Gindely, *Geschichte des Dreissigjährigen Kriegs* (4 vols., Prague, 1869–80; Eng. transl. *History of the Thirty Years' War*, by Ten Brook); also by the same author, *Illustrierte Geschichte des Dreissigjährigen Kriegs* (2d ed. 3 vols., Leipzig, 1884).

C. K. ADAMS.

**Thistle** [O. Eng. *þistel* : O. H. Germ. *distil* > Mod. Germ. *distel*]: any one of many stout spinous herbs of the family *Compositæ* and of the genera *Cnicus, Carduus, Centaurea, Onopordon.* A few have medicinal qualities, and some have fine flowers. The roots and leaves of some species were once eaten as food. The creeping thistle, commonly but er-

Creeping or Canada thistle.

roneously called the Canada thistle (*Cnicus*—or *Carduus*—*arvensis*), is a noxious weed of European origin, now naturalized extensively in America. It is a perennial, with many long, running underground stems which come to the surface and give rise to new plants. When these creeping stems are cut or broken each part produces a new plant. The plants tend to be diœcious, hence many produce no seeds.
Revised by CHARLES E. BESSEY.

**Thistle-bird**: a name given to the American goldfinch (*Spinus tristis*), often designated the YELLOW-BIRD (*q. v.*).

**Thoburn**, JAMES MILLS, A. M., D. D.: bishop; b. at St. Clairsville, O., Mar. 7, 1836; educated at Allegheny College, Meadville, Pa.; joined the Pittsburg Conference of the Methodist Episcopal Church 1858; has been engaged in missions in India since 1859; was elected missionary bishop for India and Malaysia in 1888. He has published *Missionary Addresses*; *My Missionary Apprenticeship* (New York, 1884); *India and Malaysia* (1892); *Light in the East* (1894); and *The Deaconess and her Vocation.* A. OSBORN.

**Tholuck**, tō'look, FRIEDRICH AUGUST GOTTTREU: theologian and author; b. at Breslau, Germany, Mar. 30, 1799; studied theology and Oriental languages at the Universities of Breslau and Berlin; visited England in 1825, and Rome in 1828; was appointed Professor Extraordinary of Theology at Berlin in 1824, and removed to Halle in 1826 as ordinary professor. He found the university given up to rationalism, but under his influence it largely regained its reputation for piety. His works, most of which have been often reprinted in Germany and translated into English both in England and America, were published at Gotha in a collected edition in 11 vols., 1863–72, and treat of Oriental subjects—*Sufismus, sive Theosophia Persarum pantheistica* (1821); *Blütensammlung aus der morgenländischen Mystik* (1825); *Speculativ Trinitätslehre des spätern Orients* (1826); exegetical—*The Epistle to the Romans* (1824; twice translated into English); *The Gospel of John* (1827; translated into English by Kaufmann, 1836); *The Sermon on the Mount* (1833; translated into English by R. L. Brown, Edinburgh, 1860), etc.; historical—*Vorgeschichte des Rationalismus* (4 vols., 1853–62); *Geschichte des Rationalismus* (1865, etc.); ethical and dogmatical—*Wahre Weihe des Zweiflers* (1824; translated into English by Ryland under the title of *Guido and Julius, the Doctrine of Sin and the Propitiator*); *Stunden der Andacht* (2 vols., 1840; Eng. trans., *Hours of Christian Devotion*, 1875). He was one of the most fruitful and influential German theologians and authors during the second and third quarters of the nineteenth century, and better known in England and the U. S. than any other. He was original, brilliant, suggestive, eloquent, and full of poetry, wit, and humor. He can not be classified with any school. He was influenced by Pietism and Moravianism, by Schleiermacher and Neander, and even by Hegel. His elastic mind was ever open to new light. He was particularly admired as a preacher. He lives in the lives he inspired and guided, not in the books he wrote. D. at Halle, Prussia, June 10, 1877. See his *Life*, by L. Witte (2 vols., Bielefeld, 1884–86).
Revised by S. M. JACKSON.

**Thom**, JOHN HAMILTON: preacher and author; b. probably in Scotland about 1810; became a distinguished minister of the Unitarian Church, and was many years pastor of the congregation worshiping in Renshaw chapel, Liverpool; author of *St. Paul's Epistles to the Corinthians* (London, 1851; Boston, 1852); *The Revelation of God and Man in the Son of God and the Son of Man* (1859); a *Memoir of Rev. John James Tayler* (1872), and other works; editor of *The Life of the Rev. Joseph Blanco White, written by himself, with Portions of his Correspondence* (3 vols., 1845); a book in which Dr. Liddon finds the beginnings of the Latitudinarian movement in the English Church. In 1839 he was associated with Dr. James Martineau and the Rev. Henry Giles in a course of controversial sermons delivered at Liverpool which attracted wide attention at the time, and are still a landmark of exceptional importance in the history of Unitarian thought. D. Aug. 2, 1894.
Revised by J. W. CHADWICK.

**Thoma**, RICHARD: surgeon; b. at Bonndorf, in the Black Forest, Germany, Dec. 11, 1847; studied in the Universities of Berlin and Heidelberg, graduating M. D. at the latter in 1872; settled in Heidelberg and devoted himself to the study of pathological anatomy; was elected, in 1877, extraordinary professor of that science in the university. Subsequently he accepted the chair of General and Anatomical Pathology in the University of Dorpat. He has written several monographs on pathological topics. S. T. A.

**Thomas**, or **Did'ymus**, SAINT [*Thomas* = Lat. = Gr. Θωμᾶς, from Heb. *Tᵉōm*, liter., twin; *Didymus* = Lat. = Gr. Δίδυμος, liter., twin]: one of the twelve apostles, of whose personal character and history nothing is known except by two or three allusions in the Gospel of John. The most important of these is his refusal to believe in the resurrection of Jesus until convinced by tangible proof. Two apocryphal works are ascribed to him—a "Gospel" and "Acts" (best ed. by Bonnet, Leipzig, 1883). He was represented by later so-called "tradition" as having preached in Ethiopia, Egypt, Parthia, or India, and in the latter country the CHRISTIANS OF ST. THOMAS (*q. v.*), found by the Portuguese on the Malabar coast in the sixteenth century, claimed to originate from his preaching. This, however, is probably due to a confusion with a Nestorian or Manichæan missionary. Great efforts have been made by several Spanish, Mexican, and South American theologians to make it appear that the apostle evangelized America, and traces of his presence are pointed out in sacred caves and other sites from Paraguay to Mexico, in which latter country he has been formally identified by several native antiquarians with the Aztec divinity Quetzalcoatl. Revised by S. M. JACKSON.

**Thomas**, ARTHUR GORING: opera composer; b. at Ratten, Sussex, England, Nov. 21, 1851; did not study music seriously until he became of age. In 1875 he went to Paris and studied two years, then returned to England and entered the Royal Academy, remaining there three years and twice gaining the annual prize for composition. His first opera, *The Light of the Harem*, performed by students, led to his receiving a commission from Carl Rosa, for whose company he composed his opera *Esmeralda*, produced Mar. 26, 1883, and a second opera, *Nadeschda*, was performed by the same company Apr. 16, 1885. He composed also *The Sun Worshippers*, a cantata for the Norwich festival of 1881, an orchestral *Suite de Ballet*, several smaller orchestral pieces, some church music, and many songs. D. in London, Mar. 21, 1892. D. E. HERVEY.

**Thomas**, CHARLES LOUIS AMBROISE: musician; b. at Metz, then in France, Aug. 5, 1811; entered the Paris Conservatory in 1828; took many prizes, including the Prix de Rome in 1832; has been a prolific composer of cantatas and operas, and considerable chamber music, piano pieces, and songs; also a *Requiem Mass* and other sacred music; was appointed Professor of Composition in the Conservatory in 1852, and succeeded Auber as director July 6, 1871; elected member of the French Institute in 1851; made a grand officer of the Legion of Honor, Jan., 1881. His principal operatic works are *Le Caïd* (1849); *Le Songe d'une Nuit d'Été* (1850); *Raymond* (1851); *Psyche* (1857); *Mignon* (1866); *Hamlet* (1868); and *Françoise de Rimini* (1882). D. Feb. 12, 1896.

**Thomas**, CYRUS, Ph. D.: ethnologist and entomologist; b. at Kingsport, Tenn., July 27, 1825; removed to Jackson co., Ill., in 1849, and in 1851 was elected county clerk, being at the same time admitted to the bar. After practicing law at Murphysboro for several years he entered the ministry of the Evangelical Lutheran Church in 1864. From 1869 to 1874 he was naturalist on the U. S. Geological Survey under Prof. F. V. Hayden, and from 1874 to 1877 Professor of Natural Sciences in the Southern Illinois Normal University, becoming also State entomologist of Illinois in 1875. He was a member of the U. S. entomological commission to investigate the destruction caused by grasshoppers in the West 1877–82, and then became ethnologist in the U. S. Bureau of Ethnology, in charge of mound explorations. He has studied the Maya hieroglyphs as written in the codices and on the Central American inscriptions, and claims to have discovered the signification and phonetic rendering of a sufficient number of characters to form a key by which to determine the others. His most important works are *Acrididæ of North America* (Washington, 1873); *The Noxious and Beneficial Insects of Illinois* (5 vols., 1876–80); *Study of the Manuscript Troano* (2 vols., 1878–80); *Notes on Certain Maya and Mexican Manuscripts* (1884); *Aids to the Study of the Maya Codices*; *Cherokees in pre-Columbian Times*; *The Shawnees in pre-Columbian Times*; *Catalogue of Prehistoric Works East of the Rocky Mountains*; *Mound Exploration of the Bureau of Ethnology*; and bulletins relating to the mounds.

**Thomas**, Edith Matilda: poet; b. at Chatham, O., Aug. 12, 1854. She was educated at the Normal School at Geneva, O.; removed to New York in 1888. Her poems deal mainly with aspects of nature, and are very subtle in feeling and delicate in expression. Her published volumes include *A New Year's Masque* (1885); *The Round Year* (1886); *Lyrics and Sonnets* (1887); *Babes of the Year* (1888); and *The Inverted Torch* (1890). H. A. B.

**Thomas**, George Henry: soldier; b. in Southampton co., Va., July 31, 1816; graduated at the U. S. Military Academy in 1840; served in Florida against the Seminoles and in the Mexican war; was instructor at the Military Academy 1851–54, and in 1855 was appointed major of the Second Cavalry, with which he served continuously for the next five years. On the outbreak of the civil war Thomas, notwithstanding his sympathies and associations with the South, at once gave his adherence to the Union. Promoted to be brigadier-general of volunteers in Aug., 1861, and transferred to the department of the Cumberland, he was for a time engaged in mustering and organizing the First Brigade; was given command of the First Division (Army of the Ohio) in Nov., 1861, and fought in the battle of Mill Springs (Jan. 19–20, 1862), which was the most important victory yet gained in the West and brought Thomas into general notice. He was promoted major-general of volunteers Apr. 2, 1862, and rendered valuable service in the West and South. In the battle of Murfreesboro (*q. v.*) he commanded the center, and at Chickamauga (*q. v.*), Sept. 19–20, 1863, he commanded the left wing where the great struggle took place for the repossession of Chattanooga, out of which the enemy had been manœuvered. The record of Thomas's wonderful resistance for upward of five hours against the concentrated efforts of the enemy after the Federal right was routed forms one of the most remarkable events in the history of the war. He was given command of the Army of the Cumberland, and on Oct. 27 he was commissioned brigadier-general in the regular army. On Sept. 27, 1864, Thomas was detached from the main army in Georgia, and placed in chief command in Tennessee, with large discretionary powers, as it was a matter of doubt what were the real intentions of the Confederate general Hood, who was moving northward in the hope of causing Sherman's withdrawal from Georgia. After a period of intense anxiety in Washington over what seemed an unnecessary delay, Thomas checked Hood's advance at Nashville, pursued him beyond the Tennessee, and destroyed his army. (See Nashville, Battle of.) The appointment of major-general in the regular army was (Dec. 15, 1864) bestowed upon him, and Congress tendered him a vote of thanks. During the remaining months of the war he contributed materially to the overthrow of the Confederacy by organizing raiding expeditions (resulting in the capture of Jefferson Davis in May, 1865) and by timely aid to other departments. He commanded the military division of the Tennessee (1865–66); the department of the Tennessee (1866–67); the third military district (Georgia, Florida, and Alabama), and the department of the Cumberland (1867–69). From May 15, 1869, he commanded the military division of the Pacific, with headquarters at San Francisco, where his death occurred Mar. 28, 1870.

**Thomas**, George Housman: illustrator and engraver; b. in London, England, Dec. 7, 1824; served an apprenticeship to a wood-engraver; practiced that art in Paris, giving his chief attention to the illustration of books, in which he gained such popularity that his services were engaged to go to the U. S. to illustrate a newspaper; resided at New York 1846–47; furnished designs for a number of bank-notes; returned to England on account of ill health; became one of the principal draughtsmen for *The Illustrated London News.* His best pictures were *The Queen giving the Medals to the Crimean Heroes* and *The Queen and Prince Albert at Aldershott.* His illustrations to Thomson's *Seasons* (1858) and to *Uncle Tom's Cabin* were much admired. D. at Boulogne, France, July 21, 1868.

**Thomas**, Isaiah, LL. D.: printer and editor; b. in Boston, Mass., Jan. 19, 1749; lost his father in childhood; was apprenticed when six years of age to a printer, with whom he remained eleven years; began business at Newburyport 1767; removed to Boston; aided his former employer in establishing in 1770 *The Massachusetts Spy*; became its sole editor and was connected with it until 1801; became obnoxious to the British authorities on account of the support given by his paper to the movements preparatory to the Revolution; transferred his printing-office to Worcester 1774; published a long series of reprints of popular English works, displaying good judgment in their selection, also Bibles and hymn-books; engaged in book-publishing and in printing *The Farmer's Museum*, at Walpole, N. H.; established an additional bookstore and publishing-house in Boston in 1788, under the firm name of Thomas & Andrews; issued *The Massachusetts Magazine* (8 vols., 1789–96); conducted for twenty-six years (1775–1801) the celebrated *New England Almanac*; was author of a carefully prepared *History of Printing in America* (2 vols., Worcester, 1810). He was founder and first president (1812) of the American Antiquarian Society; endowed it, erected a building for its use, and gave it a valuable library. D. at Worcester, Apr. 4, 1831. See the *Memoir* by his grandson, Benjamin F. Thomas (Boston, 1874).

**Thomas**, Jesse Burgess, D. D.: clergyman; b. at Edwardsville, Ill., July 29, 1832, graduated from Kenyon College, Gambier, O., in 1850; began a course of theological study at Rochester Theological Seminary in 1852, but relinquished it in consequence of ill health; studied law, and was admitted to the Illinois bar 1855, and engaged in mercantile pursuits in Chicago for some years. In 1862 he entered the ministry in the Baptist Church as pastor of a church in Waukegan, Ill.; in 1864 was called to the Pierrepont Street Baptist church, Brooklyn, N. Y.; accepted a call to San Francisco in 1867; returned to Chicago as pastor of Michigan Avenue Baptist church in 1871; was pastor of the consolidated First and Pierrepont Street Baptist churches, Brooklyn, N. Y., 1874–77; became professor in Newton Theological Institution, Mass., 1887. Published *The Old Bible and the New Science* (New York, 1877) and *Significance of the Historic Element in Scripture* (Philadelphia, 1883). Revised by W. H. Whitsitt.

**Thomas**, John, M. D.: physician and soldier; b. at Marshfield, Mass., in 1725; became an eminent physician in his native town and at Kingston; was surgeon to a regiment sent to Annapolis, N. S., 1746, and on the medical staff of Gov. Shirley's regiment 1747, but exchanged that post for the rank of lieutenant; attained the grade of colonel 1759; commanded a regiment under Amherst at Crown Point 1760, and took part in the capture of Montreal the same year; enrolled himself at an early date among the Sons of Liberty; was a delegate in 1774–75 to the Massachusetts provincial congress, by which he was appointed brigadier-general Feb. 9, 1775; received the same rank from the Continental Congress June 22, and was promoted to be major-general Mar. 6, 1776; was in charge of the fortification of Dorchester Heights Mar. 4, 1776, which led to the speedy evacuation of Boston by the British; succeeded at Montgomery's death to the command of the remains of the army then besieging Quebec, where he arrived May 1, found the smallpox prevalent in camp, the forces reduced to less than 1,000 effective men, and was consequently forced to raise the siege and retreat, but was attacked by the epidemic near the river Sorel, and died at Chambly, June 2, 1776.

**Thomas**, John: architect and sculptor; b. at Chalford, England, in 1813; served an apprenticeship to a stonecutter; taught himself to paint sign-boards and engrave door-plates in order to earn a few shillings out of working hours; engaged in business with his brother; was an architect at Birmingham, and later at Leamington; executed a great number of commissions for architectural and decorative sculpture, and ultimately undertook with great success the execution of works of sculpture of the highest class, among which were *Musidora, Boadicea, Lady Godiva, Una and the Lion*, and several portrait-statues, including a colossal memorial of Shakspeare, and a famous majolica fountain exhibited at the International Exhibition of 1862. He was also the architect of the seats of several noblemen. D. at Maida Hill, London, Apr. 9, 1862.

**Thomas**, John J., A. M.: agriculturist; b. near Aurora, Cayuga co., N. Y., Jan. 8, 1810; became, like his father, a distinguished writer on agriculture and pomology; was assistant editor of *The Genesee Farmer* 1834–39, horticultural editor of *The Albany Cultivator* 1841–53, assistant editor of the same and of *The Country Gentleman* for many years from 1853; contributed to the *Transactions* of the New York State Agricultural Society 1841–47 and to *The Farm* (New York, 1858); conducted *The Illustrated Annual Register of Rural Affairs* (Albany, 1857–65), and was author of *The Fruit Culturist* (1846), which in later editions, under the name of *The American Fruit Culturist*, is one of the chief American pomological works; and *Farm Implements, and the Principles of their Construction and Use* (New York, 1859). D. Feb. 22, 1895. Revised by L. H. Bailey.

**Thomas**, Joseph, M. D., LL. D.: lexicographer; brother of John J. Thomas; b. in Cayuga co., N. Y., Sept. 23, 1811; educated at the Rensselaer Polytechnic Institute, Troy, N. Y., at Yale College, and in medicine at Philadelphia; resided in India 1857–58, engaged in the study of Oriental languages; spent some months in Egypt with a similar object; and became Professor of Latin and Greek at Haverford College, Pennsylvania. He was coeditor with Thomas Baldwin of a *Pronouncing Gazetteer* (Philadelphia, 1845), which in a revised edition was entitled *A Complete Pronouncing Gazetteer and Geographical Dictionary of the World* (1855; revised 1861, 1866, 1880); and of *A New and Complete Gazetteer of the United States* (1854); published *A First Book of Etymology* (1851–52); a volume of *Travels in Egypt and Palestine* (1853); *A Comprehensive Medical Dictionary* (1864); and *Universal Pronouncing Dictionary of Biography and Mythology* (1870–71); contributed geographical and biographical pronouncing vocabularies to Webster's dictionaries, and published an edition of Oswald's *Etymological Dictionary.* D. in Philadelphia, Pa., Dec. 24, 1891.

**Thomas**, Lorenzo: soldier; b. at Newcastle, Del., Oct. 26, 1804; graduated at the U. S. Military Academy in 1823; served in the Fourth Infantry in Florida until 1831, and again in the Florida war of 1836–37; on quartermaster duty at Washington 1837–38. Upon the organization of the adjutant-general's department he was commissioned major and assistant adjutant-general, and served as chief of staff of the army in Florida 1839–40; at Washington, D. C., 1840–46; served in the war with Mexico as chief of staff to Maj.-Gen. William O. Butler, both while in command of a division of volunteers and after his succession to the command of the army. In 1852 he became lieutenant-colonel, and served as chief of staff to Lieut.-Gen. Scott from Mar., 1853, to Mar. 7, 1861, when he was promoted to be colonel, and placed in charge of the adjutant-general's office at Washington; became brigadier-general and adjutant-general of the army Aug. 3, 1861, but from 1863 was employed on special duty in organizing colored troops, inspection tours, etc., until Feb., 1869, when he was retired from active service. At the time of President Johnson's controversy with Congress he appointed Gen. Thomas (Feb. 21, 1868) Secretary of War *ad interim*, but Secretary Stanton refused to vacate. D. in Washington, D. C., Mar. 2, 1875.

**Thomas**, Mary F. (*Myers*), M. D.: philanthropist; b. in Maryland, Oct. 28, 1816; daughter of Samuel Myers, a Quaker associated with Benjamin Lundy in the first anti-slavery meeting held in Washington, D. C.; married Owen Thomas in 1839; studied medicine, and graduated from Penn Medical College in Philadelphia, Pa., in 1854; was assistant physician in hospitals during the civil war; city physician and physician for the Home for Friendless Women in Richmond, Ind.; admitted to membership in the Indiana State Medical Society in 1876; was an earnest advocate of temperance for more than fifty years; in 1851 helped to organize the first woman's rights society in Indiana, and held responsible offices in connection with the movement, State and national. D. in Richmond, Aug. 19, 1888. Susan B. Anthony.

**Thomas**, M. Carey: See the Appendix.

**Thomas**, Philip Francis: lawyer; b. at Easton, Talbot co., Md., Sept. 12, 1810; educated at Dickinson College; admitted to the bar 1831; elected to the State constitutional convention 1836; a member of the Legislature 1838 and 1843–45; member of Congress 1839–41; subsequently judge of the land-office court of the Eastern Shore of Maryland; Governor of Maryland 1848–51; comptroller of State treasury 1851–53; U. S. commissioner of patents 1860; Secretary of the Treasury from Dec., 1860, to Jan. 11, 1861; was elected U. S. Senator Mar., 1867, but not admitted to a seat, on the ground of disloyalty; was elected a Representative in Congress 1874, 1876, and 1878, and in 1880 declined a renomination. D. in Baltimore, Oct. 2, 1890.

**Thomas**, Theodore: orchestral conductor; b. at Esens, Hanover, Germany, Oct. 11, 1835; received his first musical instruction from his father, a violinist, and made a successful public appearance at the age of six; removed with his parents to New York in 1845, and played the violin in concerts and orchestras; in 1851 made a concert tour as solo violinist. In 1855 he started a series of chamber-music concerts with William Mason, George Matzka, Joseph Mosenthal, Ferd. Bergner, and Carl Bergmann, which continued till 1869. In 1864 he began his first series of symphony concerts with an orchestra which he conducted until 1888, giving nightly summer concerts in New York and making tours through the U. S. during the winter months. From 1878 to 1881 he was director of the Cincinnati College of Music. In the season of 1877–78 he was conductor of the New York Philharmonic Society, and in 1879 he was elected to this position for the second time, and held it continuously till 1890, when he went to Chicago. He has conducted the Cincinnati biennial festivals since their start in 1873. He was conductor of the Brooklyn Philharmonic Society in 1862, 1866 to 1870, and 1873 to 1890, when the society disbanded on his removal to Chicago. He was also conductor of the Mendelssohn Union, the New York Chorus Society (four years), and the great New York festival in the Seventh Regiment armory in 1882. He was conductor of the American Opera Company in 1885–87. In 1892 he was appointed musical director of the World's Columbian Exposition in Chicago. D. E. Hervey.

**Thomas**, Theodore Gaillard, A. M., M. D., LL. D.: gynæcologist; b. on Edisto island, S. C., Nov. 21, 1832; graduated M. D. at the Medical College of South Carolina in 1852, and removed to New York city during the same year; served at Bellevue Hospital; elected Professor of Obstetrics and Diseases of Women in the College of Physicians and Surgeons, New York, 1862; visiting physician to Roosevelt and Bellevue Hospitals; surgeon to the Woman's Hospital in the State of New York; president of the medical board of the Nursery and Child's Hospital; president of the American Gynæcological Society 1879; honorary fellow of the Obstetrical Society of London; corresponding fellow of the Obstetrical Society of Berlin, etc.; has contributed largely to current medical literature. His chief work is *Diseases of Women* (Philadelphia, 1868), which has been translated into several languages. Revised by S. T. Armstrong.

**Thomas à Kempis**: See Kempis, Thomas à.

**Thomas Aquinas**: See Aquinas, St. Thomas.

**Thomas, Christians of St.**: See Christians of St. Thomas.

**Thoma'sius**, Christian: jurist and theologian; son of Jacob Thomasius, a distinguished teacher and author; b. at Leipzig, Jan. 1, 1655. After studying at Frankfort-on-the-Oder and traveling in Holland, he became Professor of Law at Leipzig in 1681. Among the innovations of which he was author was the introduction of the German instead of the Latin language as a medium of university instruction, and the editing of a literary review which criticised with caustic wit and scholastic methods the proposition of the so-called territorial as a substitute for the heretofore current episcopal scheme of Church government. The foe of all that was purely speculative, his efforts in the sphere of the practical extended so far as to depreciate classical learning. In the Pietistic controversy he sided with Spener and his school in the criticism of the defects of dead orthodoxy, but unlike them, while believing in revealed religion, he offered no definite faith as a substitute for the errors he exposed.

Regarding "superstition more dangerous than unbelief or atheism," Tholuck pronounces him "the personified spirit of illuminism." As a jurist, his efforts against prosecutions for witchcraft and the use of torture in obtaining evidence are worthy of enduring memory. Fleeing from Leipzig to escape arrest, he became one of the founders of the University of Halle and Professor of Law there in 1694. D. at Halle, Sept. 23, 1728. See the *Biography*, by H. Luden (1805); article by Tholuck in Herzog's *Real-encyclopädie*; and Hagenbach's *Kirchengeschichte*, v., 455–467.

H. E. JACOBS.

**Thomasius**, GOTTFRIED, D. D.: theologian; descendant of Christian Thomasius; b. at Egenhausen, Bavaria, July 26, 1802; studied at Erlangen, Halle, and Berlin; pastor in several places in Bavaria, finally at Nuremberg 1829–42; Professor of Dogmatics at Erlangen from 1842 until his death Jan. 24, 1875. He was a representative of the confessional reaction of the nineteenth century in Lutheranism. His great work on dogmatics from the christological standpoint, *Christi Person u. Werk*, 3 vols. (1st ed. 1852–61; 2d 1856–63; 3d 1886), is a philosophical treatment of the Lutheran system, influenced to some extent by the school of Schleiermacher, and departs from the stricter Lutheran position, mainly on the doctrine of the *Kenosis*, which he ascribes to the divine nature. His *Dogmengeschichte* (2 vols., 1874, 1876; 2d ed. 1890) is also a work of importance, especially valuable for its treatment of the development of doctrine in the Lutheran Church. His strictly confessional but irenic character is indicated by his words: "The name 'Lutheran,' in my opinion, should not be used as though it referred to something alongside of or beyond what is catholic and evangelical; but we are rather convinced that in what is properly Lutheran we possess what is truly catholic, and what forms the true mean between the confessional extremes."

HENRY E. JACOBS.

**Thomas of London**: same as THOMAS A' BECKET. See BECKET, THOMAS A'.

**Thomas the Rhymer**: See RHYMER, THOMAS THE.

**Thomaston**: town; Litchfield co., Conn.; on the Naugatuck river and the N. Y., N. H. and Hart. Railroad; 8 miles S. E. of Litchfield, and 10 miles N. of Waterbury (for location, see map of Connecticut, ref. 9–F). It is principally engaged in the manufacture of clocks, cutlery, and brass goods, and contains the Laura Andrews Free Library, a national bank with capital of $50,000, a savings-bank, and a weekly newspaper. It was incorporated in 1875, and in 1894 had an assessed valuation of $1,500,000. Pop. (1880) 3,225; (1890) 3,278; (1900) 3,300.

**Thomaston**: town; capital of Upson co., Ga.; on the Cent. of Ga. and the Macon and Birmingham railways; 16 miles S. W. of Barnesville, and 75 miles S. of Atlanta (for location, see map of Georgia, ref. 4–G). It is in an agricultural region, is principally engaged in the manufacture of carriages, shoes, and furniture, is an important cotton and stock market, and contains five churches, the R. E. Lee Institute, a State bank (capital $25,000), and a weekly paper. Pop. (1890) 1,181; (1900) 1,714. EDITOR OF "TIMES."

**Thomaston**: town (incorporated in 1777); Knox co., Me.; on the St. George's river and the Maine Cent. Railroad; 4 miles W. of Rockland, the county-seat, and 12 miles N. of the Atlantic Ocean (for location, see map of Maine, ref. 9–D). It contains 6 churches, high school, 11 grammar, intermediate, and primary schools, library, the Maine State prison, 2 national banks with combined capital of $210,000, a savings-bank, and a weekly and 2 monthly periodicals. The town is connected with Rockland by electric railway, and is noted for its ship-building interests and lime manufactories. Pop. (1890) 3,009; (1900) 2,688. EDITOR OF "HERALD."

**Thomasville**: town; capital of Thomas co., Ga.; on the Sav., Fla. and West. Railway; 36 miles E. of Bainbridge, and 58 miles E. of Albany (for location, see map of Georgia, ref. 7–G). It is in a cotton and a wool growing region; is the seat of the South Georgia Agricultural and Mechanical College (a branch of the State University); and contains the Young Female College, a public library, 3 State banks with combined capital of $361,000, a national bank with capital of $100,000, a branch savings and trust company, large cigar-factories, and a daily and 2 weekly newspapers. Large quantities of fruit and melons are raised in the vicinity. Pop. (1880) 2,555; (1890) 5,514; (1900) 5,322.

EDITOR OF "TIMES-ENTERPRISE."

**Thomists**: See AQUINAS, ST. THOMAS.

**Thompson**: town (set off from Killingly and incorporated in 1785); Windham co., Conn.; on the N. Y. and New Eng. Railroad (for location, see map of Connecticut, ref. 6–L). It is watered by the French and Quinebaug rivers; contains the villages of Thompson, East Thompson, West Thompson, Grosvenor Dale, North Grosvenor Dale, Mechanicsville, Wilsonville, New Boston, and Quinebaug; and is principally engaged in agriculture and the manufacture of cotton and woolen goods. Pop. (1890) 5,580; (1900) 6,442.

**Thompson**, ALBERT: See the Appendix.

**Thompson**, ALFRED WORDSWORTH: See the Appendix.

**Thompson**, AUGUSTUS CHARLES, D. D.: clergyman and author; b. at Goshen, Conn., Apr. 30, 1812; educated at Yale College, but did not graduate; studied theology at East Windsor Seminary and at the University of Berlin; became pastor of the Eliot Congregational church, Roxbury, Mass., July, 1842; accompanied Rev. Rufus Anderson on his visit to the American missions in India 1854–55; author of *The Mercy Seat* (1863); *Moravian Missions* (1882); *Future Probation and Foreign Missions* (1886); and of many other writings.

**Thompson**, BENJAMIN: See RUMFORD, BENJAMIN THOMPSON, COUNT.

**Thompson**, DANIEL GREENLEAF: lawyer and writer; b. at Montpelier, Vt., Feb. 9, 1850; educated at Montpelier and at Amherst College; began the practice of law in New York in 1872. His principal works are *System of Psychology* (2 vols., London, 1884); *The Problem of Evil* (1886); *Social Progress* (1889); *Philosophy of Fiction in Literature* (1892). D. July 10, 1897. J. M. B.

**Thompson**, DANIEL PIERCE: author; b. at Charlestown, Mass., Oct. 1, 1793; removed to Berlin, Vt., in childhood; taught district schools 1815–16; graduated at Middlebury College 1820; was for some time a private tutor in Virginia, where he studied law and was admitted to the bar; settled at Montpelier, Vt., 1824; became register of probate; was clerk of the Legislature 1830–33; compiled the laws of Vermont 1824–34 (Montpelier, 1835); was county judge of probate 1837–40; clerk of the county 1843–45; afterward clerk of the Supreme Court and secretary of State 1853–55; author of several novels, chiefly illustrative of Vermont life and of Revolutionary history, among which were *The Green Mountain Boys* (Montpelier, 1840; republished in Boston and London); *Lucy Hosmer* (1848); *The Rangers* (1851); *Gaut Garley* (1857); and published a *History of Montpelier* (1860). D. at Montpelier, June 6, 1868.

**Thompson**, EDWARD MAUNDE: librarian and author; b. in Jamaica, May 4, 1840; was educated at Rugby School; appointed assistant in the British Museum in 1861; became keeper of the MSS. in 1878 and principal librarian and secretary in 1888. He has edited a number of mediæval Latin chronicles for the Camden and other societies; also *Diary of Richard Cocks in Japan* (for the Hakluyt Society, 1883); with Prof. R. C. Jebb, the facsimile of the Laurentian Sophocles (for the Hellenic Society, 1885); and has written a *Handbook of Greek and Latin Palæography* (International Scientific Series, 1893).

**Thompson**, ELIZABETH (by marriage *Lady Butler*): painter; b. at Lausanne, Switzerland, about 1850; acquired celebrity from her painting of *The Roll Call*, exhibited at the Royal Academy, London, 1874, highly admired by the Prince of Wales, and purchased by the Queen; visited Italy 1875; painted *The Twenty-eighth Regiment at Quatre Bras* and other military pictures, including *The Battle of Balaklava* (1876), *Inkerman* (1877), and *The Camel Corps* (1894). In 1877, she married Capt. (afterward Maj.-Gen.) Sir William Francis Butler. Revised by RUSSELL STURGIS.

**Thompson**, HENRY: author; b. in England in 1797; graduated at Cambridge, 1822; took orders in the Church of England; was for some years curate of Wrington, Somerset, and became in 1853 vicar of Chard, in the same county; author of a *Life of Hannah More* (1838); *A History of Roman Literature*; and a part of the *History of Greek Literature*, in the *Encyclopædia Metropolitana*, to which work he was a large contributor; also several religious works; translated Schiller's *Maid of Orleans and William Tell* (1845), and *Original Ballads by Living Authors* (1850); wrote for the *Lyra Messianica* and its companion volume; edited *The Complete Works of Horace, from the Text of Orellius* (1853), and *The Complete Works of Virgil, from the Text of Heyne and Wagner* (1854); contributed to a work on *Occult Sciences* (1855). D. at Chard, Dec., 1878.

Revised by H. A. BEERS.

**Thompson.** Sir HENRY, F. R. C. S.: surgeon; b. at Framlingham, Suffolk, England, Aug. 6, 1820; studied medicine at University College Hospital, London, graduating M. B. in 1851; was appointed assistant surgeon there in 1853, surgeon in 1863, Professor of Clinical Surgery in 1866, and consulting surgeon in 1874. In 1852 he gained the Jacksonian prize of the Royal College of Surgeons for his essay on *The Pathology and Treatment of Stricture of the Urethra*, and again in 1860 for his essay on *The Healthy and Morbid Anatomy of the Prostate Gland*. He was appointed surgeon extraordinary to King Leopold I. of Belgium in 1863, and to Leopold II. in 1866; made an officer of the Order of Leopold in 1864, and promoted commander in 1876. For the success of an operation on King Leopold I. he was knighted in 1867. He is a member of numerous British and foreign medical societies, and an enthusiastic advocate of cremation, and the popularity of that method of disposal of the dead in Great Britain is largely due to his efforts. He is an artist of no mean ability, and his paintings have been exhibited at the Royal Academy and the Paris Salon. Among his published works are *Practical Lithotomy and Lithotrity* (1863); *Clinical Lectures on Diseases of the Urinary Organs* (1868); *Modern Cremation* (1890); and the novels *Charley Kingston's Aunt* and *All But*, which appeared under the pseudonym of *Pen Oliver*. S. T. ARMSTRONG.

**Thompson,** HENRY DENMAN: actor; b. at Girard, Pa., Oct. 15, 1833; removed in 1847 with his parents to Swanzey, N. H., where he lived for a number of years. It was here that he studied the characters which many years after he introduced in his plays of *Joshua Whitcomb* and *The Old Homestead*. He made his first appearance on the professional stage at Lowell, Mass., in 1863 in *The French Spy*. He played on the variety stage and as an Irish comedian. He first introduced *Joshua Whitcomb* in 1875, which was worked up from a variety sketch. His greatest success was in *The Old Homestead*, which ran continuously for four years until 1891, and had many long runs.

**Thompson,** HUGH MILLER: See the Appendix.

**Thompson,** JACOB: member of Congress and cabinet officer; b. in Caswell co., N. C., May 15, 1810; graduated at the University of North Carolina 1831; was admitted to the bar in 1834; settled in the Chickasaw country, Mississippi, in 1835; was a Democratic member of Congress 1839–51; chairman of the committee on Indian affairs; opposed the Compromises of 1850; Secretary of the Interior under President Buchanan from Mar., 1857, to Jan. 7, 1861, when he resigned in consequence of the order to re-enforce Fort Sumter being given without the knowledge of the Cabinet; Governor of Mississippi 1862–64, and subsequently aide to Gen. Beauregard and inspector-general for the department of Mississippi. D. at Memphis, Tenn., Mar. 24, 1885.

**Thompson,** Sir JOHN SPARROW DAVID: statesman; b. at Halifax, Nova Scotia, Nov. 10, 1844; educated at the Free Church Academy there; admitted to the bar in 1865. He was a member of the House of Assembly of Nova Scotia 1877–82; Attorney-General of the province 1878–82; Premier and Attorney-General of the same from May 25, 1882, until July 25, 1882, when appointed a judge of the Supreme Court of Nova Scotia; resigned Sept. 25, 1885 to become Minister of Justice and Attorney-General of Canada, and was elected to the Parliament of Canada in 1885, 1887, and 1891. He was appointed Premier of Canada in Nov., 1892, upon the resignation of Sir John C. Abbott. He was a member of the senate of the University of Halifax; counsel on behalf of the U. S. Government at the fishery commission held under the Washington treaty which met at Halifax in 1877; assisted the British representatives on the fishery commission at Washington in 1887, and was knighted for his services in 1888. Sir John was one of the British representatives in the Bering Sea arbitration proceedings between the Governments of Great Britain and the U. S. which met at Paris in 1893, and became a member of the Queen's Privy Council in 1894. D. at Windsor, England, Dec. 12, 1894. NEIL MACDONALD.

**Thompson,** JOSEPH PARRISH, D. D., LL. D.: clergyman and author; b. in Philadelphia, Pa., Aug. 7, 1819; graduated at Yale College 1838; studied theology at Andover and at New Haven; became pastor of the Chapel Street Congregational church, New Haven, Nov., 1840; was minister of the Broadway Tabernacle, New York, 1845–71; was one of the founders of *The New Englander*, a quarterly theological organ of the Congregational denomination, and of the New York *Independent*; was a manager of the American Congregational Union and of the Home Missionary Society; originated in 1852 the plan of the Albany Congregationalist convention; visited Egypt, Palestine, and other Oriental countries 1852–53; afterward devoted much research to Oriental subjects, especially Egyptology. In 1872 he became a resident of Berlin, Germany, and was an active member of its literary and scientific societies, frequently delivering addresses and contributing papers to their publications. These were published under the title *American Comments on European Questions* (New York, 1884). Among many other works were *Lectures to Young Men* (1846); *Egypt, Past and Present* (1856); *Memoir of Rev. David T. Stoddard* (1858); *Christianity and Emancipation* (1863); *Man in Genesis and Geology* (1869); *Theology of Christ from his own Words* (1870); *Church and State in the United States* (1874); *Life of Christ* (1875); *The Workman: his False Friends and his True Friends* (1879). D. in Berlin, Sept. 20, 1879. Revised by GEORGE P. FISHER.

**Thompson,** LAUNT: sculptor; b. at Abbeyleix, Queen's County, Ireland, Feb. 8, 1833; removed to Albany, N. Y., 1847; began the study of medicine; afterward was pupil and assistant of Erastus D. Palmer, the sculptor, nine years; developed a remarkable talent for medallion portraits; settled in New York 1858, and became an Academician in 1862; member and vice-president of the National Academy of Design in 1874. Among his works are busts of Edwin Booth as Hamlet, Bryant, and Gen. Dix; a colossal statue of Napoleon; an equestrian statue of Gen. Burnside, in Providence, R. I.; and the statues of Winfield Scott, at the Soldiers' Home, Washington, D. C., and of Abraham Pierson at Yale College. The honorary degree of M. A. was conferred upon him by Yale in 1874. D. at Middletown, N. Y., Sept. 26, 1894.

**Thompson,** MAURICE: author; b. at Fairfield, Ind., Sept. 9, 1844. His childhood was passed partly in Kentucky and Georgia, and he served in the Confederate army during the civil war. He subsequently returned to Indiana and engaged alternately in civil engineering and in the practice of law at Crawfordsville. In 1885–89 he was State geologist of Indiana. Among his published writings are *Hoosier Mosaics* (1875); *The Witchery of Archery* (1878); *A Tallahassee Girl* (1882); *His Second Campaign* (1882); *Songs of Fair Weather* (1883); *At Love's Extremes* (1885); *By-ways and Bird Notes* (1885); *Sylvan Secrets* (1887); *The Story of Louisiana* (1888); *A Fortnight of Folly* (1888); *Ethics of Literary Art* (1893); and *Alice of Old Vincennes* (1901). D. Feb. 15, 1901.

**Thompson,** MORTIMER: humorist; b. at Riga, N. Y., Sept. 2, 1832; studied for a time at University of Michigan, but left before graduating; was for some time connected with a traveling theatrical company; became about 1852 a clerk in New York; wrote some humorous letters for the Detroit *Advertiser* which procured him employment on the New York press, and subsequently became a popular lecturer, and published several humorous volumes which had a wide circulation under the pen-name of *Q. K. Philander Doesticks, P. B.* Among his books were *Doesticks—What he Says* (1855); *Plu-ri-bus-tah*, a travesty of Longfellow's *Hiawatha* (1856); *History and Records of the Elephant Club* (1857); and *Nothing to Say* (1857). D. in New York, June 25, 1875. Revised by H. A. BEERS.

**Thompson,** RICHARD WIGGINTON: jurist and Congressman; b. in Culpeper co., Va., June 9, 1809; received a classical education; was a clerk in a store in Louisville, Ky.; afterward a school-teacher in Lawrence co., Ind., but studied law at the same time, and was admitted to the bar in 1834 and began to practice at Bedford, Ind. In the same year he was elected to the State Legislature of Indiana, and reelected in 1835. In 1836 he became a State Senator; in 1841 was chosen to Congress, and again in 1844 and 1847. He declined various appointments, including that of minister to Austria, but took active part in politics; was a delegate to the Republican conventions of 1860, 1864, 1868, and 1876; in 1867–69 was judge of the eighteenth circuit of Indiana; was Secretary of the Navy 1877–81, and then became chairman of the American committee of the Panama Canal Company; author of *The Papacy and the Civil Power* (New York, 1876); *History of the Tariff* (Chicago, 1888); *Footprints of the Jesuits* (1894); and *Personal Recollections of Sixteen Presidents* (1894).

**Thompson,** ROBERT ANCHOR; clergyman and author; b. at Durham, England, in 1821; educated at Durham School and as an engineer student of Durham University; graduated at Cambridge, 1844; was for some years connected with the astronomical observatory at Durham, and published a volume of his observations in 1849; took orders in the Church of England; became curate of Louth and (1854) of Binbrook, Lincolnshire, and in 1858 was chosen master of the hospital of St. Mary the Virgin at Newcastle-upon-Tyne; author of a volume of *Sermons* (London, 1853); of *Christian Theism, the Testimony of Reason and Revelation to the Existence and Character of the Supreme Being* (London, 2 vols., 1855; n. e. 1863), which gained the first Burnett premium (£1,800) among 208 competitors; *An Essay on the Principles of Natural Theology* (1857); *Christ the Light of the World* (1859); *The Oxford Declaration* (1864); and *Thomas Becket* (1889).

Revised by S. M. Jackson.

**Thompson**, Robert Ellis, S. T. D.: professor and editor; b. near Lurgan, Ireland, Apr. 5, 1844; educated in the University of Pennsylvania and the Reformed Presbyterian Seminary, Philadelphia, Pa.; ordained by the Reformed Church in 1873; entered the Presbyterian Church with his presbytery in 1882; instructor in the University of Pennsylvania 1868–70; professor 1870–92; and since 1894 president of the Central High School of Philadelphia. Dr. Thompson was editor of *The American Presbyterian* 1866–70; of *The Penn Monthly* 1870–80; of *The American* 1880–91; and since 1891 has been assistant editor of *The Sunday-school Times.* He was lecturer on protective tariffs in Harvard 1884–85; in Yale 1886–88; Stone lecturer in Princeton 1891. His publications are *Social Science and National Economy* (Philadelphia, 1874); third edition under the title *Elements of Political Economy* (Philadelphia, 1882); *Hard Times and what to Learn from them* (Philadelphia, 1877); *Protection to Home Industry*, Harvard lectures (New York, 1886); *Relief of Local and State Taxation through Distribution of National Surplus* (Philadelphia, 1883); *De Civitate Dei: the Divine Order of Human Society* (Philadelphia, 1891); and he has edited *Duffield's Latin Hymn-writers and their Hymns* (New York, 1890); *The American Supplement to the Encyclopædia Britannica* (vol. i., Philadelphia, 1883; vol. ii., 1884); *Life of George H. Stuart, written by Himself* (Philadelphia, 1889); *The National Hymn-book of the American Church* (Philadelphia, 1892); *A History of the Presbyterian Churches in the United States* (New York, 1895); and *A First Book in Political Economy for the Use of Schools and High Schools* (Boston, 1895). C. K. Hoyt.

**Thompson**, Silvanus Phillips: physicist and electrical engineer; b. at York, England, June 19, 1851; educated at the Royal School of Mines; in 1878 received the degree of D. Sc.; in 1879 became Professor of Experimental Physics in University College, Bristol, whence he was subsequently called to take charge of the department of electrical engineering in the Finsbury Technical College, London. He is the author of numerous memoirs; also of a volume entitled *Elementary Lessons in Electricity and Magnetism* (1881); of a voluminous treatise on *Dynamo-electric Machinery* (1885; 4th ed. 1890); and of special treatises on the arc-lamp, the electro-magnet, etc. E. L. Nichols.

**Thompson**, Smith, LL. D.: jurist; b. at Stanford, N. Y., Jan. 17, 1768; graduated at Princeton College 1788, and was admitted to the bar 1792, having been a student under Chancellor Kent at Poughkeepsie; practiced first in Troy, later in Poughkeepsie, and then in New York city. He was elected to the Legislature in 1800; was associate justice of the Supreme Court 1802–14; chief justice 1814–18; Secretary of the Navy under Monroe; justice of the Supreme Court of the U. S. (1823) till his death at Poughkeepsie, N. Y., Dec. 18, 1843. He left no permanent writings outside of his written decisions. F. Sturges Allen.

**Thompson**, Thomas Perronet: political reformer; b. at Hull, England, Mar. 15, 1783; graduated at Cambridge in 1802; entered the navy as a midshipman in 1803, and the army as second lieutenant in 1806; governor of Sierra Leone in 1808, but was so active in his hostility to the slave-trade that he was recalled in 1810. He accompanied Sir William Keir Grant as Arabic interpreter in his expedition up the Persian Gulf 1819, and assisted in negotiating a treaty with the Arab tribes by which the slave-trade was declared piracy. He was one of the founders of *The Westminster Review* (1824), and the author of pamphlets and articles on a great variety of subjects. His *Catechism of the Corn Laws* (1827) was one of the ablest of the attacks on the protective system. In the field of mathematics he published a *Theory of Parallels* (1844) and *Geometry without Axioms*; and in musical acoustics his *Theory of Just Intonation* (1850) was a valuable contribution. He became member of Parliament for Hull in 1835, and afterward sat for Bradford. D. Oct. 6, 1869.



**Thompson**, William Hepworth, D. D.: master of Trinity College, Cambridge; b. at York, England, Mar. 27, 1810; educated at Trinity College, Cambridge, where he became a scholar 1830, fellow 1834, assistant tutor 1837, and tutor 1844; elected Regius Professor of Greek in Cambridge University 1853; in the same year became a canon of Ely; on the death of Dr. Whewell in 1866 was chosen master of Trinity College; edited William Archer Butler's *Lectures on Ancient Philosophy*, also two of Plato's *Dialogues*, with criticisms; was author of papers read before learned societies and of published addresses and sermons. D. at Cambridge, Oct. 1, 1886.

**Thompson**, Zadock: naturalist; b. at Bridgewater, Vt., May 23, 1796; graduated at the University of Vermont in 1823; was tutor there 1825; published a *Gazetteer of Vermont* (Montpelier, 1824), an *Arithmetic* (1825), and a *History of the State of Vermont* (Burlington, 1833); edited the *Iris* (1828) and *The Green Mountain Repository* (1832); removed to Hatley, Canada East, 1833; was engaged as a teacher there and at Sherbrooke; published a *Geography of Canada*; studied theology, and took deacons' orders in the Protestant Episcopal Church 1835; returned to Burlington, Vt., 1837; became a professor in the Vermont Episcopal Institute; published his chief work, *The History of Vermont, Natural, Civil, and Statistical* (1841–43; appendix 1853); issued a *Guide to Lake George, Lake Champlain, Montreal, and Quebec* (1845) and *The Geography and Geology of Vermont* (1848); State geologist 1845–48; Professor of Chemistry and Natural History in the University of Vermont 1851–53; visited England as Vermont commissioner to the exhibition held in London in 1851, and published a *Journal* of his trip (1851); appointed State surveyor 1853. D. at Burlington, Jan. 19, 1856. He had issued an *Almanac* as early as 1819, made for thirty-four years the astronomical calculations for *Walton's Register*, and for some years those for *The Vermont Register*. A brief biography was published by Isaac F. Redfield (1856).

**Thompsonville**: village: Hartford co., Conn.; on the Connecticut river, and the N. Y., N. H. and Hartford Railroad; 18 miles N. of Hartford (for location, see map of Connecticut, ref. 7–H). It contains 5 churches, several schools on the consolidated system, a high school with library, a private bank, a trust company, and 2 weekly newspapers, and is known for its manufacture of carpets. Pop. (1880) 3,794; (1890) 4,673; not returned separately in 1900.

**Thoms**, William John, F. S. A.: antiquary and bibliographer; b. at Westminster, England, Nov. 16, 1803; was for some years a clerk in the office of the secretary of Chelsea Hospital; was long a clerk to the House of Lords; from 1863 to 1882 was deputy librarian to the House of Lords; was for many years one of the most active members of the Society of Antiquaries; was secretary of the Camden Society 1838–73; and was the founder of *Notes and Queries*, and its editor until 1872. Among his publications are *A Collection of Early Prose Romances* (London, 3 vols., 1828; enlarged ed. 1858); *Anecdotes and Traditions illustrative of Early English History and Literature, from MS. Sources* (1838–39); a translation of Worsaae's *Primeval Antiquities of Denmark* (1849); *Choice Notes from Notes and Queries* (2 vols., 1859); and *Human Longevity* (1873). D. in London, Aug. 15, 1885.

**Thomsen**, Christen Jürgensen: archæologist; b. in Copenhagen, Denmark, Dec. 29, 1788. In 1816 he became director of the newly established Museum of Northern Antiquities in Copenhagen, which he arranged in a masterly manner, and with which he was connected until his death, May 21, 1865. In his *Ledetraad til nordisk Oldkyndighed* (Guide to Northern Antiquities, 1836) he indicated the triple division of the prehistoric age, and prepared the way for the modern scientific study of the subject. D. K. D.

**Thomson**, Andrew, D. D.: clergyman and author; b. at Sanquhar, Dumfriesshire, Scotland, July 11, 1779; studied theology at the University of Edinburgh, and was appointed minister of Spronston, Roxburghshire, in 1802, of the East church of Perth in 1808, of the New Gray Friars' church, Edinburgh, in 1810, and of St. George's church, Edinburgh, in 1814. D. in Edinburgh, Feb. 9, 1831. He was a man of great energy and considerable eloquence, and is remembered for his attack upon the British and Foreign Bible Society for circulating the Apocrypha. He published numerous volumes of sermons. A posthumous volume of these contains his memoirs (Edinburgh, 1831; Boston, 1832).

**Thomson**, Anthony Todd, M. D., F. L. S.: physician and author; b. in Edinburgh, Scotland, Jan. 7, 1778: son of the British postmaster-general of Georgia; graduated in medicine at Edinburgh University 1799; became a physician in London in 1800; was a voluminous writer in periodicals on medical and literary subjects; edited *The Medical Repository*; became Professor of Materia Medica in London University, and of Medical Jurisprudence 1832, holding both posts until his death at Ealing, near London, July 3, 1849. Among his works were *The London Dispensatory* (1811) and *Elements of Materia Medica and Therapeutics* (2 vols., 1832–33). He edited Dr. Thomas Bateman's *Practical Synopsis of Cutaneous Diseases* (7th ed. 1829), to which he added an illustrative *Atlas of Delineations* (1829); Eusèbe Salverte's *Philosophy of Magic, Prodigies, and Apparent Miracles* (2 vols., 1846; New York, 1847); and James Thomson's *Seasons* (1847). Revised by S. T. Armstrong.

**Thomson**, César: See the Appendix.

**Thomson**, Charles, LL. D.: patriot; b. at Maghera, Derry, Ireland, Nov. 29, 1729; landed in 1741 at Newcastle, Del., with three brothers, his father having died on the voyage; educated in an academy at Thunder Hill, Md.; became a teacher in the Friends' Academy at Newcastle; removed to Philadelphia, where he became an efficient teacher; was concerned in negotiations with the Iroquois Indians and Delawares, who named him "Truthteller"; was secretary of the first Continental Congress; filled the same post to the successive Congresses until 1789; was chosen to inform Washington at Mt. Vernon of his election to the presidency; resided during his later years at Lower Merion, Montgomery co., Pa., where he died Aug. 16, 1824. He was the author of *An Inquiry into the Causes of the Alienation of the Delaware and Shawanese Indians* (London, 1759); of a valuable translation of the whole Bible, the Old Testament portion being from the Septuagint (4 vols., Philadelphia, 1808); and of *A Synopsis of the Four Evangelists, in their own Words* (Philadelphia, 1815).

**Thomson**, Sir Charles Wyville: b. at Bonsyde, Scotland, Mar. 5, 1830; educated at Merchiston Castle School and University of Edinburgh. Appointed lecturer on natural history in the University of Aberdeen in 1850, Professor of Natural History in Queen's College, Cork, in 1853, and in 1854 to the chair of Mineralogy and Geology in Queen's College, Belfast, where he also had charge of the Natural History Museum. In 1860 the charge of instruction in botany and zoölogy was given to him, and in the same year he received the degree of LL. D. Here he remained until 1870, when he was appointed to the chair of Natural History in the University of Edinburgh, a position which he held until, on account of ill health, he resigned in 1879. D. in Edinburgh, Mar. 10, 1882. His early work was in the line of botany, but that for which he will longest be remembered is the exploration of the deep seas. After conducting several smaller dredging expeditions (those of the Lightning, 1868, and Porcupine, 1869, being most prominent) and demonstrating that life existed at the greatest depths yet reached by the dredge, he was appointed to the scientific charge of the well-known expedition of the Challenger, which sailed on its voyage of circumnavigation Dec. 21, 1872, returning to England May 24, 1876. (See Challenger Expedition.) After his return he reassumed the duties of his chair and at the same time labored on the collections of the voyage, publishing in 1877 two volumes of preliminary results relating to the Atlantic and in 1880 the general introduction to the zoölogical series of reports of the voyage. Among his numerous other publications may be mentioned his *Depths of the Sea* (1873).

J. S. Kingsley.

**Thomson**, Edward, D. D., LL. D.: bishop; b. at Portsea, near Portsmouth, England, Oct. 12, 1810. His parents removed to the U. S. in 1819, and settled at Wooster, O. He received a good classical education; graduated in medicine at the University of Pennsylvania 1829; began practice as a physician at Wooster, but, experiencing a change in his religious views, became in 1833 a minister of the Methodist Episcopal Church; preached at Detroit, Mich., 1836; was principal of the Methodist Seminary at Norwalk, O., 1837–44; editor of *The Ladies' Repository* at Cincinnati 1844–46; first president of the Ohio Wesleyan University at Delaware, O., 1846–60; editor of *The Christian Advocate* from 1860 to 1864, when he was chosen a bishop. He was author of *Educational Essays* (1856); *Moral and Religious Essays* (1856); *Biographical Sketches* (1856); *Letters from Europe* (1856); and *Letters from India, China, and Turkey* (2 vols., 1870). D. at Wheeling, W. Va., Mar. 22, 1870.

**Thomson**, Elihu: See the Appendix.

**Thomson**, James: poet; b. at Ednam, Roxburghshire, Scotland, Sept. 11, 1700; studied for six years at the University of Edinburgh, with the design of entering the Church, but, abandoning this intention, went to London in 1724, where he was for several months tutor in a nobleman's family. In 1726 appeared his poem *Winter*, which speedily became popular; *Summer* followed in 1727, *Spring* in 1728, and *Autumn* in 1730, completing *The Seasons*. In the interval he had published a *Poem Sacred to the Memory of Sir Isaac Newton* (1727), and written *Sophonisba*, a tragedy, acted in 1729. He then traveled for two years as tutor to the son of Lord Chancellor Talbot, by whom he was rewarded with the post of secretary of briefs, and wrote a poem on *Liberty* (5 parts, 1735–36), which met with a very unfavorable reception, and was subsequently considerably abridged. The Lord Chancellor dying in 1737, the secretaryship was lost by Thomson, but he received from the Prince of Wales a pension of £100, and some years later was rendered independent by the appointment of surveyor-general of the Leeward islands, which, after paying the deputy who performed all the duties, brought him £300 a year. His works, besides those already mentioned, are *Agamemnon*, a tragedy (1738); *Edward and Eleanora*, a drama (1739); *Alfred*, a masque, which contains the song *Rule Britannia* (1740); *Tancred and Sigismunda*, a successful tragedy (1745); *The Castle of Indolence* (1748), a poem in the Spenserian stanza, upon which he had labored many years, and which is his best work, though far less popular than *The Seasons*; and *Coriolanus*, a tragedy, not produced until after his death. D. at Kew Lane, near Richmond, Aug. 27, 1748.

Revised by H. A. Beers.

**Thomson**, James: engineer and physicist; brother of Lord Kelvin (see Thomson, Sir William); b. in Belfast, Ireland, Feb. 16, 1822. The brothers, James and William, received their early education from their father, Dr. James Thomson the mathematician, who was one of the most remarkable teachers of his time. In 1832 the family removed to Glasgow, where the father had been appointed professor of mathematics, and Thomson continued his studies in the university classes. At the age of seventeen, he took the degree of M. A. in the University of Glasgow, with honors in mathematics and natural philosophy. He then decided to become an engineer, but serious ill health, which lasted for many years, prevented him from carrying out his plans in full. He continued to interest himself in engineering problems, however, and perfected a number of inventions in the domain of hydraulics and pneumatics. Thomson's mind was essentially philosophical and mathematical, and it turned continually even in the midst of his technical activity to questions of pure science. In 1849 he read before the Royal Society of Edinburgh a paper of the highest importance, entitled *Theoretical Considerations on the Effect of Pressure in Lowering the Freezing-point of Water*. His conclusions, subsequently verified experimentally by his brother, William Thomson, afforded the solution to the great problem of the movements of glacier ice, and threw much light upon plasticity, regelation, and various other phenomena. The discussion of these matters, which had attracted the attention of Forbes, Faraday, Tyndall, and others, lasted for many years. It resulted in the recognition of the correctness of the principles laid down by James Thomson. Among his contributions to pure and applied science may be mentioned papers *On the Continuity of the Liquid and Gaseous States of Matter*; *On the Flow of Waters in Rivers and Open Channels*; and *On the Grand Currents of Atmospheric Circulation* (Bakerian lecture for 1892). In 1853 Thomson was appointed Professor of Civil Engineering and Surveying in Queen's College, Belfast, a chair which he held for twenty years. He then became the successor of Rankine as Professor of Engineering in the University of Glasgow, in which institution his brother William occupied the chair of Physics. In 1889 he was forced by partial blindness to resign his professorship, but his activity and interest in science continued to the end of his life. D. in Glasgow, May 8, 1892.

E. L. Nichols.

**Thomson**, JAMES (*B. V.*) poet; b. in Port Glasgow, Scotland, Nov. 24, 1834; brought up in the Caledonian Orphan Asylum; entered the British army as regimental schoolmaster, where he made the acquaintance of Charles Bradlaugh, then a private soldier, who in 1860 established *The National Reformer*, to which Thomson became a contributor. While stationed in Ireland he became engaged to a young girl whose sudden death cast a gloom over his life. Discharged from the army, Thomson devoted himself to literature, writing chiefly for English radical periodicals and journals. He was for a time connected with *Cope's Tobacco Plant.* His first work was published in *Tait's Edinburgh Magazine* under the pseudonym *Crepusculus.* In 1863 he published in *The National Reformer* the powerful verses *To our Ladies of Death*, and in 1874 his chief and best-known work, *The City of Dreadful Night*, republished with other poems in book-form in 1880. In 1872 he went to the U. S. as agent of the shareholders in what he ascertained to be a fraudulent silver mine; in the following year he received a commission from *The New York World* to go to Spain as its special correspondent with the Carlists. About this time he adopted the pseudonym *Bysshe Vanolis*—afterward shortened to the initials "B. V."—Bysshe being the commonly used Christian name of Shelley, Thomson's favorite writer, and Vanolis an anagram of Novalis, the pseudonym of F. von Hardenberg. He was a prolific writer. In later years the fits of depression and insomnia to which Thomson was subject led him to seek refuge from his misery in opiates and alcohol. D. in University College Hospital, London, June 3, 1882. *A Voice from the Nile*, with memoir by Bertram Dobell, was published in 1884; *Shelley* in 1885. See *Life*, by Salt (1889). A. GROWOLL.

**Thomson**, JOHN: clergyman and painter; brother of Thomas Thomson, antiquary; b. at Dailly, Ayrshire, Scotland, Sept. 1, 1778; studied theology in Edinburgh; became minister of Dailly, succeeding his father, in 1800, and of Duddingston, near Edinburgh, in 1805. He had begun the pursuit of art before entering the Church, and at Duddingston applied himself assiduously to study, becoming one of the great landscape-painters of Scotland, and in 1830 being elected a member of the Royal Scottish Academy. He also contributed papers on optics to the early issues of *The Edinburgh Review.* D. at Duddingston, Oct. 27, 1840.

**Thomson**, JOSEPH JOHN: physicist; b. in Manchester, England, Dec. 18, 1856; educated at Owens College, Manchester, and at Trinity College, Cambridge. Since 1884 he has been Professor of Experimental Physics in Cambridge University. In addition to many scientific papers, Thomson is the author of volumes on *Vortex Motion* (1883) and on the *Application of Dynamics and Physics to Chemistry* (1888); also of an important treatise entitled *Notes on Recent Researches in Electricity and Magnetism*; the last-named work was written as a sequel to Maxwell's *Treatise on Electricity and Magnetism*, which Thomson edited with copious notes and comments in 1893. E. L. NICHOLS.

**Thomson**, KATHARINE (*Byerly*): biographer; b. at Etruria, Staffordshire, England, in 1800; married Dr. ANTHONY T. THOMSON (*q. v.*); wrote several novels and many works of biography and anecdotical literature. The later volumes appeared under the pseudonyms of *Grace* and *Philip Wharton*, her son John Cockburn Thomson having aided her. D. at Dover, Dec. 17, 1862. Among her works were *Memoirs of Sir Walter Raleigh* (1830); *Memoirs of the Jacobites of 1715 and 1745* (3 vols., 1845–46); *Recollections of Literary Characters and Celebrated Places* (2 vols., 1854); and *Wits and Beaux of Society* (2 vols., 1860).
Revised by H. A. BEERS.

**Thomson**, THOMAS: antiquary; b. at Dailly, Ayrshire, Scotland, in 1768; educated at the University of Glasgow; became an advocate 1793, deputy clerk registrar of Scotland 1806; principal clerk of session 1828, and president of the Bannatyne Club 1832; was one of the founders of *The Edinburgh Review*, and occasionally acted as its editor; was esteemed the most learned antiquary in Scotland, and as such is frequently referred to in the writings of Sir Walter Scott. He edited for the Bannatyne Club some of the works of Sir Thomas Hope, John Lesley, Sir George Mackenzie, Sir James Melville, Lady Griselda Murray, Sir James Turner, and other old Scottish writers, and superintended for the Maitland Club and the record commission other reprints of the same character. D. at Shrubhill, between Edinburgh and Leith, Oct. 2, 1852. *A Memoir* (1855) was prepared for the Bannatyne Club by Cosmo Innes.

**Thomson**, THOMAS, M. D.: chemist; b. at Crieff, Perthshire, Scotland, Apr. 12, 1773; educated at Stirling and at the University of St. Andrews; succeeded his brother, James Thomson (1768–1855), as editor of the third edition of the *Encyclopædia Britannica*, Nov., 1796–1800; graduated in medicine in Edinburgh 1799; was for some years after 1802 the scientific editor of James Mill's *Literary Journal*; was the first to introduce the use of symbols in chemistry in articles for the *Supplement* to the *Encyclopædia*, written 1798–99, and serving also as the basis of his *System of Chemistry* (4 vols., 1802); first announced to the world Dr. Dalton's atomic theory, which had been privately communicated to him in 1804, in the third edition of the same work (5 vols., 1807); was for many years a lecturer on chemistry, and conducted a laboratory for students; edited in London the *Annals of Philosophy* (1813–22); became in 1818 Professor of Chemistry in the University of Edinburgh. D. at Kilmun, Argyleshire, July 2, 1852. Among his works were *The Elements of Chemistry* (1810): *The History of the Royal Society of London* (1812); *Travels in Sweden and Lapland* (1813); *An Attempt to establish the First Principles of Chemistry by Experiment* (2 vols., 1825); *An Outline of the Sciences of Heat and Electricity* (1830); *The History of Chemistry* (2 vols., 1830); *Outlines of Mineralogy, Geology, and Mineral Analysis* (2 vols., 1836); and a recast of his earlier work on chemistry in three separate treatises—*The Chemistry of Inorganic Bodies* (2 vols., 1831); *Chemistry of Organic Bodies, Vegetables* (1838); and *The Chemistry of Animal Bodies* (1842).—His son THOMAS, b. in Glasgow, Dec. 4, 1817, was an assistant surgeon in the Bengal army, superintendent of the East India Company's botanic gardens in Calcutta, and author of *Western Himalaya and Thibet, the Narrative of a Journey through the Mountains of Northern India* (1852). D. in London, Apr. 18, 1878. Revised by IRA REMSEN.

**Thomson**, WILLIAM, D. D., F. R. S.: archbishop; b. at Whitehaven, Cumberland, England, Feb. 11, 1819; educated at Shrewsbury School; was successively scholar, fellow, tutor, and provost of Queen's College, Oxford, where he graduated 1840; was ordained deacon 1842 and priest 1843; was incumbent of the parishes of Guildford and Cuddesden; was appointed select preacher at Oxford 1848, and again 1856; preached the Bampton lectures on *The Atoning Work of Christ, viewed in Relation to some Current Theories* (1853); became rector of All Souls', Marylebone, London, 1855; contributed to the *Oxford Essays* (1855) and to *Sermons at Westminster Abbey for the Working Classes* (1858); was preacher of Lincoln's Inn 1858–61; was appointed chaplain to the Queen 1859, Bishop of Gloucester and Bristol Dec., 1861, and enthroned Archbishop of York Feb. 24, 1863; took an active part as a member of convocation in promoting ecclesiastical reform and church extension; labored for educational reform in Oxford University; was a member of the Royal, Geographical, and Photographic societies; president of the Palestine Exploration Fund; examiner in logic and mental science to the Society of Arts, and in divinity at Oxford; one of the lords of the privy council, governor of the Charter-house and of King's College, London. D. at York, Dec. 25, 1890. As an author he is best known by his *An Outline of the Necessary Laws of Thought* (1842; 9th ed. 1868), a text-book in several British and American universities. Revised by S. M. JACKSON.

**Thomson**, Sir WILLIAM (Lord Kelvin): physicist, mathematician, engineer, and inventor; b. in Belfast, Ireland, June, 1824; educated at the Universities of Glasgow and Cambridge. At the age of twenty-two years he was appointed Professor of Natural Philosophy in the University of Glasgow, and still (1895) holds the chair. During the half century of his career as a teacher of physics he has published a very large number of papers touching nearly every important theme with which the physicist has to deal. His earlier papers upon the theories of electricity and magnetism were gathered together in 1872 in an important volume entitled *Reprints of Papers on Electrostatics and Magnetism.* More complete collections have since been made (1882–90) under the titles *Mathematical and Physical Papers* (3 vols.) and *Popular Lectures and Addresses* (3 vols.). Two long and important articles published in the ninth edition of the *Encyclopædia Britannica* have also been reprinted under the titles *On Heat* and *On Elasticity.* In 1867 Thomson, in collaboration with Prof. Tait, of Edinburgh, issued the first volume of *A Treatise on Natural Philosophy* (2d ed. in two parts, 1879). This treatise, in which the effort was made to base a complete and exhaustive theoretical analysis upon the doctrine of energy, was never carried beyond the division of mechanics, but it contains much upon that subject that is of the highest scientific value. From 1846 to 1853 Thomson was editor of the *Cambridge and Dublin Mathematical Journal*; for many years also he has been the chief of the board of editors which conducts *The Philosophical Magazine*. He was president of the British Association for the Advancement of Science (1871), of the Royal Society of London (1891). and of other societies. In 1872 he was made a fellow of St. Peter's College, Cambridge. Aside from his labors in pure science, Thomson has been active as an engineer and inventor. It was in great part due to his skill in solving the many intricate problems involved in submarine telegraphy that transoceanic signaling became a practical success; and it was in recognition of that fact that he was knighted in 1866. Of his numerous inventions, many of which were made to meet the demands of the manufacture and operation of submarine cables, the best known are his quadrant and portable electrometers, compensated compasses for iron ships, various types of mirror galvanometer, the siphon recorder, a machine for the analysis of tidal curves, and a large number of commercial instruments for the measurement of electrical currents and potential differences. His services as savant and engineer received high official recognition by his elevation to the peerage in 1892 with the title of Lord Kelvin. Jan., 1897, elected honorary member of the Russian Academy of Science. E. L. NICHOLS.

**Thomson**, WILLIAM MCCLURE, D. D.: missionary and author; b. at Springfield (now Spring Dale), O., Dec. 31, 1806; graduated at Miami University 1826; spent one year in Princeton Seminary; was missionary in Jerusalem 1832–33; in Beyrout 1833–76; and in 1877 returned to the U. S. He published *The Land and the Book, Biblical Illustrations drawn from the Manners and Customs, the Scenes and the Sceneries of the Holy Land* (2 vols., New York, 1859; London, 1860; new ed. 3 vols., 1880, 1882, 1885). D. in Denver, Col., Apr. 8, 1894. Revised by S. M. JACKSON.

**Thor** [from Icel. *þōrr*, for **þonrr*: O. Eng. *þunor*, Thor, thunder]: in Scandinavian mythology, the son of Odin and Jord. He ranked next to Odin, but was far more popular, as is evidenced by the many myths and names by which he is known. He was the protector of Midgard and of human industries against nature's destructive forces personified by the giants, with whom he was in constant conflict. Thunder and lightning were caused by his riding in the clouds in his car drawn by two goats. His weapon of protection was his hammer Mjolner. He had steel gloves and a belt, Megingjarder, which doubled his strength. His home was Thrudvang and his hall was called Bilskirner. His wife was Sif. Just as the Christians put a cross on gravestones, so the Scandinavian heathens put the sign of Thor's hammer (a cross) on their rune-stones. Thursday is named after Thor. See SCANDINAVIAN MYTHOLOGY. RASMUS B. ANDERSON.

**Thorac'ic Duct** [*thoracic* is deriv. of *thorax*, from Gr. *θώραξ*, breastplate, cuirass]: the principal lymphatic vessel in the human body. It runs upward on the left side of the spinal column from the receptaculum chyli, and terminates near the junction of the left internal jugular and the left subclavian veins. It discharges into the blood-current the chyle and most of the lymph of the body. It is often represented in the lower animals by a congeries of lymphatic vessels. Birds have two thoracic ducts, one on each side. Its outlet is provided with valves which prevent the ingress of blood, and the duct has other valves which allow the contents to pass upward, but not downward.

**Thoracos'traca** [Mod. Lat.; Gr. *θώραξ*, breastplate + *ὄστρακον*, shell]: a name sometimes employed for those Crustacea (*Decapoda*, *Stomapoda*, *Schizopoda*) in which the anterior part of the body (cephalothorax) is covered with a carapace, and the eyes (except in *Cumacea*) are on movable stalks. See MALACOSTRACA.

**Thorax**: See CHEST.

**Thoreau**, thō'rō, HENRY DAVID: author; b. at Concord, Mass., July 17, 1817; was the son of John Thoreau, of Concord, and Cynthia Dunbar, and the grandson of John Thoreau, of Boston. His grandfather was a prosperous merchant of Boston, who removed to Concord in 1800, and died there; his father was originally a merchant, but in middle life took up the business of pencil-making, at Concord, which he and his children carried on for half a century. Henry, his second son and third child, learned this art while fitting for college in his native town, and practiced it occasionally, with its allied art, the preparation of finely ground graphite, for electrotyping, until a year before his death. He graduated at Harvard College in 1837, and for five or six years taught school or was a private tutor in Concord and on Staten Island, N. Y. He was an inmate of Ralph Waldo Emerson's family from Apr., 1841, to May, 1843, and again from Sept., 1847, to Oct., 1848; and in the interval of these residences with Emerson was in his cabin by Walden Pond, from July, 1845, to Sept., 1847. After 1849 he lived with his parents and his sister Sophia at Concord until his death May 6, 1862. He had been in college a close student of Greek, reading most of the common authors, and also much of the earlier English literature, with which he became very familiar. He read much and easily in Latin and French, and formed his own style on classic and French models, taking great pains with everything he wrote. He kept a journal from 1837 to his last illness, and made up his essays and books mainly from its many volumes, which were interspersed with verse, as are his two early works, the *Week on the Concord and Merrimack Rivers* (edited at Walden in 1846–47 and published in 1849), and *Walden* (written partly while living by the pond, but edited later, and published in 1854). These were the only volumes he published; but many essays and a few poems were printed by him in magazines, which have since his death been collected and published in volumes. Four volumes have also been selected from his journals by his literary executor, Harrison Blake, and two more are in preparation. An imperfect collection of his letters and poems was edited by Emerson in 1865, and a fuller volume of letters by F. B. Sanborn (*Familiar Letters of Henry Thoreau*) in 1894. No complete collection of his poems has been made, but Henry S. Salt, his English biographer, is editing a fuller selection than has yet appeared; several of them, including translations from the Greek poets, are found in his *Miscellanies*, the last of a ten-volume edition of his works, published with a general index (1893–94). Although often stated, it is not true that Thoreau never voted or attended church, paid no taxes, and never used a gun. He lived simply, but seldom alone, always supported himself by the work of his hands or otherwise, was a good land-surveyor, naturalist, and mechanic, a good citizen, a valued friend, and devoted to the comfort of his family. He never married, partly from an early disappointment in love. but was intimate with admirable women and the children of his friends, and was beloved by them, as by most of those who really knew him. He was original and sometimes eccentric, but never misanthropic or morose. His intellectual and moral elevation is plainly seen in his writings, which have steadily gained in favor since his death. He is buried in Concord, near the graves of Emerson, Alcott, Hawthorne, and Wasson, his congenial friends. See his *Life* (1882), by Franklin B. Sanborn, in the American Men of Letters Series, and a biography, *The Poet Naturalist* (1873), by Ellery Channing. F. B. SANBORN.

**Thores'by**, RALPH, F. R. S.: antiquary; b. in Leeds, England, Aug. 16, 1658; educated at Leeds School; resided some years at Rotterdam, qualifying himself for the mercantile business, which he afterward successfully conducted, devoting, however, much of his time to antiquarian pursuits. D. in 1725. Author of *Ducatus Leodiensis, or the Topography of Leeds* (London, folio, 1715), of which a new edition was brought out by Dr. T. D. Whitaker (1816); *Museum Thoresbianum, or a Collection of Antiquities in the possession of Ralph Thoresby*, and *Vicaria Leodiensis, or the History of the Church of Leeds* (1724): all which are highly appreciated by topographers. He contributed to Gibson's edition of Camden's *Britannia*, Collins's *Peerage*, Calamy's *Memoirs of Divines*, and other works, and wrote much in the *Philosophical Transactions*. His *Diary* (2 vols., 1830) and *Correspondence* (2 vols., 1832) were edited by Rev. Joseph Hunter.

**Thoresen**, tor'e-sen, ANNA MAGDALENA (*Kragh*): novelist; b. at Fredericia, Denmark, June 3, 1819. The scenes of her novels and tales are laid almost exclusively in Norway, where she married in 1844 a country parson. The best of these are *Fortællinger* (Tales, 1863); *Signes Historie* (Signe's History, 1864; translated into English 1865); *Solen i Siljedalen* (The Sun in the Silje Dale, 1868); *Billeder fra Vestkysten af Norge* (Pictures from the West Coast of Norway, 1872); *Herluf Nordal, en Fortælling fra det forrige Aarhundrede* (Herluf Nordal, a Tale from the Last Century, 1879), and *Mindre Fortællinger* (Short Tales, 1891). She is also the author of several dramas. D. K. DODGE.

**Thorild**, tor'ild, THOMAS: critic; b. at Svarteborg, Sweden, 1759. After studying at Lund, he moved to Stockholm, where he remained, with the exception of a short time spent at Upsala and in England, until 1793, when he was exiled for giving expression to advanced political views. He was afterward appointed to a professorship in the Swedish University at Greifswald. He was one of the earliest of the revolutionary writers in Sweden, and his polemics with Kellgren and Leopold are of immense importance. Hanselli published his *Samlade Skrifter* (2 vols., Stockholm, 1873–74). D. at Greifswald in 1808. D. K. DODGE.

**Tho'rium**, also **Thori'num**: one of the rare metals, discovered by Berzelius in 1828 in a Norwegian mineral which he called thorite, from the Scandinavian god Thor. Thorite is a thorium silicate, with the composition $ThSiO_4.2H_2O$. Thorium is a gray metallic powder, which burns with great brilliancy to snow-white infusible thoria, $ThO_2$. Water does not act upon it, and nitric and sulphuric acids with difficulty, though hydrochloric acid attacks and dissolves it powerfully. This is the statement of Berzelius, but Chydenius states that it is easily soluble in nitric and difficultly in hydrochloric acid. Thorium occurs also in other minerals besides thorite, as orangite, as columbate in some pyrochlores, as phosphate in monazite, and according to Chydenius in euxenite, as columbate and tantalate. Its atomic weight is 232·6. Revised by IRA REMSEN.

**Thorn**, or **Thorn-bush**: See CRATÆGUS.

**Thorn**, torn: town of Prussia; province of West Prussia; on the Vistula, 31 miles by rail E. S. E. of Bromberg (see map of German Empire, ref. 3–I). It was made a fortress of the first rank in 1878 by Prussia; has manufactures of cloth, linen, soap, tobacco, and gingerbread, and carries on an active trade in grain and timber. Copernicus was born here, and a bronze statue of him stands in the market-place. Pop. (1890) 27,018. Revised by M. W. HARRINGTON.

**Thorn**, FRANK MANLY: lawyer and U. S. official; b. at North Collins, N. Y., Dec. 7, 1836; educated in common schools and at Fredonia Academy; studied law; clerk of the surrogate's court in Erie County 1857–60; practiced law and did journalistic work until 1871; member county board of supervisors during 1871–80; chief clerk in the bureau of internal revenue in Washington, D. C.; 1885; superintendent U. S. COAST AND GEODETIC SURVEY (*q. v.*) from July, 1885, to July 1, 1889.

**Thorn-apple**: See DATURA.

**Thornback** [i. e. back with prickles or thorns]: the name given in parts of Great Britain to the *Raia clavata*. This is a short-snouted ray, whose dorsal surface, especially about the snout and interorbital space, is covered with small spines, and along the middle of the back and tail with a row of large spines, resembling somewhat the thorns of a rosebush; the male has further still larger thorns on the sides of the head and pectoral fins, and the female has numerous spines, each arising from a large roundish base. It is very abundant along parts of the British coast, and is the most esteemed as a table-fish of any member of the genus. It comes into shallow water in spring and summer, and is then taken in the greatest numbers. Revised by E. A. BIRGE.

**Thornbury**, GEORGE WALTER: author; b. in London, England, in 1828; became contributor to periodicals at the age of seventeen; was connected with *The Athenæum* 1851; studied art and occasionally practiced painting, but devoted himself to literature and produced some twenty-five volumes. D. in London, June 11, 1876. Among his works are *Shakespeare's England, or Sketches of our Social History during the Reign of Elizabeth* (2 vols., 1856); *Songs of the Cavaliers and Roundheads* (1857); *Life in Spain* (2 vols., 1859); *Turkish Life and Character* (2 vols., 1860); *British Artists from Hogarth to Turner* (2 vols., 1860); *Life of J. M. W. Turner, R. A.* (2 vols., 1861); *Haunted London* (1865); *Two Centuries of Song* (1866); *Old and New London* (2 vols., 1873–74); and *Historical and Legendary Ballads and Songs* (1876). Revised by H. A. BEERS.

**Thornton**, Sir EDWARD, D. C. L., LL. D.: diplomatist; b. in London, July 17, 1817, son of Hon. Edward Thornton, British minister in Portugal; was educated at Cambridge; entered the diplomatic service in 1842 as *attaché* at Turin; successively held important places in the legations in Mexico and several South American states; was envoy to Brazil 1865–67; envoy to the U. S. 1867–81; a member of the joint high commission on the Alabama claims 1871; appointed privy councilor 1871; and arbitrator of the Mexican and U. S. claims commission 1873. He was appointed British ambassador to Russia 1881, and to Turkey in 1884; retired in 1887.

**Thornton**, MATTHEW: signer of the Declaration of Independence; b. in Ireland in 1714. His parents emigrated to New England, living at Wiscasset, Me., and removing thence to Worcester, Mass. He received a classical education and studied medicine; accompanied Pepperell's expedition against Louisburg as a surgeon 1745; became a physician at Londonderry, N. H., and a colonel of militia; was president of the convention which in 1775 assumed the government of New Hampshire; took his seat as a delegate to the Continental Congress Nov. 4, 1776; signed the Declaration of Independence, though he was not a member at the time of its adoption. In 1779 he removed to Exeter, and shortly thereafter relinquished his practice and settled on a farm at Merrimack. He was afterward chief justice of Hillsboro County, judge of the New Hampshire Supreme Court, and member of both branches of the Legislature and of the council (1785). D. at Newburyport, Mass., June 24, 1803.

**Thornton**, Sir WILLIAM: soldier; b. in England about 1775; entered the British army as ensign 1796; became major 1806; was appointed military secretary and aide-de-camp to the Governor-General of Canada Aug., 1807; returned to England 1811; took part in the Peninsular war and Wellington's campaign in Southern France 1813–14; was sent to the U. S. and commanded the light brigade and advance of Gen. Ross's expedition up the Chesapeake May, 1814; was severely wounded and made prisoner at Bladensburg; was exchanged for Commodore Barney; commanded the advance of the British army sent against New Orleans in October, and the detached corps which operated on the right bank of the Mississippi in the battle of New Orleans, Jan. 8, 1815, when he was again severely wounded. He reached the rank of lieutenant-general in 1838. D. near Hanwell, England, Apr. 6, 1840.

**Thornton**, WILLIAM THOMAS: publicist and miscellaneous author; b. at Burnham, Buckinghamshire, England, Feb. 14, 1813; son of Thomas Thornton, president of the Levant Company's establishment in Constantinople; educated in the Moravian settlement at Oekbrook, near Derby; was secretary to the British consul-general at Constantinople 1830–35; was a clerk in the India House, London, 1836–56, when he was placed in charge of the public works department of that office, and in 1858 became secretary for public works in the India Office, a post which he held till his death. He was the author of *Over-population and its Remedy* (1845); *A Plea for Peasant Proprietors* (1848; 2d ed. 1873); *Zohrab and other Poems* (1854); *Modern Manichæism, and other Poems* (1856); *Old-fashioned Ethics and Common-sense Metaphysics*; *On Labor, its Rightful Dues and Wrongful Claims, its Actual Present and Possible Future* (2d ed. 1869); and a verse translation of the *Odes of Horace* (1878). D. June 17, 1880. Revised by H. A. BEERS.

**Thorntown**: town; Boone co., Ind.; on the Rock river, and the Cleve., Cin., Chi. and St. L. Railway; 26 miles S. E. of Lafayette, 38 miles N. W. of Indianapolis (for location, see map of Indiana, ref. 6–D). It is in an agricultural region, and contains a high school, a State bank (capital $25,000), and a weekly paper. Pop. (1890) 1,530; (1900) 1,511.

**Thornwell**, JAMES HENLEY, D. D., LL. D.: clergyman and educator; b. in Marlborough district, S. C., Dec. 9, 1812; graduated at South Carolina College, Columbia, S. C., 1831; studied and taught till the summer of 1834, when he spent some weeks at Harvard College, Cambridge, Mass.; was settled over a Presbyterian church in Lancaster, S. C., June 12, 1835; took the professorship of Logic and Belles-lettres in South Carolina College in Jan., 1838; resigned to take the pastorate of the Presbyterian church in Columbia in 1840; in 1841 returned to the college as chaplain and Professor of Sacred Literature and the Evidences of Christianity; from July to Dec., 1851, was pastor of the Glebe Street church in Charleston; returned again to the college, to become its president, in Jan., 1852; in 1855 accepted the professorship of Didactic and Polemic Theology in the Theological Seminary at Columbia. D. at Charlotte, N. C., Aug. 1, 1862. He was a man of rare critical acumen, of great personal magnetism, and the acknowledged theologian of the Southern Presbyterian church. He published several sermons and addresses; his *Collected Writings* were edited by Rev. J. B. Adger and J. L. Girardeau (4 vols., Richmond, Va., 1871–73), and his *Life and Letters* by Rev. Benjamin M. Palmer (1875). Revised by S. M. JACKSON.

**Thornycroft**, JOHN ISAAC, F. R. S.: engineer and naval architect; b. in Rome, Italy, Feb. 1, 1843; studied practical engineering at an early age, and in 1863 designed the Ariel, which may be regarded as the forerunner of modern torpedo-boats; went through the engineering course at Glasgow University, and studied ship-building at Govan on the Clyde. He then became a builder of torpedo-boats at Chiswick, and has constructed a number of such boats for the British and other governments. Among his inventions may be mentioned the turbine propeller for use in shallow-draught vessels. Mr. Thornycroft is the vice-president of the Institute of Naval Architects of Great Britain.

**Thornycroft**, Walter Hamo, R. A.: sculptor; b. in London, Mar. 9, 1850; was educated at University College School, London; in 1869 began to study at the schools of the Royal Academy, and exhibited first in 1871. In 1880 he made a success with a statue of Artemis, now in Eaton Hall, near Chester. Among his more important works are *Teucer* (1881), in the South Kensington Museum; *The Sower* (1886); *The Mower* (1894); *Science* (1891); a bust of S. T. Coleridge, in Westminster Abbey (1885); an equestrian statue of Edward I (1885); and the national memorial to Gen. Gordon in Trafalgar Square.

**Thorold**: town of Welland County, Ontario, Canada; 7 miles S. of Lake Ontario, on the Welland Canal (see map of Ontario, ref. 5–E). It is a station on the railway from St. Catharines to Port Colborne. Pop. 2,275. M. W. H.

**Thorold**, Anthony Wilson, D. D.: bishop; b. at Hougham, Lincolnshire, England, June 13, 1825; educated at Queen's College, Oxford, and graduated in 1847; was rector of St. Giles-in-the-Fields, London, 1857–68, minister of Curzon chapel, Mayfair, 1868, vicar of St. Pancras 1869, and canon residentiary of York in 1874. He was appointed Bishop of Rochester in 1877, and Bishop of Winchester in 1891. His *Presence of Christ* went through over twenty editions. D. in Farnham Castle, Surrey, July 25, 1895.

**Thorough-bass**: in music, the mode or art of expressing chords by means of figures placed over or under a given bass. These figures indicate the harmony through all the other parts, and hence the name. Thorough-bass may be considered as the first department in the study of harmony. The term is sometimes taken in a larger sense, as equivalent to musical science. See Figured Bass and Harmony.

**Thoroughwort**: See Eupatorium.

**Thorpe**, Benjamin: Anglo-Saxon scholar and author; b. in England in 1782; devoted himself at an early age to the study of the Anglo-Saxon and Scandinavian languages and literatures; made a complete translation of the *Edda* (unpublished); received a pension from the British Government. D. at Chiswick, July 19, 1870. Among his numerous works were a translation of Rask's *Grammar of the Anglo-Saxon Tongue* (Copenhagen, 1830; new ed. 1865); Cædmon's *Metrical Paraphrase of Parts of the Holy Scriptures, in Anglo-Saxon, with an English Translation, Notes, and a Verbal Index* (1832); *The Anglo-Saxon Version of the Story of Apollonius of Tyre, upon which is founded the Play of Pericles, with a Translation and Glossary* (1834); *Analecta Anglo-Saxonica, a Selection in Prose and Verse from Anglo-Saxon Authors of Various Ages, with a Glossary* (Oxford, 1834; 3d ed. 1868); *Libri Psalmorum Versio Antiqua Latina, cum Paraphrasi Anglo-Saxonica, etc.* (1835); *Ancient Laws and Institutes of England, enacted under the Anglo-Saxon Kings from Ethelbert to Canut, with an English Translation of the Saxon* (London, folio, 1840); *The Holy Gospels in Anglo-Saxon, edited from the Original MS.* (Oxford, 1842; new ed. 1848; New York, 1846); *Codex Exoniensis, a Collection of Anglo-Saxon Poetry, etc., with English Translation and Notes* (1842); *The Homilies of the Anglo-Saxon Church, etc., with an English Version* (2 vols., 1843–46); *The History of England under the Anglo-Saxon Kings, translated from the German of Dr. J. M. Lappenberg, with Additions and Corrections by the Author and Translator* (2 vols., 1845; new ed. 1857); *Florentii Wigorniensis Chronicon* (2 vols., 1848–49); *Northern Mythology, etc., compiled from Original and other Sources* (3 vols., 1851; new ed. 1863); *Yule-Tide Stories, a Collection of Scandinavian Tales and Traditions* (1853); *Pauli's Life of Alfred the Great* (1854); *The Anglo-Saxon Poems of Beowulf, with a Literal Translation, Notes, and Glossary* (Oxford, 1855); *Lappenberg's History of England under the Norman Kings* (1857); *The Anglo-Saxon Chronicle, according to the several Original Authorities* (London, 2 vols., 1861); *Diplomatarium Anglicum Ævi Saxonici, a Collection of English Charters, etc.* (1865).

**Thorpe**, John: architect; b. in England about 1540; was the chief designer in what is known as the Elizabethan style of domestic architecture, having built Kirby House in Northamptonshire (1570); Burleigh, Holdenby, Audley End, and Ampthill; Longford Castle in Wiltshire, in the form of a triangle; Liveden Hall in Northamptonshire; Slaugham Place in Sussex; the Strand front of Somerset House (1607), and many other edifices. A valuable collection of his drawings exists in the Soane Museum, and offers the most complete example known of the methods of work of an architect and building surveyor of the sixteenth century. The particulars of his life and date of his death are unknown.

**Thorpe**, Rose (*Hartwick*): See the Appendix.

**Thorpe**, Thomas Bangs: journalist and artist; b. at Westfield, Mass., Mar. 1, 1815; educated at the Wesleyan University, Middletown, Conn.; studied art; resided in New Orleans, La., from 1836 to 1853; edited a Whig paper there several years; raised volunteers for the Mexican war; was the writer of the first newspaper correspondence narrating military events on the frontier; published *Our Army on the Rio Grande* (1846) and *Our Army at Monterey* (1847); was an active political speaker in the campaign of 1848; became known by the pseudonym of *Tom Owen, the Bee-hunter*, as the writer of a series of tales of Western life, including *Mysteries of the Backwoods* (1846); *The Hive of the Bee-hunter* (1854); and *Scenes in Arkansaw* (1858); and became in 1859 editor and proprietor of *The Spirit of the Times*; published *Lynde Weiss, an Autobiography* (1854); *A Voice to America* (1855), and other works; and wrote a series of biographical sketches of American artists. His best-known painting is *Niagara as it is*. He was city surveyor of New Orleans during the administration of Gen. Butler (1862–63), and later became connected with the U. S. custom-house in New York city, where he died Sept. 20, 1878.

Revised by H. A. Beers.

**Thorpe**, Thomas Edward, Ph. D., F. R. S.: chemist; b. at Harpurhey, near Manchester, England, Dec. 8, 1845; was educated at Owens College, Manchester, and the Universities of Heidelberg and Bonn; was appointed to the chair of Chemistry in Anderson's College, Glasgow, in 1870, and to similar positions in the Yorkshire College in Leeds (1874) and the Royal College of Science, South Kensington (1885). He has contributed a large number of papers on chemistry to the *Philosophical Transactions, The Journal of the Chemical Society*, the *Reports of the British Association, Nature*, and other scientific journals. He edited *Coal: its History and Uses*, and is the author of a *Dictionary of Applied Chemistry*, 3 vols.; *Inorganic Chemistry*, 2 vols.; *Qualitative Analysis*; *Quantitative Analysis*; *Chemical Problems*; and *Essays in Historical Chemistry*.

**Thorpe**, William: reformer; b. in England about 1350; received a good education; became a priest; preached the doctrines of Wiclif for twenty years from 1386; was imprisoned in Saltwood Castle, Kent, as a Lollard, 1407, and examined before Archbishop Arundel, then Lord Chancellor, July 3 of that year. He wrote an account of his *Examination*, which was widely circulated, and was condemned by an assembly of the clergy so late as 1530. The subsequent history of Thorpe is unknown. His *Examination*, which may be found in Foxe's *Book of Martyrs* and in Dr. Christopher Wordsworth's *Ecclesiastical Biographies*, is elegantly written, and is of great value as a picture of English society and manners in the time of Chaucer and Gower, and especially as a trustworthy summary of Lollard doctrines.

Revised by S. M. Jackson.

**Thorwaldsen**, tor'wa̋ald-sen, Albert (Bertel): sculptor; b. at sea, Nov. 19, 1770. His father, Gottschalk Thorwaldsen, a native of Iceland, then on his way to Copenhagen, was a wood-carver and poor. Bertel's schooling was short and unprofitable until he was sent to the free school of the Academy of Arts at Copenhagen. There, at the age of seventeen, a bas-relief of Cupid reposing gained the silver medal; at twenty a sketch of *Heliodorus driven from the Temple* gained the small gold medal; two years later he obtained the grand prize, which entitled him to receive the royal pension, available for five years, beginning in 1796. In Mar., 1797, he arrived in Rome. His model of *Jason*, which Canova praised, attracted the admiration of an English connoisseur, Thomas Hope, who gave the artist a commission to execute it in marble. This was the beginning of a great career. The *Adonis*, begun in 1808, was not finished until 1832. It is the only one of Thorwaldsen's statues which was entirely carved by his own hands. It is a triumphant answer to the charge brought against Thorwaldsen in his lifetime, that he could not work in marble. "Not work in marble!" he said. "Tie my hands behind my back, and I will hew out a statue with my teeth!" The bas-relief, *The Triumphal Entry of Alexander into Babylon*, celebrated Napoleon's entry into Rome in 1812. The familiar bas-reliefs *Night* and *Morning* were modeled in 1815. The *Venus Victrix* (1813–16) and the *Mercury* (1818) are, with the *Adonis* just mentioned, his most perfect works. In 1819 Thorwaldsen returned to Copenhagen, and was received with great demonstrations. The well-known groups of *Christ and the Twelve Apostles* and *John the Baptist preaching* were completed in 1838 for the Church of Notre Dame at Copenhagen. Another visit in that year to Copenhagen, where he meant to live for the rest of his life, was cut short by the uncongenial climate. In 1841 he went back to Italy, stayed a year, then returned to Copenhagen, intending to remain for a short time only, but died suddenly of heart disease Mar. 24, 1844. The chief part of his fortune was left as a perpetual endowment for the museum at Copenhagen, which is raised around his grave, and contains only his works. (See COPENHAGEN.) The best and most accessible works on Thorwaldsen are J. M. Thiele, *Thorwaldsens Biographie* (4 vols., Copenhagen, 1851–56; Am. ed., translated by Prof. Paul C. Sinding, New York, 1869); *Thorwaldsen, sa Vie et son Œuvre*, by Eugène Plon, with two etchings and thirty-five wood-cuts (Paris, 1867; Am. ed. Boston, 1874, with the wood-cuts of the Paris ed.). Thorwaldsen's works are very numerous—205 as mentioned by Thiele—and of them, his colossal lion carved out of solid rock near Lucerne, Switzerland, commemorating the Swiss guards who fell while defending the Tuileries in 1792, and his bas-reliefs of *Night* and *Morning*, executed at a single sitting, are the best known. He may be considered as the chief of those modern sculptors who have tried to follow a purely classical tradition.

**Thoth** [Egypt. *Tehuti*, the measurer]: an Egyptian lunar deity, god of wisdom, whom the Greeks identified with Hermes. He was the god of HERMOPOLIS MAGNA (*q. v.*), the son of Ptah and Mut (other parents are also assigned), and husband of Māt, goddess of truth (also of Nephthys). He is represented as an ibis-headed man, and occasionally he is shown surmounted with a crescent moon and the sun-disk. He was regarded as the adviser and scribe of the gods, as the inventor of writing and of numbers, and as the measurer of time. He was believed to have been the author of the most sacred books, prayers, and laws (Diodorus, i., 94, 75), and the *Book of the Dead* is ascribed to him. Hence he was the tutelary deity of scribes, and because of his knowledge of magic, one of the chief reliances of physicians, he was also their special god. He was regarded as the guardian, companion, and advocate of the dead, whom he accompanied to the "Hall of Double Justice," where he superintended the weighing of the heart of the deceased against the symbol of truth, and noted the result. To him the ibis and the cynocephalus ape were sacred, as were also the first month of the year and the sixth hour of the day. Few temples were reared to him, but in the eighteenth dynasty he was apparently held in special honor, as is shown by the fact that his name appears in that of Thothmes, "son of Thoth." See also HERMES TRISMEGISTUS. CHARLES R. GILLETT.

**Thothmes, Tahutmes, Tutmes** [*Tahuti-mes*, son of Thoth]: the name of four kings (the fourth, fifth, sixth, and eighth) of the eighteenth Egyptian dynasty. During the reign of the first king Egypt regained most of the ground, as regards both art and national power, which had been lost through the Hyksos invasion and domination. With the expulsion of these "shepherd kings" Egypt entered upon an era of foreign conquest which reached its furthest limits under Thothmes III. The booty which was brought back from various expeditions served to enrich both rulers and soldiers, and its evidences are seen in numerous buildings and temples in all parts of Egypt, but particularly at Thebes, the national capital. It was a period of renaissance and prosperity, and in matters of foreign trade and intercourse it marks an epoch in Egyptian history.

Following in the footsteps of Ahmes (the Amosis of Manetho), THOTHMES I. made conquest of Ethiopia and established rule there after the pattern of Egypt. At the head of this government was a "prince of Cush" who was also frequently the heir-apparent to the Egyptian throne. To the eastward he pushed as far as the Euphrates, where he set up two stelæ as the boundaries of his dominions. At home he was active in building, especially at Thebes, but most of his edifices have been obscured by the remodeling of his successors or destroyed by time. His reign covered only nine years, and he left as his successors his son Thothmes II., his daughter HATASU (*q. v.*), and also Thothmes III., a son by a concubine. After death he received divine honors.—THOTHMES II. reigned only a brief time, as coregent with Hatasu; and we know only of unimportant expeditions against the nomads of the deserts that bordered Egypt on the E., and Nubia on both sides. He contributed to the architectural splendors of Thebes, but his name was erased from his monuments by his sister, who survived him.—THOTHMES III. was perhaps the greatest warrior produced by Egypt. After twenty-one years of joint reign with Hatasu, he became sole king, and he at once entered upon his warlike career. His efforts were directed toward the entire subjugation of Western Asia, and during the first twenty years of his sole reign there are records of fourteen campaigns to the East. He subdued Palestine, Syria, and a portion of Mesopotamia, together with the region between the Euphrates and the Mediterranean. He took Megiddo, Tyre, Kadesh on the Orontes, Carchemish, and a large number of other places, whose names he inscribed on the walls of the temple of Karnak. It is supposed that his dominion extended to the border of Asia Minor, and from Cyprus also he received tribute. At home he built on an extensive scale in various parts of Egypt from the Delta to the second cataract of the Nile. Thebes naturally received most of his attention, and there he labored principally in extending the temple of Karnak, which he adorned with inscriptions that give a very complete record of his reign. Evidence of an intense hatred of his early coregent, Hatasu, is seen in the fact that he industriously erased her name wherever it was possible. He was succeeded by Amenhotep II., whom he had previously associated with himself in the government. His reign covered about fifty-three years in all, of which for about thirty-one he was sole king. Dr. Mahler, of Vienna, using astronomical data, has calculated that his reign extended from Mar. 20, 1503, till Feb. 14, 1449 B. C. —THOTHMES IV. was the son of Amenhotep II., mentioned above. His reign covered only seven years, during which he claimed to have waged war in Ethiopia, Syria, and Phœnicia. But the pompous style of the narratives of these exploits throws doubt upon their historical trustworthiness. Early in his reign he cleared the great sphinx of Gîzeh of the sand which had buried it, and erected between the paws a tablet 13 feet high. (See SPHINX.) He was followed by Amenhotep III. and his son Khunaten, and after them the kingdom became much weakened, till its power was again restored by Seti I. and Ramses II., the mighty kings of the nineteenth dynasty. CHARLES R. GILLETT.

**Thott**, tōt, BIRGITTE: scholar; b. in Denmark, 1610; the most learned woman and one of the greatest scholars of her time. Her chief work is a translation of Seneca (Sorö, 1658), which won admiration by its correctness and elegance. She also translated Epictetus and Cebes. In the preface to the Seneca she makes a strong plea for the intellectual rights of her sex. D. 1662. D. K. D.

**Thou**, too, JACQUES AUGUSTE, de: historian; b. in Paris, Oct. 8, 1553; studied law at Orleans and afterward at Valence, under Cujas; traveled in Italy, Germany, and Holland; and was made councilor to the Parliament in 1578, councilor of state in 1588, vice-president of the Parliament and keeper of the royal library in 1593. Henry III. and Henry IV. showed him great confidence, and employed him in many difficult diplomatic and political negotiations; but under the regency of Marie de Médicis he felt himself to be slighted and retired from public life. He was a member of the Politique party, a strong opponent of the League, and a supporter of the policy of toleration toward Protestants, being one of the promoters of the Edict of Nantes. D. May 7, 1617. His great work, *Historia mei Temporis*, comprising the period from 1546 to 1607, written in Latin, and divided into 138 books, was published in part in 1604 and succeeding years; but the last part did not appear till 1620, when it was issued by his friends, Dupuy and Rigault, the latter of whom added a continuation or conclusion based on the papers of the author; complete edition in seven folio volumes (London, 1733); French translation in sixteen volumes 4to (1734). Though the author betrays his sympathy with the Politiques, the work is in general impartial, and is one of the chief authorities for the period. He also wrote some Latin poems and an autobiography, edited by Masson (1838). See John Collinson, *Life of Thuanus, with some Account of his Writings* (London, 1807). F. M. COLBY.

**Thought**: the mental processes of comparing, judging, and reasoning. The term thought is used to mark off those mental states in which there is a breaking loose from particular objects and the manipulation of general notions, concepts, signs, or terms. It involves Apperception (*q. v.*), the relating function, primarily, but after it comes to work upon the more abstract material used in arguments, reasonings, inferrings, and the like. In its nature, however, thought can not be held to differ from the lower exercises of mind seen in perception. The distinction is largely one of range and reach in the use of material. The lower animals seem to come only to a very small degree of thought.

Psychologists distinguish certain stages in the process of thought, having mainly in view the degree of generality of the object to which the mind is directed. These stages may be given a further word under the names which they hold in popular language, i. e. conception, judgment, reasoning.

*Conception.*—In conception, the object which the mind is thinking about is a "general idea," concept, or notion. It is a mental state which is equivalent in thought to more than one object in the external world. When, for example, a man speaks of the "place of the *horse* in the animal kingdom," he is using a concept, "horse." The psychological point at issue is the way the mind comes to have a state which thus stands not for any particular object—no one single horse—but for any of the objects which go in a class, large or small. General ideas are generally distinguished as "abstract," i. e. when they designate a quality of objects, such as "green," "sweet," etc., independently of the kinds of objects to which this quality may apply; and concrete, or "general," in a narrow sense, i. e. when they refer to the objects themselves, as to number, distribution, etc., independently of the qualities which they possess, as, for example, the case given, "horse." The way that the concept arises on the basis of the perception of the particular objects which come first in mental growth is called "abstraction" and "generalization" in these two cases respectively.

*Judgment.*—This term is usually applied to the mental procedure of asserting anything, as, for example, "Socrates is mortal," "It rains." The theory of judgments when they are thrown into statements called "propositions" belongs to the ordinary or Aristotelian theory of Logic (*q. v.*). The action of the mind in getting and using its judgments, however, belongs to psychology. The theory most current on the psychological side looks upon judgment as just the mind's own consciousness of the progress it is making with its conceptions. For example, the judgment "horses eat grass" is looked upon by the newer theory as the mind's expression to itself of the fact that the new quality or attribute of eating in a particular way has to be added, in future cases when horses are thought of, to the concept which stands for this class of animals. There seems to be nothing added to the concept by the mere fact of judgment—that is, nothing additional to what is already there in the altered concept. But connected with this very growth of the concept there arises as a necessary part of the function itself the recognition by consciousness of the addition being made to its content, and this recognition of and assent to its own process constitute judgment. Consequently, the older school of psychologists who thought that judgment represented an entirely new function or faculty are no longer considered authorities; yet the newer school, represented by Brentano, Sigwart, Lotze (especially the first named), are disposed to think that the predication of existence is always carried by the exercise of judgment, and that that is a new mental movement, since in conception the notion may or may not have the attribute of existence attached to it. The view of Brentano is probably correct, as far as it finds in judgment the attribution of existence; but this attribution of existence is a fact of emotion, which becomes explicit at a certain stage in the development of conception, and then gives the form of conscious recognition or assertion which we call judgment.

*Reasoning.*—It is the process of reasoning which is usually suggested by the word thought; and reasoning is, when psychologically considered, the most explicit form of the growth of conception, and with it of the direct assertion found in judgment. The detailed treatment of reasoning belongs to Logic (*q. v.*); and it only remains to say in this connection that reasoning is again only a further stage in the growth of conception. In every piece of reasoning, in every argument, what we really have is an attempt to broaden our conception of the subject reasoned about by adding to it certain new elements. We do this by discovering relations between concepts formerly held apart; and the successful union of such conceptions in one is what we call the "conclusion" of the argument. So here again the old psychology is wrong in thinking that reasoning is a distinct faculty. It is only the general apperceptive or synthetic function of consciousness, as it works on more general and detached elements of perception and conception. The reason, therefore, that animals do not show more reasoning power than they do is probably simply that they are not developed far enough, either in consciousness or in the brain complexity that accompanies consciousness, to do much of the synthesis which thought embodies.

Literature.—See the references given under Logic; also the *Psychologies* of Brentano, James, Höffding, and Baldwin.

J. Mark Baldwin.

**Thought-transference**: See Telepathy.

**Thousand and One Nights**: See Arabian Nights.

**Thousand Islands**: a group of about 1800 islands situated in the St. Lawrence river, near the outlet of Lake Ontario; famed for the beauty of their scenery, and annually visited by large numbers of tourists. Many have been chosen as sites for summer cottages. An expansion of the river, caused by the numerous islands obstructing it, is known as the Lake of the Thousand Islands. A belt of crystalline rock termed Laurentian gneiss, which unites the Adirondack hills of New York with a vastly larger area of a similar geological character in Canada, is crossed by the St. Lawrence, and owing to the unevenness of the surface of the rock and inequalities in the depth of the glacial deposits spread over it, many islands were formed when the region became partially submerged.

Israel C. Russell.

**Thrace** (in Gr. Θράκη): in earliest times the entire and wholly indefinite region of country N. of Mt. Olympus, but later on the boundaries were in general these: On the N. the Danube, on the E. the Black Sea, on the S. the Hellespont and Thracian Sea, on the W. the Strymon. The Thracians belonged to the Indo-European family, and in earliest times had attained a relatively high standard of culture, as is indicated by the religious myths that originated in or were connected with Thrace, though they failed to keep pace with their southern neighbors. Little is known concerning the history of the country. The people were very warlike, living mainly by plunder and robbery, and were notorious for their drunkenness. The Greeks planted many colonies along the coast of Thrace, but the Thracians never exercised any great influence upon political affairs in Greece. They were conquered by Philip and Alexander, and from the Macedonians the country passed into the hands of the Romans, though it was not fully subdued until 26 b. c.

J. R. S. Sterrett.

**Thrale**, Hester Lynch Salusbury: See Piozzi.

**Thrasher**: a name applied in parts of the U. S. to the species of *Turdidæ* or thrush-like birds belonging to the genera *Oroscoptes* and *Harporhynchus*. *Oroscoptes* has the wings and tail of nearly equal length, the tail nearly even, and a slightly notched moderate bill. *Harporhynchus* has the wings decidedly shorter than the tail, the tail long and graduated, and the bill not notched and diversiform, but generally quite elongated and decurved. The color is rather plain, generally brownish or ash above, whitish or spotted on the breast. The species include the sage-thrasher or mountain-mocker (*O. montanus*), the brown thrasher (*H. rufus*), Cape St. Lucas thrasher (*H. cinereus*), gray curve-bill thrasher (*H. curvirostris*), California thrasher (*H. redivivus*, and red-vented thrasher (*H. crissalis*).

Revised by E. A. Birge.

**Thrashing**: See Threshing Machinery.

**Thrasybu'lus** (in Gr. Θρασύβουλος): son of Lycus of the deme Steiria, one of the leaders of the democratic party in Athens during the latter part of the Peloponnesian war. He was one of the associates of Thrasyllus at Samos, and was prominent in the attempt against the four hundred. He then fought under Alcibiades in the Hellespont and elsewhere, and as trierarch took part in the battle of the Arginusæ, being one of those ordered to pick up the shipwrecked sailors. He was banished by the Thirty Tyrants and took up his residence in Thebes, where he planned his successful attempt to redeem Athens from the rule of the Thirty. From the fortress of Phyle as his base of operations he seized Munychia, the stronghold of the Piræus, and finally succeeded in overthrowing the Thirty and in reestablishing a democratic form of government in Athens (403 b. c.). He served as general in Bœotia and at Corinth, but without distinction (394 B. C.). In 391 B. C. he commanded the Athenian fleet, and succeeded in restoring the Athenian prestige in the Hellespont, but was charged not only with embezzlement, but with treason as well. When his fleet was visiting Pamphylia his soldiers angered the people of Aspendus by acts of violence, and Thrasybulus himself was killed in his tent during the night. His death probably saved him from execution at Athens, a fate which overtook Ergocles, his fellow general. J. R. S. STERRETT.

**Threadworm**: any nematode worm. See NEMATHELMINTHES.

**Threats**: expressions of intention to inflict injury on another. At common law they are criminal offenses when directed against persons under the protection of a court, or when made against the life, reputation, or property of another for the purpose of extorting money from him, provided they are of a nature calculated to overcome a firm and prudent man. (*King* vs. *Southerton*, 6 East. 126.) This subject became a matter of legislative regulation at an early day, and is governed wholly by statutes in each jurisdiction. Threats for the purpose of intimidating a public officer, or of preventing a person from exercising his lawful calling, or threats to publish a libel, or threats in a letter sent or delivered for the purpose of extorting money or annoying persons, are generally declared misdemeanors by these statutes. Threats which unlawfully interfere with one's business are actionable as a tort. In an early English case the owner of a stone-quarry was allowed to recover damages against a party who by threats of bodily harm and of lawsuits frightened away plaintiff's workmen and customers. (*Garret* vs. *Taylor*, Croke, James. 567, A. D. 1620.) Threats may also interfere with one's personal freedom to such an extent as to amount to FALSE IMPRISONMENT (*q. v.*). See BOYCOTTING and CONSPIRACY. FRANCIS M. BURDICK.

**Three Bodies, Problem of**: the problem of determining the motion of three mutually gravitating particles. The discovery of the law of universal gravitation by Newton reduced the question of the motion of the planets to one of almost pure mathematics. Newton himself was able to show, by a rigorous but intricate geometrical demonstration, that if two bodies like the sun and a planet attract each other with a force inversely as the square of their mutual distance they will each describe a conic section around their common center of gravity. The planet being very small relatively to the sun, this common center of gravity would be very near the center of the sun, and the planet might therefore be said to describe a conic section around the sun. It was thus shown that, considering only the attraction of the sun upon the planets, each planet would revolve in an ellipse having the sun in one of its foci, which was Kepler's first law of planetary motion. But since each planet is attracted by all the other planets, as well as by the sun, this motion in an ellipse does not represent the mathematical truth, but only an approximation to the real motion. Hence mathematicians were led to propound the problem more general than that solved by Newton: *Three bodies being projected in space with any velocity and in any direction whatever, and then left to their mutual attraction, to find the motion of each of them during all time.* The general and complete solution of this problem was found to be beyond the power of mathematical analysis, for the reason that the curves described by the several bodies would be so irregular, subject to such constant variation, and changing so greatly according to the masses of the bodies, that it would be impossible to express them by any mathematical formula. It was, however, possible to find certain general laws to which the motion would be subject. The center of gravity of the three bodies would always move in a straight line with a uniform velocity. Certain relations were found to subsist between the masses of the bodies, their distance apart, and their velocities, and certain great principles established relating to the secular changes as well as to the real permanence and stability of the solar system. See LAGRANGE.

All this, however, did not suffice to determine completely the motion of any one body. In consequence of the impossibility of the general solution, the efforts of mathematicians have generally been directed, not to the general problem, but to two special cases of it which occur in the solar system. The first of these cases is that of the motion of two planets around the sun, in which the masses of the bodies are very small compared with that of the sun, while their motion takes place in nearly circular orbits. The deviations of each planet from the average ellipse in which it would move if not attracted by the other, then admit of being determined with any required degree of accuracy, though not with mathematical rigor. The actual problem of planetary motion is, however, not simply that of three bodies, or two planets, but of nine bodies, there being eight large planets. But the solution of the problem of any number of planets involves no greater mathematical difficulties than are encountered in the case of two, though the labor of the numerical solution is immensely greater. The other special case is that of the motion of the moon around the earth, under the influence of the attraction of the sun as well as of that of the earth. This is a more complicated case than that of planetary motion, because while the moon revolves round the earth both the earth and moon revolve together around the sun. But by the researches of Hansen and Delaunay this difficult problem of the moon's motion has been solved with nearly the same degree of accuracy as that of planetary motion.

The efforts of several generations of mathematicians since the middle of the eighteenth century have resulted in the general problems of planetary and lunar motion being rendered comparatively simple from a purely mathematical point of view. But the problem of actually calculating the formulas necessary to determine the motion of any one planet is one of immense labor, the increased accuracy demanded by modern astronomy having more than made up for the greater simplicity of the methods now used. The difficulty involved is indicated by the fact that the algebraic formulas by which Delaunay represents the position of the moon occupy 120 4to pages. S. NEWCOMB.

**Three-chapter Controversy**: an episode in the great Monophysite controversy. In order to win over the Monophysites the Emperor Justinian issued in 544 an edict condemning the so-called Three Chapters—the person and writings of Theodore of Mopsuestia, the writings of Theodoret against Cyril and in defense of Nestorius, and the letter of Ibas of Edessa to the Persian Maris. Though this condemnation involved a condemnation of the Council of Chalcedon (451), which had expressly affirmed the orthodoxy of Theodoret and Ibas, the Greek Church accepted the edict, as did also Pope Vigilius (540–555), while the whole Western Church rejected it and excommunicated the pope. Revised by S. M. JACKSON.

**Three Estates**: See ESTATES, THE THREE.

**Three Rivers** (Fr. *Trois Rivières*): city, port of entry, and *chef-lieu* of St. Maurice County, Quebec, Canada; on the northern bank of the St. Lawrence where it is joined by its tributary the St. Maurice (see map of Quebec, ref. 4–C). The Canadian Pacific Railway connects the city with Montreal, 95 miles distant, and with Quebec, 77 miles distant. There is also a branch of the Grand Trunk terminating here by means of a ferry from the other side of the river. The river steamboats make this a place of call during summer. The town is one of the oldest in Canada, having been settled in 1634. It is an ecclesiastical center, with its cathedral, bishop's palace, college, and convents. The old original parish church still stands. The city owes its growth to the development of the lumber-trade of the St. Maurice and its tributaries. The St. Maurice iron-works are 10 miles distant, and connected with the city by rail. The manufactures of Three Rivers are lumber, boots and shoes, and iron ware. The cathedral, with its massive spire, surrounded as it is by many handsome edifices, gives the city an imposing appearance as it is approached by rail. Some of the streets have an untidy appearance, while the system of water-supply and drainage needs improvement. The city sends one member to the House of Commons at Ottawa, and one to the House of Assembly at Quebec. There are 2 weekly newspapers, 3 branch banks, 3 Protestant churches, and several well-equipped schools. Three Rivers was in origin the fort or central station of the three great tributaries of the St. Lawrence; hence, perhaps, the name, though it is generally thought to have been given on account of the two dividing islands at the mouth of the St. Maurice. Pop. (1881) 7,998; (1891) 8,334. J. M. HARPER.

**Three Rivers**: village; St. Joseph co., Mich.; at the junction of the St. Joseph, Portage, and Rocky rivers; on the Lake Sh. and Mich. S. and the Mich. Cent. railways; 8 miles N. of Constantine, and 25 miles S. of Kalamazoo (for location, see map of Michigan, ref. 8–H). It has excellent water-power for manufacturing; is in a lumber region, and contains 2 flour-mills, several saw and planing mills, foundries, agricultural-implement works, paper mill, peppermint-oil works, 2 national banks with combined capital of $114,000, a State bank with capital of $30,000, a free public library, and 3 weekly newspapers. Pop. (1880) 2,525; (1890) 3,131; (1900) 3,550. EDITOR OF "HERALD."

**Thresher**: See FOX SHARK.

**Threshing Machinery**: machinery for the separation of grain from the straw.

*Primitive Methods of Threshing.*—There are two methods of threshing without machinery—one by blows which beat out the grain, the other by a kind of trituration which breaks its hold on the straw. The former appears to have been developed from the latter. The earliest method of threshing was doubtless that of treading the grain to and fro by horses or oxen—a method in common use on the small farms in the U. S. and elsewhere, especially for buckwheat, and notably for clover. Another ancient method still in use in the Orient, but probably nowhere else, is that of drawing a sled back and forth over the unthreshed straw. The primitive method of beating out the grain was by means of a flail, an implement comprising a staff wielded by the thresher, and having at one end a swingle shorter, thicker, and heavier than the staff, to which it is connected by a flexible thong. The flail is uniformly used even now where only small quantities of grain are to be threshed. The best flails have staves made of ash and swingles of hickory; the staff in each case being provided with a wooden bow swiveled at its upper end in order that the swingle may be free to swing around the line of the staff, the swingle being attached to the bow by a looped thong made preferably of eel-skin, which best resists the great and continual strain and friction brought upon it. In threshing grain with straight straw, such as oats, wheat, barley, etc., the sheaves are laid in double rows with their heads turned inward and slightly overlapping. The thresher first threshes down the middle, beating out the heads. The bands upon the sheaves are then broken, and the whole is uniformly again threshed over. It is then turned or inverted and flailed again. If the weather is damp, the straw is tougher and holds the grain more firmly; and in such cases the straw is shaken up with a pitchfork once or more as may be required, and repeatedly gone over with the flail. With buckwheat, in which the sheaves or stooks are of conical form, the stooks are placed upright, and the whole mass is beaten down upon the floor by first striking upon the tops of the stooks, the straw being turned and shaken up as often as may be required, and repeatedly threshed until the grain is completely separated. Clover, beans, peas, etc., are flung promiscuously on the threshing-floor and turned and beaten until the threshing is complete. These last, however, are readily threshed by horses trampling upon them, an attendant turning the straw at one part of the floor while the horses are trampling at another.

*Early Forms of Threshing Machinery.*—From the very earliest times until a very recent period, the methods just described were the only ones by which grain was separated from the straw, unless the rude method sometimes used by warlike Celtic tribes of burning the straw and gathering the parched grain left behind be excepted; also that other method in which may be detected the faintest suggestion of the principle of modern inventions—the hurdles made of planks or wide beams, stuck over with flints or hard pegs to rub the grain ears between them; for it is only necessary to curve one of these planks to the arc of a circle, and bend the other to a complete cylinder revolving within the concave, to have an imperfect representation of the two essential parts of a modern threshing-machine. It is to such beginnings that the principles of improved machinery may be frequently traced; and the modern threshing-machine finds its inception in the pegged hurdles of the ancient Romans, just as the harvester had its beginning in the comb-like reaping-blade mounted on wheels mentioned by Pliny as in use among the Gauls. The first threshing-machine that could in any sense be considered a practical success, and which was the prototype of those that led to the displacement of the hand-flail, was that invented by Michael Menzies, of East Lothian, in Scotland, who used a number of flails attached to a revolving shaft driven by a water-wheel. This machine succeeded in threshing very rapidly, but the high velocity required soon broke and destroyed the flails, and the mechanical resources of that time were not equal to the task of constructing an apparatus on this principle which would successfully stand the wear and tear of actual use. Afterward, in the year 1758, another Scotchman, Michael Sterling, in Perthshire, constructed another thresher, which appears to have been merely an experiment. This had a vertical shaft with radial arms working within a cylinder, the shaft being turned by a water-wheel. The sheaves were thrown in at the top of the cylinder and were beaten by the radial arms. This appears to have been of little utility, and was followed twenty years later by another machine, in which a number of rollers were arranged around an indented drum, the drum being revolved and the rollers rubbing out the grain. This was manifestly impracticable, as were also several modifications. At a later date another Scotchman, Andrew Meikle, devised a machine in which rollers and drums were retained, but in which beating was substituted for rubbing. The first machine of this kind was made in 1786, and appears to have been the earliest threshing-machine that was practically adapted to extended and successful use. In this, scutches were attached to the drum, and arranged to strike the grain from the straw. At first this invention was adapted merely to detach the grain from the straw, and threw grain, chaff, and straw in a heap together. But early in the introduction of these machines screens were added, and the grain, separated from the straw, was passed to a winnower. This was really a most notable invention, and the threshing of grain by a machine turned by horse-power or steam-power, which had been before at most an experiment, became an accomplished fact. This machine, as well as those that followed it, was expensive. A large one with suitable rakes and fanners for separating straw from the grain and chaff, and the grain from the chaff, cost £150 sterling at that time, when the purchasing power of money was at least three times what it is now. But such machines enabled one man to do the work of six, and secured 5 per cent. more of winnowed grain from a given weight of straw than was possible with hand-threshing. And as has been said: "If 5 per cent. is added to the national produce, it is as great a gain to the public as if the national territories were increased one-seventh." Notwithstanding the comparative excellence of these early British machines, they have been much changed, and the steam threshing-machines exhibited at the annual agricultural shows in Great Britain are triumphs of mechanical engineering.

*Threshing-machines in the U. S.*—In North America threshing-machines were early invented, but for the reason that most of the farms were newly cleared from the wilderness, divided into small fields, and almost necessitating hand-labor in all departments of agriculture, it is only since about 1840 that this class of machinery has been brought to any perfection. Among those earlier invented, the plan of rotary beaters or flails attached to a revolving shaft was the subject of much experiment. But a revolving cylinder provided with radial teeth or spikes, and working with a concave or section of a cylinder provided with similar but inwardly projecting teeth, comprised the beating mechanism which was first found uniformly successful, and which continues in use. The changes and improvements have related for the most part to the mode of giving motion to this cylinder and to accessories for securing safety and convenience in the operation of the machine. Those which first came into common and satisfactory use had the cylinder actuated by intermediate gearing from a vertical driving-shaft, from the upper end of which extended radial arms. To the outer end of these arms was attached a whippletree, on which draught was exerted by a single horse. The four horses walked in a circular path, and thus gave rotary movement to the vertical driving-shaft and rapid rotation to the cylinder. The sheaves, unbound, were fed with the heads first into the space between the cylinder and its concave. In some of the first of these machines shaking screens were so applied as to sift the grain and chaff from the straw, the latter being carried and deposited by itself, while the former passed to the hopper of a fanning-mill, which cleaned or separated the grain from the chaff, while a graduated system of sieves separated the small seeds, pigeon-weed, devil's-gut, etc. Many attempts were made to supersede this clumsy mode of driving the cylinder by an inclined endless belt constructed with transverse wooden lags, and driven after the manner of a treadwheel by horses. This plan has been adopted with success for small dog-power machines for churning. Many experiments were made to apply the same principle in various forms to the heavier work of driving a thresher. The first attempts of this kind were made at a foundry in the village of Fly Creek, N. Y. A resident of that place had succeeded in making a horse-power on the plan just mentioned, which theoretically appeared to be perfect, but with which no steadiness of motion could be given to the cylinder. When the sheaves were not passing to the machine the apparatus ran too fast for the horses; when the sheaves were applied the apparatus choked. This was about 1830–35; the apparatus was laid aside, but shortly after a projector from the State of Maine came to the same foundry and had constructed a far ruder apparatus, which on trial gave a perfectly satisfactory motion to the cylinder. The constructor of the first-named device was not long in discovering that this was due to a balance-wheel placed on the main shaft of the horse-power. He added this useful appliance to the shaft of the previous machine, and from this was developed the Badger railroad horse-power, which for many years held its own as the most efficient power for driving threshing-machines. It is difficult to explain the construction of this apparatus without elaborate diagrams. It consisted, in brief, of a framework carrying at each side two endless cast-iron tracks situate in vertical planes. The endless belt was composed of two systems of iron links arranged around the two tracks, and connected by the transverse lags or wooden bars which composed the traveling floor of the apparatus. Each link carried a broad-faced wheel resting upon the upper part of the adjacent endless track. The endless belt thus constructed and arranged was of course in an inclined position, the weight of the horse walking thereon as upon a treadmill giving a motion to the endless belt, the wheels of which traveled upon and around the endless tracks, from which operation the designation "railroad" was derived. A large broad-faced wheel constituted at once the balance-wheel to give steadiness of motion and the driving-wheel from which, by means of a belt, power was transmitted to the threshing-cylinder. At a later date the construction was much simplified, and what are now termed railroad horse-powers differ materially in construction from the first representatives of the class. In the use of this class of machinery much difficulty was at first experienced from the breaking or slipping of the driving-belt, which by relieving the horse-power from the resistance of the thresher was liable to throw the horses back out of the machine, with consequent injury and loss. This was remedied by an ingenious application of a lever arranged in such relation to the belt that the breaking of the belt lets fall the lever, and this in its turn actuates a brake that, coming in contact with the driving-wheel, stops the motion of the endless platform.

The ordinary threshing-machine in use in the Eastern States comprises either a portable steam-engine or a railroad horse-power for two or three horses, and a thresher composed essentially of the toothed cylinder acting in conjunction with the toothed concave. An endless shaker formed with transverse wires and operated like an endless belt conveys the straw some distance in the rear of the thresher, a vibrating motion given to the belt shaking out the chaff and grain, these latter being passed to a fanning-mill which separates the chaff, small seeds, etc., from the winnowed grain. These machines are commonly owned by some enterprising farmer, who, aside from the threshing of his own farm, journeys from farm to farm by appointment, and threshes either for a stated price per bushel or for a percentage of the grain itself, commonly one-tenth. The large farms of the West and the immense quantities of grain produced have called into existence far more elaborate apparatus, in which, however, the principle of operation is substantially unchanged. A thresher in use for a number of years in the Western States may be taken as a type of the improved threshing-machine in use in the Prairie States. In this the threshing-cylinder "is made of skeleton form, having cast-iron heads, and the central annular brace of the same material; wrought-iron bars are arranged on these parts, and form the circumferential parts of the cylinder, being held in position by the external wrought-iron rings. The bars carry the teeth, the shanks of which pass through holes in the bars, and are held by nuts firmly screwed upon their inner ends; the uniformity in shape and size of the teeth arises from their being made by machinery properly shaped in dies under a drop-hammer. The concave is of cast iron, with slots in it which allow the grain to pass through to separate from the straw at the earliest possible stage of the threshing operation. The straw as it leaves the cylinder is flung back, the grain being then shaken out by a vibrating shaker and its separation completed by an air-blast from a revolving fan."

In the Pacific States the peculiar dryness of the atmosphere greatly facilitates not only the threshing but the reaping of grain; the standing grain, instead of crinkling down when ripe, as is the case in the Eastern States, stands straight for many weeks; and this without the shaking out of the kernels incident to ripe grain in other portions of the country. It is, however, dry enough to thresh immediately; the threshers are driven by portable steam-engines, and the threshing is carried on in the open field. During recent years much attention has been given to straw-burning furnaces for steam-boilers of threshing-machines in the open field. By these the straw is used in generating the power which drives the thresher, and a comparatively waste product is made to cheapen the expense of the work. Straw-burning furnaces have been used in Hungary during a long period, and for many years the straw of the rice-fields in the Southern U. S. has been utilized in the same manner. A Californian apparatus for cutting, threshing, and winnowing grain in the field, devised many years ago, is constructed as follows: A large grain-frame is supported on two heavy driving-wheels, and has two lighter ones in front arranged as guiding-wheels. Projecting from the side of this frame is a platform like that of an ordinary reaper, but about 12 feet long. This runs at such height that the reciprocating sickle at the front will cut off the heads from the standing grain; the heads fall on an endless apron running longitudinally upon the platform, and are carried by this to a hopper that conducts them to a threshing-cylinder having a fanning-mill and straw-separator arranged behind it. The threshed and winnowed grain is thrown out from the fan-mill through a spout at the side directly into the mouth of a sack suspended under the spout. An attendant riding upon the platform ties the sacks when full, and throws them off upon the ground to be collected at leisure. The driving parts receive their motion from the large or driving wheel by means of suitable bands and gearing. This apparatus was designed to be drawn by ten horses, the management of which would constitute the greatest difficulty in the operation of the apparatus. Something similar to this has been projected in Australia, where the peculiarities of the climate permit the immediate threshing of the grain as soon as cut. The plan is not more audacious than that experimentally carried into effect about 1850 in Devonshire, England, of connecting a threshing and winnowing apparatus with a run of mill-stones, so that the grain was stripped from the straw, separated from the chaff, ground, and bolted at one continuous operation.

JAMES A. WHITNEY.

**Thrift**: the *Armeria elongata*, a European seaside and mountain plant, found also on British American shores, and often grown in gardens as an edging for flower borders. It has diuretic powers. *A. latifolia* is a fine ornamental plant from Portugal. They are of the family *Plumbaginaceæ*.

**Thring**, EDWARD, A. M.: educator; b. in England, Nov. 21, 1821; studied at Eton; graduated at Cambridge 1847; took orders and served as curate for a time, always wishing to teach; went to Uppingham, Rutland, as head master Sept. 10, 1853, where he had a career as one of the most famous of English schoolmasters. D. Oct. 22, 1887. He published four volumes of school sermons, *Thoughts on Life Science* (1869); *Education and School*; *Theory and Practice of Teaching* (3d ed. 1886), besides poems and addresses. See Skrine, *A Memory of Edward Thring* (1889); Rawnsley, *Edward Thring, Teacher and Poet* (1889). C. H. THURBER.

**Thrips**: See *Physopoda*, under ENTOMOLOGY.

**Throat Diseases**: Although the specialty of the study and treatment of throat diseases is designated laryngology, it includes diseases of the posterior nares, the fauces, pharynx, and larynx. Exceptionally, some of these diseases may be suspected or even diagnosticated from symptoms only, as laryngitis from hoarseness, stridor, or aphonia; chronic tonsilitis from muffled voice and habitual snoring; elongated uvula and papular pharynx from habitual spasmodic pharyngeal cough. But physical exploration, the direct examination of the oral cavity and the passages to the posterior nares and larynx, is essential both to diagnosis and to correct treatment. Simple examination—the depression of the tongue by a spoon or tongue spatula—will suffice in many cases, exhibiting the tonsils, soft palate, uvula, posterior wall of the pharynx, and the top of the epiglottis. To discover the root of the tongue, the entire epiglottis, the true and false vocal cords, the chink of the glottis, and even the upper rings of the trachea and division of the bronchi, the laryngoscopic mirror must be employed. Laryngoscopy may be performed by the use of either bright sunlight or a concentration of artificial light.

Specialists employ lamps with condensing lenses; with such methods of illumination the examination is conducted in a dark room. A good light, whether the sun's rays or artificial, is reflected, by a concave mirror held by the physician or worn upon a head-band, into the patient's opened mouth. The patient's tongue being drawn forward and gently held, a small circular or oval laryngeal mirror is introduced. There are several sizes of mirrors, varying from one-quarter to one inch in diameter; they are attached to delicate handles at an angle, so that when passed to the back of the throat they catch the rays thrown into the mouth by the concave mirror, and reflect them downward, illuminating the larynx. The parts thus rendered luminous present a distinct picture in the small laryngeal mirror above them; and this is seen by the observer.

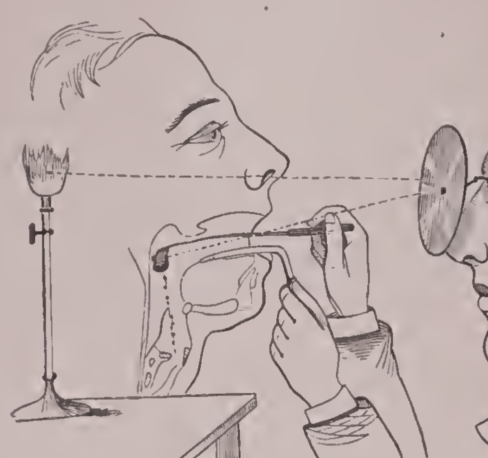


FIG. 1.

The laryngoscopic examination is easily accomplished after a brief period of practice. More difficult is the exploration of the upper pharynx and the posterior nares, termed *rhinoscopy*. The uvula has to be drawn forward, and the reflecting laryngeal mirror passed well back and turned upward. When correctly held, a distinct image of the septum between the nostrils, and of the extensive corrugated surfaces of the naso-pharyngeal spaces, is transmitted to the eye (Fig. 3). Patients are easily trained to permit the presence of the throat mirror, and even to explore their own throats. The movements of the vocal cords are displayed best in uttering the sound *a* (*eh*).

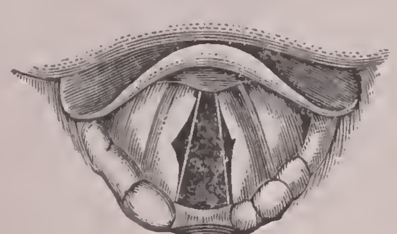


FIG. 2.—Healthy larynx.

All of these several connecting parts of the throat are richly supplied with blood-vessels and lined by a mucous membrane, secreting mucus. They are therefore liable to hypersecretion of mucus, or catarrh, which may be acute, subacute, or chronic; to active and passive congestions, inducing redness, heat, and swelling; to active inflammations, with formation of submucous abscess, erosion of the epithelial covering of the mucous membrane, or ulceration and sloughing of its deeper layers. Such destruction of soft tissue may induce necrosis of the underlying hard structures, the nasal and laryngeal cartilages. Inflammation may terminate in an exudation of membranous character, as those of croup and diphtheria. Repeated congestions and inflammations tend to engorge and hypertrophy the structures of the mucous membrane and glandular bodies embedded in it. The papillæ of the back of the throat and of the columns of the fauces are very often thus enlarged. The surface is seen to be studded with prominent ovoid papules or tubercles, a condition often known as clergyman's sore throat, and technically as papular pharyngitis. Polypoid growths of variable size develop in the nares, pharynx, and on and around the vocal cords—products of papular growth and of granulation.

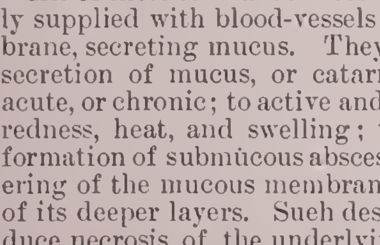


FIG. 3.

A most alarming and critical condition is acute œdema of the larynx. This is an acute inflammatory disease attended with great swelling, by œdema, of the submucous tissue. The distended, swollen structures overlap the opening of the glottis and occupy the ventricles of the larynx, preventing inspiration and threatening immediate death by suffocation. The laryngoscopic mirror definitely locates the seat of these dropsical sacs, and is the sure guide to efficient scarification and evacuation of their contained fluid.

The vocal cords may be affected by spasms, producing hoarseness, aphonia, and labored respiration, in which case the mirror detects the unusual approximation and irregular action of the cords, and excludes the presence of more serious organic disease. One of the vocal cords may be found paralyzed, inactive, and relaxed, while the other remains normal. Such paralysis of a cord may be due to inflammation or abnormal growth, or may depend upon lesions of the nerves in the neck, or again, coexisting with paralysis of half of the body, depend on a lesion of the brain. Ulceration or inflammation may so seriously damage the vocal cords that cicatricial or scar-like tissues are formed, tending to contract and harden; in time the chink of the glottis becomes contracted and narrow—termed stenosis of the larynx. The aperture being no longer adequate for the ingress or egress of air, gradual suffocation must ensue unless surgical relief is afforded. Extensive destruction of the vocal cords often occurs from syphilis and epithelial cancer.

The more accurate diagnosis of throat diseases, and intelligent study and classification by aid of laryngoscopy, have led to corresponding progress in treatment. Applications are no longer applied at random by probangs, uncertain of the condition that exists and of the parts which are reached. Remedies are applied with accuracy by various methods, with definite regard for the indications of each case. Astringents—as tannin, iron, and silver—are employed to contract blood-vessels, lessen congestions, and relaxations of surfaces. Caustics are sometimes used, local applications are made to heal ulcers, and inflammation is checked by warm solutions and vapors, or in other cases by cold gargles or sprays. Anodynes are given to allay pain, either by the stomach or locally. Electricity is applicable directly to the paralyzed vocal cord. The knife is constantly of service in treating throat diseases, for the excision of the tonsils and uvula, opening abscesses, the scarification of œdema of the glottis, and for the operations of tracheotomy and laryngo-tracheotomy, whenever, by inflammation, tumors, croupous or diphtheritic membrane, or whatsoever obstruction, the larynx is closed to the passage of air and death is imminent by suffocation. Of recent years the operation of intubation has been introduced. This consists in the insertion of a metallic tube directly into the larynx from the pharynx. In this way the larynx is kept open and suffocation prevented. See CATARRH, DIPHTHERIA, MOUTH, DISEASES OF THE; QUINSY, and TONGUE.

Revised by W. PEPPER.

**Thrombosis**: See HEART DISEASE.

**Throm'bus** [Mod. Lat., from Gr. θρόμβος, lump, clot of blood]: in pathology, a clot of blood within the blood-vessels or heart. Inflammations of the lining membrane of the vessels, altered states of the blood, and slowing of the current of blood are the principal factors which contribute to the formation of clots. Their appearance varies according as they are formed rapidly or slowly. Thus in the heart the clots which so frequently result from slowing of the current of blood have a yellow or white appearance, from the fact that the heavy red corpuscles are carried along by even a sluggish current, whereas the lighter white corpuscles cling to the walls and enter into the formation of the thrombus. If the current is alternately slow and rapid, stratified or laminated clots result; and if the stream is suddenly and completely checked, a red clot results. Thrombi in the vessels or heart tend to undergo softening or disintegration, and particles may thus be swept to distant parts of the circulation. On the other hand, under favorable conditions, and particularly in those in small vessels, thrombi become organized, and thus obliterate the lumen of the blood-vessel where they occur. This is the most important feature of thrombosis, for in this manner severed blood-vessels are obstructed and hæmorrhage permanently arrested. W. P.

**Thrush** [M. Eng. *þrusche* < O. Eng. *þrysce*: O. H. Germ. *drosca* < Teuton. **þrus-ka*; cf. *throstle* < O. Eng. *þrostle*: Germ. *drossel* < Teuton. **þrustala*: Lat. *turde'la* < Indo-Eur. **trzdela*]: any one of various birds of the family TURDIDÆ (*q. v.*), a group of Oscines, which stands at, or near, the head of the class of birds, and includes many of the best songsters. They are birds of moderate size, well typified by the wood-thrush (*Turdus mustelinus*) of the eastern parts of the U. S., a delightful songster and a near relative of Wilson's thrush

(*T. fuscescens*) and the gray-cheeked thrush (*T. aliciæ*). These birds resemble one another quite closely, being more or less olive brown above and white below, with blackish spots. The European song-thrush (*Turdus musicus*) is much like the wood-thrush on a larger scale. The common robin (*Merula migratoria*) of the U. S. is a thrush, and so is its relative, the blackbird of Europe (*M. merula*). For the golden-crowned thrush, see OVENBIRD. F. A. L.

**Thrush**: See MOUTH, DISEASES OF THE (*Stomatitis hyphomycetica*).

**Thrush**: an abscess in the sensitive frog of the horse's foot. Cleanliness and the paring away of loose pieces of the frog are useful toward a cure. Carbolic-acid lotions or occasional sprinkling with calomel are also beneficial.

**Thucydides**, thyu-sid'i-dēez [= Lat. = Gr. Θουκυδίδης]: Greek historian; son of Olorus and Hegesipyle, of the Attic deme Halimus. He belonged on one side of the house to an old aristocratic Athenian family, on the other to a line of Thracian princes. The year of his birth is uncertain, not much earlier than 470 B. C., nor later than 454. He received an education that matched his lineage and his wealth; and the influences of Anaxagoras the philosopher and Antiphon the orator have been traced in his thought and in his style. The story that he heard Herodotus read his history at Athens is destitute of warrant, but not destitute of probability. At the outbreak of the Peloponnesian war Thucydides had reached what he calls the age of discernment, and in 423 commanded a detachment of Athenian forces, which was to operate on the Thracian coast, the region in which he had large possessions. Having failed to relieve Amphipolis, he was condemned to death for high treason, and forced to withdraw from Athenian territory; nor did he receive formal permission to return until the end of twenty years, an interval which he spent partly on his estate in Thrace, partly in visits to the scene of hostilities, notably to Italy, Sicily, and Macedon. The time and manner of his death are alike uncertain. One account has it that he was assassinated—cut off untimely, as was his history; and his silence as to the eruption of Etna in 396 makes it probable that he did not long survive the end of the fifth century.

The history of Thucydides, which covers twenty-one years of the Peloponnesian war, has come down to us in eight books, of which the eighth, in which the characteristic speeches are lacking, has not received the last hand of the author. This division into eight books is not the author's division, and we read of other distributions, one into nine, one into thirteen books. A noteworthy break takes place at v., 26, which marks the opening of a second part. But the whole matter of the composition of the work of Thucydides is disputed, some holding that the history was conceived and executed as a whole, others that the piecemeal composition has only been partially effaced by later revision.

Thucydides is universally considered the first and greatest critical historian of antiquity, and claims for himself the credit of an exactness which is possible only to conscientious research as distinguished from hearsay report. His theme, as announced in the outset, is the war and its causes. It is a theme of which he has personal knowledge, and he sticks to it closely, indulging in few episodes, and excluding the sidelights of literature and art. His narrative is rigidly annalistic, year by year, summer by summer, winter by winter, to the detriment of effective grouping, and to the disgust of the rhetorical historians of a later day. Thucydides brought to his task rare qualifications. He was a man of affairs and a soldier, and knew the springs of action even if he could not always work them. His vision was clear of superstitious glamour, his deity was "the strong god, the chance central of circumstance." His aim was the truth, and this praise, though of late years eagerly disputed, can hardly be denied him. He saw and described the men of his time and the movements of his time as they were. His portraits of character abide not merely because of his artistic power, but because of their truth to life. His exhibit of the political forces at work commends itself the more because of the impartiality of the form. He does not tell us what was thought, he bids us listen to the voices of the time, and the statesmen and the captains of the period are made to give abundant expression to the motives of the war. No less than one-fifth of the history is taken up with the speeches in which the thought of the times is dramatized. His narrative shows great variety, sometimes breathlessly rapid, sometimes lingering on each picturesque detail; now a line-engraving, now a painting full of color. The story of the Sicilian expedition is the most elaborate specimen of his art, the retreat of the Athenians from before Syracuse one of the most famous descriptions in all literature. His style is confessedly a hard style, and not undesignedly so. Those who attribute the difficulties of Thucydides to the crude state of Attic prose forget that he could be as simple as the simplest. The fact is that the harshnesses to which all manner of crabbed rhetorical names have been given are of the essence of his genius, are of the essence of his time. Thucydides mirrors more or less consciously in his style a period of conflict and distraction.

EDITIONS.—I. Bekker (4 vols., 1821), also text ed.; Poppo (11 vols., 1821–40), also a smaller ed. revised by Stahl; Goeller (2 vols., 1826, 1836); Didot (3 vols., 2d ed. 1868); Thomas Arnold (3 vols., 8th ed. 1874); S. T. Bloomfield (2 vols., 1842–43); K. W. Krüger (2 vols., 1846–47, and often since); Classen (8 vols., 1862–76, and often repeated); new ed. by Steup in progress 1893; American translation and revision by Fowler, C. D. Morris, C. F. Smith, in progress: by Boehme-Widmann (5th ed. 1882). Noteworthy text editions by Stahl (2 vols., 1873–74) and van Herwerden (5 parts, 1877–83). To these may be added editions of single books and selections by Bigg, Croiset, Dougan, Frost, Goodhart, Graves, Holden, Lamberton, Marchant, F. Müller, Rutherford, Schoene, Shilleto, Simcox, Sitzler, Tucker. Translated into English by Hobbes, Bloomfield (3 vols., 1829), Dale in the Bohn Library, Crawley (1876), B. Jowett with introductions, notes, etc., a monumental work in two volumes (1881). There is an important translation of the speeches by Wilkins (3d ed. 1881), and an admirable essay on the same subject by R. C. Jebb in Abbott's *Hellenica* (1880). See also Bétant, *Lexicon Thucydideum* (2 vols., 1843–47), and von Essen's remarkably complete *Index Thucydideus* (1887). B. L. GILDERSLEEVE.

**Thugs** [from Hind. *thag*, deceiver, robber]: members of a religious fraternity of robbers and murderers which flourished in India from the fourteenth till the nineteenth century. They were worshipers of Kālī (see HINDUISM), by whom they believed themselves to be commanded to murder and rob. Therefore they were utterly unconscious of wrongdoing, considering themselves priests of the goddess carrying out a pious work, for which they were rewarded with the booty gained on their expeditions. They never committed a murder without solemn preparatory rites, prominent among which were the sacrifice of sugar and the consecration of the pickaxe, symbolizing the tooth of Kālī.

The origin of the sect is obscure. The earliest mention of thugs is in the *History of Firoz Shāh*, written by Ziā-ud-dīn Barnī about 1356. It is there related that in 1290 a thousand thugs were captured in Delhi on the information of one of the brotherhood and transported to the island of Lakhnautī. Many of the methods of the fraternity are detailed by the Frenchman Thévenot in relating his travels through India in the years 1665–67. Thuggee (as the system is called) grew rapidly, owing to the extraordinary precautions of its members, and the want of national union among the tribes of India. Thugs were thoroughly organized, and had a special language (Ramasī) and secret signs by which they could recognize each other anywhere. By paying a share of their gains, they even received the support, at least in secret, of many of the native princes.

They went about in bands of from ten to two hundred. Each man was allotted a special duty. There were the leader, the pick-bearer, entrappers, scouts, stranglers, and grave-diggers. It was the business of the entrappers to discover rich travelers, and, representing their band to be merchants or pilgrims, to offer to go with them for mutual protection against robbers or for the sake of each other's society. Having started on the journey, scouts and grave-diggers were sent out ahead to find a favorable spot and prepare a place for the burial of the bodies of those who were to be murdered. Often it would be many days before the opportunity arrived, especially since the omens had to be auspicious. Meanwhile the members of the band mixed on the most friendly terms with their victims—ate and slept with them, and worshiped together at the wayside shrines. When the chosen spot was reached each thug was at his post, and on a given signal from the leader the victims were strangled with the handkerchief (*romāl*). All witnesses were put to death. The bodies of the dead were buried, sometimes being mutilated to hasten decomposition, or fastened down with stakes. The booty was divided among the band, a considerable amount being reserved for their tutelar goddess. Those who did not know their real trade are said to have taken the leaders of these bands to be the ablest, most estimable, and amiable members of native society, and often even the families of the thugs were kept in utter ignorance of their true profession. Several unsuccessful attempts were made by the British Government to stamp out this pest, until, in 1826, owing chiefly to the efforts of Lord William Bentinck and Capt. (afterward Sir) William Sleeman, the movement was started which within a few years utterly broke the power of the sect. This result was reached chiefly by admitting many of the fraternity as king's evidence.

See Sleeman's *Ramaseeana* (Calcutta, 1836); Hutton's *Popular Account of the Thugs and Dacoits* (London, 1857); and Meadows-Taylor's *Confessions of a Thug* (London, 1839; new ed. 1879).

**Thule**, thyu'lee: the name which Pytheas (at the time of Alexander the Great) gave to a land which he discovered after sailing six days in a northerly direction from the Orkney islands. Later, the Romans used the name as a general signification for the northernmost parts of the habitable earth —*ultima Thule*. What island Pytheas meant is unknown.

**Thumbscrew**, or **Thumbkin**: an instrument of judicial torture formerly used in various parts of Europe, but particularly in Scotland. The thumb was compressed by a screw. Its last official use was in the trial and on the person of Principal Carstairs in 1682, after the Rye House Plot.

**Thümen**, tü'men, FELIX, von, Baron: botanist; b. in Dresden, Germany, Feb. 6, 1839. He is known in botany for his many papers on the fungi, published mainly in *Hedwigia*, *Flora*, *Grevillea*, besides other journals, and the proceedings of learned societies between the years 1873 and 1891. He published four series of *exsiccati*, viz.: *Die Pilze des Weinstocks*, 25 species (1877); *Herbarium Mycologicum Œconomicum*, 1,300 species (1872–79); *Fungi Austriaci Exsiccati*, 1,300 species (1871–75); *Mycotheca Universalis*, 2,300 species (1875–84). D. at Schönau near Teplitz, Bohemia, Oct. 13, 1892. CHARLES E. BESSEY.

**Thunberg**, toon'bārch, CARL PETER: botanist; b. at Jönköping, Sweden, Nov. 11, 1743; studied at Upsala under Linnæus; resided at the Cape of Good Hope 1772–75, and in Japan 1775–78; returned in 1779 to Sweden; succeeded Linnæus in 1781 as Professor of Botany at the University of Upsala. His principal works are *Flora Japonica* (1784); *Prodromus Plantarum Capensium* (1794–1800); *Icones Plantarum Japonicarum* (1794–1805); *Flora Capensis* (1807–13); and *Resa uti Europa, Africa och Asia* (4 vols., 1788–93). D. near Upsala, Aug. 8, 1828. C. E. B.

**Thunder**: a rumbling or crashing noise heard after vivid flashes of lightning. Intense electrical discharges in the atmosphere, whether from cloud to cloud, from cloud to earth, or from cloud to cloud and then to earth, are followed after an appreciable interval by the sound which, on a small scale, is represented by the snap and crackle of an artificial electric discharge. The origin of the sound is in the violent sudden increase in volume of the air along the path of discharge. The exceedingly high temperature, sufficient to make the air-column incandescent, causes tremendously rapid expansion and motion of the air. P. G. Tait shows that "such a sound-wave must at first be of the nature of a bore or breaker. But as such a state of motion is unstable after proceeding a moderate distance, the sound becomes analogous to other loud but less violent sounds, such as those of the discharge of guns." Calculations have been made showing that if a cannon-ball could have imparted to it a velocity of 100,000 meters per second we should hear something like the rumble of thunder instead of a whistling noise. Inasmuch as lightning flashes are of very variable dimensions, and as cloud-masses are also variable, and the air itself is of different density and purity at different times, all manner of sounds are produced, from the sharp crash to the prolonged rumble. As the sound-waves may be variously reflected, the original thunder-peal may be reenforced, and, on the contrary, it may even happen that because of interference a sound which if free would have been loud may be deadened. The column of air thus suddenly heated and producing sound-waves may be several miles in length, though recent estimates make the length of the average flash of lightning considerably below this. The beginning of the thunder may be ordinarily taken to determine the nearest point of "break-down" (or lightning) in the air and the duration of the thunder the length of the flash. Thunder may be heard from a great distance, but not so far as some artificial noises have been heard. J. J. Symons has run to earth a number of so-called thunder-bolts, and concludes that the belief in the fall of material substances during thunder-storms is merely the survival of the belief in mythical bolts of irate Jupiter. Belemnites frequently preserved as thunder-bolts are really fossils. Sometimes aërolites and meteorites fall during thunder-showers, but there is no necessary relation between them. Fulgurites or lightning-tubes are found where heavy lightning penetrates into a bed of sand containing silex. The sand for a depth of several feet is fused into a glassy tube. Many of these have been dug out in good preservation, and good specimens are to be seen in museums. A. MCADIE.

**Thunder-storm**: a small short-lived local storm named from the intense electric phenomena which usually accompany it, but which are probably rather a result than a cause. These storms favor warm latitudes, the warm season, and the warm hours of the day. They are often accompanied by a peculiar form of cumulus-cloud called thunder-head, and many are preceded by a short rush of wind outward, accompanied by a slight but sharp rise in the barometer, and followed by cooler weather, a change of wind, and higher pressure. Others seem to have a well-developed but small system of cyclonic winds. The rain which accompanies them is usually intense and the first drops are very large. It sometimes passes into hail. Thunder-storms differ much in intensity, and under this name are probably included phenomena of very different character. The classification is imperfect, but the best is the genetic one, according to which we have: (1) *Stationary* solitary thunder-storms, when in favorable topography a cumulus-cloud on a hot afternoon grows black below and begins to move only after the rain from it has begun. This type is the commonest in the tropics, where it gives most of the rainfall, occurs most frequently in hilly and mountainous regions in the temperate zone, may be very intense among mountains, especially in the arid regions, but shows no relations to "highs" and "lows." (2) *Sporadic* thunder-storms when over a large area, covering perhaps a middle-sized State, a storm crops up here and there, especially in the warmer hours, travels eastward for a few hours, and then disappears. The critical area is a few hundred miles S. E., S., or S. W. of a "low," forms in the morning, becomes best developed in the afternoon, and disappears at night to reform the next day, if favorable, as far in advance of the preceding day as the "low" has traveled in the interval. This is a common condition in midsummer in the U. S., and the individual storms are dependent on topography. (3) *Deploying* thunder-storms, those which travel in a rank in a straight or curved line, sometimes radiating from a point and covering a fan-shaped area. These are always a few hundred miles S. E. or S. of a "low," are generally more intense and longer lived than the preceding, and are independent of the lesser elements of topography. They are common in the U. S. and Europe, and may pass into hail-storms, thunder-squalls, or tornadoes. (4) Winter thunder-storms, the only ones that belong to the cold season. They are isolated, generally intense, often destructive, longer lived, and are rare in the U. S. They are essentially northern, nocturnal, and oceanic. MARK W. HARRINGTON.

**Thun** (toon), **Lake of**: a body of water in the canton of Berne, Switzerland, at an elevation of 1,837 feet above the level of the sea; 10 miles long and 2 miles broad. On its eastern shore stands Interlaken, and beyond its northwestern shore—on the Aar, about a mile from its exit from the lake—the town of Thun. Both these towns are visited every summer by a great number of tourists. Steamers ply on the lake.

**Thurber**, CHARLES HERBERT, A. M.: educator; b. at Owego, N. Y., Mar. 24, 1864; graduated at Cornell University in 1886; registrar of Cornell University 1886–88; taught in the Haverford College grammar school 1888–90; traveled and studied in France and Germany 1887, 1889, and 1890–91; during 1890-91 was also a special agent of the U. S. Bureau of Education; instructor in French, Cornell University, from 1891 to 1893, when he became principal of Colgate Academy and Professor of Pedagogy in Colgate University, Hamilton, N. Y. In 1895 he was appointed Associate Professor of Pedagogy in the University of Chicago, and Dean of the Morgan Park Academy. He has been editor of *The School Review* since 1893, is author of numerous magazine articles, and of *The Higher Schools of Prussia and the School Conference of 1890* (in *Report* of the U. S. Commissioner of Education, 1889–90), and edited Gherardi del Testa's *L'Oro e l'Orpello* (Boston, 1893).

**Thurber**, George, A. M., M. D.: botanist; b. in Providence, R. I., Sept. 2, 1821; educated in the Union Classical and Engineering School in Providence; botanist to the U. S. Mexican boundary commission 1850, the collections resulting in *Plantæ Novæ Thurberianæ*, by Dr. Gray; lecturer on botany in the New York College of Pharmacy 1856–57; Professor of Botany and Horticulture in the Michigan Agricultural College 1859–63; editor of *The American Agriculturist* 1863–90. He revised Darlington's *Agricultural Botany*, bringing it out under the title of *American Weeds and Useful Plants* (1859); wrote the botanical articles for Appletons' *American Cyclopædia* (1876–80); besides many papers in scientific journals and the proceedings of societies. D. at Passaic, N. J., Apr. 2, 1890.

**Thurber**, Samuel: See the Appendix.

**Thurgau**, toor'gow: canton of Switzerland; bordering N. on the Rhine and the Lake of Constance. Area, 381 sq. miles. The surface is undulating, but not mountainous, except in the southernmost districts. The soil is very fertile and agriculture is the main industry pursued; several cotton and linen spinning and weaving factories are in operation. Pop. (1888) 104,678, of whom 70·7 per cent. are Protestants. Capital, Frauenfeld.

**Thu'rible**, or **Censer** [*thurible* is from Lat. *thuri'bulum*, censer, deriv. of *thus* (or *tus*), *thu'ris*, incense; *censer* is shortened from *incenser*, viâ O. Fr. from Late Lat. *incensarium*, deriv. of *incen'sum*, incense, deriv. of *incen'dere*, *incen'sum*, kindle, burn]: a vessel of silver suspended by four short chains, used in the services of certain churches. It is charged with burning charcoal, upon which incense is placed. The thurible is borne by an acolyte called the thurifer. See Censer.

**Thüringerwald**, tü'ring-er-vaalt [Germ., Thuringian Forest]: a picturesque mountain range in Central Germany, extending along the right bank of the Werra, from the influx of the Hörsel, for about 60 miles, and joining the Franconian Forest in Northern Bavaria. Its highest point is Schneekopf, 3,460 feet high. It is covered with pine forests, and consists mostly of granite, porphyry, and slate, interspersed with rich veins of iron ore. It forms the southern boundary of Thuringia (*q. v.*).

Revised by M. W. Harrington.

**Thurin'gia** (Germ. *Thüringen*): the general name for that region of Central Germany which lies between the Hartz and the Thuringian Forest, the Saale, and the Werra, and which comprises parts of the Prussian province of Saxony and the Saxon duchies. The name originated from the Thuringii, who settled here, but since the fifteenth century it has had no definite political signification.

**Thurles**, thĕrlz: town; in the county of Tipperary, Munster, Ireland; on the Suir; 46 miles E. of Limerick (see map of Ireland, ref. 11–E). It has a Roman Catholic college, an establishment of Christian Brothers, two convents, a handsome cathedral, and carries on an active general trade. Pop. about 4,850.

**Thurlow**, Edward B.: lawyer and politician; b. at Bracon-Ash, Norfolk, England, in 1732; entered Cambridge University, but was compelled to withdraw for an act of discourtesy; entered the Inner Temple, and was called to the bar in 1754; established a reputation for ability and determination. He entered politics, and after some vacillation sided with the Tory party, holding numerous offices, becoming Lord Chancellor in 1778, and taking his seat in the House of Lords as Baron Thurlow of Ashfield. He was averse to constitutional and economic reforms, and opposed violently the interests of the American colonies, as well as any attempt at suppression of the slave-trade. He lent only an insincere support to his party from 1788 to 1792, and in the last-mentioned year he was at the instance of Pitt (one of whose measures he had captiously but violently opposed) dismissed from the office of Lord Chancellor, which he had again taken in 1783 when Pitt took office. Having been a few days before made Baron Thurlow of Thurlow, he retired to private life, and died at Brighton, Sept. 14, 1806, without again acquiring any decided influence in politics.

F. Sturges Allen.

**Thurman**, Allen Granbery: lawyer; b. at Lynchburg, Va., Nov. 13, 1813; removed to Ohio in 1819; received an academic education; studied law, and was admitted to the bar in 1835; was elected to Congress in 1844; elected judge of the Supreme Court of Ohio in 1851; was chief justice from 1854 to 1856; unsuccessful Democratic candidate for Governor of Ohio in 1867; succeeded Benjamin F. Wade in the U. S. Senate Mar. 4, 1869, and served till Mar. 3, 1881; was prominent among the candidates for the Democratic nomination for President in 1876, and in 1888 was defeated as Democratic candidate for Vice-President of the U. S. D. in Columbus, O., Dec. 12, 1895.

**Thurneysen**, toor'nī-sen, Eduard Rudolph: comparative philologist; b. at Basel, Switzerland, Mar. 14, 1857; studied at the Universities of Basel, Leipzig, and Berlin; privat docent, and later assistant Professor of Romanic Philology, at Jena 1882–87; since 1887 Professor of Comparative Philology at Freiburg im Breisgau. His unusually complete command of the scientific detail of three provinces of Indo-European philology, namely, Romanic philology, Italic philology, and Celtic, coupled with a quick, fine insight into the historical mechanism of language, assigns him a prominent and fairly unique place among the authorities in the field of Italo-Celtic philology. He is the author of *Ueber Herkunft und Bildung der lateinischen Verba auf -io* (1879); *Das Verbum être und die französ. Conjugation* (1882); *Keltoromanisches* (1884); *Der Saturnier und sein Verhältniss zum späteren römischen Volksverse* (1885); *Mittelirische Verslehren*, in Windisch's *Irische Texte*, iii. (1891); also articles in *Kuhn's Zeitschrift* and the *Revue Celtique*.

Benj. Ide Wheeler.

**Thurn und Taxis**, toorn'oont-taaks'is: the name of a noble family of the German empire, famous for its former possession of a monopoly of the postal service. It is descended from the della Torre (whence the name Thurn, a German translation of Torre), one of whom took the name de Tassis (Taxis) from the castle of Tasso. In 1516 Franz von Thurn established the first post between Vienna and Brussels, and in 1595 his descendant became postmaster-general of the empire, securing for himself and his heirs the right of carrying the mail throughout the imperial dominions. A century later the princely rank became hereditary in the family, but the postal privileges were gradually curtailed by the different governments, which granted extensive territories in compensation. The family has hereditary possessions in Austria, Bavaria, Belgium, Würtemberg, and Prussia. The last of these states arranged with the family for the abolition of the monopoly in 1867.

F. M. Colby.

**Thursby**, Emma: concert-singer; b. in Brooklyn, N. Y., Nov. 17, 1857; studied under local teachers and in 1873 at Milan under Lamperti, and finally in New York under Madame Rudersdorff; made a tour of the U. S. and Canada in 1875; first appeared in England May 22, 1878, at a Philharmonic Society concert; in 1879 sang in Paris; and in 1880–81 made an extended concert tour through Europe, everywhere with great success. Her voice is a rich and high soprano, ranging to E flat in alt.

D. E. H.

**Thursday** [M. Eng. *Thursdei*, *þorsday* (by anal. of Icel. *þōrsdagr*), for earlier *Thunres dæi* < O. Eng. *þunres dæg*, Thunder's (or Thor's) day. See Thor]: the fifth day of the week. The later Roman pagans adopted the week of seven days and named the fifth day *Jovis dies*, Jove's day; the name Thursday originated as a translation of this.

**Thurston**, Robert Henry, LL. D., Dr. Eng.: mechanical engineer, inventor, educator, and author; b. in Providence, R. I., Oct. 25, 1839. During childhood and youth he spent much time in the workshops of his father's establishment, then devoted especially to the building of steam-engines. He graduated at Brown University in 1859 with the degree of Bachelor of Philosophy, and immediately entered the works of his father's firm, spending some time as a designing engineer. In 1861 he joined the Engineer Corps of the U. S. navy, serving in Dupont's and Dahlgren's fleets throughout the war; was made engineer-in-charge of the Chippewa in 1863 when a second assistant engineer, and was later transferred to the Dictator iron-clad, and commissioned first assistant in 1864. He served as a Professor of Natural Philosophy in the U. S. Naval Academy from Jan. 1, 1866, to June, 1871, when he became Professor of Engineering at Stevens Institute of Technology, resigning in 1885 to assume the directorship of the Sibley College of Mechanical Engineering in Cornell University, where he still (1895) remains. Under his administration this college has grown in size and efficiency, and now has over 500 students and an equipment valued at nearly half a million dollars. He has been employed on many Government commissions, as the U. S. scientific commission to the Vienna International Exhibition (1873); to Paris (1889); the U. S. commission to investigate the causes of boiler explosions (1875); U. S. commission to test iron, steel, and other metals (1875–88); U. S. commission on safe and bank-vault construction (1891); U. S. board to report on best construction of iron-clad Puritan, etc. He is a member of a number of American and European societies, has been first president of the American Society of Mechanical Engineers, and three times vice-president of the American Association for the Advancement of Science. He has designed engines, boilers, and many kinds of machinery, and has written many treatises, among which are his *Manual of the Steam Engine* (2 vols., 1890–91); *Manual of Steam Boilers* (1890); *Engine and Boiler Trials* (1890); *History of the Steam-engine* (1878); *Materials of Engineering* (3 vols., 1882–86). He has published over 250 papers, mainly on professional subjects. He translated Carnot's *Reflexions sur la Puissance motrice du Feu*, the basis of the modern science of thermodynamics, and edited the reports of the U. S. scientific commission to the Vienna International Exhibition of 1873 (4 vols. 8vo, 1874–75), his own report constituting the third volume. He has invented magnesium-burning lamps, army and navy signal apparatus, various forms of testing-machines for iron and other metals and to ascertain the quality of lubricants, some improvements on the steam-engine, and scientific and engineering apparatus. He has performed much work in scientific research and in the investigation of engineering problems; his determination of the useful qualities of the alloys of copper and tin, of copper and zinc, and the ternary alloys of the three metals; his studies of boiler-explosions; his examination with his own apparatus of the laws of friction and of lubrication, as published in his *Friction and Lost Work*; his investigations of the laws of variation of engine-wastes of heat and power; and his studies in commercial economy of steam-engines, are among the best known. He organized in 1872–73 the first laboratory for research in applied sciences of engineering in the U. S. When organizing Sibley College he made this a separate and prominent department.

**Thwing**, Charles Franklin: See the Appendix.

**Thyatira**: See Ak-Hissar.

**Thy'ine Wood** [*thyine* is from Gr. θύϊνος, deriv. of θύειν, sacrifice]: a kind of wood mentioned in the Bible; probably the arar or sandarach wood, the wood of *Callitris quadrivalvis*, a large tree of Barbary. This tree affords the resin called gum sandarach, and its timber is considered imperishable by the Turks, who floor their mosques with its planks.

**Thylacine**: See Tasmanian Wolf and Thylacinidæ.

**Thylacin'idæ**, or **Dasyu'ridæ** [*Thylacinidæ* is Mod. Lat., named from Gr. *Thyla'cinus*, the typical genus, from Gr. θῦλαξ, θύλακος, sack, pouch (perh. with similation in the last syllable of Gr. κύων, κυνός, dog); *Dasyuridæ* is Mod. Lat., named from *Dasyu'rus*, another genus; Gr. δασύς, shaggy + οὐρά, tail]: a family of mammals of the order *Marsupialia* and sub-order *Dasyuromorpha*, including the chief carnivorous mammals of Australasia. The form varies in the several genera, the larger species much resembling a dog externally, others an opossum, and the small species simulating a mouse in appearance, although anatomically they differ but little from each other. The snout is like that of a dog or acutely pointed; the ears moderate or large; the tail is generally more or less long, and the feet have separate toes, four or five in number. The teeth are well developed, and simulate those of the placental carnivores (dogs, etc.), and are in considerable number; there is no such distinction between molars and premolars as in placental carnivores, only the last premolars having deciduous predecessors; the premolars are compressed, conical; the canines generally well developed and typical in form, and the incisors cylindroid and curved, and moderate or rather large. The skull superficially has much resemblance to that of a dog, but is of course radically different, and exhibits the typical marsupial modifications of the mammalian skeleton, and the small size of the cerebral cavity is indicated externally by the absence of inflation; the palate has a pair of large longitudinal vacuities between the true molar teeth of the respective sides. The stomach is simple, and there is no intestinal cæcum. The family is peculiar to the Australasian region, and its representatives there take the place in the economy of nature held by the placental carnivores and insectivores in other parts of the world. The species are numerous. See Tasmanian Devil and Tasmanian Wolf. Revised by F. A. Lucas.

**Thyme** [from O. Fr. *thym* < Lat. *thy'mum* = Gr. θύμον, thyme; cf. θύειν, to sacrifice, and θύος, incense]: any one of certain labiate half-shrubby plants of the genus *Thymus*. None is indigenous to America. Two kinds are cultivated in gardens, the common, *T. vulgaris*, and the lemon-scented, a variety of *T. serpyllum* or wild thyme. Both afford good bee-pasture. The leaves are used for flavoring soups and forcemeats; the volatile oil is sold for oil of origanum, which it closely resembles. Revised by L. H. Bailey.

**Thyme, Oil of**: a volatile oil obtained by the distillation of the common thyme (*Thymus vulgaris*) with water. It usually is brownish red and has a thickish consistency, although when freshly prepared it is nearly colorless and is mobile. It possesses a pleasant pungent odor and an aromatic taste, has a specific gravity of about 0·9, and is but slightly soluble in water, although it dissolves in alcohol and in ether. Oil of thyme contains two hydrocarbons, a terpene ($C_{10}H_{16}$) and cymene ($C_{10}H_{14}$), and a phenol, Thymol (*q. v.*). These compounds are separated by submitting the oil to fractional distillation. When oil of thyme is distilled with a mixture of 8 parts of chlorinated lime and 24 parts of water, chloroform is formed. Revised by Ira Remsen.

**Thym'ol**, also called **Thymyl'ic Hydrate**, **Thymylic Alcohol**, and **Thymylic Acid** [*thymol* is deriv. of *thyme*]: a homologue of phenol and an isomer of cymylic alcohol; formula, $C_{10}H_{14}O$. It is obtained from the oil of thyme (see Thyme, Oil of), of which it is the oxygenated camphor or stearoptene, by distillation. Thymol forms crystalline rhomboidal plates that have a weak odor and a peppery taste. It fuses at about 111° F. to a colorless liquid which has a boiling-point of 446° F., and dissolves with difficulty in water, but easily in alcohol and in ether. By the action of chlorine, bromine, and nitric acid upon thymol, series of derivatives are formed.

**Thy'mus Gland** [*thymus* is Mod. Lat., from Gr. θύμος, a warty excrescence (so called from its resemblance to a bunch of thyme—θύμος), the thymus gland in the chest of young animals]: a ductless gland, with no known function, located in the neck below the thyroid gland, and in the chest beneath the sternum, in the mediastinal space, as low as the fourth costal cartilage. It develops at the third month of fœtal life, weighs ½ oz. at birth, and grows until the second year, attaining a length of 2 inches. Thereafter it atrophies, and at the fourteenth or sixteenth year is obliterated, or its site marked only by a few fibers and a small deposition of fat. It has abundant blood-vessels, nerves, and lymphatics, but endless research has failed to disclose positively its use in either the fœtal state or during childhood, though many investigators are of the opinion that the gland is connected with manufacture of blood in fœtal life. The thymus of calves and lambs is called sweetbread, or neck-sweetbread. Revised by W. Pepper.

**Thy'roid Gland** [*thyroid*, more properly *thyreoid*, from Gr. θυρεοειδής, shield-shaped; θυρεός, a large oblong shield (deriv. of θύρα, door) + εἶδος, appearance, form]: a glandular structure consisting of two lateral lobes, with a connecting band or isthmus, situated on the anterior surface of the neck and attached to the sides of the larynx. The gland moves with the larynx in respiration and deglutition. The isthmus bridges across from the lower or basic portion of the lobules, and covers in its transit the front of the second and third tracheal rings. By this relation and its great vascularity it has an important surgical relation to the operation of tracheotomy. It has an external fibrous coat, which gives off numerous internal partitions and bands, so that the gland consists of communicating cavities like a sponge. The thyroid gland is ductless, and its functions are obscure. Very probably it aids in the manufacture of blood in fœtal life, and after birth it would seem to have certain functions connected with the animal chemistry. Its removal or disease occasions peculiar metamorphosis of the subcutaneous tissues, known as myxœdema. The thyroid gland is the seat of goiter. Revised by W. Pepper.

**Thysanop'tera** [from Gr. θύσανος, fringe + πτερόν, wing]: a synonym of the group *Physopoda*, given in allusion to the fringe of hairs on the wings. See Entomology.

**Thysanu'ra** [Mod. Lat.; from Gr. θύσανος, fringe + οὐρά, tail]: minute wingless insects of considerable interest, since they retain some primitive hexapodan features. (See Entomology.) Thus among the *Cinura*, *Campodea* shows the three portions of the thorax distinctly, while on the ventral surface of the abdomen are sac-like organs comparable to coxal sacs and on the first abdominal segment a pair of bud-like legs, thus indicating a former polypodal condition.

Respiration is carried on by tracheæ and by these ventral sacs, or, where tracheæ and sacs are wanting, as in *Isostoma*, through the skin. In the *Collembola*, which with the *Cinura* composes the order, the end of the abdomen is furnished with a pair of stylets. These are bent under the body with the tip of the abdomen, and held by a pair of processes on the first abdominal segment. The apparatus serves as a spring, and has given rise to the popular name of springtails. In the *Cinura* the terminal processes may be developed into a pair of forceps, as in *Iapyx*, or be very long or filamentous—as is usually the case. In some forms there may be as many as seven of these filaments. The body is in some forms covered with many delicately marked scales of much interest to amateur microscopists. The *Thysanura* are found everywhere, in moist earth, under stones, logs, in cellars—wherever, in fact, decaying vegetation occurs. One species is found on the snow of the Alps; other forms are even found on floating objects at sea or near shore on seaweeds. One form, popularly known as the silver-fish (*Lepisma*), occurs in old libraries, where it often does considerable damage by eating the paste of the binding of books. It also devours the sizing of the paper, destroying thus the printed matter. See Lubbock, *Monograph of the Collembola and Thysanura*; A. S. Packard, *Synopsis of the Thysanura of Essex County*; T. J. Oudemanns, *Beiträge zur Kenntniss der Thysanuren und Collembola.* F. C. Kenyon.

**Ti** [ = native (Polynesian) name]: a liliaceous tree-like plant of the genus *Cordyline*, found in the Pacific islands and in parts of Asia. Its leaves afford roofing for houses, food for cattle, and fiber for cloth. The sap yields sugar and a stimulating drink, while the roots, when baked, afford a valuable supply of food.

**Tia'ra** [ = Gr. τιάρα, a Persian head-dress]: the papal crown, consisting of a cap of cloth of gold, encircled by three golden coronets, and surmounted by a mound and cross of gold. It is considered symbolical of the pope's temporal authority.

**Tiahuana'co**: See Incan Antiquities.

**Tiber** [from Lat. *Tiberis*, Tiber; Ital. *Tevere*]: river of Italy, passing through Rome, the largest stream of the peninsula proper; rises in Mt. Fumaiolo, Tuscany, at an elevation of 3,830 feet, flows in a southerly direction, and empties into the Mediterranean 22 miles below Rome; length, 260 miles; area of basin, 6,225 sq. miles; breadth at Rome, 250 feet. The principal affluent is the Nera, which descends from the Sibylline Mountains, and enters on the left about 100 miles from the mouth; above it and on the same side enters the Clitunno (*Clitumnus*), praised by the Latin poets, and below the Anio. On the right the most important affluent is the Chiana, which is connected by canal with the Arno. The Tiber is navigable for small steamers to the mouth of the Nera, and for larger ones to Rome. The river delivers at the mouth on the average 10,250 cubic feet of water a second, but in the highest floods this may amount to 60,000 cubic feet, and in lowest water is only 5,650 cubic feet. The floods of the Tiber have been formidable from the foundation of Rome, not only for their height, but for their suddenness and for the large amount of sediment carried. The Romans called the river *flavus* because of the yellow clay it carries. This has gradually extended the delta of the Tiber until the ancient port Ostia is now 4 miles inland and the port of Trajan is a marsh. The growth at the southern or principal mouth for the last 800 years has been 10 feet a year. At the northern mouth it is about a third as much. The branches to the two mouths embrace the ancient Sacred Isle, dedicated to Venus, now marshy and very unhealthful. Between Rome and the sea the Tiber is practically an estuary, and the navigation of this was apparently easier in ancient times than now.

Mark W. Harrington.

**Tiberias, Lake of**: See Gennesaret, Lake of.

**Tibe'rius** (full name *Tiberius Claudius Nero Cæsar*): Roman emperor 14–37 A. D.; b. Nov. 16, 42 B. C.; a son of Tiberius Claudius Nero and Livia Drusilla. In 38 B. C. Livia was divorced from Claudius and married to Augustus, who thus became the step-father of Tiberius. Tiberius was large and strong of body, with handsome features, a man of simple habits and reserved manners, not altogether without literary taste, and with a decided aptitude for military affairs. He commanded successively in Cantabria, Armenia, Rhætia, Dalmatia, and Germany, and finished the wars promptly and with honor. From Germany, where he commanded after the death of his brother Drusus, he returned in 7 B. C. to Rome, celebrated his second triumph, was chosen consul for the second time, and was the following year invested with the *potestas tribunitia* for five years. His relations with Augustus soon became strained. He had divorced his wife Vipsania Agrippina at the emperor's command and married Julia, the dissolute daughter of Augustus; and, disgusted by Julia's conduct, he withdrew to Rhodes, where he spent seven years in exile. By his mother's exertions he was recalled to the court in 2 A. D., and in 4, all the male heirs of Augustus having died, he was adopted by the emperor and appointed his successor. The next ten years he spent mostly in wars on the northern frontier, and on the death of Augustus in 14 he succeeded to the throne. Except in the transfer of elections from the people to the senate, Tiberius made no noteworthy change in the system of government instituted by Augustus. As an administrator he showed an earnest desire to correct abuses and to secure the welfare of all parts of the empire. The northern and eastern frontiers were strengthened, strict discipline was enforced in the army, and considerable improvement was made in the government of the provinces, where Tiberius was always popular. Drusus, the son and heir of Tiberius, was poisoned in 23 by his wife at the instigation of Sejanus, the pretorian prefect, who divorced his own wife to marry the murderess. Sejanus also induced Tiberius to banish the widow and sons of his brother Germanicus, the remaining heirs, and aspired to succeed to the throne himself. Always sensitive and distrustful, Tiberius was now morbidly suspicious and apprehensive, and in 26 retired to the island of Capri, intrusting the government to Sejanus, whose rule was almost absolute. Finally, however, in 31, he suspected Sejanus, and gave orders to have him executed. Tiberius, however, remained at Capri, placing the management of affairs in the hands of Macro, Sejanus's successor as pretorian prefect. During all his later years the class of private informers (*delatores*) was encouraged, and condemnations for treason became more and more common. The last six years of his rule seem to have been a real reign of terror. Tiberius died at Misenum, Mar. 16, 37. The common view which represents Tiberius as a monster of vice and cruelty rests chiefly upon the authority of the historian Tacitus, a bitter critic of the imperial system. Recently there has been a growing tendency among scholars to question this estimate of Tiberius, or at least to limit it to the closing years of his life, when as "an old man of seventy, broken in body and spirit, betrayed, disappointed, morbidly brooding in solitude upon his wretchedness," he may have allowed the bad elements in his character to gain control.

C. H. Haskins.

**Tibesti**, tee-bes-tee' (the Arab name; the native name is *Tou*): country of the Sahara, about Mt. Tarso, between the parallels 18° and 22° N. and the meridians 15° and 18° E. Area about 60,000 sq. miles, occupied by Tibbus, numbering 12,000 according to the estimates of the traveler Nachtigal. It is a mountainous country, bare, infertile, and arid, but favored with summer rains. The population is tribal and nomadic, depending chiefly on the domestic animals, consisting of camels, asses, goats, and sheep. The flora is poor, but the fauna includes the dog-faced baboon, the hyæna, jackal, fox, gazelle, antelope, and many birds and insects. The ostrich was formerly common, but has nearly disappeared. See Tibesti in the Appendix.

**Tibet** (called by the natives Bod or Bodyul, and Bhot and Bhotiya in India): the high and massive table-land, buttressed on the N. by the Kuen-lun or Kulkun and Altyn Tagh ranges, which mark a sudden descent to the deserts of Eastern Turkestan and Gobi, and on the S. by the Himalayan range and the northern portion of British India (see map of China, ref. 5-C). It is one of the least-known countries of the world. Its area (651,500 sq. miles) can only be vaguely estimated, vast portions are as yet unexplored, and present geographical knowledge is based solely on the Jesuit survey (1708–18), and on the route surveys of a score or so of European travelers and trained Indian observers.

*Physical Features, Productions, Fauna, etc.*—The dip and drainage of the Tibetan plateau is generally eastward, so the highest part of this vast lacustrine plateau is the western, where it adjoins the British feudatory state of Kashmir. Here its mean level is from 16,000 to 17,000 feet above sea-level, and in the southwest angle thereof there spring three great rivers, the Sutlej, Indus, and Sanpur, which burst through the Himalayan chain at different points on their way to the Arabian Sea and Bay of Bengal, The last of these three rivers flows through Great or Southern Tibet in a generally easterly direction for nearly 1,000 miles before it turns abruptly southward, and, piercing the Himalayas, emerges into British territory, where it assumes the name of Brahmaputra. A large belt of country N. of and parallel to the valley of the Brahmaputra is drained by another river which connects a chain of lakes and flows away to the E. It is believed to be the upper course of the Salwen, but the view is contested by some authorities, and the determination of this point, as well as of the precise sources of the Salwen, is an interesting geographical problem that awaits solution. In Northern and Eastern Tibet, again, lie the sources of the Mekong or Cambodia river and those of the great Yang-tse-kiang and Hwang-ho of China. The lower courses of the Sanpur or Brahmaputra and Salwen drain the most populous part of Tibet; most of the remainder of the country, being too bleak and unproductive to support life, is either totally uninhabited or else tenanted by bands of nomad Turk and Mongol tribes; the Tangla plateau, however, N. of Lhasa, and no doubt other parts of the country, affords luxurious pasture to antelopes and other game.

An interesting analogy between the Andes and the Himalayas was perceived by Warren Hastings, India's first governor-general, and has been elaborated by C. R. Markham, C. B., president of the Royal Geographical Society (1895), in his work *Bogle and Manning*. Both the mountain masses of the Old and New World consist of three parallel chains; in both great rivers rise in the inner chain and force their way through the other two, while smaller rivers rise in the central cordillera and after lateral courses force their way through the outer chain. In both Peru and Tibet the staple product is wool, conveyed through numerous passes by the llamas and sheep used as beasts of burden.

The chief mineral products of Tibet are gold, silver, salt, and borax; the metals first named are fairly plentiful, but the jealousy of the lamas against foreign intrusion prevents any systematic working and export thereof, though gold mines exist at Thok-Jalung (32° 24′ 26″ N. and 81° 37′ 38″ E. of Greenwich) and in the northwest of the country.

Among the principal domesticated animals are sheep, horses, yaks, and mastiffs, while the wild fauna comprise bears, antelopes, musk-deer, and wild asses, and on the extreme northern confines of the table-land wild camels are occasionally found.

*Climate.*—The climate, as might be inferred from the excessive altitude, is of Arctic rigor, and only the hardier cereals can be raised in the valleys, though in the E., where the streams enter upon a lower level, the vegetation becomes rather more assimilated to that of the contiguous quasi-tropical regions of Assam, Bhutan, and Western China.

*Inhabitants.*—The inhabitants of Tibet, about five and a half to six millions in number, belong to the great Mongolian family, and are described by the Abbé Huc (whose *Souvenirs*, dating from 1852, furnishes still a most graphic and intelligible picture of Tibetan life) as a people with small, contracted black eyes, thin beard, high cheek-bones, flat noses, wide mouths, and thin lips. The skins of the upper classes are as white as those of the Europeans, but the ordinary complexion is tawny. They are of middle height and combine agility and suppleness with force and vigor. They are said to be brave in war, though the inferiority of their weapons and ignorance of the art of war placed them at an enormous disadvantage in the Sikkim war with Great Britain, the last hostilities in which they were engaged.

*Literature and Religion.*—The literature is vast, including all the Buddhist canon of scripture, translated from the Sanskrit, the *Tripitaka*, or three baskets of precepts and other works, one list of which has been given by Csoma de Körös, the Hungarian scholar. The art of printing by means of engraved wooden blocks has been known to the Tibetans for many centuries. Traces of the old religion called *Bon* or *Pon* still linger in the eastern province of Kam. It appears to have been a worship of the powers of nature. Buddhism seems to have reached Tibet about the beginning of the seventh century, from both China and India. (See Lamaism.) The history of its development is full of interest, and at present the numerous hierarchy of Tibet plays the foremost part in national politics, besides supplying the educational requirements of the country, so far as any provision may be said to be made for the same.

*Political Divisions and Government.*—Politically, Tibet is divided into four great provinces called Kam, U, Tsang, and Ari. The first named is in the E., and adjoins the Chinese province of Szechuen; Ari is the mountainous region W. of the Mariam-la Pass, including Ladak; while U and Tsang or Utsang form Central or Great Tibet, and practically coincide with the basin of the Brahmaputra river. Here are found the capital or sacred city of Lhasa and other important towns, besides the greater monasteries.

Tibet is politically subject to China, but the enormous distance and difficulties of communication have naturally made the country more or less independent of the suzerain power. The visible sign of Celestial supremacy is the presence of the two Chinese *ambans* or residents, with their military guard, at the capital. Appointments to the first offices in the state are bestowed by the emperor, and in all measures of consequence reference is made to the court of Peking, but the internal government of the country is intrusted entirely to natives, the executive administration being in the hands of a regent and four ministers or councilors called *kahlons*. The governors of forts and provinces are appointed by these, and the revenue is collected by officers sent annually from Lhasa. The Dalai lama on attaining full age has in times past been invested with supreme authority by the Emperor of China, but for some years all the grand lamas have died in infancy, a circumstance that sheds a significant light on the methods resorted to by those who wish to keep the power in their own hands. The position of the grand lamas has been thus very similar to that of the popes of Rome, and the analogy is still more observable in the tenets and rites of the Roman Catholic and Tibetan religions, between which there is a striking similarity; this is probably due to the early Capuchin missionaries who settled in Lhasa having introduced a knowledge of Catholic observances. The *gylongs* (monks) and *annis* (nuns) are found in huge monasteries presided over by abbots and scattered all over the kingdom, and indirectly possess much influence; the actual executive authority is, however, vested in *jongpons*, or district officers, under the supervision of the provincial governors.

*Trade and Commerce.*—Lhasa, the capital, is the great central mart, and thither traders repair from China with silks, carpets, and hardware; from Mongolia come leather, saddlery, sheep, and horses; from Kam come perfumes; from Szechuen, tea; from Tawang, Bhutan, and Sikkim, rice and tobacco; from Nepal, broadcloth, silk, indigo, coral, pearls, sugar, spices, and Indian manufactures, while the latter, with saffron, also enter by way of Kashmir and Ladak. The merchants come in December and leave in March, before the rivers become flooded, having provided themselves with silver and gold, salt, wool, woolen manufactures, furs, drugs, and musk. By the Nepal and Ladak routes Tibet exports large quantities of yaks' tails, borax, gold, silver, and ponies. The great and inexhaustible staple of the country is wool, a remarkably fine quality of which can be largely produced on its vast plains and mountain-slopes. But for this trade it is essential that intercourse with India should be thrown open and all the passes through the Himalayas made free to traffic, the live stock, which constitute the chief beasts of burden, requiring a large area of pasturage for their support. Warren Hastings made wise and strenuous efforts to establish regular commercial intercourse between the two countries, but through neglect his policy was not continued; the passes to the S. were sealed up, and it was not until after repeated efforts to remove the restrictions that a treaty between China and Great Britain was negotiated in 1893, providing for the establishment of a trade mart at Yatung in the Chumbi valley. This arrangement was practically forced upon the Tibetans after their invasion of British Sikkim had been forcibly repulsed. But the military victory was not followed up, the Tibetans were not much impressed, and the latest information is that the treaty, in consequence of the lama jealousy of foreigners, has practically become a dead letter. The importance, however, of finding a Tibetan market for Indian tea makes it unlikely that the British will submit to be thus rebuffed; tea is a prime necessary of life in Tibet, and its eventual introduction into the country and the complete opening up of the land to Western civilization and trade can be only a matter of time.

*History.*—The early history of Tibet is naturally obscure. It is said that a native king established the seat of government at Lhasa in 617 A. D.; that he married a Chinese princess of the Buddhist faith; and that he sent his minister to India, who returned with the Buddhist canonical scriptures, framed the Tibetan alphabet from the Devanagari of India, and commenced the translation of the canon from Sanskrit into the language of the country. For a long time there was a struggle for supremacy between the old nobility and the new hierarchy, in which, after several vicissitudes, the Buddhist monks gained the ascendency. It was during this early period of Buddhist rule in Tibet that the first European visited the country. Friar Odoric, of Pordenone, between 1316 and 1330, traveled through Shansi and Szechuen and reached Lhasa. Three centuries elapsed before another European visited the sacred capital. In the middle of the fourteenth century a great reforming lama, named Tsong-khapa, arose in Tibet. He forbade clerical marriages, prohibited necromancy, and introduced the custom of frequent conferences among the lamas. These reforms led to a schism in the Tibetan Church, the older sect being called Red Caps or Shukpas and the reformers Yellow Caps or Gelupkas, and since the reformation the latter have been in the ascendency. Gedun-tupba, another great reformer, who died in 1474, is said to have revived the spirit of Tsong-khapa, and with him the doctrine and system of perpetual reincarnation began. Two grand lamas then arose, one called the Dalai lama, with his headquarters at Galdan, near Lhasa, and the other at Teshu Lumbo. A third grand lama, called the Taranath lama, is also mentioned as having his seat in the Khalka country in Mongolia. The first of the Jesuits who penetrated into Tibet was Antonio Andrada, who in 1624 set out from Agra and, scaling an appalling mountain, reached Rudok, in Tibet, and eventually made his way through Tangut to China. Other missionaries followed: Grueber and Dorville, who passed from China through Lhasa into India, and Desideri and Freyre, who also visited the capital. The Capuchin mission under Father della Penna was established at Lhasa in 1719. Just before they reached the capital the famous native survey had been completed, a work which formed the basis of d'Anville's well-known atlas. In 1717 an army of Dzungarians or Eleuths stormed Lhasa, but in 1720 order was restored by the Emperor of China, Kang-hi, who established two residents at the capital as his representatives. It was about this time that the Dutch traveler Samuel van de Putte made his remarkable journey from India to Lhasa and China and back again. In 1749 the Chinese residents put the Tibetan regent to death. The people, incensed, flew to arms and a massacre of the Chinese took place. An expedition was duly dispatched by the emperor, but timely concessions were made to appease the wrath of the lamas and people, and succeeding regents were more subservient to China. The Capuchin missionaries were expelled from Lhasa in 1760 and settled in Nepal, where some of them were eye-witnesses of the troubles ending in the Gurkha conquest of that country. At the same time the aggression of Deb Judhur in Bhutan led to British intervention and to subsequent attempts to mediate on the part of the Teshu lama of Tibet. This furnished an opportunity to Warren Hastings to dispatch G. Bogle as envoy to Tibet in 1774 to conclude a treaty of amity and commerce between the two countries. The negotiations were most friendly, and after the lama's death at Peking in 1780 a new mission was sent under Capt. Turner to do homage to the new lama, a child of eighteen months. In 1792 the Nepal regency, tempted by stories of the great riches in the the Teshu lama's palace, determined to invade Tibet, and actually plundered Teshu Lumbo. The Chinese Government on hearing this dispatched a powerful expeditionary force under Gen. Sund Fô, who defeated the Gurkhas on the plain of Tingri Maidan, laid siege to Kuti, and finally routed the enemy 20 miles from Kathmandu, the Nepalese capital. The conditions of peace imposed were humiliating, and included the payment of an annual tribute to China and the dispatch of an embassy to Peking every five years. During this war the policy of the British under Lord Cornwallis was unfortunate, and led to the closing of the passes from Tibet into India, all the good results of Hastings's negotiations being thereby lost. Nevertheless, Thomas Manning, the friend of Charles Lamb, in the guise of a doctor, managed in 1811 to get to Lhasa through Bhutan, a success doubtless due to his knowledge of Chinese, which enabled him to make friends with a Chinese general. In 1834 Golab Sing, of Jammu, afterward Maharajah of Kashmir, sent an army commanded by his general, Zorawar Sing, to invade Ladak. In 1841 this chief advanced into Eastern Tibet, but was utterly defeated by the Chinese Dec. 12 (almost simultaneously with the destruction of a British division at Cabul). Three years later the French missionaries Huc and Gabet arrived at Lhasa and were well treated by the new regent, who had been installed in the place of one Si-fan, who had been disgraced for complicity in the murder of three of the Dalai lamas. Subsequently Chinese jealousy prevailed, and Huc and Gabet were compelled to return to Europe. The Teshu lama, the same who had received Capt. Turner, died at an advanced age in 1854.

The recent history of Tibet has been marked by but few conspicuous events. Numerous European travelers have entered the mysterious land from the west, the north, and the east, but none has been enabled to reach Lhasa. Among these may be mentioned Prejevalsky, Carey, Bonvalot, Rockhill, Bower, and Miss Taylor. The endeavors of these and other travelers, however, seem only to have made the Tibetans more determined to keep out the dreaded foreigner. Their invasion of Sikkim in 1888 aroused the Indian Government, which compelled the Tibetans to retreat and eventually to sign a treaty recognizing Sikkim as British.

Bibliography.—The best general account of Tibet will be found in the *Narratives of George Bogle and Thomas Manning* (London, 1879; 2d ed. by C. R. Markham). Capt. Turner's account of his mission (1800) is most interesting, and the works of Brian Hodgson, Archibald Campbell, Csoma de Körös, and Joseph Hooker deal exhaustively with the scientific sides of the subject. Of late years the travelers above mentioned have all [particularly William Rockhill, *The Land of the Lamas* (New York, 1891) and *Diary of a Journey Through Mongolia and Tibet in 1891 and 1892* (Washington, 1894)] written valuable works on Tibet, while the Indian native travelers, the Pundits Nain Singh and Kishen Singh, have recorded in the publications of the Royal Geographical Society a mass of scientific, statistical, and general information. The *Narrative of a Journey to Lhasa*, by Sarat Chandra Das, a confidential work and still unpublished, gives the latest authentic information regarding the capital and inner government of the country. For a copious bibliography, see vol. ii. of Lansdell's *Chinese Central Asia* (London, 1893; New York, 1894).

Charles E. D. Black.

**Tibetan Language**: the language spoken in Tibet. It is slightly agglutinative and monosyllabic, and forms words and sentences by the juxtaposition of roots and particles, except in the verb, in which changes in the roots are quite frequent. There is considerable resemblance between its dialects and those of Northern Burma. Its alphabet consists of ninety consonants, each with an inherent *a* (as in Sanskrit), and the five vowels *a*, *e*, *i*, *o*, and *u*. Tibetan became a written and literary language more than 1,200 years ago; yet on account of the religious or idolatrous reverence with which the written word is regarded by Buddhists, it has, with some few and insignificant exceptions, maintained its written forms of sounds unchanged up to the present time, while the style and the oral speech have undergone considerable alterations. This clinging to the old, full pronunciation of many sounds characterizes Eastern and Western Tibet, while in Central Tibet, the principal seat of national civilization, a refined but somewhat effeminate pronunciation of the consonants may be observed; here also occurs the greatest difference between the spoken and the written sound. In 632 A. D. the Indian Devanagari alphabet was adapted to the Tibetan language by the order of King Srongtsan Gampo, who also ordered the sacred books to be translated into Tibetan. The work of translation was carried on with remarkable zeal; and for the sake of uniformity, vocabularies of the Sanskrit proper names and of the technical and philosophical terms occurring in the original texts were prepared. King Srongtsan Gampo and his learned translators also issued books written in their native tongue, and, beginning with Tsonkhapa, the great reformer of the fourteenth century, native literature developed itself on a larger scale; even Mongolians write in Tibetan, as it is the language of the divine service. In the beginning of the eighteenth century all the Sanskrit translations were collected in two large and voluminous works, to which were added the sacred and profane native publications of different periods. These compilations bear the title of *Kanjur* (The Translated Word of Buddha) and *Tanjur* (Translation of the Doctrine). The *Kanjur* contains 100 volumes, comprising 689 works, which are classed under seven divisions—discipline, transcendental wisdom, association of Buddhas, jewel-peak, sūtras or aphorisms, deliverance or emancipation from existence, and *Tantra* or mysticism. The *Tanjur* comprises 225 volumes, divided into mysticism and discipline; its contents are of a more miscellaneous character. Tibetan is written from left to right. For printing capital letters are always used. The books are not folded, but consist of loose leaves laid between boards kept together by a string. Little is known of the non-religious literature of Tibet. One of the most popular works is the *Hundred Thousand Songs of Milaraspa*, a mendicant monk of the eleventh century. The Hungarian Csoma de Körös was the first who brought (1832) Tibetan language and literature within the reach of European students. In 1875 a German Moravian missionary, H. A. Jäschke, published a most learned Tibetan-German dictionary, and a grammar in 1883.

**Tibul'lus**, ALBIUS: poet; b. about 54 B. C.; was descended from an equestrian family of good standing in Roman society; accompanied Messalla, his patron, in 28 B. C. to Aquitania, and started with him on a mission to Asia, but, falling ill, got no farther than Corcyra. After these journeys he lived on his estates near Rome, devoting himself to poetry and literary occupation. D. probably in 19 B. C. Three books of elegies ascribed to him have come down to us in the MSS., but the third book is now often divided into two. The first book sings of the love of Delia, the second of Nemesis, both being assumed names. The third book is by a poet much inferior to Tibullus, who calls himself Lygdamus, and sings the praises of Neæra. The fourth book opens with a panegyric on Messalla, in hexameters, which is universally pronounced by scholars to be unworthy of Tibullus. Critics are divided still as to whether elegies 2–6 which follow the panegyric are by Tibullus. For the Sulpicia elegies 7–12, see SULPICIA. Editions by Dissen (Göttingen, 1835, 2vols.); Bährens (Leipzig, 1878); Müller (1880); E. Hiller (Leipzig, 1885); and translated into English by Dr. Grainger (1752) and Cranstoun (London, 1872). On account of the genuineness and simplicity of their feeling, these poems belong to the best Latin literature contains. See also Sellar, *Horace and the Elegiac Poets* (Oxford, 1892).

Revised by M. WARREN.

**Tibur**: See TIVOLI.

**Tic Douloureux**: a form of facial NEURALGIA (*q. v.*).

**Tichborne Case**: an English *cause célèbre*, famous for its length, the estate involved, and the character of the persons concerned. It consists of two trials, one (in 1871) an action in ejectment by an impostor for the recovery of the Tichborne estates in Hampshire and Dorsetshire, England, valued at £24,000 yearly; and the other (in 1872) an action for perjury against the defeated impostor.

The estate in question was that which had belonged to Roger Charles Tichborne, who was born in Paris Jan. 5, 1829, son of Sir James Tichborne, by his wife Henriette Félicité, a French woman of noble extraction. Roger continued to live in Paris, having French tutors and speaking French rather than English as his native tongue. He was later sent to the Roman Catholic College of Stonyhurst, England, having been brought up a Roman Catholic, and here his education practically ended, he being, however, idle rather than dull. In Feb., 1853, he went to Paris to bid his mother farewell previous to his departure upon an extended tour, and on Mar. 4 sailed for Valparaiso. In Apr., 1854, he sailed in the Bella from Rio de Janeiro for New York, having previous to his embarking written a letter showing his intention to stay from home for two or three years. The Bella was lost at sea, and no person on board was ever heard of again, although her long-boat was picked up at sea. The will of Roger Charles Tichborne was proved and his estate placed in the hands of the executors.

Roger's mother had become possessed of the belief that he was still living, and in 1862, after the death of her husband, she advertised in English and Australian papers for her son, and in 1866 a butcher who was then living at Wagga Wagga, Australia, under the name of Thomas Castro, but whose real name was Arthur Orton, asserted that he was the lost Roger, having been saved from the wreck of the Bella. After considerable correspondence between the impostor and Lady Tichborne and the receipt of a remittance to defray his expenses, he went to London, where Lady Tichborne received him as her son. He was repudiated by the rest of the family, but was supplied with money by Lady Tichborne, and went about collecting witnesses and gathering information to be used in establishing his identity. Lady Tichborne died in 1868, but Castro had found so many believers in his claims that he raised considerable sums by selling bonds conditioned to be paid upon his coming into possession of his claimed estates. On May 11, 1871, he began an action in ejectment for the recovery of the Tichborne estates. The trial lasted for 103 days, till Mar. 6, 1872, when he was non-suited, the jury declaring before its close that they believed that the claimant was not Roger Charles Tichborne.

Castro was then arrested upon a charge of perjury, and the trial was begun in the court of queen's bench on Apr. 23, 1873, and lasted 188 days, until Feb. 28, 1874. when he was found guilty of perjury and was sentenced to fourteen years' penal servitude.

For the purposes of the two trials the smallest details of the life of Roger and the claimant were investigated at an enormous expense, and it was proven by a complete chain of the strongest evidence that not only was the claimant an impostor, but that he did not even resemble Roger, nor have any intimate acquaintance with his affairs. It was shown that Castro was the son of a London butcher, and was born June 1, 1834, and that his real name was Arthur Orton; that in 1848 he went to Valparaiso, where he took the name of Thomas Castro; that he later returned to London, and then went to Australia, where he led a disreputable life, one time as a horse-breaker, at another as a butcher, having married a servant girl under the name of Castro, Jan. 29, 1865. It was proved that Roger left balances with two Australian bankers which Castro did not use; that immediately on his arrival in London he sought the Ortons, and sent photographs of his wife and children to them as being the wife and children of Arthur Orton; that he was ignorant of the circumstances of Roger's life in France, and spoke no French; that Roger had a common education, while Castro was extremely illiterate; that Roger's person was thin, his hair straight, and his ears closely adhering to the sides of his head, while Castro was enormously fat, an inch taller than Roger, and had large pendulous ears and curly hair. In 1895 Castro admitted, in a confession printed in a London paper, that he was an impostor, and that he was the original Arthur Orton.

For a full account of the trials, see Morse's *Famous Trials* (Boston, 1874); *The Tichborne Romance: a Full and Accurate Report*, etc. (Manchester, England, 1871, 2d ed.); *The Tichborne Trial: the Summing-up by the Lord Chief Justice of England* (London, 1874); *Charge of the Lord Chief Justice of England in the Case of the Queen against Thomas Castro* (2 vols. 8vo, London, 1874).

F. STURGES ALLEN.

**Ticino**, tee-chee'nō, or **Tessin**; the southernmost canton of Switzerland, on the Italian side of the Alps and on both sides of the river Ticino; borders on Lago Maggiore. Area, 1,088 sq. miles. Its northern frontier toward Uri and Grisons is formed by a range of the Lepontine Alps 12,000 feet high, branches of which cover the whole northern part of the canton. In the southern part the ground becomes low and the surface level. Dairy-farming and cattle-breeding are the principal occupations in the Alpine regions, and agriculture and the cultivation of grapes, olives, figs, almonds, and melons in the southern part. Pop. (1894) 127,940, most of whom speak Italian and are Roman Catholics. Capital, Bellinzona. Revised by M. W. HARRINGTON.

**Tick**: any one of various parasites of the higher animals. The true ticks (*Ixodes*) belong to the ARACHNIDA (*q. v.*), order *Acarina*. They fasten upon the skin, and, burrowing the head beneath the surface, feed upon the blood, the abdomen meanwhile growing to enormous size. The name is also given other parasites belonging to the *Diptera* (flies), as the sheep-tick, horse-tick, and bird-tick, and in some of these parasitism has resulted in a loss of wings, the animal having a spider-like appearance. J. S. K.

**Tickell**, THOMAS: poet; b. at Bridekirk, Cumberland, England, in 1686; was educated at Queen's College, Oxford, of which he became a fellow in 1710; became a friend of Addison, through whose influence he was in 1717 appointed Under-Secretary of State, and in 1725 was made secretary to the lords justices of Ireland, a post which he retained until his death. His principal works are *The Prospect of Peace*, a poem; *The Royal Progress*, verses celebrating the arrival of George I.; a translation of the first book of the *Iliad* (1715); *Kensington Garden*, a poem (1722); a fine *Elegy on Addison*; and the popular ballad *Colin and Lucy*; besides which he contributed to *The Spectator* and *The Guardian*. D. at Bath, Apr. 23, 1740. An edition of his poems was published at Boston in 1854. Revised by H. A. BEERS.

**Ticket of Leave**: originally a kind of permit or license given to British convicts transported to the Australian colonies, by which they were allowed to be at large within a certain specified territory. The ticket of leave was granted upon good behavior for a certain period of years, and was revocable upon misconduct. The term is now popularly applied to what is technically called an order of license, whereby a portion of a convict's time of imprisonment is remitted as a reward for industry and good behavior. This remission was first used in England, about 1840, upon the refusal of the colonies to receive convicts. Since the sentence of those convicts subject to transportation would be much more severe if they were imprisoned for the entire period, a portion of the terms of such as were not transported was remitted; and afterward, when the form of punishment was changed from transportation to penal servitude, the partial remission of sentences was made systematic in order to induce industry and good behavior.

F. STURGES ALLEN.

**Tickets**: See TRAVELERS, LEGAL RIGHTS OF.

**Ticknor**, GEORGE: literary historian and biographer; b. in Boston, Mass., Aug. 1, 1791; graduated at Dartmouth College in 1807; admitted to the bar in Boston in 1813; spent four years (1815–19) in study and travel in Europe, and during his absence was chosen (1817) to the Smith professorship of Modern Languages at Harvard; filled that post from 1820 to 1835, when he resigned; spent three years in Europe, chiefly engaged in preparatory researches for his principal work, to which he devoted several more years of assiduous labor; published in 1849 in London and New York his *History of Spanish Literature* (6th American ed., 3 vols., Boston, 1888), which was translated into French, German, and Spanish, and accepted as the standard work on its subject even in Spain; printed some occasional essays, chiefly on educational topics, and several biographical sketches; wrote an elaborate *Life of William Hickling Prescott* (1864); contributed to various magazines and reviews; and was a munificent benefactor to the Boston Public Library, presenting it with 2,000 volumes in 1860. He was a member of the leading literary societies of Europe and the U. S. D. in Boston, Jan. 26, 1871. The 4th ed. of his *History of Spanish Literature* appeared shortly after his death under the editorship of George S. Hillard, who also published his *Life and Correspondence* (2 vols., Boston, 1876). See E. P. Whipple, *Recollections* (Boston, 1877), section on Ticknor. Revised by H. A. BEERS.

**Ticknor**, WILLIAM DAVIS: publisher; b. at Lebanon, N. H., Aug. 6, 1810; became in 1832 a bookseller in Boston; subsequently added a publishing business, which attained to great importance under the firm-name of Ticknor & Fields (subsequently James R. Osgood & Co., and still later Ticknor & Co.); published *The Atlantic Monthly* and *The North American Review*, and made his office a center for the brilliant literary circle connected with that magazine, including Longfellow, Holmes, Whittier, Lowell, and Saxe, whose poems were issued by the firm. D. in Philadelphia, Pa., Apr. 10, 1864.

**Ticondero'ga**: township and village; Essex co., N. Y.; on the Cent. Vt. and the Del. and Hud. railways; 24 miles N. of Whitehall, and 100 miles N. of Albany (for location, see map of New York, ref. 2–J). The township contains deposits of graphite, from which, for several years, the entire commercial product of this mineral in the U. S. has been obtained. The largest output was in 1891, when 1,559,674 lb., valued at $110,000, were mined. There are also extensive deposits of iron ore. The village and a part of the township occupy a lofty promontory between Lakes George and Champlain, Mt. Defiance, at the extremity, being 750 feet above the level of Lake Champlain. The outlet of Lake George is 4 miles long, has a fall of 220 feet in 2 miles, and furnishes abundant power for manufacturing. Here are several foundries, machine-shops, extensive pulp and paper mills, large lumber interests, a national bank with capital of $50,000, and a weekly newspaper. Ticonderoga was prominent in colonial and Revolutionary history from its celebrated fortress, built by the French in 1755, and originally named Carillon (chime of bells) from the music of the neighboring waterfall. It was the headquarters of Montcalm in 1757; was unsuccessfully assaulted by Gen. Abercrombie July 8, 1758; occupied after a siege by Gen. Amherst July 30, 1759; captured by Ethan Allen May 10, 1775; retaken by Burgoyne July 5, 1777, and again by Gen. Haldeman 1780, but soon abandoned on each of the last two occasions. Pop. (1880) township and village, 3,304; (1890) township, 3,980; village, 2,267; (1900) township, 5,048; village, 1,911.

EDITOR OF "SENTINEL."

**Tidball**, JOHN CALDWELL: soldier; b. in Ohio co., Va. (now West Virginia), Jan. 25, 1825; graduated at the U. S. Military Academy, West Point, 1848; appointed second lieutenant Second Artillery; served in Florida war 1848–50; in explorations to Pacific coast 1853–54; on coast survey 1854–59; captain Second Artillery May 14, 1861, in command of battery at battle of Bull Run, and in the operations of the Army of the Potomac in the Peninsular campaign of 1862, the battles of Antietam, Chancellorsville, Gettysburg, etc.; appointed Aug., 1863, colonel Fourth New York Volunteer Artillery; commanded the artillery of the Second Corps during the Richmond campaign, May to July, 1864, including the battles of the Wilderness and those around Spottsylvania; commandant of cadets, U. S. Military Academy, July–Sept., 1864; in command of artillery, Ninth Corps, Army of the Potomac, in siege of Petersburg, Va., Oct., 1864–Apr., 1865, in pursuit of the Confederate army, and in other operations terminating in Lee's surrender; at close of war returned to duty with his company; promoted major Second Artillery, Feb., 1867; commanded in Alaska 1868–71; superintendent of instruction at artillery school, Fort Monroe, Virginia, 1874–80; aide-de-camp to general of army 1880–84; promoted lieutenant-colonel First Artillery, June 30, 1882, and colonel of same regiment Mar. 22, 1885; in command of the U. S. artillery school and post of Fort Monroe, Virginia, Nov., 1883–Jan. 25, 1889, when he was retired; breveted brigadier-general Mar. 13, 1885; author of *Manual of Heavy Artillery Service* (Washington, 1880) and of numerous professional papers.

**Tidemill**: an apparatus for the utilization of the water-power of the tide. In some cases, as at the old London Bridge tidemills, the water-wheels, mill and all, were afloat, so that no adjustment of the wheels to the height of the water was necessary, and the tide was utilized both on its ebb and flow. In other cases dams are constructed which shut the water at high tide, and its outflow through a raceway gives motion to the mill; and during the return of the tide through the sluice its power may again be utilized. On account of the great expense usually involved in the construction of dams of sufficient extent to retain the quantity of water necessary, and the usually moderate extent of the rise and fall of the tide, it is probable that in very few places in the world will it be found practicable to install tidemills in competition with steam-engines. A project for the continuous utilization of tidal power in connection with the training-walls to be constructed in the estuary of the Seine is described by P. Decœur in the *Proceedings of the Institution of Civil Engineers* (1890). The method proposed is to have two basins separated by a bank rising above high water, within which turbines would be placed. The upper basin would be in communication with the sea during the higher one-third of the tidal range, rising, and the lower basin during the lower one-third of the tidal range, falling. The turbine proposed is of an improved model designed to utilize a large flow with a moderate diameter. One has been designed to produce 300 horse-power with a minimum head of 5 ft. 3 in. at a speed of fifteen revolutions per minute, the vanes having 13 feet internal diameter. The speed would be maintained constant by regulating sluices. The available gross horse-power in such a design is estimated to be about one-thirtieth of the product of the area of the lower basin in acres by the square of the tidal range in feet.

Revised by WILLIAM KENT.

**Tides** [O. Eng. *tīd*, time: O. H. Germ. *zīt* > Mod. Germ. *zeit.* (See TIME.) Cf. Sanskr. *a-diti*, unlimited, timeless]: the motions of the waters of the ocean arising from the attraction of the sun and moon. Those living on the shores of the ocean see it rise and fall regularly twice every day. For six hours the water rises, or *flows*; then, remaining stationary for a short time, it gradually recedes or *ebbs* for another six hours; after a short lull, called *slack water*, it again rises and falls as before. The rising sea is called the *flood tide*; the receding sea, the *ebb tide*. When the water is at its greatest height, it is *high water*; when at its lowest point, *low water*. There are thus daily two high tides and two low tides. The time of high water and low water, at the same place, however, is gradually changing. The mean interval of time between two consecutive high tides or low tides being really twelve hours and twenty-six minutes, and the hour of the day at which high water or low water occurs is later every day by an average amount of fifty-two minutes.

*Cause of the Tides.*—Though the dependence of the tides upon the course of the moon seemed to point out their source, the real cause of these mysterious movements was not understood before the discovery of the law of gravitation by Sir Isaac Newton. Applying here this new principle, Newton showed that the rise of the waters was due to the attraction of the moon and the sun upon the revolving globe of the earth. The moon, on account of its proximity, and notwithstanding its smaller mass, has an influence more than double that of the sun (100 to 38); its action is illustrated by Fig. 1. It attracts the solid earth as if the

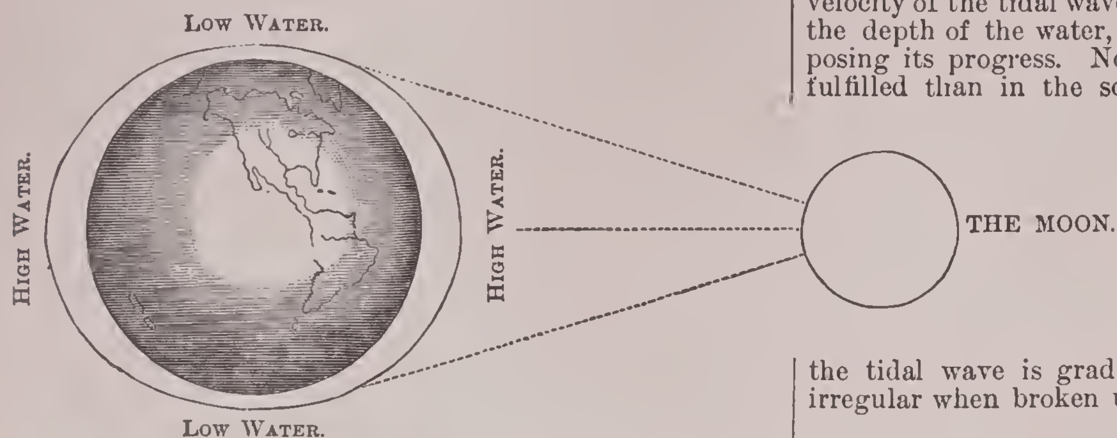



FIG. 1.

whole mass of the earth were concentrated at its center. But owing to the greater proximity of the region marked in the figure "high water" to the moon, the attraction is there greater than for the center of the earth. Hence a tendency to a high tide in that region. On the side opposite the moon, also marked high water, the attraction is less than at the center of the earth. Hence the attraction draws the earth away from the water toward the moon, so that a high tide is produced there also. At the points marked low water the components of the forces shown by the dotted lines converge toward the moon. But for this convergence the attraction of the moon on the solid earth and on the water would be equal. But owing to the convergence the water is drawn toward the center of the earth, and thus low tides are produced. This is why there are two high tides and two low tides in the course of a day. There are thus always simultaneously and directly under the moon two high waters opposite each other, and two low waters at equal distances between them. Owing to the rotation of the earth, this permanent system of swells and troughs travels from E. to W. over every part of the ocean and of its coast, and explains the regular succession of rising and falling waters, at equal intervals of time, which we call the tides.

*Spring-tides and Neap-tides.*—The sun also asserts its attractive power on the ocean, and causes a similar system of four daily tides. Owing, however, to the great distance of the sun, the solar tides are much smaller, and mostly merged in, or masked by, the lunar tides. As the relative position of the moon and sun is constantly changing, the solar and lunar tides seldom coincide; but twice a month, at new moon and full moon, the sun and moon, being on a line with the earth, as shown in Fig. 2, act together, and cause an unusually high water, which is the sum of the lunar and solar tides. These are the spring-tides. High water is then highest, and low water lowest. When the sun is placed 90° from the moon (Fig. 3)—that is, at the time of

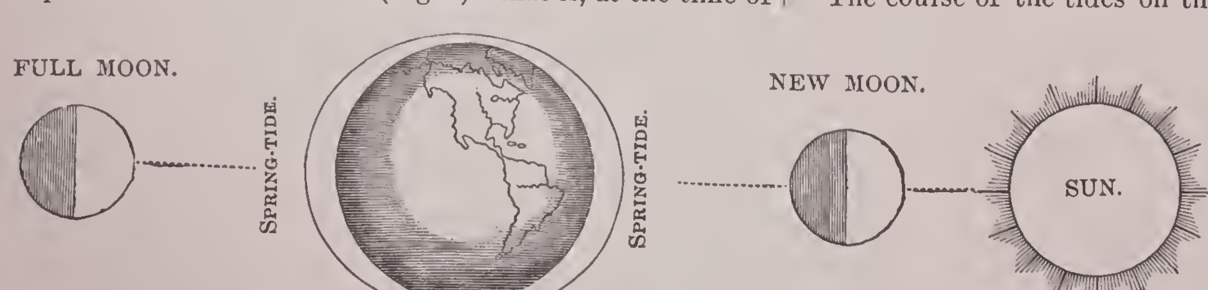



FIG. 2.

the first and third quarter of the moon—its attraction acts against that of the moon, diminishing the height of the high tide and increasing that of low water. These are the neap-tides. High water is then lowest, and low water highest. The proportion of the rise and fall in the spring-tides and neap-tides is nearly as 7 to 3.

*Course of the Tidal Wave.*—If the ocean covered the whole earth with a uniform depth of water, the tidal wave, with its long crest extending from N. to S., would follow the apparent course of the moon, and travel from E. to W. around the globe in twenty-four hours. It would be greatest in the equatorial regions, and move there with a velocity of over 1,000 miles an hour. But the continents which cut the ocean into several large basins oppose its passage, and in each of these basins the course of the tidal wave is subjected to great modifications. The regularity and velocity of the tidal wave depend upon the size of the basin, the depth of the water, and freedom from all obstacles opposing its progress. Nowhere are these conditions better fulfilled than in the southern half of the Pacific Ocean. There is formed what might be called the parent tidal wave, which, advancing rapidly westward, enters the Indian and Atlantic Oceans, and seems to control their tides.

*Tides in the Pacific Ocean.*—In the middle and equatorial part of the Pacific Ocean the advance of the tidal wave is gradually slackened, and becomes very irregular when broken up by the numberless islands of the East Indian Archipelago. The influence of shallow water, and of friction on the bottom and on the coasts of the ocean, is evident in the slow progress of the tide-wave between New Guinea and Australia, and in the Chinese Sea. Its rapid motion, on the contrary, toward the N. W. in the middle of the North Pacific shows the influence of deep and open water. Thence, however, the tidal wave ceases to be direct, and assumes the shape of a free reflected wave, which turns N. and E. toward the western coast of the North American continent. In the Southern Pacific, while the main tidal wave seems to start on its westward course from the 90th meridian, it sends a reflected wave eastward along the western coast of South America, from which this coast seems to derive its tides. This meets, at Cape Horn, the Atlantic tide coming from the E.

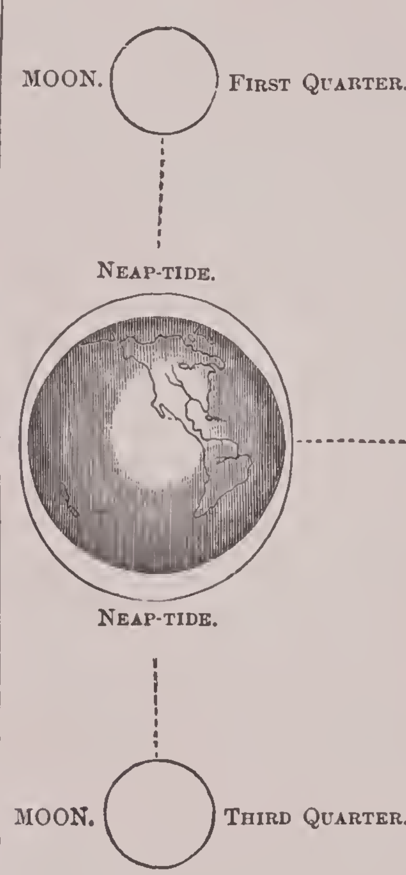
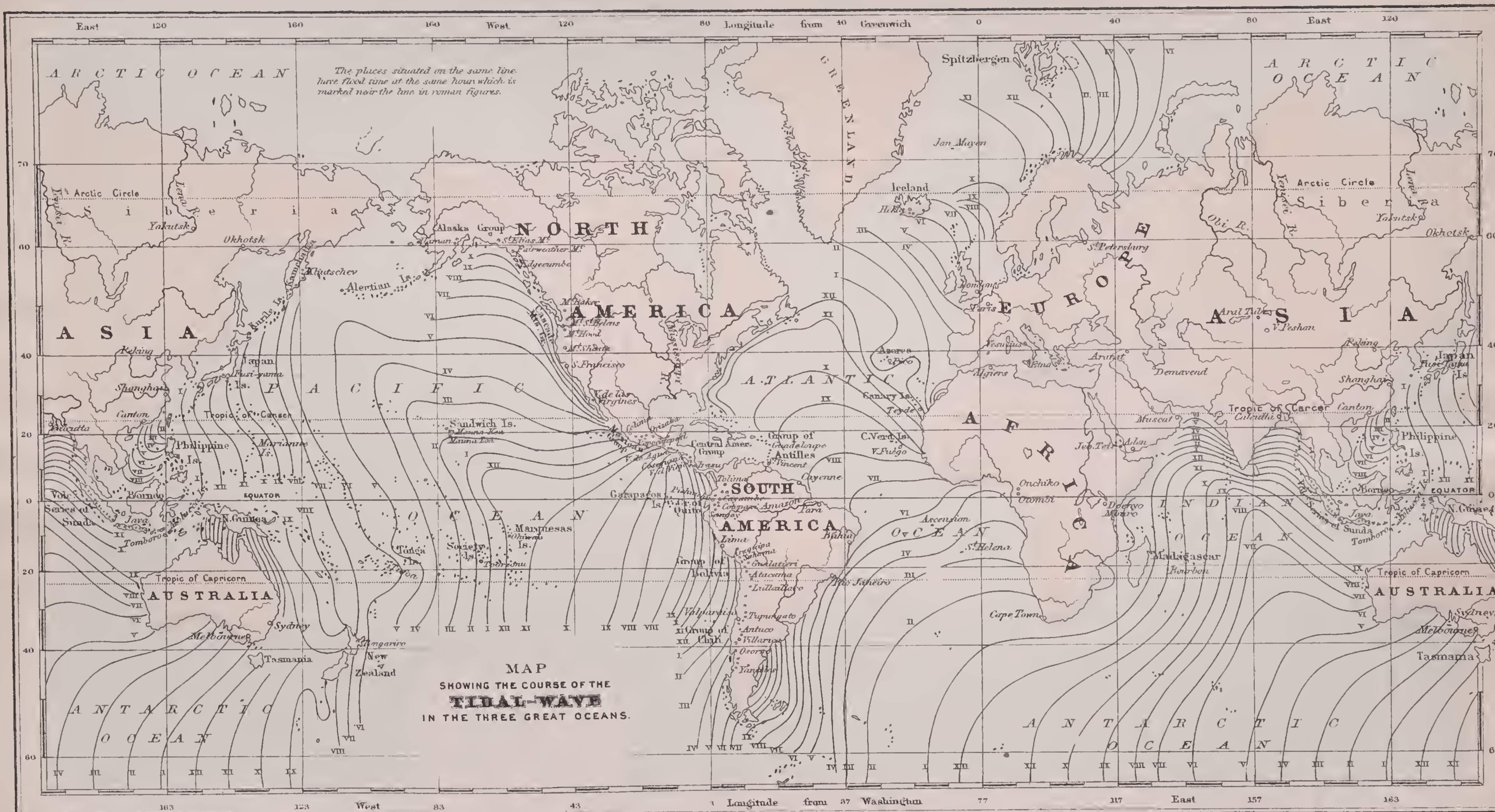



FIG. 3.

The course of the tides on the coast of Great Britain, in the Channel, and the German Ocean, as shown in the map of cotidal lines in that region (Fig. 4), illustrates the retardation of the tidal wave in shallow and narrow seas. The main tide-wave in the broad Atlantic moves on, unobstructed, around the British isles, reaching the Orkneys in four hours, and moves southward along the eastern coast of Scotland before the slackened tide-wave has forced its way through the Channel to Dover Straits. Each wave then continues its course, the first along the English coast, that from the Channel along the coast of Holland, causing tides at different hours on the opposite shores.




MAP
SHOWING THE COURSE OF THE
TIDAL-WAVE
IN THE THREE GREAT OCEANS.

*The Age of the Tide.*—This course of the tidal wave shows that the tides of the Indian and Atlantic Oceans are not generated in these basins, but are mainly derived from those of the Pacific Ocean. But the tide-wave takes some

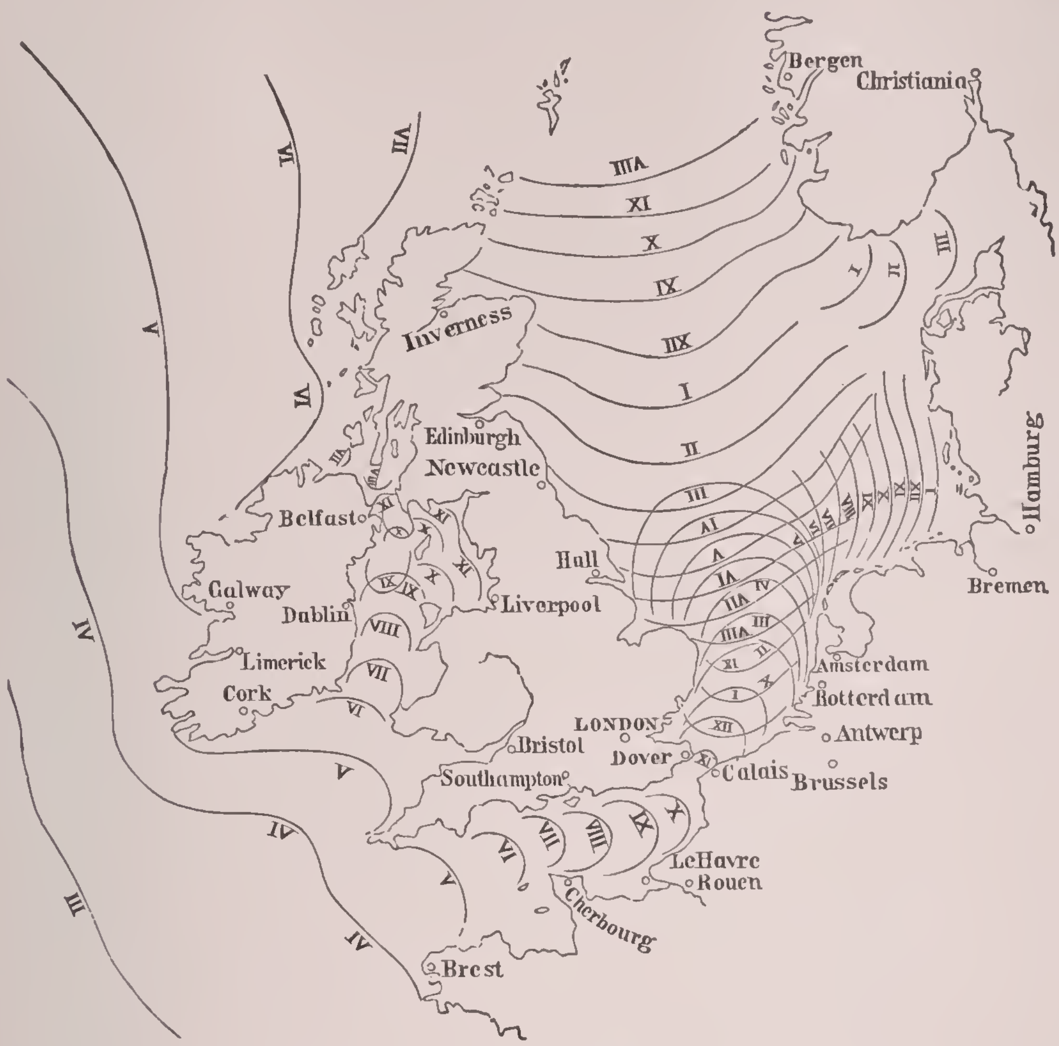



Fig. 4.

time to travel over this vast extent. The map shows that in twelve hours the Pacific wave reaches Tasmania; in twelve hours more, the coast of India; another twelve or thirty-six hours brings it to the coast of North America; a few hours more, to the shores of Europe. Therefore the tide on the eastern shores of North America is not the one caused by the last passage of the moon over them, but the one which had its origin thirty-six hours before in the Pacific Ocean, and is therefore one day and a half old. It is two days old in London.

*The Height of the Tide.*—The height of the tide depends very much upon local circumstances. In the midst of the Pacific it is scarcely more than from 2 to 5 feet, which may be considered as the natural height of the tide. But when dashing against the land and forced into deep gulfs and estuaries, the accumulating tide-waters sometimes reach a very great height. On the eastern coast of North America, which is directly in the path of the great Atlantic wave, the tide rises on an average from 9 to 12 feet. In the Bay of Fundy, which opens its bosom to receive the full wave, the tide, which, at the entrance, is 18 feet, rushes with great fury into that long and narrow channel, and swells to the enormous height of 60 feet, and even to 70 feet in the highest spring-tides. In the Bristol Channel, on the coast of England, the spring-tides rise to 40 feet, and swell to 50 in the English Channel at St.-Malo, on the coast of France. It is obvious that differences so considerable in the level of the water will cause strong currents, constantly varying in force and direction with the tide, such as those witnessed in Hell Gate, a few miles west of the point where Long Island Sound connects with New York harbor. To the same cause may be traced the dangerous whirlpools which have long been celebrated on various coasts. The famous Maelstrom off the Norwegian coast is but a tidal current rushing with great violence between two of the Lofoden islands, causing a whirling motion, which is reversed at every new tide. Such, too, in the Straits of Messina, are the classic Scylla and Charybdis, so much dreaded by the navigators of old, and many other whirlpools of less celebrity.

Bibliography.—The mathematical theory of the tides is developed very abstrusely by Laplace in *Mécanique Céleste* vol. ii. Much simpler and more modern is Airy's treatise on *Tides and Waves*, forming a part of the *Encyclopædia Metropolitana* (London, 1848). Yet later developments are found in Ferrel's *Tidal Researches*, published in the annual report of the U. S. Coast Survey for 1874.

Revised by S. Newcomb.

**Tidioute′**: borough; Warren co., Pa.; on the Allegheny river, and the West N. Y. and Pa. Railroad; 35 miles N. E. of Oil City, and 160 N. by E. of Pittsburg (for location, see map of Pennsylvania, ref. 2–C). It has large lumber and petroleum interests, and contains several saw, planing, and grist mills, manufactories of lumber, chairs, and hubs, a savings-bank, and a weekly newspaper. Pop. (1890) 1,328; (1900) 1,237.

**Tieck**, teek, Ludwig: poet; b. in Berlin, May 31, 1773; studied theology, philology, and literature at Halle, Göttingen, and Erlangen; resided in Berlin 1795–99, went in the latter year to Jena, where he founded with the Schlegel brothers, Novalis, and others the so-called romantic school; returned to Berlin; lived for a number of years at Frankfort-on-the-Oder; visited Italy in 1805 and England and France in 1817, and finally, in 1819, settled in Dresden, where he was made director of the court theater, and where he became the center of a large and select literary circle. On the invitation of King Frederick William IV., who assured him a large pension, he went in 1841 to Berlin, and here assisted in the production of *Antigone* and other Greek plays. D. in Berlin, Apr. 28, 1853. In the literary career of Tieck, who has always been recognized as the head of the older romantic school, we can distinguish several periods. In his earliest productions the influences of the Storm and Stress period are decidedly noticeable, and his novel *William Lovell* (1799) is in this respect an especially interesting document of his literary development. The pronounced predominancy of the imagination, which is quite apparent in his first productions, may be considered the chief characteristic of Tieck's entire poetic activity. Thus, in accordance with the cardinal doctrine of romanticism which proclaimed the sovereignty of the poet's imagination, Tieck revived the mediæval legends and fairy-tales (*Der blonde Eckbert*, *Haimonskinder*, *Magelone*, etc.); thus he wrote his fantastical comedies (*Der gestiefelte Kater*, *Prinz Zerbino*, *Die verkehrte Welt*, etc.), and thus he was first attracted by Shakspeare as the poet of unlimited imaginative powers. The result of this one-sided accentuation of the imagination is the absolute lack of plastic power in Tieck's earlier productions, none of which became popular with his nation. Even his reproductions of mediæval legends and fairy-tales are artificial, and can not compare with the naïve and truly popular style of the fairy-stories of the Grimm brothers. Despite his vivid imagination, Tieck's poetic genius was decidedly of a reflective nature, as may be seen from his *Gedichte* (1821), which lack the ring of the true lyric. A greater and more lasting influence was exerted by Tieck in his masterly translations from the Spanish (*Don Quixote*, 1799–1801), the English (*Shakespeare*, *Altenglisches Theater*, 1811), and the Middle High German (*Minnelieder*, 1803, *Ulrich von Lichtenstein*, 1812), by his critical writings (*Dramaturgische Blätter*, 1826, and *Kritische Schriften*, 1848), and by his excellent editions of the works of Solger, Novalis, Lenz, and Kleist. During the last period of his literary activity he devoted himself exclusively to the writing of novels, taking his subject-material partly from history (*Dichterleben*, a sort of biography of Shakspeare, *Aufruhr in den Cevennen*, etc.), partly from real life (*Vittoria Accorombona*, *Musikalische Leiden und Freuden*, etc.), and producing a number of stories which will be read and enjoyed when his romantic productions are recorded in histories of literature only.

See *Schriften von Ludwig Tieck* (20 vols., Berlin, 1828–46); R. Köpke, *Ludwig Tieck* (1855); von Friesen, *Ludwig Tieck* (1871); K. von Holtei, *Briefe an Ludwig Tieck* (1864); R. Haym, *Romantische Schule* (1870). JULIUS GOEBEL.

**Tiele**, tee′le, CORNELIS PETRUS: theologian; b. at Leyden, Holland, Dec. 16, 1830; studied theology at Amsterdam; became pastor at Moordrecht in 1853 and at Rotterdam in 1856; professor in a seminary at Leyden in 1873; and Professor of the History of Religions in the University of Leyden in 1877. He has written many important theological works. His *Comparative History of the Egyptian and Mesopotamian Religions* (1869–72) and *Outlines of the History of Religion* (1876) have been translated into English and French; the latter also into German. Other works treat of the Gospel of John as a source of the life of Jesus (1855), the religion of Zarathustra (1864), and Babylonian-Assyrian history (German trans. 1886–87). S. A. T.

**Tiel-tree**: See TEREBINTH.

**T′ien′-Shan** or **Thian-Shan** (celestial mountains): a lofty mountain chain in Central Asia, in lat. 42° N. from lon. 70° to 90 E., forming the boundary between the Balkash basin and that of the Kashgar and Tarim, and lying partly in the Russian provinces of Syr-Darya and Semirechensk and partly in Chinese Turkestan. Its mean elevation is 10,000 to 12,000 feet, highest at the west, and descending in Chinese territory. There are several summits which reach 15,000 to 18,000 feet. The highest peak is Khan-Tengri (24,000 feet), on the Russo-Chinese boundary. M. W. H.

**Tientsin**, teen′tsin′. Chinese pron. tyen′cheen′ (literally Heaven's Ford): a walled city and river-port of the province of Chihli, in China; capital of a department of the same name. The city is situated at the junction of the Grand Canal with the Pei-ho, 80 miles S. E. of Peking and 35 miles (by water 70) from Taku, at the mouth of the river; lat. 39° 10′ N., lon. 117° 3′ 55″ E. (see map of China, ref. 3–J). Next to Peking it is the most important city of the province. Prior to 1872 it was merely a *wei* or military station for the protection of the river traffic. The city itself is comparatively small, its walls having a circuit of little over 3 miles, but its suburbs are extensive, and in them most of the business is transacted. The streets both within and without the city are narrow and filthy, and the buildings lacking in interest or beauty. Tientsin was designated in the treaty made here in 1858 as a treaty-port, but was not opened to foreign residence and trade until Jan., 1863. The foreign settlement, which is called *Tsz′-chu-lin*, or Red Bamboo Grove, is situated 2 miles below the city, and consists of three "concessions," as in Shanghai, the French nearest the city, then the British (the largest and most important), and lastly the "American." City, suburbs, and settlements are all inclosed in a circular rampart, known as "San-ko-lin-sin's folly," because thrown up in 1858 by the Tartar general Sŭng-ko-lin-sin as a defense against the British forces. Since 1881 Tientsin has been connected by telegraph with Shanghai, Peking, and the chief cities of China, and with Europe. It is also connected by rail with the mouth of the Pei-ho, the Peh-tang coal mines, and Shan-hai-kwan and beyond. Though the river is frozen over from the early part of December to the middle of March and later, the trade of Tientsin is considerable. The imports in 1899 were valued at 14,255,209 haikwan, or custom-house taels ($10,235,234); the exports at 10,871,539 taels ($7,805,765). Estimated population, 1,000,000.

Tientsin was the center of important military operations during the Boxer uprising of 1900. Thence Admiral Seymour's unsuccessful relief expedition set out for Peking on June 10. After the Boxers had cut off his communications they turned to the investment of the European quarters of the city, which suffered greatly from the bombardment. The siege was not raised till June 23. The Chinese defended themselves in the native city, and were not dislodged till after the hard fighting of July 13–14, in which 800 of the allied armies were killed and wounded. Tientsin was made the base of the subsequent operations for the relief of Peking. See CHINA.

**Tiepolo**, tēē-ā′pō-lō, GIOVANNI BATTISTA: painter; b. in Venice, 1692, or 1696; pupil of Gregorio Lazzarini, but in a peculiar way the student of Paolo Veronese and other great Venetians of an earlier day, and their follower. His life was spent in constant work, chiefly in Venice and its neighborhood. In 1761 he went to Madrid, it is said on special invitation of the King of Spain, and, although a very old man, painted several large frescoes, one of which covers the ceiling of the throne-room of the palace, and has for its subject the *Majesty of Spain*. Fresco was Tiepolo's especial field, and he did wonderful things in it. He was the last man of the great Venetian school, an embodiment of the traditions of centuries, and almost a worthy successor to Tintoretto and Veronese; lacking in color, but in dextrous and varied composition and drawing one of the most able of painters. D. in Madrid, Mar. 27, 1770. Of his numerous large frescoes, besides several at Madrid, there are a number at the Villa Valmarana, near Vicenza; at Udine, in the bishop's palace, several large ones; at the Palazzo Lobia, in Venice, a series representing the *History of Cleopatra*. Painted in oil there are ceiling-pictures in the Church of Santa Maria del Rosario and the Church of Santa Maria dei Scalzi, both in Venice; an altarpiece in the former church, and in the Academy of Venice another ceiling brought from a church at Castello and representing the *Invention of the Cross*; also at the Hermitage, in St. Petersburg, a large ceiling-picture, *Cleopatra Feasting*; also in the academy is a *St. Joseph and Christ with Saints*; at the Santi Apostoli is a *St. Lucy*. In London, in the National Gallery, are two studies for altarpieces, and in Stockholm two similar studies. In the Louvre is a fine *Last Supper*, and a banner painted on both sides with a *St. Martin* and a *Virgin and Child*. RUSSELL STURGIS.

**Tierce** [Fr.]: a stop in the organ, tuned a seventeenth (or two octaves and a third) above the diapasons.

**Tierney**, teer′nē̆e, GEORGE: politician; b. at Gibraltar, Spain, Mar. 20, 1761; son of a London merchant; educated at Eton and at Peterhouse, Cambridge, where he graduated in law 1784; became a lawyer in London, but soon abandoned law for politics; published a treatise on *The Real Situation of the East India Company, considered with reference to their Rights and Privileges* (1787); entered Parliament in 1789; became a leader of the Whigs, and acquired celebrity as a debater and satirist; fought a bloodless duel with Pitt May 27, 1798; opposed the war with France; brought forward annually a series of resolutions in opposition to those of the Chancellor of the Exchequer; was treasurer of the navy 1803–04, and a privy councilor; Secretary of State for Ireland 1806; president of the board of control 1806–07, with a seat in the cabinet; was the head of the opposition after the death of Ponsonby in 1817, and was master of the mint in the administration of Canning 1827–28. D. in London, Jan. 25, 1830.

**Tierra del Fuego**, ti-er′rā̆ā-del-foo-ā′gō: an archipelago at the southern extremity of South America, separated from the continent by the Strait of MAGELLAN (*q. v.*). Length from N. W. to S. E., about 400 miles. Of the total land-area (over 21,000 sq. miles) at least four-fifths is included in the large island called King Charles South Land, Tierra del Fuego, or Fuegia. W. and S. of this are Desolation, Clarence, Navarin, Wollaston, Dawson, Londonderry, and numerous smaller islands and islets, all separated from the larger island and from each other by tortuous channels; a group at the southern end, separated by the navigable Lemaire Channel, includes Horn island and Cape Horn: and the Isla de los Estados is somewhat outlying, toward the S. E. N. of the western mouth of the Strait of Magellan a group of very similar islands lines the coast; they belong, physically, to the Tierra del Fuego group, but those between the strait and Wellington island are distinguished as the Madre de Dios Archipelago. The Andes are continued into Tierra del Fuego, occupying the greater part of the small islands and the southwestern side of King Charles South Land; some of the peaks are over 6,000 feet high and partly covered with perpetual snow, but there are no active volcanoes. The bases of the mountains are covered with pine forests, and numerous glaciers descend from their sides. All the islands are very irregular and cut by deep fiords, affording the most magnificent scenery. The eastern part of King Charles South Land is lower and contains some good pasture-land. Gold has been found in paying quantities. The climate is damp, very changeable, and subject to violent storms and severe cold, especially from June to October. By the treaty of 1881 that portion of the archipelago lying E. of lon. 68° 34′ W. (the meridian of the eastern entrance to the Strait of Magellan) is held by the Argentine Republic; it constitutes the territory of Tierra del Fuego, with an area of 8,217 sq. miles; there are two or three small civilized settlements. The remaining surface belongs to Chili, and is included in the territory of Magallanes; at present (1895) it is unsettled. The Indian inhabitants belong to three distinct races, but are classed together as Fuegians; all are savages of a low grade, but inoffensive, subsisting on fish, seals, etc. They number about 8,000. FERNÃO DE MAGALHÃES (*q. v.*) discovered the archipelago in 1520. It is said that he named it, in allusion to the smoke from Indian watch-fires, *Tierra de Humos* (land of smoke), and that Charles V. changed this to Tierra del Fuego (land of fire). HERBERT H. SMITH.

**Tierra Firme**: See SPANISH MAIN.

**Tietjens**: See TITIENS.

**Tiffany**, FRANCIS: clergyman; b. in Baltimore, Md., Feb. 16, 1827; educated at Harvard College and at Harvard Divinity School; pastor of Unitarian churches in Springfield and West Newton, Mass., 1852–62, and 1865–82; spent many years in Europe; has charge of the Indian department of the American Unitarian Association; author of *Life of Dorothea L. Dix* (New York and Boston, 1890). J. W. C.

**Tiffany**, LOUIS COMFORT: See the Appendix.

**Tiffin**: city (founded in 1817); capital of Seneca co., O.; on the Sandusky river, and the Balt. and O., the Cleve.. Cin., Chi. and St. L., and the Penn. railways; 34 miles S. W. of Sandusky, and 42 miles S. S. E. of Toledo (for location, see map of Ohio, ref. 2–E). It contains 16 churches, public-school property valued at over $150,000, Heidelberg University (Reformed, founded in 1850), with academical school, college, and theological seminary, public and university libraries, orphan asylum, a national bank (capital $250,000), a State bank (capital $100,000), an incorporated bank with capital of $50,000, a private bank, and 2 daily, 3 weekly, and 3 monthly periodicals. There are woolen-mills, foundries, stone and tile works, machine-shops, agricultural-implement works, flour-mills, pottery and glass, straw-board, and emery-wheel works. Pop. (1880) 7,879; (1890) 10,801; (1900) 10,989. EDITOR OF "SENECA ADVERTISER."

**Tiffin**, EDWARD, M. D.: first Governor of Ohio; b. at Carlisle, England, June 19, 1766; emigrated to the U. S. 1784, settling at Charlestown, Va.; studied medicine and took his degree at the University of Pennsylvania. He became a local preacher in the Methodist Church, but continued the practice of medicine. Having removed to Chillicothe, O., in 1796, he was elected to the Territorial Legislature, and when Ohio was admitted to the Union was chosen Governor (1803–07). He was U. S. Senator 1807–09; commissioner of the U. S. land-office 1812–15, and subsequently surveyor-general of the Northwest Territory. D. at Chillicothe, O., Aug. 9, 1829. Three of his sermons, preached in 1817, were published in the *Ohio Conference Offering* (1851).

**Tiflis**, tif-lees': government of Russia; bounded N. by the Caucasus and S. by Turkey in Asia. Area, 15,306 sq. miles. Tiflis is a mountainous region, covered with splendid forests of oak, chestnut, and maple. The valleys are fertile and, though poorly cultivated, produce tobacco, cotton, indigo, wheat, and all the fruits of Southern Europe. Pop. (1891) 800,875, mainly Georgians, Armenians, Russians, and Tartars. E. A. G.

**Tiflis**: town; former capital of Georgia and now of the Russian government of Tiflis, on both sides of the Koor (see map of Russia, ref. 12–F). It carries on simple manufactures and is famous for the skill of its workers in metals. It is the center of South Caucasian commerce between Russia, Persia, and Europe, and is connected by rail with Baku on the Caspian and Batoum on the Black Sea. Trade is mostly in the hands of Armenians. It was almost totally destroyed by Mehemet Khan (1795), and was ceded to Russia by its last king, George (1801). In the vicinity are naphtha and thermal springs, the latter much frequented. Pop. (1897) 159,862. E. A. GROSVENOR.

**Tiger** [viâ O. Fr. *tigre*, *tygre* (> Fr. *tigre*), from Lat. *ti'gris* = Gr. τίγρις; cf. TIGRIS]: the name applied to certain quadrupeds. (1) Primarily and of right it belongs only to the *Felis tigris*, one of the largest of living *Felidæ*, about equal in size and superior in strength to the largest lions, and more destructive and far more dangerous to man. Tigers have been known to measure over 10 feet in length, including the tail, and to weigh over 500 lb. It is peculiar in the development of spreading thick, whisker-like hairs on the sides of the head; its tail is elongate and smooth-haired, and the color is a tawny yellow transversely striped with black. It ranges N. into Southern Siberia, and S. as far as the Spice islands. E. and W. its habitat extends from Persia to the Pacific. It prefers forests and jungles near river-banks for its abode. It is much dreaded by man, especially in parts

The tiger.

of India. The tiger has been frequently induced to hybridize with the lion in captivity. Old tigers sometimes acquire a great fondness for human flesh, and are then called "man-eaters." The hunting of the tiger is a favorite though perilous form of sport in Oriental lands. (2) The name is also sometimes applied by hunters to the American JAGUAR (*q. v.*). (3) It is further transferred in Van Diemen's Land to the striped *Thylacinus cynocephalus*, a carnivorous marsupial. See THYLACINIDÆ. Revised by E. A. BIRGE.

**Tiger-cat**: any one of a large number of striped and spotted wildcats, mostly rather small tropical animals, often arboreal in their habits.

**Tiger-flower**: the *Tigridia pavonia*, a garden-flower of the family *Iridaceæ*. It is a native of Mexico, and is cultivated for its gorgeous blossoms, each of which lasts but a day. The garden forms known as *T. conchiflora* and *T. grandiflora* belong to this species.

**Tigert**, JOHN JAMES, M. A., D. D.: clergyman and author; b. at Louisville, Ky., Nov. 25, 1856; educated in Louisville public and high schools, Vanderbilt University (1875–77), and Southern Baptist Theological Seminary; served in pastorates of Methodist Episcopal Church South (1877–81); was Professor of Moral Philosophy in Vanderbilt University (1882–90); again a pastor at Kansas City, Mo. (1890–94); since 1894 has been editor of *The Methodist Quarterly Review*, Nashville, Tenn. He has published *Handbook of Logic* (1885); *The Preacher Himself* (1889); *A Voice from the South* (1892); and *Constitutional History of American Episcopal Methodism* (1894). He also edited Summers's *Systematic Theology* (2 vols., 1887–88) and McTyeire's *Sermons* (1886). A. OSBORN.

**Tighe**, tī, MARY (*Blachford*): poet; b. in Dublin, Ireland, in 1773; married in 1793 her cousin, Henry Tighe, of Rosanna, County Wicklow, a member of the Irish Parliament; published in 1805 for private circulation her *Psyche*, a poem of remarkable excellence, based on the story of Apuleius. D. at Woodstock, County Kilkenny, Ireland, Mar. 24, 1810. Her *Works*, which appeared in 1811, have passed through several editions, and she was the subject of a song by Moore and a poem by Mrs. Hemans. Revised by H. A. BEERS.

**Tiglathpileser**: See ASSYRIA.

**Tigra'nes II.**, THE GREAT: King of Armenia (96–55 B. C.). He carried on successful wars against Parthia and the Seleucidæ, conquered all the country between the Euphrates and Mediterranean, and assumed the title of King of Kings. After twenty-two years of prosperity he was involved in war with Rome by his father-in-law, Mithridates, and was twice defeated by Lucullus, who took and sacked his capital, Tigranocerta (69 B. C.). After a final defeat by Pompey (65 B. C.) he repaired to the Roman camp and in sign of submission placed his tiara at the feet of the Roman general. He was compelled to pay 6,000 talents, but was allowed to retain Armenia proper. Armenia Minor was assigned to Deiotarus and most of Tigranes's foreign conquests were restored to their former rulers or incorporated in the Roman dominions. He was succeeded by his son Artavastes. E. A. GROSVENOR.

**Tigré**, tē-grā′: province of Abyssinia, between lat. 12° and 16° N. and lon. 37° and 40° E.; formerly an independent state until conquered in 1855 by Theodore. Its capital is Adua, one of the principal stations on the caravan-route between Massowah and Gondar.

**Tigri**, Giuseppe: author; b. at Pistoia, Italy, Nov. 22, 1806; entered the Church, but spent his life in teaching and writing; journeyed through Europe in 1861; was later an inspector of schools in Pistoia and San Miniato, and finally a librarian in the former place, where he died Mar. 9, 1882. His chief work is the collection *Canti popolari toscani* (Florence, 1856; 2d ed. 1860). He wrote also a didactic poem *Le selve* (1844); a novel, *La selvaggia de' Vergiolesi* (1870); several works treating of the mountaineer, *Il montanino toscano volontario alla guerra dell' independenza italiana, 1859* (1860), *Volontario e soldato* (1872), *Celestina* (1880), and *Matilda*; a versified novel; and several treatises, such as *Contro i pregiudizi popolari* (1870), and *Da Firenze a Constantinopoli e Mosca* (1877). J. D. M. Ford.

**Ti′gris** [= Lat. = Gr. Τίγρις, from O. Pers. *Tigra* (> Pers. *Tīr*), liter., the Arrow, so called from its swiftness]: river of Asiatic Turkey. Under the name of *Hiddekel*, it was one of the four rivers of Eden. It rises in the mountains of Kurdistan, only 4 miles distant from the channel of the Eastern Euphrates. After a winding but generally southeastern course of about 1,000 miles it joins the Euphrates at Korna. Together they form the Shatt-el-Arab, which empties into the Persian Gulf nearly 100 miles distant. On its banks are the towns of Diarbekir, Mosul, and Bagdad, and the ruins of Nineveh, Seleucia, Ctesiphon, and Opis. Its banks above Diarbekir afford pasturage to nomad tribes, and below Diarbekir are finely cultivated as far as Mosul. There the land on both sides becomes a desert. From Bagdad to Korna the banks are steep and overgrown with high reeds and brush which form the haunts of beasts of prey. The upper Tigris as far as Mosul is navigable only by rafts and thence by small vessels to Bagdad, to which steamers of light draught ascend from the Persian Gulf. Its average breadth between Mosul and Bagdad is 200 yards, but the breadth, velocity, and depth vary with the season. Its greatest height is attained toward the last of May, and then rapidly decreases in June. During a brief period (114–117) it formed the boundary between the Parthian and Roman empires. E. A. Grosvenor.

**Til′burg**: town; province of North Brabant, Netherlands; 14 miles E. S. E. of Breda (see map of Holland and Belgium, ref. 7–F). It is the seat of a large cloth-manufacturing industry, employing several thousand persons, and each family has a house of its own. Print-works, breweries, and tanneries are also in operation. Pop. (1899) 40,684.

**Tilden**, Samuel Jones: statesman; b. at New Lebanon, N. Y., Feb. 9, 1814; studied at Yale College and the University of New York; took the course of law at the latter, and was admitted to the bar in 1841. He became prominent in politics as an able champion of Van Buren's administration, and at the same time won for himself a high place in his profession, amassing by a judicious investment of his earnings one of the largest fortunes ever accumulated in legal practice. During the most laborious period of his professional life he was one of the leaders and most trusted counselors of the Democratic party. He was a member of the convention for a revision of the constitution of the State in 1846, and again in 1867. He also served two terms in the lower branch of the State Legislature—first in 1846, and second in 1872. He was one of the foremost in the overthrow of the Tweed ring, and in the establishment of a reformed city government. (See Tweed, William Marcy.) In 1874 he was nominated and chosen Governor of the State of New York by a majority of more than 50,000 votes, defeating Gen. Dix, a Republican candidate, who had been elected two years before by a majority of 55,451. As Governor he exposed the iniquities of the canal ring and crushed its sway over the legislative, administrative, and judicial departments of the State. His was a reform administration and most successful in its results. In 1876 he was nominated without considerable opposition by the national Democratic convention for the presidency of the U. S. At the election he received a much larger popular vote than any other candidate, and 184 uncontested electoral votes. Only one additional electoral vote was required for his election, while twenty additional votes were required for the election of the rival candidate. Owing to differences of opinion as to the proper mode of counting electoral votes and passing upon contested returns, the settlement of the matter was intrusted by Congress to a specially appointed tribunal known as the Presidential Electoral Commission (*q. v.*), which decided in favor of the Republican electors in every contested case, and certified to the election of Rutherford B. Hayes, the Republican candidate for the presidency. Impressed with the conviction that Mr. Tilden had been lawfully elected to the presidency, the Democratic party continued to regard him as its candidate for the succeeding election, in 1880, but he was obliged by failing health to decline the nomination and withdraw from public life. Despite Mr. Tilden's retirement the Democratic party seemed determined to nominate him for the presidency in 1884, public opinion refusing to concentrate upon any other candidate, and it was not till he had again publicly declared his unalterable determination not to return to public life that his party made another choice. During the latter part of his life he spent most of his time at Graystone, his country home on the banks of the Hudson, where he died Aug. 4, 1886. After providing for his heirs Mr. Tilden bequeathed the bulk of his property for the establishment of the Tilden Trust to found a free library and reading-rooms in the city of New York. This clause gave rise to a long contest, which was decided on appeal in favor of the heirs on Oct. 27, 1891. Mrs. William B. Hazard, however, though entitled by this decision to half of the estate, relinquished over $2,000,000 of her share for the purpose of carrying out Mr. Tilden's wishes. On Feb. 22, 1895, it was agreed by representatives of the Tilden Trust Fund, the Astor Library, and the Lenox Library to consolidate these institutions into a single library to be known as the New York Public Library—Astor, Lenox, and Tilden Foundations. See John Bigelow, *The Life of Samuel J. Tilden* (New York, 1895). Revised by F. M. Colby.

**Tiles** [O. Eng. *tigel*, like Germ. *ziegel*, an early loan-word from Lat. *te′gula* > Fr. *tuile*: Ital. *tegola*: Span. *teja*]: originally, flat slabs of baked clay. A tile is broader and thinner, a brick is thicker, and there is no absolute distinction between the two; thus the thin ancient Roman bricks used for wall-facing are often called tiles or tile-bricks. In common usage tiles are of three principal kinds—roofing-tiles, tiles for walls and floors, and drainage tiles. Roofing-tiles may be divided into (1) flat, overlapping tiles, which are used nearly as shingle or slate is used, and which have either a projection made in the solid mass or holes for nails by which they are kept in position; (2) pan-tiles, which are in section both convex and concave—that is, have an ∽ curve, the convex part lapping over the concave part; and (3) ridge-tiles, which are used not only for the topmost ridge or crest of the roof, but also for the projecting hips. There are many varieties of each of these kinds of roof-tile; thus one system of roofing provides flat tiles with small half-tubes of the same material to cover the joints between the flat tiles, and adaptation of the principle of the ridge-tile to a kindred use. Roofing-tiles have sometimes been enameled, and are much better for being so, from the waterproof character of the enamel. Such tiles are also frequently in brilliant colors; roofs made decorative in this way are known both in Asia and Europe, and in ancient and modern times. Perhaps the most remarkable instance of a large roof made decorative in this way is St. Stephen's Cathedral in Vienna. In Western France during the Middle Ages and at the time of the Renaissance roofs were commonly decorated in this way with the addition of crest ornaments and *épis* made of the same brilliant enameled earthenware. Modern taste is rather for unglazed tile, and finds great beauty in the unpolished surface and the slight variation of tint, increased by the varying angles at which the tiles are laid. Unglazed tiles absorb water readily. All tiles are heavy, and necessitate an expensive roof structure.

Tiles for floors and walls are of great variety in form and size and decoration. Old houses in the south of Europe, and even houses of no great pretension, have their rooms floored with tiles of red clay not finer than common bricks, but hard baked and practically a variety of terra-cotta. Throughout the Middle Ages hard-baked clay tile was in very common use for flooring, and the usual method of decorating this was to inlay clays of different colors in the body of the tile, yellow in red, and the like. Some of these tile floors still preserved are of great beauty. Down to the first half of the nineteenth century such tiles were in common use as far north as Holland. Paving with bricks passes imperceptibly into tile-paving, and the sidewalks of Baltimore offer many instances of hexagonal pieces of baked clay, which may be either bricks or tiles, according to their thickness. In the fifteenth and sixteenth centuries flooring, especially of chapels, oratories in private houses, and other rooms considered especially notable, were paved with enameled tiles of great beauty, but extremely perishable. A few such floors remain nearly intaet in Franee and in Italy, as at the manor-house of Oiron, in the department of Deux-Sèvres, at the famous castle of Écouen, in the Cathedral of Ravello, and in the Church of San Domenico at Naples. These beautiful tiles were less used for wall-decoration, because, in a room sufficiently important to call for rich ornament, the walls were usually in stone like the exterior, and beeause a protecting dado, if required, would naturally be of wood. In modern times, however, with the growing tendency to decorate closed and confined interiors with something more effeetive than plastering, there has been an inereased use of tile, painted and glazed and decorated with large and brilliant patterns, or even elaborate pictures, the prineiples of design in which are akin to those of decorative windows. Thus Théodore Deek produeed splendid wall-decorations covering whole sides of large rooms with admirably eonventionalized landscapes, eonsisting eaeh of perhaps 800 square tiles.

In all the above-mentioned instanees the surface is smooth, but much beautiful wall-tiling has been made with figures in slight relief. The Persians of the fifteenth and sixteenth centuries excelled in these. Sueh decoration has been traditional in Persia since antiquity (see *Earthenware, Glazed and Enameled*, under POTTERY AND PORCELAIN), and in that later epoeh they produeed what are probably the most beautiful wall-tiles ever made, sometimes in relief, but mueh more often smooth and painted with eonventional flower-patterns. The use of these tiles extended to the Mohammedan nations of the West; the finest specimens known are in the mosques of Cairo, and similar examples oeeur as far W. as Spain. Tiles with figures in relief are made in the U. S. at Chelsea, Mass., Beaver Falls, Pa., Indianapolis, Ind., Trenton, N. J., and Zanesville, O.

*Encaustic tiles* are those modern tiles made in imitation of the mediæval ones mentioned above, different-colored clays being inlaid upon a clay background and all fired together. The term has no particular significance, and must be considered as a mere trade-name.

BIBLIOGRAPHY.—Mediæval earthenware tiles are well treated in *Les Carrelages émaillés du Moyen Âge, etc.*, by Emile Amé; Turner and Parker, *Domestic Architecture of the Middle Ages* (4 vols., 1851, etc.); Henry Shaw, *Specimens of Tile Pavements* (1852); Viollet-le-Duc, *Dictionnaire Raisonné de l'Architecture* (for roof-tiles, see article *Tuile*; for floor-tiles and wall-tiles, article *Carrelage*). Many works contain colored and other illustrations of fine aneient tiles; for Oriental ones see Prisse d'Avenne, *L'Art Arabe*; Bourgoin, *Les Arts Arabes*; for European specimens, see Jacobsthal, *Süd-Italienische Fliesen-Ornamente*, and Meurer, *Italienische Majolika-Fliesen*. RUSSELL STURGIS.

**Till**: See DRIFT.

**Tillamook Rock**: See LIGHTHOUSE.

**Tilland'sia** [Mod. Lat., named by Linnæus in honor of Dr. Elias Tillands, a Finnish botanist]: a genus of epiphytie air-plants of the family *Bromeliaceæ*. There are many species, eight of which are natives of the southern parts of the U. S. Of these, *T. usneoides*, the long or Spanish moss, is the best known. It is abundant in the more humid districts of the South, where it hangs in long festoons from the trees. Its eentral fiber is largely used in stuffing mattresses. The plant is used in making an ointment asserted to be a cure for hæmorrhoids, and in winter it is eaten by cattle. Revised by CHARLES E. BESSEY.

**Tillemont**, tēēl'mōn', LOUIS SÉBASTIEN LE NAIN, de: ecclesiastical historian; b. in Paris, Nov. 30, 1637; educated by the Jansenists of Port Royal; studied theology at the seminary of Beauvais; took holy orders in 1672, and became subdeacon at the St. Lambert; retired in 1677 to the monastery of Port-Royal, and, when the Government closed this institution in 1679, to his estate of Tillemont, between Vineennes and Montreuil, where he died Jan. 10, 1698. He wrote *Mémoires pour servir à l'Histoire ecclésiastique des six premiers Siècles* (16 vols., Paris, 1693–1712); *Histoire des Empereurs et des autres Princes qui ont régné durant les six premiers Siècles de l'Église* (6 vols., 1692–1738); *Vie de Saint Louis* (first published by the French Historical Society, 6 vols., 1847–51). Revised by S. M. JACKSON.

**Tillett**, WILBUR FISK, A. M., D. D.: clergyman; b. at Henderson, Vanee co., N. C., Aug. 25, 1854; edueated at Trinity College, North Carolina, Randolph-Maeon College, Virginia, and Theological Seminary, Prineeton, N. J.; entered the ministry of the Methodist Episcopal Church South; was pastor at Danville, Va., 1880–82; Professor of Systematic Theology, dean of the theologieal faculty, and viee-ehaneellor of Vanderbilt University 1882–95. Besides frequent eontributions to religious and secular periodicals, he has published *Our Hymns and their Authors* (1889) and *Discussions in Theology* (1890). A. OSBORN.

**Tilley**, Sir SAMUEL LEONARD, K. C. M. G.: statesman; b. at Georgetown, Queen's County, New Brunswick, May 8, 1818; educated at the County Grammar Sehool. He was a druggist until 1854; represented St. John, New Brunswick, in the Legislative Council of the provinee 1850–51, 1854–56, 1857–65, 1866–67; was a member of the Executive Council, New Brunswick, 1854–56, 1857–65, 1866–67; during those several periods held the office of Provineial Secretary, and from Mar., 1861, to Mar., 1865, was leader of the Government. He had a seat in the Parliament of Canada 1867–73, 1878–85; was appointed Minister of Customs for the Dominion July 1, 1867; acting Minister of Public Works 1868–69; Minister of Finanee for a short time in 1873, and from 1878 until 1885. He was lieutenant-governor of New Brunswick from Nov., 1873, until July, 1878, and was reappointed to the same offiee Oct. 31, 1885. He was a delegate to the Charlottetown union eonference in 1864, to that in Quebee the same year, and to the London colonial eonference 1866–67. He was knighted in 1879, and reeeived the degree of LL. D. from the University of New Brunswiek in 1890. D. June 25, 1896. NEIL MACDONALD.

**Tillman**, BENJAMIN RYAN: politieian; b. in Edgefield co., S. C., Aug. 11, 1847; was edueated at Bethany Aeademy, and engaged in farming. He was Governor of South Carolina from 1890 to 1894, and was then eleeted U. S. Senator. As Governor he was well known for the diffieult but persistent enforeement of the dispensary law, assuming for the State a monopoly of aleoholic beverages.

**Tillman**, SAMUEL ESCUE: soldier and edueator; b. near Shelbyville, Tenn., Oct. 2, 1847; graduated at the U. S. Military Academy June, 1869; promoted seeond lieutenant Fourth Artillery; transferred to the Corps of Engineers as first lieutenant June 18, 1872; served on frontier duty in Kansas 1869–70; at the military academy as Assistant Professor of Chemistry, etc., 1870–73 and 1879–80, and as Assistant Professor of Philosophy 1875–76; as assistant astronomer to the U. S. expedition to Tasmania to observe the transit of Venus 1874–75; as assistant engineer on the explorations W. of the 100th meridian (Wheeler survey) 1873–74 and 1876–79 in Arizona, New Mexico, California, Nevada, Utah, Idaho, and Montana; Professor of Chemistry, Mineralogy, and Geology at the U. S. Military Academy sinee Dec. 21, 1880; author of *Elementary Lessons in Heat* and *Essential Principles of Chemistry*. JAMES MERCUR.

**Tillodon'tia** [Mod. Lat.; from Gr. τίλλειν, pluck, tear + ὀδούς, ὀδόντος, tooth]: a group of extinct Tertiary mammals, now regarded as forming a distinct order, possessing characters intermediate between carnivores, rodents, and ungulates. In *Tillotherium*, the typical and best-known genus, the skull resembles in shape that of the bear. The orbits are confluent with the large temporal fossæ, whieh are separated at the middle line of the skull by an obtuse sagittal crest. The nasals are stout, and expanded behind. The dental formula in the adult is ineisors, $\frac{2-2}{2-2}$; eanines, $\frac{1-1}{1-1}$; premolars, $\frac{3-3}{2-2}$; molars, $\frac{3-3}{3-3}$. The anterior ineisors, both above and below, are large, curved, scalpriform, and faced in front with enamel. They grow from persistent pulps, and strongly resemble the corresponding teeth of rodents. The canines are small. The upper molars are peculiar, and the lower are of the palæotherium type. The brain-cavity is small. As in most Eocene mammals, the hemispheres are small, and extend but slightly over the cerebellum or over the olfactory lobes. The latter were large and projected well forward. The eerebellar fossa is large, expanded transversely, and extends above the cerebral cavity. The vertebræ resemble those of some earnivores; the cervicals were short, the lumbars large. The radius and ulna were separate and of nearly equal size. The scaphoid and lunar bones were distinct. The feet were plantigrade, apparently fitted for digging, and each had five toes. There was a well-marked third trochanter on the femur, and the tibia and fibula were distinct. The best-known species (*T. fodiens*, Marsh) was about two-thirds the size of a tapir. The genus *Tillotherium* represents a distinct family. A second family of this order is represented by *Stylinodon*, in which the molars are rootless, subquadrate in transverse section, and faced with enamel within and without. O. C. MARSH.

**Tillotson**, JOHN, D. D.: archbishop and preacher; b. at Sowerby, Yorkshire, England, in Oct., 1630; was educated at Clare Hall, Cambridge, where he was made a fellow in 1651. He was originally a rigid Puritan, and in 1657 became tutor in the family of Cromwell's attorney-general, but at the Restoration went over to the Established Church, in which he took orders, and became in succession curate of Cheshunt, rector of Kedington, preacher at Lincoln's Inn, dean of Canterbury, prebendary of St. Paul's, and, in 1691, Archbishop of Canterbury, having in the meanwhile served as clerk of the closet to William III. and as member of the commission appointed in 1689 to revise the English liturgy. He took an active part in measures in opposition to Roman Catholicism, opposed the declaration of Charles II. in favor of liberty of conscience, and was an earnest advocate of the exclusion of the Duke of York from the succession. He ranks among the foremost of English preachers, and in lieu of preaching with the Puritan prolixity or the pedantic clumsiness of the Established Church he established the practice of speaking in plain almost familiar style, while at the same time his culture commended him to scholars. He published during his lifetime several volumes of sermons, and left many more in manuscript, and for the copyright of these his widow received 2,500 guineas. Several editions of his *Sermons*, in twelve and fourteen volumes, were published. His complete works have been published (3 vols. fol., London, 1707-12, and 10 vols. 8vo, 1820), and many of his sermons have been translated into French and German. D. in London, Nov. 22, 1694. Revised by S. M. JACKSON.

**Til'ly**, JOHANN TSERKLAES, Count von: general of the Thirty Years' war; b. in the castle of Tilly, near Gembloux, province of Brabant, Belgium, in Feb., 1559; being a younger son, was destined for the Church, and educated by the Jesuits, but preferred the military profession; served under Parma in the Netherlands, and under Duke Philip Emanuel of Lorraine in Hungary, and was in 1610 appointed field-marshal by Duke Maximilian of Bavaria. When the Thirty Years' war broke out he was made commander-in-chief of the army of the Holy League; suppressed the insurrection in Bohemia after the battle of Prague Nov. 8, 1620; won the battles of Wimpfen and Höchst in 1622, and Stadtlohn in 1623, and drove the Protestants from the Palatinate. He defeated Christian IV. at Lutter Aug. 27, 1626, and with Wallenstein forced the Protestants to the Peace of Lübeck. Appointed commander-in-chief also of the imperial army after the dismissal of Wallenstein in 1630, he stormed Magdeburg May 20, 1631. The brutal outrages committed by the Walloons and Croats on entering the city have left a stain on Tilly's reputation, though it is questionable how far he was responsible for them. He was utterly defeated by Gustavus Adolphus at Breitenfeld Sept. 17, 1631, and again on the Lech Apr. 5, 1632, in which battle he was mortally wounded. D. at Ingolstadt, Apr. 20, 1632. F. M. COLBY.

**Til'sit**: town of Prussia, province of East Prussia; on the Niemen; 65 miles N. E. of Königsberg by rail (see map of German Empire, ref. 1-K). It is regularly built, and in a fertile and well-cultivated district. It manufactures cloth, hosiery, oil, paper, chemicals, has several sugar-refineries and important fisheries for eel and salmon, and carries on a considerable trade in grain, hemp, flax, wool, and horses. It is famous for the Treaty of Tilsit concluded between Napoleon and the Czar Alexander in 1807 after the humbling of Prussia by the French. By this peace the foundation was laid for a Russian-French alliance, and Prussia lost nearly half of her territory. Pop. (1890) 24,545.

**Til'sonburg**: post-village, Oxford County, Ontario, Canada; on Big Otter creek; 16 miles N. of Port Burwell (see map of Ontario, ref. 5-C). It has good water-power, large lumbering interests, and is a station on the Grand Trunk and Michigan Central railways. Pop. (1891) 2,163.

**Tilt Cove**: port of entry; on White Bay, Newfoundland; 230 miles by steamer N. W. of St. John. It is a picturesque village on the border of a lovely lake, and owes its importance to a rich copper mine which is actively worked. There is also a vein of nickel, occurring in a regular lode; the copper, however, is in pockets or bunches. The harbor is not very good. Pop. about 800.

**Tilton**: town; Belknap co., N. H.; on the Merrimack and Winnipiseogee rivers, and the Concord and Montreal Railroad; 10 miles S. W. of Laconia, and 18 miles N. of Concord (for location, see map of New Hampshire, ref. 8-F). It contains the villages of Tilton and East Tilton; has five churches, a national bank with capital of $70,000, a savings-bank, a union graded school, and the New Hampshire Conference Seminary and Female College; and is principally engaged in the manufacture of woolen goods, hosiery, and pulp. Pop. (1880) 1,282; (1890) 1,521; (1900) 1,926.

**Tilton**, THEODORE: journalist; b. in New York, Oct. 2, 1835; was educated at the New York Free Academy (now the College of the City of New York); entered on journalism at an early age, and in 1856 was employed upon the New York *Independent*, to the editorship of which he succeeded upon the resignation of Henry Ward Beecher in 1863. In 1872, in consequence of disputes, his connection with *The Independent* was discontinued, and he established *The Golden Age*, a weekly journal, which he conducted till 1874. In that year he brought suit against Mr. Beecher, whom he charged with criminal intimacy with his wife, claiming damages of $100,000. The suit lasted six months, and the jury were unable to agree upon a verdict. He published *The American Board and Slavery* (1860); *Memorial of Mrs. Browning* (1862); *The King's Ring* (1866); *The True Church* (1867); *The Sexton's Tale and other Poems* (1867); *Sanctum Sanctorum, or Proof-sheets from an Editor's Table* (1871); *Life of Victoria C. Woodhull* (1871); *Tempest-tossed*, a novel (1875); *Thou and I*, poems (1880), and other works. He was for many years a popular lecturer. Since 1883 he has resided in Europe. Revised by H. A. BEERS.

**Timæus**, tī-mee'ŭs (Gr. Τίμαιος): Greek historian of Tauromenium, in Sicily; b. 352 B. C. The greater part of his long life was spent in Athens, where he studied rhetoric under Philiscus, a pupil of Isocrates. D. in Sicily in 256. His *History of Sicily*, in sixty-eight, or, according to others, thirty-eight books, told the story of the island from the oldest times to 264 B. C., and that of Italy and Carthage as well. Famous also was his chronological work *The Victors of the Olympic Games* (Ὀλυμπιονῖκαι). Timæus was a closet historian, and his writings showed a lack of familiarity with the practical problems of statesmanship. He made diligent use of his authorities, but he was a determined fault-finder, and for this censoriousness, as well as for his other shortcomings, he was mercilessly criticised by Polybius. His style found few eulogists. Fragments in Müller's *Fragmenta Historicorum Græcorum*, vol. i., pp. 193-233.

B. L. GILDERSLEEVE.

**Timber and Timber-trees** [*timber* is O. Eng. *timbor*, *timber*: O. H. Germ. *zimbar*, *timber*, house, room (> Mod. Germ. *zimmer*, room): Goth. *timrjan*, build; cf. Lat. *domus*: Gr. δόμος: Sanskr. *dama*, house, and Gr. δέμειν, build]: wood suitable for constructive purposes, as for making buildings and ships, or for furniture, tools, and the like; also the trees furnishing such material. The most prominent species of timber-trees used in the U. S. are the following:

(1) *Coniferous Division.*—Of those of the Atlantic States and Canada, the most important, and for its uses the best in the world, is white pine (*Pinus strobus*), in England called Weymouth pine. Hard-pine lumber, variously called yellow pine, pitch-pine, etc., is most largely furnished, and of best quality, by *P. palustris*, the long-leaved pine of the Southern States. *P. rigida*, the Northern pitch-pine, both in the Northern and Southern States furnishes a similar but inferior and generally smaller timber; and excellent hard pine is yielded by the short-leaved pine (*P. echinata*); while the loblolly-pine at the South (*P. tæda*) and the red or Norway pine at the North (*P. resinosa*) furnish a softer and less resinous lumber. Larch or hackmatack (*Larix laricina*) of the North furnishes a very valuable lumber, important in ship-building. Next are the spruces, with wood tougher than white pine, but more liable to shakes and splits. Black spruce (*Picea mariana*) has the widest range and yields the best lumber, especially prized for spars. White spruce (*P. canadensis*) is a smaller tree, and the wood inferior. Hemlock-spruce (*Tsuga canadensis*) furnishes at the North a valuable but coarse lumber, very liable to shakes and of moderate durability. The balsam-firs, both the Northern species (*Abies balsamea*) and that of the mountains in the South (*A. fraseri*), are of no value for timber, being small trees, with soft wood, lacking strength and durability. Of the cypress tribe, the bald cypress of the Southern States

(*Taxodium distichum*) furnishes lumber of great size and much durability, but light and shaky; while the arbor-vitæ or white cedar of the North (*Thuja occidentalis*) and that of the Middle and Southern States (*Chamæcyparis thyoides*) yield small timber of exceeding durability, especially for posts; and red cedar (*Juniperus virginiana*) furnishes a red and fragrant fine-grained wood of the greatest durability and value. The yew occurs as a tree only in a limited part of Florida, as does its relative the stinking cedar (*Torreya taxifolia*), rendering their excellent timber practically unimportant.

In the Pacific States and Rocky Mountain region the coniferous trees are numerous, and some are of immense height and girth. Of soft-wooded or white pines no one equals the white pine of the East. The sugar-pine (*Pinus lambertiana*), with its immense trunks, takes its place, but the wood is much coarser-grained. *P. ponderosa*, with its heavy wood, furnishes excellent hard-pine lumber, less resinous than the Eastern species; and there are several other species intermediate as to the character of the wood. For spruces, the *Pseudotsuga taxifolia* or Douglas spruce, of Oregon and California, is far the best of the race, as well as the largest. The hemlock-spruce and the larch are represented by species very like the Eastern; while the Menzies spruce (*Picea sitchensis*) surpasses the black spruce; and the balsam-firs are represented by several nobler species, which furnish better lumber. The cypress tribe is represented by several cypresses of considerable value; also in Oregon and northward by an arbor-vitæ (*Thuja gigantea*), vastly surpassing the Eastern species in size and value for timber, and in California by the famous redwood (*Sequoia sempervirens*), the light and reddish wood of which is incomparable for building and excellent for interior finish. See Sequoia.

(2) *Amentaceous Trees.*—The oaks are the most important, and the most valuable species is the white oak (*Quercus alba*), which in the Atlantic States takes the place of the *Q. robur* of Europe. It grows to a height of 80 to 100 feet and a diameter of 6 or 7 feet, and yields handsome logs. The wood is of a pale-reddish color, straight-grained, compact, tough, strong, durable, and shrinks but little. It is used for frames of structures where strength and durability are required, coachmaking, coopering, ship-building, and for a great variety of purposes in the domestic arts. For cabinet-making and interior decoration it is highly valued. The other annual-fruited species come next to this in value—viz., chestnut-oaks, post-oak, bur-oak, etc. In the Southern States, along the coast, the live-oak (*Q. virginiana*) represents a peculiar type, and for ship-building is prized above all others, but it does not give large timber. Its height is from 40 to 50 feet; diameter, 1 to 2 feet. The wood is yellowish when first cut, and deepens to a dark brown with age; it is hard, tough, strong, heavy, and very difficult to work, on account of the grain being waved or twisted. The pores are minute, and the silver-grain very bright and distinct. The biennial-fruited oaks have a more porous wood, unfitted for casks to hold liquids, less durable, and less strong. The best of them—viz., black oak (*Q. velutina*)—is found on poorer soils than the white oak, and grows to the height of 80 to 90 feet, with a diameter of 4 to 5 feet. The wood is reddish, porous, and coarse-grained. The outer bark is greatly used for tanning, and the inner bark, called quercitron, for dyeing. Red oak (*Q. rubra*) is used for similar purposes, though it is inferior in quality. Spanish oak (*Q. digitata*) and willow-oak (*Q. phellos*) are superior; and so are laurel or shingle-oak (so called because the wood was used for shingles). California and Oregon have oaks of peculiar species, some of them valuable timber-trees, but none which equal white oak. Chestnut (*Castanea dentata*) is a large tree, of the Atlantic States only, essentially of the same species as the European, yielding a coarse-grained and porous but durable lumber, easily worked, and valuable for wainscoting, etc. The medullary rays can not be traced in it. The American beech (*Fagus atropunicea*) has a very close-grained and hard wood, like that of the European species, of which joiners' tools are made. Iron-wood (*Ostrya*) and horn-beam (*Carpinus*), as the names denote, have very hard wood, but they are rather small trees, peculiar to the Atlantic States, with corresponding species in the Old World. The hickory, in several species, is peculiar to the Atlantic States. The shell-bark or shag-bark (*Hicoria ovata*) is the best, but all have a very tough and hard wood of remarkable strength, much prized for tools and the like. The walnut (*Juglans*) is known in the Atlantic States by two species—i. e. white walnut or butter-nut (*J. cinerea*), the favorite wood for gunstocks and of late for wainscoting and cabinet-work, but a small tree; and black walnut (*J. nigra*), the most important of native woods for the cabinet-maker, a tree of ample size. The heart-wood is of a violet color when first cut, but upon exposure becomes dark. It is far superior to the European walnut; it is strong, tough, durable when seasoned, and not apt to warp and split. It has a fine and compact grain, and is susceptible of a high polish. The birches are valuable timber-trees of the second class, having a hard and fine-grained wood, valued by cabinetmakers. Of the five species which in the Atlantic States and Canada form good-sized trees, the black or sweet birch, sometimes called cherry-birch (*Betula lenta*), is most prized, being excellent for furniture; and yellow birch (*B. lutea*) is equally good, but lighter in color. Poplars or cottonwoods (*Populus*) make large trees, as do some willows, but the wood is weak, soft, and usually of no durability.

(3) *Other Deciduous Trees.*—Only the most important can be mentioned. Plane-tree, buttonwood, or sycamore (*Platanus occidentalis* of the Atlantic States, and a corresponding species in California) deserves notice on account of the size which the trunk may attain, but it soon becomes hollow, and the wood, which is handsome on account of the strong silver-grain, is useless for the purposes it would otherwise be well adapted for. The laurel family is represented in the East by the sassafras, and in California by a laurel (*Umbellularia californica*), the light-colored and variegated wood of which is extremely beautiful. Elms are given only to the eastern side of the continent, and white elm (*Ulmus americana*) is the most noted species, a large tree, with handsome but not very durable wood. Slippery elm (*U. pubescens*) is a smaller tree, and the reddish wood is tougher. The ashes are timber-trees of the first class, of which there are six species in the Atlantic and two in the Pacific States. The yellowish wood is very firm and tough, but comparatively light, straight-grained, and easy to work. White ash (*Fraxinus americana*) is the best and most used, and is unexcelled for purposes where strength, elasticity, and durability are needed, and it is preferred to chestnut for interior finish. Black ash (*F. nigra*), a smaller tree, has tougher wood, easily separable into layers, and is therefore used for hoops and strong basket-work. American holly (*Ilex opaca*) of the Atlantic States, like the European species, has a very fine-grained and compact white wood, used for ornamental cabinet-work, wooden screws, etc. Tupelo, pepperidge, or sour-gum trees (*Nyssa*) of two or three Atlantic States species, and sweet gum (*Liquidambar styraciflua*), mostly have a very tough wood, of various uses, but not much used as timber; and flowering dog-wood (*Cornus florida*), although the wood is prized, is seldom large enough to form a timber-tree. The Kentucky coffee-tree (*Gymnocladus dioicus*) is a stately tree, of peculiar aspect, with handsome rosy or brownish wood, well suited for cabinet-work. Honey-locust is of little account, but the true locust (*Robinia pseudacacia*) affords a timber equal to live-oak and red cedar in durability, especially valued for treenails and in naval architecture generally. Maples are fine trees, of which one species on the Pacific coast and two or three on the Atlantic side are important for timber. Sugar-maple (*Acer saccharum*) is much the most valuable, having a hard and close-grained wood, of light color and silky luster when polished, and the varieties called curled and bird's-eye maple are greatly prized for cabinet-work. The soft maples, so called from the character of their wood, are the white or silver maple (*A. saccharinum*) and the red or swamp maple (*A. rubrum*), the former a large and the latter a medium-sized tree, the wood of which is used for lasts, for carvings, etc. Lindens or limes, in the U. S. commonly called basswood, of which there are two well-marked species in the Atlantic, but none in the Pacific States, are first-class forest-trees for size, and their soft and white fine-grained wood is excellent for coach-bodies, interior of cabinets, and various purposes where lightness with moderate strength is demanded. Tulip-tree (*Liriodendron tulipifera*), sometimes called whitewood, but in the eastern part of the Mississippi valley (where it abounds and develops its noblest proportions) commonly known as poplar, has a light and soft wood, like that of the linden, but more valuable and much more extensively employed for the same purposes. This noble tree is of the magnolia family, which in the cucumber-tree and in the great-flowered magnolia of the Southern States furnishes two other fine trees of the same character of wood, but of comparatively small use.

(4) *Exotic Timber-trees.*—Those of Europe are analogues of those of the U. S.—i. e. different species of pine, larch, spruce, oak, beech, elm, ash, linden, etc., only the chestnut being the same or nearly so—but are far fewer in species and in kind, tulip-trees, gum-trees, locusts, hickories, sassafras, bald cypress, red wood, etc., being wholly wanting. As to foreign woods of tropical regions imported for the use of cabinetmakers—such as mahogany, Spanish cedar (*Cedrela odorata*), rosewood, lignum-vitæ, and the like—they are mostly treated under their names in this work. See FORESTRY and PRESERVATION OF TIMBER.

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**Timbre**: See ACOUSTICS and VOICE.

**Timbuc'too**: town of the Sudan, Central Africa; capital of the Fulbe state Massina; 10 miles N. of the Niger, near the desert of Sahara, in lat. 16° 49′ N., lon. 3° 7′ W. (see map of Africa, ref. 3-B). It is in an unhealthful and unproductive district; provisions have to be brought to it from distant places; but for the traffic between Northern and Central Africa it is of great importance, and although it has repeatedly suffered severely from being conquered and sacked by the Moors and by neighboring tribes, it has always risen again and is still increasing. Dates, European manufactures, firearms, gunpowder, tobacco, and paper are brought here through Sahara and exchanged for gums, ostrich-feathers, gold-dust, and palm oil. The rapid development of its commerce has been hindered by the rivalry and jealousy between the British and French merchants. The town is poorly built; it consists mainly of one-story mud huts and, with the exception of a mosque dating from 1325, it contains few buildings worth noticing. It was formerly surrounded by walls. The inhabitants, variously estimated at from 5,000 to 20,000, are indigenous Negroes, but mixed with them are Tuaregs, Fulahs, Bambarras, Mandingoes, Arabs, and representatives of the merchants of Mogadore, Morocco, Fez, and other places in Northern Africa. The city seems to date back to the twelfth century, but was visited by no European until Laing reached it in 1826. See Lenz, *Timbuktu, Reise durch Marocco, die Sahara, und den Sudan* (2 vols., 1884); Constantin, *Alger et Tombouctou* (1885); Caron, *De Port Louis au port de Tombouctou* (1891). Revised by M. W. HARRINGTON.

**Timby**, THEODORE RUGGLES, S. D., LL. D.: inventor; b. at Dover, N. Y., Apr. 5, 1822; he attended a common school, and early showed an inventive faculty; in 1841 submitted to the chiefs of engineering and ordnance a revolving battery to be constructed of iron, the first practical suggestion for the use of iron in the construction of military defensive works, and in 1843 filed a caveat in the U. S. Patent Office for "a metallic revolving fort to be used on land or water, and to be revolved by propelling engines located within the same, and acting upon suitable machinery"; in 1862 he made an agreement with the contractors and builders of the original Monitor for the use of his patent covering the turret system. The most important of his patents are the cordon of revolving towers across a channel (1862); the mole and tower system (1880); the subterraneous system (1881); the tower and shield system (1885); and the hemispheroidal system (1889). He also originated in 1862 the plan of firing heavy guns by electricity.

**Time** [O. Eng. *tīma*: Icel. *tīmi*: Dan. *tid*, time (an hour) < Teuton. **tī-*, found also in **tī-di* > Germ. *zeit*, time: Eng. *tide*. See TIDES]: The measurement of time is of such importance in modern life that a description of the methods by which it is made and the principles which govern it will be interesting. Measurements of long periods, months, and years depend on astronomical phenomena, especially the motions of the sun and moon. Measurements of fractions of a day are made by observing the different directions of the sun, or in our time by clocks and watches.

The longest unit of time which can be determined directly by observation is the year. This is the time occupied by the earth in one revolution around the sun; but, as shown in the article YEAR, there is a slight ambiguity as to the time when a revolution shall be regarded as complete. The sidereal year, which is properly that of the earth's revolution, is slightly longer than the solar year on which the seasons depend. Since it is the change of seasons which fixes the length of the year for practical purposes, the solar year is that universally used both in astronomy and in daily life. The next shorter unit of time is the lunar month or the interval between one new moon and the next. As this interval is neither an entire number of days nor an aliquot part of a year, it is no longer used as a measure of time. It has given way in most nations to the calendar month.

The most certain and exact measure of all is the day. This is the most obvious measure, because on it depends the alternation of day and night, and it is the most exact because the time of the earth's revolution on its axis remains unchanged, so far as observation has yet shown, from century to century. If it varies at all the change does not amount to one-thousandth of a second in a century. The time of one revolution of the earth on its axis is called the "sidereal day" because it is equal to the interval between two passages of a star across the meridian of a place. Owing to the annual revolution of the earth around the sun the sidereal day does not coincide with the interval between two transits of the sun over the meridian. If the sun and the star cross at the same moment to-day, the sun will be nearly four minutes later than the star in crossing to-morrow. In the course of a year the number of revolutions which the earth actually makes on its axis is one greater than the number of days; hence the sidereal day can not be used for the purposes of daily life and the solar day must take its place.

The true or apparent solar day is the interval between two transits of the sun over the meridian. Were this interval invariable no difficulty would be found in using the true solar day as a measure of time; but as a matter of fact it is always changing. Owing to the varying velocity of the earth in its orbit and to the obliquity of the ecliptic the difference between a transit of the sun and that of a star will sometimes change by more than four minutes and sometimes by less than four minutes in a day. Thus the solar days are a little longer at some seasons and a little shorter at others.

A hundred years ago, when men depended mainly on observations of the sun, or on a sun-dial or a meridian-mark, for their time, the difference caused no trouble, but when accurate clocks and watches were introduced they had to be constantly set forward or back in order to keep time with the sun. Thus arose the distinction between mean solar time and apparent solar time, two quantities which may be defined as follows:

*Apparent solar time* is time measured by the actual passage of the sun over the meridian. Owing to the variability of this measure, apparent time is a varying quantity. *Mean solar time* is defined by the motion of a fictitious sun called "the mean sun," which is imagined to move with perfect uniformity, being sometimes behind the true sun and sometimes in advance of it. The hours of this time are those measured by a perfectly regulated clock. The difference of these two times is called the *equation of time*. The diagram on the next page shows the way in which this equation varies in the course of a year. The straight line in the center of the diagram may be supposed to represent the equable course of mean time, while the curved line passes to the left or right of the straight one according as the sun is ahead of the mean-time clock or behind it. It will be seen that about Apr. 15, June 15, Aug. 31, and Dec. 24 the two lines cross; at those periods the mean-time clock and the sun coincide. From Dec. 24 until Apr. 15 the sun is behind the clock; the greatest difference occurs about Feb. 10, when the sun does not cross the meridian until about fifteen minutes past twelve by the clock. During May the sun is ahead of the clock, from June 15 to Aug. 31 behind it again, and then ahead of it from September until December. About Oct. 27 the sun is so far ahead as to pass the meridian sixteen minutes before noon by the clock.

*Local Time.*—On the system of measuring the day by the sun, noon at any place is the moment at which the mean sun passes the meridian of that place. To speak with more exactness, it is the moment at which the place passes under the sun as the earth revolves. Owing to the roundness of the earth different places pass under the sun at different times; one may say, in fact, that noon continually travels around the earth, reaching every part of it in succession during intervals of one day. Noon takes about three hours to pass from New York to San Francisco. When it is noon at San Francisco it is one o'clock in the region of the Rocky Mountains, two o'clock in the Mississippi valley, three o'clock in the Atlantic coast, four o'clock in Labrador, eight o'clock at Greenwich, etc. Hence, when it is noon at any one place, say New York, it is later than noon at every point farther east in longitude, and earlier at every point farther west. The difference is four minutes for every degree of longitude.

So long as men did not travel rapidly this difference of time caused no inconvenience; but when railways were in-

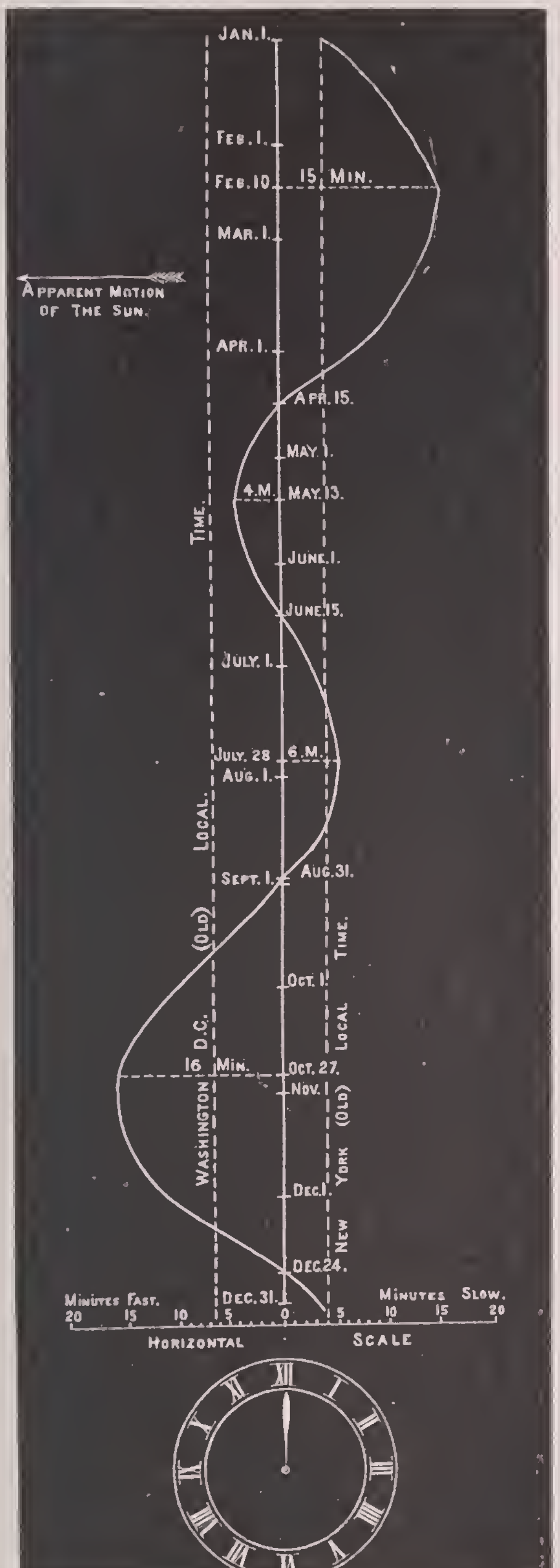



Diagram showing comparison of mean (or clock) time with solar (or apparent) time, at the several seasons of the year. The perpendicular central line represents mean time, and the curved line solar time, at mean noon. If the central line be taken to represent standard Eastern time, the dotted lines represent the local mean time for New York and Washington.

troduced it became a source of great confusion. The Bostonian visiting New York would find his watch eleven minutes fast. If he traveled farther west he would find his watch more and more ahead of the local time at every station he reached. Every railway chose its own meridian for running its trains, and a traveler could never determine at what time by his watch a train was booked to leave unless he knew what meridian the railway time was referred to. To lessen this confusion what is called standard time was introduced in 1883.

*Standard Time.*—The relation of standard time to local time is so little understood that some explanation is necessary. Suppose an astronomical clock to be set up some 6 miles E. of the Central High School of Philadelphia, across the Delaware river. Let the observer be able to fire a cannon, the sound of which could in imagination be heard all the way to the Mississippi valley. He knows the exact instant when the mean sun reaches his meridian. This instant is for him noon. At this moment of noon he fires his cannon. It would take thirty-eight seconds for the mean sun to pass from the observer's meridian to that of the High School. Supposing sound to travel instantaneously, an observer at the High School would hear the gun thirty-eight seconds before his own noon. Of course the farther we move toward the W. the longer it would take the mean sun to reach us, and therefore the earlier in the day we should hear the sound. An observer at Pittsburg would hear the report about twenty minutes before noon, and one at Newark, O., at half-past eleven. But an inhabitant of New York would not hear the report until four minutes past twelve at that place, because the mean sun marked noon for him four minutes before it marked noon for the observer E. of Philadelphia. On the meridian of Boston the report would be heard at sixteen minutes past their noon, and on the meridian of Calais, Me., the difference would be half an hour. Thus between the meridian of Calais, Me., and Newark, O., there would be a range of one hour in the local time. The rule for standard time then is simply this: That within this whole belt—that is, the belt included between the meridians of Calais, Me., and Newark, O., railways and the public shall use the time (which is called Eastern time) determined by the observer E. of Philadelphia, who, as we have placed him, is situated exactly 75° in longitude or five hours in time W. of Greenwich. Going farther west, say to Cincinnati, it will be more than half an hour before noon when the gun is heard—in fact, only twenty-three minutes past eleven. Therefore for Cincinnati a new meridian of 90° W. of Greenwich is taken, which passes near New Orleans, St. Louis, and Davenport. The mean sun crosses this meridian one hour after it crosses that at Philadelphia, and the moment of crossing is taken as noon, not only for all places on the meridian, but for all places within half an hour E. or W. of it; this time is called Central. At Denver the St. Louis noon gun would be heard at eleven o'clock. So we pass a new meridian near Denver, which is 105° W. of Greenwich, and which the sun does not reach until two hours after it has passed Philadelphia, and one hour after it has passed St. Louis. The time of this meridian (called Mountain time) is used for all the places whose time does not differ from it by more than half an hour. A fourth meridian is that of 120° from Greenwich, and it passes near the Pacific coast, E. of Sacramento and Stockton, where the time is called Pacific time. The moment when the sun crosses this meridian is taken for noon for all places not more than half an hour distant from it E. or W. Thus the traveler who wishes to know the time actually used at any railway station, or by the inhabitants of any city, has only to change his watch by one or more entire hours, the minutes remaining the same.

This is a great improvement on the old system, but every improvement in human affairs has its drawbacks, and standard time is no exception. The drawback in this case is that noon corresponds to the transit of the mean sun only on the four standard meridians of Philadelphia, St. Louis, Denver, and that of a point a little E. of Sacramento. If people had to set their watches by the sun, as they did a hundred years ago, this would be a great inconvenience. It is, however, little felt in these days of telegraphs and railways, when nearly every one to whom local time is important can set his watch by the clock of a railway station, or of a telegraph office. It might also be inconvenient if the farmer in Ohio were obliged to take his mid-day meal by standard time, which for him would mean the time of St. Louis. But if he deems this of importance he has only to set his dinner hour at half-past eleven instead of twelve. It will then correspond to the middle of his mean day or to his noon. If he is near the Pennsylvania border, where the time of the Philadelphia meridian is used, and he waits until half-past twelve by his standard time he will have his dinner at true noon at his place.

It must also be remembered in this connection that the almanac times of sunset necessarily correspond to the old local time, and not to standard time. Suppose, for example, that on the parallel of latitude for Philadelphia, which answers for New York, Pittsburg, Cincinnati, St. Louis, Denver, San Francisco, and in fact for almost the entire range of the Middle States, the sun is put down in the almanac as setting on a certain day at twenty minutes past six. The sun sets at Philadelphia five minutes after it does at New York, at Cincinnati thirty-seven minutes after it does at Philadelphia, and so on. It does not pass from place to place by jumps, but gradually, as the earth revolves. Twenty minutes past six, local time, at New York will be twenty-four minutes past six standard time, and so the standard time of sunset will differ four minutes from the almanac. At Newark, O., the error will be nearly half an hour in either direction, and although the almanac will give twenty minutes past six as the time of sunset, the standard time of sunset will be only ten minutes before seven. Hence if the almanac is used by the farmer to set his clock by sunset or sunrise, he must either use the local time of his own meridian or make a proper allowance, never more than half an hour, for the difference between his own meridian and the standard meridian.

In European countries, Greenwich time, six hours faster than Central time in the U. S., is used by the railways of Great Britain, Belgium, and Holland, and it is the legal time for all purposes in Great Britain and Belgium. Ireland uses Dublin time, and France that of Paris. Middle European time, one hour faster than Greenwich time, is used on the railways in Sweden, Germany, Austria-Hungary, Servia, and Western Turkey. It is the legal time for all purposes in Sweden and the German empire, and in 1894 was adopted in Denmark and Switzerland. Eastern European time, two hours faster than Greenwich time, is used by the railways of Eastern Turkey, Bulgaria, and Roumania. The time of the 135th degree of east longitude, nine hours faster than Greenwich time, is the official standard time used for all purposes in Japan. The Australasian colonies adopted standard time Jan. 31, 1895, thus making Melbourne, Sydney, and Brisbane time ten hours ahead of Greenwich time, while Adelaide, Perth, and Wellington are respectively nine, eight, and eleven hours ahead.

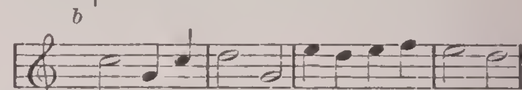
*Sidereal Time.*—Owing to the revolution of the earth around the sun, the sidereal day, as already defined, is three minutes fifty-five seconds shorter than the solar day. To state the case with entire precision, 365·2422 mean solar days, which is the solar year, are equal to 366·2422 sidereal days. In sidereal time the day is divided into twenty-four hours, the hour into sixty minutes, and the minute into sixty seconds, exactly as in solar time. The sidereal clock is one whose pendulum is a little shorter than that of the ordinary seconds clock, so as to keep sidereal time. All the units of this time are shorter than those of the solar time in the same proportion, and the sidereal clock gains one day in a year on the ordinary clock, which is a gain of nearly one second in six minutes. Once a year, at the vernal equinox, near Mar. 21, the two clocks agree. At all other times they differ. In astronomy, sidereal time is not used as a standard of measuring time, but only for finding or expressing the right ascensions of the heavenly bodies. S. NEWCOMB.

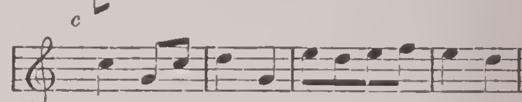
**Time**, in music: rhythm. Music, every sound, and every rest or intermission of sound, necessarily occupies some portion of time. The duration of such sound or rest is not absolute, but relative—i. e. it is not measured by clock-time, but depends upon the rate or speed assigned to any piece of music by the composer or performer. When that rate is once determined, then the duration of each individual note or sound is also determined, as would be the case with the minutes and seconds of a clock if its rate of motion were subject to change. Notes and rests represent portions of time in the order of 1, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, etc. If the duration of the semibreve should be equal to 8 seconds of time, then the minim would occupy 4 seconds, the crotchet 2, the quaver 1, and so on; and if the duration of the semibreve should be arbitrarily fixed at more or less than 8 seconds, the shorter notes must all conform and preserve their relative proportions. This is the simplest and most elementary office of time in music. (See LARGE and NOTATION.) Notes written in a continued series without any regular divisions or periodical accent, would be unmeaning and unfit for the expression of musical sentiment and beauty, except in very rudimentary forms. Regularity of accent and rhythm is at the foundation of all excellence in modern music, which is therefore written in regular periods, phrases, etc., with smaller divisions into measures or bars. These measures are of several kinds, representing various styles of movement and peculiarities of accent, the leading idea being that musical sounds tend to fall into rhythmical groups of equal duration, and that these groups may be reduced into two classes, having one, two, or four times in a bar, and the other having three. Regularity of rhythm is an essential element in all grades of musical composition. There is a certain degree of interest created in the mind even by the repeated strokes of a drum when marked off into groups by a periodical accent. In such a case there is no diversity of musical sound, but yet the mind receives pleasure from such regularly recurring accents or pulsations. A succession of such will naturally fall into groups of twos or threes, or, in technical language, it will be duple or triple, binary or ternary. Other distinctions, as imagined by musicians of the eighteenth century, are unreal and have no philosophical basis. The reduction of all musical times into the genera of duple and triple, says a writer, "would long ago have been recognized had music made advances equal to other arts and sciences." Duple or *common* time (embracing also the quadruple) contains two or four equal beats in a bar, with the accent on the first part of each bar, and (in the latter) an inferior accent on the third beat. In ordinary common time each bar contains a semibreve, or shorter notes unitedly equivalent to it in value. It is known by a large C at the clef, with or without a stroke drawn through it. In church music this time is often written with two semibreves or four minims in a bar. The figures $\frac{2}{4}$ indicate another mode of writing common time, every bar containing *two-fourths* (or the half) of a semibreve. These kinds of common time are essentially one. The ear can detect no difference between them if in performance a bar of one is made equal to a bar of the other in *velocity*. Thus the strain variously written at *a*, *b*, *c* in Ex. 1 might be played by three instruments simultaneously without the least difference being perceptible even to the most critical ear.

Ex. 1.—MM 𝅗𝅥 = 80.

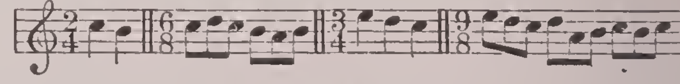
*a*

♩ = 80.

*b*

♪ = 80.

*c*

In regard to accent it was formerly assumed that in a bar with four equal beats the first only was accented, and in a bar of two equal beats the first was accented and the last unaccented. In actual practice, however, this nice distinction vanishes. Albrechtsberger remarks that the difference between these two is not a real one, as "a bar of four crotchets or beats is really only a double bar of two-crotchet time." *Triple* time contains three equal beats in each bar. Like common time, it may be written in minims, crotchets, or quavers, and marked as $\frac{3}{2}$, $\frac{3}{4}$, and $\frac{3}{8}$, which figures give the time-value of each bar as compared with the semibreve. In old collections of music, pieces may be found in $\frac{3}{16}$ time, each bar containing only three semiquavers, or their value in other notes or rests. *Compound* time is a modification of the above simple times, produced by a mingling of the triple element with the duple or quadruple; as when the two crotchets of a bar in two-four time are turned into two groups of three quavers each, or when the same process is applied to a bar in three-four or any other triple time. See Ex. 2, at *a* and *b*.

Ex. 2.—*a* *b*

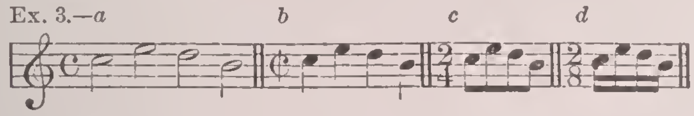


The forms of compound *common* time in most ordinary use are $\frac{6}{4}$ and $\frac{6}{8}$, the former having 6 crotchets (or their value) in each measure, and the latter having six quavers (or their value). The times marked $\frac{12}{8}$ (twelve quavers) and $\frac{12}{16}$ (twelve semiquavers) are less frequently used by modern composers. The forms of compound *triple* time are chiefly $\frac{9}{4}$, having the value of nine crotchets in each measure, and $\frac{9}{8}$, with the value of nine quavers. In the writings of the old masters, and even as late as the time of Beethoven, we find several other varieties of time (and various modes also of indicating the times already described), such as

$$\frac{2}{1}, \frac{2}{8}, \frac{3}{1}, \frac{4}{2}, \frac{4}{4}, \frac{4}{8}, \frac{4}{16}, \frac{6}{16}, \frac{9}{16}, \frac{12}{4}.$$

Much of the difficulty attending the study of musical time would disappear if it were borne in mind that the ear, and not the eye, is the proper judge in all questions of this nature. There are indeed certain reasons of convenience for writing common or triple time in four or five different modes, but the ear infallibly reduces them all to one, provided that they all proceed at the same rate. Everything, in fact, depends on velocity, for in an *adagio* in two-crotchet time every *quaver* may equal in duration a *minim* in moderately quick or four-minim time. The ear knows only one kind of common time; and the most experienced musician can not detect a difference between the groups at *a*, *b*, *c*, and *d* in Ex. 3 when performed at the same speed.

Ex. 3.—*a* *b* *c* *d*



That the same remarks will apply to the several forms of triple time needs no demonstration.

Revised by Dudley Buck.

**Timm**, Henry C.: See the Appendix.

**Timo'creon** (Gr. Τιμοκρέων) **of Iālȳsus**, in Rhodes: a lyric poet who took sides with the invaders during the Persian war. He is famous for his poetical tirade against Themistocles, and for his enmity against Simonides, the friend of Themistocles, was pilloried by Simonides in a familiar epitaph, which may be paraphrased:

> Hearty drinker, hearty eater,
> Hearty railer, hearty hater,
> Here I lie beneath this stone—
> Rhodian Timocreon.

The chief fragments are found in Plutarch's *Life of Themistocles.* See also Bergk's *Poetæ Lyrici Græci* (4th ed. vol. iii., pp. 536–541). B. L. G.

**Timo'leon** (Gr. Τιμολέων): a native of Corinth and a member of one of the most prominent families of the city. He put to death his brother, Timophanes, who attempted to overthrow the democratic constitution of their native city and make himself tyrant. In 344 B. C. an embassy arrived from Syracuse in Sicily, a colony of Corinth, and demanded the intervention of the mother city in the struggle between Hicetas and Dionysius the Younger, each of whom wished to become master of the city, and were ruining it by their strife. The aid was willingly granted, and Timoleon was appointed commander of the expedition. Although the armament was very small, he succeeded in expelling both Dionysius and Hicetas, established a democratic constitution, repeopled the city, and brought it in a very short time into a most flourishing state. This excited the jealousy of the Carthaginians, and under the command of Hasdrubal and Hamilcar they sent an army of 80,000 men against Syracuse, but Timoleon, although his force numbered only 12,000 men, attacked them while crossing the Crimissus, routed them completely in 339 B. C., and a treaty was concluded by which the Halycus was fixed as the boundary between the Greek and Carthaginian dominions in Sicily. He also expelled Hicetas from Leontini and Mamercus from Catana, introducing free constitutions in all the Greek cities of Sicily. The last years of his life he spent in retirement in Syracuse, living as a private citizen, though enjoying the greatest fame and honor throughout the Greek world. D. in 337 B. C. An annual festival was instituted in Syracuse in honor of his memory. Revised by J. R. S. Sterrett.

**Timon** (Gr. Τίμων): surnamed The Misanthrope; an Athenian citizen who lived at the time of the Peloponnesian war, and was embittered against mankind by the ingratitude of his friends. He is frequently alluded to by the comic poets of the period, was made the subject of one of Lucian's most famous dialogues, and has been rendered especially familiar by Shakspeare's play, which goes back ultimately to Lucian's dramatic sketch. *Timonium* was the name of Mark Antony's retreat at Alexandria and is the equivalent of "growlery." B. L. G.

**Timon of Phlius**: a man of letters who flourished at Athens about 275 B. C. His authorship was varied and multitudinous, embracing poetry and prose, tragedies, satyr-drama, elegy, but he is chiefly known as a satirist or writer of *Silli* (Σίλλοι). His brilliant satire was aimed at the dogmatic philosophers, for he himself was a skeptic, and the form which he employed, the heroic hexameter, is noteworthy, as it became the vehicle for the classic satire of Rome. The remains of Timon may be found in Diogenes Laertius, ix., 109–112. Ed. by Wachsmuth in *Corpusculum poesis epicæ ludibundæ* (1885). B. L. G.

**Timoor**: another spelling of the name Timur (*q. v.*).

**Timor**, tē-mōr': an island of the Malay Archipelago, the largest of the chain which stretches eastward from Java; between lat. 8° 16' and 10° 25' S., and between lon. 123° 25' and 127° 10' E.; area, 11,967 sq. miles. It is traversed from E. to W. by a range of lofty mountains, which everywhere show marks of volcanic agencies; earthquakes are frequent. Along the shore the districts are very fertile and densely peopled, and in these rice, sugar, indigo, papaw, sago, pineapples, and cocoanuts are cultivated. Buffaloes, oxen, pigs, and fowls are plentiful; turtles, pearl-oysters, and elegant coral are found along the shores; gold-dust and timber are exported. The inhabitants are partly Malayans, partly Oceanian Negroes, and as the population belongs to two different races, in the same manner the fauna and flora of the island belong to two continents, to Asia and to Australia. The Dutch have a residency, Kupang, in the southwestern part of the island, the Portuguese, a district (6,290 sq. miles with about 300,000 inhabitants) with the chief town, Deli, in the northeastern. Revised by M. W. Harrington.

**Timor-Laut**, -lowt', or **Tenim'ber Islands**: a group of islands belonging to the Malayan Archipelago, and lying E. of Timor. Their area is estimated at 2,120 sq. miles; their population at 20,000. The larger ones, Timor-Laut and Larat, are volcanic; the smaller of coral formation. Birds are numerous and brilliant, especially cockatoos.

**Timo'theus** (Gr. Τιμόθεος): the most admired Greek musician of his day; flourished toward the close of the fourth century B. C. His innovation consisted in the use of a chorus in rendering the so-called Nome (νόμος) and in the employment of mimetic action to enliven the delivery. B. L. G.

**Timothy**, or **Herd's-grass** [*timothy* is from Timothy Hanson, who carried the seed to the southern colonies of North America about 1720]: the *Phleum pratense*, one of the best of forage-grasses, a native of Europe, and much cultivated there and in the U. S. In Pennsylvania, etc., the red-top, *Agrostis vulgaris*, is called herd's-grass. Timothy will not stand close pasturage, but affords fine crops of the best of hay.

**Timothy** [from Lat. *Timo'theus* = Gr. Τιμόθεος, one who honors God]: a disciple and companion of Paul; b. at Lystra or Derbe in Lycaonia, Asia Minor, probably about 20 A. D., the offspring of a Greek father and a Jewess; was carefully trained in a knowledge of the Jewish Scriptures by his mother Eunice and his grandmother Lois, who were Christians, but was not circumcised until Paul in his second missionary journey selected him as a companion. He became the most constant and devoted of Paul's numerous fellow workers; was regarded by him with truly paternal affection, and employed as "the messenger of the churches," as the apostle's "other self," in the execution of the most responsible spiritual commissions, and was doubtless his amanuensis in the preparation of most of the Epistles, his name being associated with Paul's, in a manner to suggest some degree of joint authorship, at the head of the Second Epistle to the Corinthians, those to the Philippians and Colossians, and the two to the Thessalonians. Whether he shared in the voyage to Italy is uncertain, but he afterward appears at the side of Paul while a prisoner in Rome, and finally as overseer of the important church at Ephesus, where Paul addressed him two canonical Epistles. His later history is unknown, as the tradition of his martyrdom under Domitian rests upon no evidence. Revised by S. M. Jackson.

**Timothy, First and Second Epistles to**: epistles addressed by Paul to Timothy, the former in 64, the latter in 65 or 66, both from Rome. They are chiefly occupied with instruction in the duties of a spiritual teacher, mingled with some admonitions of a personal nature and some references to Timothy's personal history; and the Second Epistle is endowed with a peculiar interest from its references to Paul's anticipated martyrdom, this being probably the last extant production of his pen. With the similar letter to Titus they constitute the so-called Pastoral Epistles. See Pauline Epistles. Revised by S. M. Jackson.

**Tim'perley**, C. H.: printer and author; b. in Manchester, England, about 1794; entered the army, and was wounded at the battle of Waterloo; resumed his early occupation of engraver and copperplate printer, and in 1821 became a letter-press printer; wrote *Annals of Manchester*; *Printer's Manual* (1838); *Dictionary of Printers and Printing, with* *the Progress of Literature, etc.* (1839; the second edition of 1842 includes the two last works); *Songs of the Press, and other Poems relative to the Art of Printers and Printing* (1845). D. about 1848.

**Timrod**, HENRY: poet; b. in Charleston, S. C., Dec. 8, 1829. He was educated at the University of Georgia, studied law and supported himself as a private tutor until the civil war, when he became war correspondent for *The Charleston Mercury*, and in 1864 assistant editor of *The South Carolinian*, at Columbia. The burning of Columbia during Sherman's march to the sea broke up his business, and after two years of poverty and ill health he died at Columbia, Oct. 6, 1867. His *Poems*, many of which were inspired by the war, were published in 1873 in New York, with a memoir by Paul Hayne. H. A. BEERS.

**Tims**, THOMAS DILLON: financier; b. at Castle Polland, Ireland, Jan. 6, 1825; entered the civil service of Canada in 1858; in 1865 was appointed Government superintendent of engraving and printing of the first issue of legal-tender notes; in 1867 reported upon financial system for the Province of Quebec; same year placed in charge of Dominion affairs in Halifax; in 1868 appointed to inquire into the management of Government railways in Nova Scotia; 1868–72 organized financial department and savings-banks in Nova Scotia and New Brunswick; and 1872–73 established branches of the Finance Department and savings-banks in British Columbia and Manitoba. He was appointed financial inspector of the Dominion in 1870, and is inspector of Dominion savings-banks and sub-treasurer and auditor of Government railways. NEIL MACDONALD.

**Tim'sah, Lake** [Arab. *timsâḥ*, crocodile]: previous to Nov., 1862, a small body of brackish water in the middle of the Isthmus of Suez, but since the completion of the Suez Canal a lake covering about 6 sq. miles. It is one of a series of lakes intersected by the canal (the Bitter Lakes, Lake Balaḥ, and Lake Menzaleh), which appear to be the remains of an ancient strait separating Asia and Africa. It is supposed to be a portion of the *Kem-ur* (great black water) on the eastern Egyptian frontier mentioned in the papyrus of the twelfth dynasty, now in Berlin, and also a portion of the "sea of reeds" across which the Israelites passed at the Exodus. (Müller, *Asien und Europa*, Leipzig, 1893.) On Lake Timsah is the town of Ismailia, which served as headquarters during the construction of the canal. CHARLES R. GILLETT.

**Timuquan'an Indians**: a family of North American Indians named after an ancient town situated on St. John's river, Florida. The Timukua term *ati-muca*, ruler, lord, embodied in the title, perhaps refers here to a preponderating influence of that town, like the word capital. The area occupied by these people during the sixteenth and a part of the seventeenth century coincided very closely with the northern portion of what is now Florida; and the southern part of the peninsula, held by Calusan and Tekestan tribes, must have used dialects cognate with the Timukua. The oldest map of the region gives the names of thirty-eight villages, and other sources about twenty-two more. The names of the sixty towns are enumerated in the *Seventh Annual Report of the United States Bureau of Ethnology*. Nothing is known of the political subdivisions of this ancient people except the names of five head chiefs existing there in 1564: Saturiwa, Holata Utina, Potanu, Onetheaqua, and Hostaqua. But these are only local designations of five confederacies, for it was customary in those times to call chiefs by the names of their respective tribes. From the writings of the missionary Fr. Francisco Pareja (1612) it may be inferred that there existed at least seven dialects spoken by that people—Timukua, Potanu, Itafi, the Fresh-water District, Tucururu, Mocamu (on the coast), and Santa Lucia de Acuera. This last one probably corresponded with the dialect of the "province" of Asis, spoken on the west coast, N. of Cape Canaveral. To judge by the reports left by the chroniclers of the sixteenth century, these Indians were bold fighters and stubbornly opposed the Spanish invaders. About 1706 their villages were broken up by an armed mob from the English colonies during a war with the Spanish troops in Florida, and their remnants fled to the eastern shore of the peninsula. No trace of Indians speaking this language can be found, but in ancient times they must have been numerous. See De Bry, *Brevis narratio* (Frankfort-on-the-Main, 1591: sketches of the country and people, engravings, and map); Romans, *East and West Florida* (New York, 1775); Réné de Laudonnière's report in French's *Hist. Coll. of Louisiana* (New York, 1869). See also INDIANS OF NORTH AMERICA. F. W. HODGE.

**Timur'**, or **Tamerlane'** (the latter name being a corruption of TIMUR LENK—that is, Timur the Lame): Mongol conqueror; b. about 1336 at Kesh, near Samarcand, the son of a chief of a Mongol tribe and a descendant of Genghis Khan. In 1369 he became chief of his tribe, and from his capital, Samarcand, established a firm and orderly government in his dominions. He then set out on his career of conquest, which resulted in the subjugation of the whole of Central and Western Asia, from the Chinese wall to the Mediterranean and from the Siberian steppes to the mouth of the Ganges. In 1393 he stood on the banks of the Dnieper threatening Moscow, but he turned to the S., burnt Azof, and retreated into Asia. In 1398 he conquered Northern Hindustan, whence he sent an immense amount of booty to Samarcand, and meditated pushing onward to the S., when he was called by the Eastern emperor and some of the princes of Asia Minor to aid in repelling the Turks led by their great chief Bayazid (or Bajazet). On July 20, 1402, the two huge armies, led by Bajazet and Timur, met each other on the plain of Angora, and the Turks were completely routed; Bajazet himself was taken prisoner. In 1404 Timur prepared for a grand expedition to China, and in the beginning of the following year crossed the Jaxartes at the head of a large army of veteran troops, but died at Otrar, Feb. 17, 1405, and his empire soon became dismembered. His cruelty and that of his soldiers were beyond description. Thousands of his captives were put to death, and he is said on one occasion to have had an enormous pyramid built of the skulls of his slaughtered foes. As an administrator, however, he seems to have shown moderation as well as statesmanlike foresight and ability. See *Histoire de Timur-Bei* (4 vols., Paris, 1721; translated into French by Pietis de la Croix from the Persian text by Sharifu 'd-Din). F. M. COLBY.

**Tin** [O. Eng. *tin* : O. H. Germ. *zin* (> Mod. Germ. *zinn*): Icel. *tin* (Fr. *étain*, Lat. *stan'num*)]: a lustrous, white metal, not easily affected even by moist air at low temperatures; soft, malleable, of low tenacity, quite ductile at 212° F. (100° C.), a moderately good conductor of heat and electricity; not sensibly volatile at ordinary furnace-heat, fusing at 442° F. (227·8° C.), having after fusion a specific gravity of 7·292. Very pure tin in blocks is sometimes disintegrated by extreme cold. It is one of the oldest of known metals, being mentioned in the Pentateuch, and obtained long before the Christian era by the Phœnicians from the British isles, hence called Cassiterides (from κασσίτερος, tin). Pliny's *stannum* was an alloy of silver and lead, perhaps also tin, which he called *plumbum album*, white lead; the alchemists called it Jupiter, and gave it the symbol of that planet, ♃. The most important ore is the oxide, called cassiterite, tinstone, and tin ore; it occurs in veins, when it is called mine tin, and also as rolled pebbles in alluvial deposits, furnishing excellent ore, known as stream-tin and wood-tin. It is generally a dark-brown mineral, very hard, of sp. gr. 6·4 to 7·1; crystallizing in tetragonal prisms, with pyramidal ends; generally has a high, vitreous luster, and contains 78·67 per cent. of tin. A far less abundant and less valuable ore is stannite or tin-pyrites, a sulphide of tin, copper, iron, and zinc, with 27·2 per cent. of tin and 29·3 per cent. of copper. Native metallic tin has probably never been found. A little tin has been detected in meteoric iron, some zinc-blendes, and several rare minerals.

According to Charles M. Rolker, in *The Mineral Resources of the United States for 1894* (U. S. Geological Survey), the supply of tin has steadily increased from about 50,000 gross tons in 1886 to the following quantities in 1894:

| | |
|---|---|
| England ...long tons | 8,800 |
| Straits Settlements, shipped to Europe and America | 46,724 |
| Straits Settlements, shipped to India and China | 4,655 |
| Banca, sales to Holland | 6,139 |
| Billitong, sales to Holland and Java | 4,764 |
| Bolivian, imported into England | 3,482 |
| Sing Kep | 261 |
| Mexico | 10 |
| Japan | 40 |
| Burma | 65 |
| Russia | 8 |
| Portugal and Spain | 258 |
| Germany | 950 |
| Austria | 65 |
| Total | 82,045 |

To this should be added about 10,000 tons produced by the Australasian colonies.

Rolker estimates that of this total 82 per cent. is derived from stream-tin. The principal source of tin is the Malay peninsula, and notably Perak, a state under British protection on the west coast, which is divided by three mountain-chains into three plains parallel to the coast-line, the Larut, Perak, and Kinta valleys. The deposits are alluvial, and although the tin-bearing stratum is regularly distributed throughout the deeper plains, it assumes proportions worthy of working only within a certain distance of the foot-hills. It is covered with 6 to 26 feet of unproductive overburden, and carries from 2 lb. and upward of tin-stone to the cubic yard. The tin-stone is generally deep brown, but is found whitish gray and rose in color in the Kinta valley. Perak produced in 1893 18,821 long tons of tin. Next to Perak in importance are the deposits of Selangor, a native state under British protection, the principal district being the Kwalla Lumpor. Sometimes as many as three stanniferous layers occur, running in depth from 3 to 40 feet; the average value of the gravel is 0·5 per cent. of tin-stone. The total product of Selangor in 1890 was 8,798 long tons. Some tin is also mined in Pahang, Malacca, Sunjie-Ujong, and in the Siamese states. In all of these sections coolie labor is employed in washing the gravel, and the majority of the diggings are worked by Chinese companies.

In Burma tin is found on the Tenasserim river and its tributaries. The mines of the island of Banca are largely owned by the Dutch Government. They are washings, the tin-bearing layer of about 3 feet in thickness being covered by 25 to 35 feet of overburden. The average product per man per annum is 0·72 ton of tin. In the fiscal year 1891–92 Banca produced 5,755 gross tons of tin, the principal districts being Djebos, Blinjoe, Soengeiliat, Merawang, Pairg-Kalpinang, and Soengleisleian. Nearly all the metal coming from Billitong and the adjoining island of Sing Kep comes from alluvial diggings, the principal districts being Manggar, Poeding, and Linggar. The total product in the washing season 1891–92 was 6,384 gross tons. A sliding scale of paying wages to the coolies prevails, they being guaranteed a minimum of $48.24 for the working year.

Nearly every Australian colony produces some tin. In New South Wales, which reached a maximum of 8,680 tons in 1883 and produced 2,637 tons in 1893, both lode-mining and stream-washing are pursued, the latter being more important. Two groups of tin-drifts are known—those of recent origin and the Tertiary deep leads capped by lava, in which the gravel is often so cemented together as to make crushing necessary. These Tertiary river-channels are at a depth of 20 to 137 feet, and vary in width from 18 to 400 feet. The stanniferous layer is usually 3 feet thick, but swells up to 13 feet. In Queensland, which produced 2,389 tons of tin ore in 1892, the leading alluvial districts are the Severn river and the Wild river diggings.

Tasmania has been an important tin-producer, and promises to continue to be so. Its maximum product was in 1878, with 5,369 tons, the output in 1893 having been 3,129 tons of white tin. The alluvial deposits, which range in age from Miocene to recent, are in the northeast district along the valleys of the Ringarooma and George's river. It is for lode-mining, however, that Tasmania is conspicuous, the principal dependence being large stockwerks or impregnations of granite low in tin, some of them paying for working down below 1 per cent. of tin ore. The Mt. Bischoff is the most famous of these mines, having paid during a brief career 210 dividends, to 1894 aggregating £1,342,500. In 1892 the company worked 70,584 tons of rock and 960 tons of concentrated sands, which yielded 2,235 tons of black tin containing 68·31 per cent. of tin.

Tin has been continuously mined in Cornwall from the time of the Phœnicians, and for many centuries was the principal source of supply for the world. The ore is found in the "Killas," a metamorphic clay slate, and along its line of junction with granite. In some instances the mines have reached great depth, and some of them have penetrated to considerable distances under the sea. A number of them are still very remunerative, but on the whole the Cornish tin-mining industry has declined in importance.

In Bolivia tin deposits are met at intervals along the eastern border of the Bolivian table-land from Lake Titicaca to near the Argentine boundary. The principal mines are those of the Potosí and Oruro, the tin being sometimes associated with silver.

Germany has old tin mines at Zinnwald, Kahlenberg, and Altenberg, Saxony, while Schlaggenwald and Graupen were once famous producers in Austria.

In Mexico some mining has been done in the state of Durango.

In the U. S. efforts at mining have been made in the greisen lodes on King's Mountain, N. C., at the Martha Cash mine, Irish Creek, Rockbridge co., Va., and at the Broad Arrow deposit, Clay co., Ala. In the Black Hills, S. D., very extensive prospecting has been done at Harney's Peak, and large works were built, but no production of any consequence has been recorded. For a brief period tin-mining was conducted at Temescal on the San Jacinto estate near Riverside, Cal., but the operation did not pay. Tin is reported also from Texas at Barringer Hill, Llano County, and on Herman and Willow creeks, Mason County, but no work has been done.

The most important alloys of tin are britannia metal, 75 to 94 parts of tin, 5 to 10 parts of antimony, and 2 to 8 parts of bismuth; pewter, 4 of tin and 1 of lead; queen's metal, 9 of tin and 1 each of antimony, bismuth, and lead; fine solder, 2 of tin and 1 of lead; common solder, equal parts of each; coarse solder, 2 of lead and 1 of tin; speculum metal, 1 of tin and 2 of copper (but variable) with sometimes a little arsenic; bell metal, 78 of copper and 22 of tin, with sometimes a little zinc and lead; bronze, with less tin than bell metal, and with 3 to 4 of zinc; gun-metal, best with 9 of copper and 1 of tin; sheathing for ships, 32 of copper and 1 of tin; fusible metal, with 1 of lead, 2 of bismuth, and 1 of tin (fuses at 200·7° F.); amalgam of tin and mercury for coating mirrors; and Babbitt metal; type metal, also, for fine work, contains a little tin. Melted tin is used to coat sheet-iron (tin-plate) and copper; copper, zinc, brass, and iron can also be tinned in the wet way; and tin has been successfully deposited on textile fabrics. Phosphor-tin is largely used for the manufacture of phosphor-bronze. See TIN-PLATE.

COMPOUNDS OF TIN.—Stannous chloride, $SnCl_2$, is formed by dissolving tin in hydrochloric acid; it is a powerful reducing agent, and is used as a mordant under the name of *salt of tin*. Stannic chloride, $SnCl_4$, can be formed by heating corrosive sublimate with tin filings, or by passing chlorine over melted tin. It forms with chloride of ammonium a double salt, called *pink salt*, used for a red dye. An impure stannic chloride, formed by the action of nitric and hydrochloric acids on tin, is used for brightening and fixing red colors, under the name of *nitro-muriate of tin*, *composition*, or *tin solution*. Stannous oxide, SnO, stannous hydrate, $Sn_2H_2O_3$, and sesquioxide of tin, $Sn_2O_3$, are unimportant commercially. Stannic oxide, $SnO_2$ (*putty powder*), is formed when tin is heated above fusion in the air. It forms two hydrates; one of these, stannic acid, $H_2SnO_3$, forms various stannates, the stannate of soda being used as a mordant in calico-printing; arsenic-stannate of soda is also employed. The other is metastannic acid, produced by the action of nitric acid of sp. gr. 1·3 upon tin. Dried at 212° F. (100° C.), it is $H_{10}Sn_5O_{15}$. It becomes anhydrous on ignition. Monosulphide of tin, SnS, and sesquisulphide, $Sn_2S_3$, are of little interest. The bisulphide, $SnS_2$ (*mosaic gold*), can be obtained by powdering an amalgam of 12 parts of tin and 6 of mercury, and heating it in a flask with 7 parts of sulphur and 6 of sal-ammoniac; other proportions are also used. Tin forms many other chemical compounds of little general interest. Revised by CHARLES KIRCHHOFF.

**Tinam'idæ** [Mod. Lat., named from *Tin'amus*, the typical genus, from Fr. *tinamou*, from the S. Amer. name]: a family of birds, the sole one of the order *Crypturi*, containing the tinamous, a group of remarkable species of small or medium size, peculiar to Central and South America. They are characterized by having the bones of the palate arranged as in the ostriches, the bones of the pelvis free behind, and a keeled sternum of peculiar pattern. Although Huxley kept the *Tinamidæ* with the *Carinatæ*, he recognized the importance of the above combination of characters, by making the group one of the four main divisions of that section. Other writers justly consider that the divisions *Ratitæ* and *Carinatæ* are not natural, and that this fact is well shown by the *Tinamidæ*. Dr. Stejneger places them in the superorder *Dromæognathæ*, just after the apteryxes, while Dr. Fürbringer puts them in the *Alectornithes*, between the apteryxes and fowls. In external appearance the species resemble the quails and partridges more than any other familiar birds; the head is rather small, the neck rather short, and the back and tail depressed; the bill is rather slender and mostly straight, but more or less decurved at the tip, and with the upper mandible overhanging the lower; the base is covered with a membrane which encroaches on the nostrils; the wings are rounded behind, concave, and short; the tail is short, and sometimes quite rudimentary, and more or less concealed by the decumbent coverts; the tarsi moderate or stout, and provided with large plates in front, the anterior toes well developed and entirely free, the posterior small and elevated or wanting; the claws are curved. The species differ in habits, some inhabiting the thickest forests and others open plains. They feed chiefly on grains, and indeed resemble in many respects the partridges, etc., which they replace in South America. The females generally lay about a dozen (but some not more than half a dozen) eggs, which look as if polished, and are deposited in rude nests made on the ground. The young follow their mother as soon as hatched. There are about fifty species, distributed among the genera *Tinamus*, *Nothocercus*, *Crypturus*, *Rhynchotus*, *Nothoprocta*, *Nothura*, *Taoniscus*, *Eudromias*, and *Tinamotis*. Revised by F. A. Lucas.

**Tinamou**: See Tinamidæ.

**Tincal**: See Borax.

**Tincker**, Mary Agnes: novelist; b. at Ellsworth, Me., July 18, 1833. She was educated at the academy at Blue Hill, Me.; became a Roman Catholic in 1863 and served as a hospital nurse at Washington during a part of the civil war. She afterward lived in Boston till 1873, when she went to Italy, returning to Boston in 1887. She has been a frequent contributor to *The Catholic World*, and has published a number of works of fiction, including *The House of Yorke* (1872); *Signor Monaldini's Niece* (1879); *By the Tiber* (1881); *The Jewel in the Lotus* (1884); *Aurora* (1885); and *Two Coronets* (1889). H. A. Beers.

**Tinctures** [from Lat. *tinctu'ra*, a dyeing, deriv. of *tingere*, *tinc'tum*, tinge, dye, whence Eng. *tinge*, *tint*]: in pharmacy, solutions of medicinal substances in alcohol. In their preparation the medicine should be dried and pulverized, and as a rule it is found advantageous to use diluted or aqueous alcohol as the solvent, as by this means numerous substances which are insoluble in anhydrous alcohol can be brought into solution; but many of the tinctures prepared in this way undergo acetous fermentation, which difficulty is best obviated by preserving them in well-closed and completely filled bottles. Maceration and digestion accelerate the preparation of tinctures, but percolation is extensively practiced. Occasionally the expressed juice of the plant is dissolved in alcohol, which method is especially applicable to the preparation of tinctures of narcotics, such as conium and belladonna. Revised by H. A. Hare.

**Tindal**, Matthew, LL. D.: deistical writer; b. at Beer Ferris, Devonshire, England, in 1657; studied at Oxford, where he took his degree in 1676; became fellow of All Souls 1677, and in 1685 was made LL. D., shortly after which he went over to the Roman Catholic Church, but returned to the Church of England when the revolution of 1688 seemed imminent. After the revolution he held several legal positions, and received from the crown a pension of £200. He took an active part in the polemics of his day, and in 1706 published *The Rights of the Church Asserted*, in which he took ground against the prevalent High Church doctrines. This gave rise to sharp controversies, during which he put forth two *Defenses*, in which he treated of the obedience due to princes, the law of nations, the liberty of the press, and the rights of mankind in matters of faith. In 1710 he issued a pamphlet, the *New High Church turned Old Presbyterian*, in opposition to the famous sermon of Dr. Sacheverell. The House of Commons ordered the productions of both controversialists to be burned publicly. In 1730 he put forth his most noted work, *Christianity as Old as the Creation*, in which he argued that in Christianity there was nothing which human reason might not have discovered without a special revelation; this called forth a host of replies, and a defense by himself of the doctrines which he had advanced. He also wrote a second volume of his work, of which only the preface has been published. D. at Oxford, Aug. 16, 1733. Revised by S. M. Jackson.

**Tindale**, William: See Tyndale, William.

**Tinder** [O. Eng. *tynder*: O. H. Germ. *zuntara* (> Mod. Germ. *zunder*): Icel. *tundr*; cf. Germ. *zünden*, kindle]: a material, usually composed of half-burned linen, formerly used in kindling fires. A flint and steel ignited the tinder, which inflamed in turn a sulphur match. Amadou, touchwood, and touch-paper were substitutes for tinder.

**Tinea**: See Favus.

**Tine'idæ** [Mod. Lat., named from *Ti'nea*, the typical genus, from Lat. *ti'nea*, worm, moth]: a family of *Lepidoptera* including many species, among them the moths so destructive to clothes. The developed insects are of small size, have a slender body, elongated, narrow wings, which when the insect is at rest are rolled round the body, and which are edged with long fringes; the maxillary palpi are very large, and the antennæ are long and filiform. The larvæ are elongate, and generally provided with numerous (14 to 18) feet, although occasionally entirely footless. They differ among themselves chiefly in the form and furniture of the head (whether hairy or naked), the development of the maxillary and labial palpi, and the form of the wings. The imagines are found mostly on the sheltered side of hedges, etc.; the larvæ burrow in leaves, stems, grain, etc., of plants, as well as other substances, such as cloth. The most notable species are the clothes moth (*Tinea flavifrontella*), the carpet moth (*Tinea tapetzella*), and the grain moths (*Tinea granella* and *Gelechia cerealella*). The clothes moth is light buff, glanced with a silvery iridescence on the wings and tawny on the head. It makes its appearance in the Northern U. S. in May or June. The female lays her eggs in cloth, generally woolens, sometimes cotton, and whitish larvæ are soon hatched therefrom. The carpet moth has yellowish-white but black-based fore wings, dark-gray hind wings, and white head. Benzine and carbolic acid, and precautions as to cleanliness, are the best antidotes to the ravages of these little pests. Revised by E. A. Birge.

**Tinel**, Edgar: composer; b. in Belgium, Mar. 27, 1854; educated at first by his father, who was a schoolmaster and organist. In 1863 he entered the conservatory in Brussels, and in 1873 carried off the first prize for piano-playing. He also at this time made his first essays on composition. In 1877 he won the Prix de Rome with a cantata *De Klooke Roeland*, and when Lemmens died in 1881 he succeeded him as organist of the church in Mechlin. He has composed some fine organ music, incidental music for Corneille's *Polyeucte*, and other works. His greatest work is his oratorio *St. Francis d'Assisi* to a text by the Flemish poet Lodewijk de Koninck. It has been performed in Berlin and New York. D. E. Hervey.

**Tin-foil**: See Foil.

**Tinghai**: See Chusan.

**Tinker's Weed**: See Feverwort.

**Tinne**, tin'ne, Alexandrina Petronella Francina: traveler; b. at The Hague, Holland, Oct. 17, 1839, the only child of a rich English merchant; received an excellent education; traveled after the death of her father through most European countries, Syria, Palestine, Egypt, etc., and settled in 1861 in Cairo. From Feb. 2, 1863, to Mar. 29, 1864, she undertook a grand journey of exploration from Khartum to the Bahr el-Ghazal, the western arm of the White Nile. She invited Baron von Heuglin and Dr. Steudner to accompany her, and the valuable scientific results of the expedition were communicated in John A. Tinne's *Geographical Notes of an Expedition in Central Africa*, in the *Transactions* of the Historic Society of Lancashire and Cheshire (Liverpool, 1864); von Heuglin's *Die Tinnesche Expedition im westlichen Nilquellgebiet*, supplement to Petermann's *Mittheilungen* (1865); and Th. Kotschy and Peyritsch's *Plantæ Tinneanæ* (1867). From Tripoli she started on another expedition, Jan. 30, 1869, with the purpose of reaching the upper Nile through Bornu, but at Fezzan she was murdered by her Arab attendants, Aug. 1, 1869.

Revised by M. W. Harrington.

**Tinnevel'li**: town and district of the southernmost part of Madras, British India (see map of Southern India, ref. 8–E). The former is an important Protestant missionary center, and contains a Hindu college. Pop. (1891) 24,768.

**Tino**: same as Tenos (*q. v.*).

**Tinoc'eras** [Mod. Lat.: Gr. τίνεσθαι, punish + κέρας, horn]: a genus of extinct herbivorous mammals from the Eocene of Wyoming and Utah, and the first known representative of a remarkable group now regarded as forming a distinct order, Dinocerata, so named from the best-known genus, *Dinoceras*. This genus may be taken as typical of the order, and its principal characters are as follows: The skull is long and narrow, the facial portion being much produced. It supports three separate pairs of osseous elevations, some of which may have been the bony support for horns. They form the most conspicuous feature of the skull, and suggested the name of the genus, "the terrible-horned." The smallest pair are near the end of the nasal bones; a larger pair rise from the maxillary or cheek bones, in front of the orbits; while the largest pair are on the parietal bones, and are supported by an enormous crest, which extends from near the orbits around the lateral and posterior margins of the cranium, nearly surrounding a deep depression upon the crown of the head. The dental formula in *Dinoceras* is as follows: incisors, $\frac{0-0}{3-3}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{3-3}{3-3}$; molars, $\frac{3-3}{3-3}$. The premaxillaries are toothless, as in ruminants, and may have supported a callous pad also, as in that group. The upper canine teeth are deeply implanted in the maxillary bones. They are long, decurved, and trenchant, separated by an interval from the molar teeth, which are comparatively small. The lower incisors and canines were approximate, projecting forward, and separated from the small molars. The lower jaw sends down a massive process on each side near its extremity, apparently for the support and protection of the large upper canines while the mouth was closed. The cervical vertebræ are longer than in the elephant, while the legs are short and the skull elongated, so that the head could easily reach the ground. The feet were short and stout, and there were five toes before and behind, but the carpal bones form interlocking series, and the astragalus articulated with both the navicular and cuboid bones. The metapodial bones are of moderate length, and their articular surfaces for the phalanges nearly flat, or even concave, indicating but little motion in the toes. In the hind limb when at rest the knee-joint was straight, as in the elephant and man, instead of being considerably flexed, as in nearly all quadrupeds. The brain-cavity of *Dinoceras*, however, is the most remarkable feature of this remarkable genus. It proves that the brain was smaller than any more recent mammal, whether living or fossil, and was even less than in some reptiles. The entire brain was so diminutive that it could perhaps have been drawn through the neural canal of all the presacral vertebræ, certainly through the cervicals and lumbars. Besides the genera already mentioned, there was at least one other, *Uintatherium*, closely allied. These animals were all large, some of them nearly equaling the elephant in size.

O. C. MARSH.

**Tin-plate**: sheet-iron or sheet-steel coated with tin. *Terne-plate* is sheet-iron or sheet-steel coated with an alloy of tin and lead, the latter predominating. The manufacture of tin-plate originated in Bohemia prior to 1600. Early in the seventeenth century it was introduced into Saxony. In 1625 Andrew Yarranton visited Saxony, and learning the methods of manufacture, started works on a small scale at Pontypool, Monmouthshire, England, but failed to continue the enterprise. In 1720 John Hanbury built a plant at Pontypool. This second start led to the development of the industry in Wales, which soon dwarfed the production of the older centers, and gave the principality the unchallenged control until the industry was finally successfully introduced in the U. S. In 1872 and 1873 two firms, Rogers & Burchfield, of Leechburg, Pa., and the United States Tin Plate Company, at Demmler, near Pittsburg, Pa., started the manufacture of tin-plate, but were forced to abandon it. It was not until the passage of the Tariff Act in 1890, which granted a protection of 2·2 cents a pound under certain conditions, that the manufacture was started on a large scale by numerous concerns. The principal aid to its establishment was the low price of steel. Formerly the sheets to be coated were made of iron, the production of which involved a large expenditure of skilled labor. The introduction of steel as the new material, with its substitution of machinery for labor, brought the labor cost per unit of product so much closer on both sides of the Atlantic that numerous works have been started since the passage of the Tariff Act in 1894, which reduced the duty to 1·2 cents per pound.

Originally the sheets were made from iron produced with charcoal as a fuel, so that when pig-iron smelted with coke was puddled to make the sheets, the term "coke tin-plates" was introduced to designate this method of manufacture. Now no charcoal is employed, so that the term charcoal plates refers merely to the quality, and openhearth and Bessemer steel have almost entirely superseded puddled iron. The method of manufacture may be described as follows: The steel ingot as cast in the steel-works is rolled into a bar about 7 inches wide and from ½ to ⅝ inch in thickness, which is sheared into lengths weighing about 19 lb. each. The bar after being heated is rolled as a single plate until it can be easily doubled, that is, the sheet can be folded over. When this point has been reached the sheet is folded over, reheated, and is then rolled doubled up. The reheating, doubling, and rolling is repeated three times, so that a pack is produced which consists of eight sheets. After the pack has been trimmed and squared the sheets are separated from one another. During the process of reheating and rolling the sheets have been covered with a layer of scale. The black plates, as they are called, must be cleaned by pickling in hot dilute sulphuric acid. This black-pickling is now done in machines, which also provide for the washing away of the acid adhering to the plates. The continued rolling has hardened the steel, but this is softened by annealing, which is accomplished by exposing the sheets in tightly closed iron vessels to a dull red heat for a period varying from ten to twenty hours. In order to smooth the surface of the sheets they are rolled when cold, the operation being repeated if necessary. This hardens the steel, which is again annealed and finally is pickled, this "white pickling" being done in a more diluted solution. The sheets are then ready to be tinned. The apparatus consists of a set of pots, heated by fire-places. The first operation is to plunge the plates into heated palm oil, to remove the moisture and heat the sheets. Then they are allowed to soak for a while in a pot filled with molten tin covered with palm oil. The tinman passes them over to the washman, who allows them to remain for a little while in a pot filled with molten tin, and brushes both sides carefully. Finally they are passed into the patent pot filled with tin, in which a series of rollers revolve through which the plates pass singly, stripping off the surplus material and by their tension determining the thickness of the coating of tin. There are a number of different designs of such patent pots, among the leading ones being the Morewood, Leyshon, Newbold, and Norton. The plates are finally rubbed with bran and with sheepskin, are sorted, and are packed into boxes.

The standard sizes are 10 inches by 14 inches, or 14 inches by 20 inches, the thickness or gauge varying. The latter is designated by arbitrary marks, IC being No. 30 gauge, weighing 107 lb. per box of 112 sheets of 14 inches by 24 inches; IX is of No. 28 gauge, IXX of No. 26 gauge, and IXXX of No. 24 gauge. For several years lighter plates weighing 80, 85, 90, 95, and 100 lb. per box of 112 sheets, 14 by 24 inches, have been made.

No exact statistics of production of tin-plate in Wales are available. The exports were 448,379 gross tons in 1891, and 379,172 gross tons in 1893. The British home consumption was estimated at 65,000 to 75,000 tons. The U. S. imported the bulk of the Welsh tin-plate. The maximum was reached in 1889, when the imports were 331,311 gross tons. In 1900 the quantity imported was 60,318 gross tons. Since 1891 the production of tin-plate in the U. S. has expanded very rapidly. It reached 113,666 tons in 1895 and amounted to 302,655 tons in 1900.

CHARLES KIRCHHOFF.

**Tintoretto**: See ROBUSTI, JACOPO.

**Tio'ga River**: a river which rises in the west part of Bradford co., Pa. Its general course is northward through Tioga co., Pa. At Painted Post, Steuben co., N. Y., its waters enter the Chemung river. The upper part of Tioga valley affords much semi-bituminous coal of great value.

**Tipitapa** (river): See NICARAGUA.

**Tippecanoe' City**: village; Miami co., O.; on the Great Miami river, and the Cin., Ham. and Dayton Railroad; 14 miles N. of Dayton, 14 miles S. of Piqua (for location, see map of Ohio, ref. 5–C). It contains manufactories of paper, glucose, excelsior, flour, and brooms, a high school, a national bank with capital of $60,000, and a weekly newspaper. Pop. (1880) 1,401; (1890) 1,465; (1900) 1,703.

**Tippecanoe River**: a river of Indiana, rising in Tippecanoe Lake, Kosciusko County. It pursues a devious S. W. course for 200 miles, and falls into the Wabash. On the banks of this river, at the present village of Battle Ground, in the county and township of Tippecanoe, Gen. Harrison fought and defeated the Indian tribes commanded by the Prophet, the brother of Tecumseh, Nov. 7, 1811. In the middle of the night, when the whole force, consisting of 300 regular troops and 500 militiamen, was asleep, the Indians suddenly made the attack upon the camp. A desperate fight ensued, the Indians several times advancing and retreating; but after daylight they were finally defeated and dispersed by the two mounted companies belonging to Harrison's force. They left forty of their dead on the field; Harrison's loss was sixty killed and twice as many wounded. On the following day the Prophet's city was visited; it was found completely deserted, and was burned down. Harrison, nevertheless, considered it prudent to effect a speedy retreat, more especially on account of the great number of wounded with which he was encumbered, and he consequently fell back upon Vincennes. Revised by F. M. COLBY.

**Tip'perah**: name of a tribe, a feudatory state, and a district of Northeast British India. The tribe is of Tibet-Burmese relationship, occupies the parts of Bengal and Assam adjoining Upper Burma, and numbers about 60,000, of whom about two-thirds are in the principality, one-fourth in the British district, and the remainder in Assam. The native state is called Hill Tipperah by the British and lies in the extreme east of Bengal, adjoining Assam and Upper Burma with the district of Tipperah on the W. and Noakhali and Chittagong on the S. Area, 4,086 sq. miles. Pop. about 100,000. The rajah belongs to the Tipperah tribe. The country is hilly with much jungle and swamp and many rivers. Travel is chiefly by boat; the principal crop is rice; the government is despotic and patriarchal. There are no towns, and Agartala, the capital, is simply the residence of the rajah. The district of Tipperah lies between the preceding and the river Meghna. Area, 2,491 sq. miles. Pop. 1,500,000. It is flat and open, abundantly supplied with streams, many of which are affected by the tide; is fairly fertile and principally devoted to rice; and is traversed N. and S. by a railway. The capital is Comillah (pop. about 15,000), and the largest town Brahmanbaria (17,500).

MARK W. HARRINGTON.

**Tippera'ry**: county; in the province of Munster, Ireland. Area, 1,659 sq. miles. For the most part, the county lies in the basin of the river Suir, and touches the Shannon on the N. W. The surface is generally level, and the mountains which diversify it are rather groups of peaks than portions of connected ranges. These mountains are the Galtees (3,000 feet high), Knockmeledown (2,700 feet), and Slievenamon on the S., Keeper Mountain (2,100 feet) on the W., and the Slievardagh Hills on the E.; completely isolated is the curious peak the Devil's Bit, the center and source of many popular legends. The soil is a rich calcareous loam, and in the district called the Golden Vale, around the town of Tipperary, is exceedingly fertile and productive. Agriculture, especially dairy-farming, is the principal occupation. Coal, copper, lead, and zinc are found, but not worked, and the formerly flourishing woolen-trade is nearly extinct. The antiquities of the county are numerous and interesting, both those from the Anglo-Norman and Celtic periods. The ruins of Holy Cross, in the city of Cashel, is a noble specimen of the monastic remains of the mediæval period, as the Castle of Cahir is of the military and baronial architecture of the same age. Pop. (1891) 172,882. Tipperary, the county-town, 110 miles by rail S. W. of Dublin, has a butter-market (see map of Ireland, ref. 12–F). Pop. (1891) 7,274. In 1890 a new Tipperary was founded, as part of a plan of campaign against land-owners, but proved a miserable fiasco in the following year.

**Tippoo' Sa'hib**: Sultan of Mysore; b. Nov. 19, 1749, a son of HYDER ALI (*q. v.*); was instructed in European tactics by French officers, and distinguished himself in the war against the British, defeating them at Perimbakum Sept. 10, 1780, and on the banks of the Kolerun Feb. 18, 1782. On Dec. 7, 1782, Hyder Ali died, and Tippoo Sahib then prepared for a still more energetic prosecution of the war. Apr. 28, 1783, he took Bednore, and soon after also Mangalore, but in the meantime peace had been concluded between Great Britain and France, so that Tippoo Sahib was compelled also to conclude peace at Mangalore Mar. 11, 1784, but on advantageous conditions. He continued to intrigue against the British, and in 1790 the war was renewed. In spite of his brilliant tactics in laying waste the Carnatic almost to the gates of Madras, and thereby for a time baffling his enemies, he was finally defeated, and was compelled in 1792 to sue for peace by ceding half of his dominions and paying 3,030 lakhs of rupees. However, he still intrigued with the French, and when Napoleon landed in Egypt Oct. 18, 1798, the British East India Company determined to crush its enemy before it might become too late. On Feb. 22, 1799, the company declared war against Mysore, invaded the realm with two armies, and shut up the sultan in his capital, Seringapatam. Here he fell May 4, 1799, while fighting on the walls; his dominions were confiscated by the company, and the spoils from his palace were carried to London. During the last years of his reign, after 1792, his government was of a very oppressive character, but he was exceedingly popular among his subjects, and after his death he was considered a martyr to the faith of Islam by Mohammedans in general.

**Tipton**: city; capital of Tipton co., Ind.; on Cicero creek, and the Lake Erie and West. Railroad; 38 miles N. of Indianapolis (for location, see map of Indiana, ref. 5–E). It is in an agricultural region, contains new a court-house (cost $190,000), a jail (cost $35,000), canning factory, flour, saw, and planing mills, and stave factory, and has 2 private banks and 3 weekly newspapers. It is in a natural-gas belt. Pop. (1880) 1,250; (1890) 2,697; (1900) 3,764.

EDITOR OF "TIMES."

**Tipton**: town (founded in 1840); capital of Cedar co., Ia.; on the Burl., Ced. Rap. and N. and the Chi. and N. W. railways; 40 miles N. W. of Davenport, 42 miles S. E. of Cedar Rapids (for location, see map of Iowa, ref. 5–K). It is in an agricultural region, and has 6 churches, large public-school building, a national bank with capital of $50,000, 2 State banks with combined capital of $75,000, 2 weekly newspapers, a carriage-factory, machine-shop, creamery, and poultry-packing establishment. Pop. (1880) 1,299; (1890) 1,599; (1900) 2,513. EDITOR OF "ADVERTISER."

**Tipton**: town; Moniteau co., Mo.; on the Mo. Pac. Railway; 25 miles S. of Booneville, 27 miles E. of Sedalia (for location, see map of Missouri, ref. 4–G). It is in an agricultural region, with coal, lead, and zinc mines in the vicinity, and has a high school, several factories, a State bank with capital of $20,000, an incorporated bank with capital of $25,000, and a weekly newspaper. Pop. (1880) 989; (1890) 1,253; (1900) 1,337.

**Tiraboschi**, tēē-rāā-bos'kēē, GIROLAMO: literary historian; b. at Bergamo, Italy, Dec. 28, 1731; educated by the Jesuits, whose order he afterward joined. He taught in Brescia and Milan, producing in the latter university his *Vetera Humiliatorum monumenta* (1766), an account of the order of Humiliati. In 1770 Francis III., duke of Modena, appointed him librarian of that city, where he remained until his death June 4, 1794. The chief result of his labors in Modena was the great *Storia della Letteratura italiana* (14 vols., 1770–82; reissued, in an amplified and corrected form, 1787–93). Though now antiquated, it still remains an example of thoroughness in method. His other monumental work is the *Biblioteca modenese* (6 vols., Modena, 1781–86), devoted to the history of Modenese authors. This was followed by the *Memorie storiche modenesi* (1793–94), and a *Codice diplomatico*, which was in process of compilation at the time of his death. He worked upon the *Enciclopedia italiana* and the *Giornale d'Italia*, and issued many biographical and other monographs. The best edition of the *Storia* is that printed in Milan (16 vols., 1822–26). J. D. M. FORD.

**Tirard**, tēē'raar', PIERRE EMMANUEL: statesman; b. in Geneva, Switzerland, Sept. 27, 1827, of a French family; was educated in his native city, but moved in 1846 to Paris as chief of an exporting-house in jewelry. An open enemy of the second empire, he was elected mayor of the second arrondissement of Paris Nov., 1870, and a member of the National Assembly Feb., 1871. After an energetic protest against the assumptions of the Commune, he resigned his mayorship and fled to Versailles. In 1876 he was elected a member of the Legislative Assembly, and took his seat among the republican left. In 1879–81 he was Minister of Agriculture and Commerce and exercised considerable influence on the formation of the tariff. He was head of the cabinet in Carnot's administration 1887–88, and again 1889–90. D. in Paris, Nov. 4, 1893. He published *Du Développement de la bijouterie et de l'orfèvrerie par la liberté des titres de l'or et de l'argent* (1868). F. M. COLBY.

**Tiree'**, or **Tyree**: an island of Scotland, one of the Inner Hebrides; 13 miles long and 6 miles broad. It is low except on the S., where hills reach 400 feet, and destitute of wood, but affords good pastures. Oats, barley, and potatoes are raised, but the inhabitants are mostly engaged in fishing and rearing poultry. Pop. (1891) 2,600.

**Tire'sias** (Gr. Τειρεσίας): a celebrated soothsayer in Thebes. He was blind, but understood the language of the birds, and lived to a great age. Even after his death he did not lose his power of prophecy. He had a famous oracle near Orchomenus, but after a plague it became silent. The Greek mythology tells many stories of the origin of his blindness and soothsaying power.

**Tir'hakah** [Heb. = Egypt. *Ta-h-r-q*, *Taharqa*, *Taharaqa*; the *Tarkos* or *Tarakos* of Manetho]: an Ethiopian king (702–664 B. C.); an ally of the Egyptian king Shabataka of the twenty-fifth dynasty against Sennacherib (Sanherib) of Assyria, when the latter was subduing Syria and Palestine. The rumor of the approach of Tirhakah into Palestine caused Sennacherib to hasten affairs connected with Hezekiah of Judah and himself to advance toward Egypt, but a sudden pestilence caused an abrupt retreat to Nineveh, where he was soon afterward assassinated. Later, Tirhakah deposed and killed Shabataka (693 B. C.) and usurped the Egyptian throne, becoming the last king of the twenty-fifth dynasty. The remainder of his life was occupied with struggles against the Assyrian power and in attempts to achieve the freedom of Egypt. For his alliances with Hezekiah of Judah and other Phœnician and Syrian princes he was severely punished by Esarhaddon and Asurbanipal, kings of Assyria, who defeated him within Egypt itself and pursued him as far as Thebes, causing him to retreat into Ethiopia (672 and 667 B. C.). According to Greek writers he was a great warrior, but his own lists of conquered peoples are evidently copied from those of his predecessors. He was active in building operations at Thebes, but particularly at his original capital, Napata, near Gebel Barkal, in Nubia, where he erected a temple. C. R. G.

**Tirlemont**, teer'le-mōn': town; in the province of Brabant, Belgium; on the Grande-Geete; 30 miles E. S. E. of Brussels by rail (see map of Holland and Belgium, ref. 10–F). The churches of St. Germain, dating in part from the ninth century, and Notre Dame, founded in 1298, are its chief architectural features. It manufactures machinery, woolen stuffs, hosiery, leather, soap, malt, and gin, and carries on an active general trade. Pop. (1891) 16,157.

**Tir'nova**: town; in Bulgaria; on the Jantra, an affluent of the Danube; 35 miles S. S. E. of Sistova (see map of Turkey, ref. 3–D). It was the capital of the Bulgarian kingdom until 1394, and continued to be the seat of the Bulgarian patriarchate until its suppression in 1767. It has large dyeworks and manufactures cloth and copper utensils. Pop. (1893) 12,858. E. A. G.

**Tiro**, Marcus Tullius: the freedman and pupil of Cicero, to whom he became an amanuensis. He was also an author of some reputation, writing several works, including a life of his patron. To him is due the collection of Cicero's *Letters*. He is commonly believed to have invented the art of short-hand writing, hence the name *Notæ Tironis* or *Tironianæ*. (See Stenography.) It is believed he lived to the age of 100. Revised by M. Warren.

**Tirol**: another spelling of Tyrol (*q. v.*).

**Tirso de Molina**: See Tellez, Gabriel Maestro Fray.

**Tiryns**, tī'rinz (Gr. Τίρυνς): in Argolis; one of the most ancient cities of Greece. Its inhabitants appeared in history for the last time at the battle of Platææ, but shortly thereafter the city was destroyed by the Argives, though its massive walls still exist to excite the wonder of the visitor. Tiryns was excavated by Schliemann in 1884. See his *Tiryns*, but, better still, Schuchhardt, *Schliemann's Excavations* (London, 1891), and Perrot and Chipiez, *History of Art in Primitive Greece* (London, 1894). J. R. S. S.

**Tischbein**, tish'bīn, Johann Heinrich Wilhelm: painter; b. at Haina, Hesse, Feb. 15, 1751; received his first instruction in painting from his father, uncle, and elder brother, who all were painters of reputation; went in 1770 to the Netherlands, in 1779 to Rome, in 1787 to Naples, where he was director of the Academy of Painting from 1790 to 1799; returned in the latter year to Germany and settled in Hamburg. He painted many portraits, among which is one of Lady Hamilton, and some historical and allegorical pictures, but he is most widely known as an engraver. The Hamilton collection of Greek vases, published first in Naples, was his work. Of his original etchings the largest collection is a series of illustrations from Homer, published at Göttingen 1801–04. D. at Eutin, July 26, 1829. Russell Sturgis.

**Tisch'endorf**, Lobegott Friedrich Konstantin, LL. D., D. C. L.: biblical scholar; b. at Lengenfeld, Saxony, Jan. 18, 1815; studied theology and philology at Leipzig 1834–38; was appointed Professor of Theology there in 1845. From an early period of his life he concentrated his study on a critical revision of the text of the New Testament: made extensive journeys in Europe, examining the materials for such a revision contained in the various European libraries, and visited Egypt, the Sinaitic Peninsula, Syria, and Palestine in 1844, 1853, and 1859, the last time at the expense of the Russian Government. From the monastery of Sinai he brought back the famous *Codex Sinaiticus*, the oldest Greek manuscript of the Bible, which is now preserved in St. Petersburg, and was published in 1862 in 4 vols. fol. at the expense of the Emperor Alexander II. He has told the romantic story of its recovery in *Die Sinaibibel* (Leipzig, 1871). The *Codex Sinaiticus* is written upon vellum sheets of extreme fineness and beauty and consists of 346 leaves, of which 199 contain 22 books of the Old Testament and Apocrypha in the Septuagint version, beginning at the first book of Chronicles, while the remaining 147 present the whole of the New Testament, the Epistle of Barnabas, and a part of the Shepherd of Hermas. (To these should be added the 43 leaves of the Codex Friderico-Augustanus.) D. in Leipzig, Dec. 7, 1874. The principal results of Tischendorf's researches were several critical editions of the New Testament, but he also published *Codex Ephraemi Syri* (1843); *Monumenta Sacra Inedita* (1846); *Evangelium Palatinum Ineditum* (1847); *Codex Amiatinus* (1850); *Codex Claromontanus* (1852); *Novum Testamentum Vaticanum* (1867); *Monumenta Sacra Inedita, nova Collectio* (9 vols., 1854–65); *Acta Apostolorum Apocrypha* (1851); *Evangelia Apocrypha* (1853); *Apocalypses Apocryphæ* (1866); *Reise in den Orient* (2 vols., 1845–46); *Aus dem heiligen Lande* (1862); and *Wann wurden unsere Evangelien verfasst?* (1865; translated into English, *When were our Gospels written?*, and many other languages). His prolegomena to the 8th ed. of his larger Greek New Testament were completed in a remarkable manner by C. R. Gregory, who examined every uncial and very many cursive MSS. of the New Testament (Leipzig, 1884–94). Revised by S. M. Jackson.

**Tis'ri** [= Heb. *tishrī*, deriv. of Chald. *sherā*, open, begin]: the first Hebrew month of the civil year and the seventh of the ecclesiastical year. It corresponds to part of September and October.

**Tissapher'nes**: Persian satrap. He was appointed satrap of Lower Asia by Darius II. Nothus in 414 B. C. In the reign of the latter's successor, Artaxerxes II., Tissaphernes received the command also in Asia Minor after the death of Cyrus at the battle of Cunaxa. His attempt, however, to punish the Greek cities which had supported Cyrus was unsuccessful. They were supported by the Spartans, and the Persians were defeated by Agesilaus in Lydia. Meanwhile his treachery and cowardice had made him contemptible in the eyes of Artaxerxes, and on the instigation of Parysatis, the king's mother, he was assassinated at Colossæ, Phrygia, in 395.

**Tissot**, tee'sō', James: genre-painter; b. at Nantes, France, Oct. 15, 1836; pupil of Lamothe and Flandrin; medal, Salon, 1866; first-class medal, Paris Exposition, 1889. He lived for a number of years in London and did not exhibit in the Salon after 1870. He reappeared, however, at the Salon of the Champ de Mars in 1894 with a series of pictures representing the life of Christ. One of his earlier works, *The Meeting of Faust and Marguerite*, painted in 1861, is in the Luxembourg Gallery, Paris. W. A. C.

**Tissues**: See Histology and Fibrous Tissues.

**Tisza**, tee'sǎa, Koloman Borosjenö, von: statesman; b. at Grosswardein, Hungary, Dec. 16, 1830; was educated for the civil service, and became a member of the Hungarian Reichstag in 1861. At first a leader of the moderate radicals, he founded a new liberal party made up for the most part of the followers of Deák, and controlled the majority in the Reichstag. He held the portfolio of the Interior in the ministry of Wenkheim, and on Oct. 21, 1875, became Prime Minister of the Hungarian cabinet, a position which he held for over fourteen years. Possessing the confidence of the majority of the nation, he has done more than any other Hungarian statesman in reorganizing the state and, while promoting harmony between his own and the imperial Government, in raising the position of Hungary to one of controlling importance in the Hapsburg empire. In 1876–78 he opposed the policy of Russia respecting Turkey, but acquiesced in the proposed Austrian occupation of Bosnia and Herzegovina as a necessity of the war, and when the financial condition of the imperial Government prevented that occupation, he resigned with his co-ministers. Subsequently, however, he resumed his office, which he held till 1890, retaining his seat in the new parliament. See Visi, *Koloman Tisza* (Budapest, 1886). F. M. Colby.

**Tit**: See Titmouse.

**Titanic Dioxide**, generally called **Titanic Acid** ($TiO_2$) [*titanic* is deriv. of *titanium*. See TITANIUM]: a compound which constitutes three distinct mineral species—*octahedrite*, *brookite*, and *rutile*. A synonym of octahedrite is *anatase*, and a synonym of brookite is *arkansite*. Of the three mineral forms of titanic dioxide, *rutile* is far the most abundant. The commoner varieties have a peculiar reddish tinge, and a luster of a peculiar dark metallic brilliancy on the cleavages, which, with its high density, enables it to be distinguished at a glance by those expert in minerals. Its hardness is between those of quartz and feldspar. The crystals are dimetric or tetragonal, and usually prismatic, sometimes acicular, and are found in the latter form penetrating transparent quartz-crystals from side to side in a great many directions, like needles, forming interesting cabinet specimens known as "rutilated quartz." In these cases the rutile needles have evidently been first formed, crossing a cavity filled with the menstruum from which they were deposited, in which the quartz has subsequently crystallized out from the same or some other menstruum. In the U. S. there are a great many localities in which rutile is found. *Brookite* is trimetric or orthorhombic in crystallization, translucent, with cleavage less distinct than rutile, but having the same metallic adamantine luster. It has been found in small crystals in North Carolina placer gold, at Paris in Maine, and at Ellenville in Ulster co., N. Y., and in a number of foreign localities. At the celebrated mineral locality at Magnet Cove, Ark., it is found as the variety *arkansite*, so called by Prof. Charles U. Shepard, which is described as iron-black and opaque, though nearly pure titanic oxide, according to Whitney and Damour. *Octahedrite*, or anatase, is tetragonal like rutile, but with very different angles and cleavages. It is usually octahedral in form, highly lustrous like diamond, and sometimes mistaken for it in placer washings. In North America, it occurs in dolomite at Smithfield, R. I. Revised by IRA REMSEN.

**Tita'nium** [Mod. Lat., named in fanciful allusion to the Titans, from Lat. *Tita'nes* = Gr. Τιτᾶνες, Titans]: an element first discovered by Dr. William McGregor, in examining the mineral now called *menaccanite*, from Menachan in Cornwall, in 1791. It was afterward found by Klaproth (in 1794) in *rutile*, and called by him in 1797 *titanium*. Titanium is quite an abundant element. For a long time certain cubical crystals of a copper color found in blast furnaces were believed to be metallic titanium, but Wöhler proved that these contain cyanogen and nitrogen. The element is obtainable by heating the double fluoride of titanium and potassium with sodium. It is described as a dark-green, heavy powder, which can not be burnished and is infusible. Titanium occurs in many minerals. The three minerals *rutile*, *brookite*, and *anatase* are all TITANIC DIOXIDE (*q. v.*). *Menaccanite* or *ilmenite*, in which titanium was first discovered, contains titanic dioxide with iron oxides. *Sphene* or *titanite* contains titanate and silicate of calcium. *Perofskite* is simple calcium titanate, and it is very common in magnetic iron ores and many other minerals. Titanium forms three chlorides, $TiCl_2$, a black powder, $TiCl_3$, lustrous dark-violet scales, and a colorless transparent liquid tetrachloride, $TiCl_4$. It is believed to form two compounds with oxygen, the sesquioxide, $Ti_2O_3$, and the dioxide, $TiO_2$. The chief practical interest that attaches to titanium is in consequence of its frequent occurrence as a constituent of iron ores, chiefly of magnetite, which passes into ilmenite or menaccanite, the two apparently occurring mixed in all proportions, and called titaniferous iron ore. Such ores are liable to be very pure—that is, free from sulphides and phosphates—but, unfortunately, it happens that the titanium is excessively difficult to flux out from the mass, tending apparently to form slags of very difficult fusibility, thus limiting their use greatly. It has been reported that this obstacle has been overcome. Revised by IRA REMSEN.

**Titanothe'rium** [Mod. Lat.; Gr. Τιτάν, a Titan + θηρίον, wild beast]: a genus of extinct mammals first found in the Mauvaises Terres, or Bad Lands, of South Dakota. The formation is Miocene, and the bones of this animal were the first fossils obtained from the region. Later researches in Nebraska and Colorado have shown that this genus is but one of an extinct family of herbivorous mammals including several genera, viz., *Titanotherium*, *Brontotherium*, *Brontops*, and others. The best-known genus is *Brontotherium*, and its principal characters are as follows: The skull is long and depressed, and resembles that of the rhinoceros. There is a pair of large horn-cores on the anterior part of the skull, in front of the orbits. They stand on the maxillary bones, and are placed transversely, as in ruminants. The nasal bones are greatly developed and firmly co-ossified. They are produced in front, and overhang the narial orifice. The dental formula is as follows: incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{4-4}{3-3}$; molars, $\frac{3-3}{3-3}$. The brain-cavity is small in proportion to the skull. The cerebral hemispheres did not extend at all over the cerebellum, and but little over the olfactory lobes. The neck was stout and of moderate length. The atlas is large, and much expanded transversely; the axis massive, and its odontoid process stout and conical. The lumbars are slender and smaller than the dorsals. There are four sacral vertebræ. The caudals indicate a long and slender tail. The limbs were intermediate in proportion between those of the elephant and the rhinoceros. The radius and ulna are separate. The carpal bones are shorter than in the rhinoceros, and support four stout toes. The fibula is separate from the tibia. There were three toes on the hind foot, of nearly equal size. None of the bones of the skeleton is hollow. The *Brontotheridæ* nearly equaled the elephant in size, but the limbs were shorter. The nose was probably flexible, as in the tapir, but evidently there was no true proboscis. All the remains yet known are from the Miocene beds of the Rocky Mountains, in South Dakota, Nebraska, Wyoming, and Colorado. O. C. MARSH.

**Titans** [from (and transl. of) Lat. *Tita'nes* = Gr. Τιτᾶνες]: in Greek mythology, the children of Uranus and Gæa, numbering, according to the most common record, twelve—six male, Oceanus, Cœus, Crius, Hyperion, Iapetus, and Cronus; and six female, Theia, Rhea, Tethys, Phœbe, Mnemosyne, and Themis. Uranus feared his own children, and shut them up in Tartarus, but by the aid of Gæa they broke out of the prison, overthrew their father, and placed Cronus on the throne. The curse, however, which Uranus let fall on his children was fulfilled. Cronus was dethroned by his own son, Zeus, and the Titans were once more imprisoned in Tartarus, where the Cyclopes and Hundred-handed were set to watch them. Among their descendants were Atlas, Prometheus, Helios, Hecate, and Selene.

**Titchener**, EDWARD B.: See the Appendix.

**Tite**, Sir WILLIAM, F. R. S.: architect; b. in London, England, in 1802; educated at a private school; was articled as a pupil to Mr. Laing, the architect of the custom-house; was intrusted with the rebuilding of the Church of St. Dunstan's-in-the-East, which he executed so successfully in the Gothic style, then recently become popular, as to gain a high reputation; was employed to erect a Gothic church for the celebrated Edward Irving; subsequently built many public and private edifices, including some of the largest railway stations of England and France; became architect to the new Royal Exchange 1840; was for some time president of the Architectural Society and of the Royal Institute of British Architects; was elected Liberal member of Parliament from Bath 1855; was governor of the London and Westminster Bank and of the Bank of Egypt and member of parliamentary committees on banking, and was knighted in 1869. He published some essays and lectures, and was author of a *Descriptive Catalogue of the Antiquities found in the Excavations at the New Royal Exchange* (1848), and other miscellaneous writings. D. Apr. 20, 1873.

**Tithes** [M. Eng. *tithe*, *tethe* < O. Eng. *tēoða*, liter., tenth, a tenth, for *teog(e)ða*; cf. Goth. *tigus*, a decade: Gr. δεκάς]: taxes, consisting of one-tenth of the annual profit of land, stock, or labor, which, instituted by Moses, was paid by the Jews for the maintenance of the Levites and in compensation for their service in the temple (Lev. xxvii. 30–33; Num. xviii. 21–24). Of this tithe the Levites paid a tenth to the priests (Num. xviii. 26, 28). Deut. xiv. 22–29 enjoins the payment of a second tithe which was either to be eaten before the Lord, if it were in produce, or turned into money and the money spent for food to be eaten at the central sanctuary. In this feast the Levites shared. Every third year there was apparently a third tithe in kind which was to be eaten by all comers to the feast. Tithes were known also to Roman law, but are no part of New Testament legislation. In the Christian Church they were first enjoined about 350 as due for the support of the clergy, recommended by the Second Council of Tours, 567 (see Harduin's *Councils*, iii., 368), and first decreed by the Second Council of Macon, 585 (see Harduin, iii., 461). They were not firmly established, however, in Germany, France, and England until the ninth century, and in the Scandinavian countries not until the eleventh century. Even before the period of the Reformation, but especially after that time, the tithes became subjects of bargains, of buying and selling, like other property. Originally they were paid in kind, but in the eighteenth century a certain sum of money was generally substituted. In France they were finally abolished by the Revolution. In England tithes were collected from early times in support of the Church. Such tithes up to the value of 40*s.* must be paid. See J. Selden, *History of Tithes* (London, 1618); H. W. Clarke, *History of Tithes* (1891; 2d ed. 1894). See also HEREDITAMENTS. Revised by S. M. JACKSON.

**Titian**, tish'an, or **Vecellio**, vā-chel'li-ō, TIZIANO: painter; b. at Pieve di Cadore, Italy, in 1477. At the age of ten years he was sent to Venice, where he first studied the principles of art with Sebastiano Zuccato; he then worked with Gentile Bellini, but soon preferred the instruction of Giovanni Bellini, whom he left to work under Giorgione. In 1507 Giorgione and Titian painted together at the Fondaco de' Tedeschi, decorating the exterior with frescoes. Titian was after this invited to Padua, where he executed three frescoes in the building called the Scuola del Santo, the oratory or service-house of St. Anthony, in 1511. At the death of Giovanni Bellini, Titian received the order to continue the work in the hall of the Grand Council of the ducal palace at Venice, which Bellini had left unfinished, and the senate showed their satisfaction with the work done by conferring on him an office which brought 120 crowns a year and the obligation of painting for eight crowns the portrait of every doge created during his lifetime. Pietro Lando, Francesco Donato, Marcantonio Trevisano, and the Veniori were all painted by the great master, who on account of the infirmities of age was unable to portray the last two doges of his time. In 1517, at the call of Alfonso d'Este, Titian went to Ferrara and executed several great works, among them the *Bacchus and Ariadne*, and the *Sacrifice to the Goddess of Festivity* and *The Bacchanal*, both in the Madrid Gallery. Titian was employed by princely clients until 1523. He was then recalled to Venice to paint the Doge Gritti, and his fresco above a staircase of the ducal palace of *St. Christopher carrying the Christ Child* is one of this period, and an example of his power in this branch of painting. His marriage took place about this time, and in 1530 he was already a widower with three children. In 1530 Titian was called to Bologna to paint a portrait of Charles V., who had come there to meet the pope. He then went to Mantua with the Duke Federigo Gonzaga to execute several commissions for him. He returned in 1532 to Bologna to paint a second portrait of the emperor, and was then rewarded by receiving the order of the Golden Spur, which brought with it the title of Count Palatine of the Lateran. Ten years later Titian was again called to Bologna to paint a portrait of Pope Paul III. In 1545 he was in Rome, where he produced one of his most famous portrait-pieces, representing the pope and his relatives the Cardinal Alessandro Farnese, and the Duke Ottavio Farnese, the pope's relatives. Titian spent but one year in Rome, and must have declined the post offered to him, according to Vasari, at the death of Sebastiano del Piombo by the holy father. In 1547 Titian was summoned to Augsburg by the emperor, who employed him to paint the portraits of the great or noble men around him there. Titian was in great favor with the emperor, and after two years of court life he returned to Venice much the richer, but always greedy of wealth, even showing himself servile in his anxiety to obtain it. He returned to the imperial court in 1550. Philip II., King of Spain, showed himself as great a patron and friend of Titian as his father. We read of his writing an order to the governor of Milan to pay up the arrears of Titian's pension of 400 crowns, granted by his father, but he seems to have been less ready to pay his own debts, for in Titian's letters, written in the last year of his life, he recalls to Philip the work of the past twenty years, for which he has not been paid. Vasari wrote his notice of Titian during the painter's lifetime, and describes how he went to visit him in Venice, where he was still painting in his house. Titian lived luxuriously, and received all the princes and learned and famous men of his time. He had the most pleasant and courteous manners. He is the only painter who worked for a period of ninety years. He was carried off by the plague Aug. 27, 1576. He had among his scholars his younger brother Francesco, his son Orazio, his nephew Marco, and his cousin Cesare. Among his most famous pictures are the *Tribute Money* of the Dresden Gallery; the *Sacred and Profane Love*, in the Borghese Gallery, Rome; the *Assumption of the Virgin*, in the Academy at Venice; the *Presentation of Giovanni Pesaro to St. Peter*, in the Antwerp Museum; the *Entombment*, in the Louvre; and the *Bacchus and Ariadne* and *Venus and Adonis* in the London National Gallery. For further information, see Crowe and Cavalcaselle, *Life and Times of Titian* (London, 2d ed. 1881); R. F. Heath, *Titian*, portrait and illustrations; S. Ticozzi, *Vite dei Pittori di Cadore* (1819); J. Northcote, *The Life of Titian*. W. J. STILLMAN.

**Titicaca**, tē-tē-kaa'kā: the largest inland lake of South America; on the confines of Bolivia and Peru, 12,545 feet above sea-level. Area, 3,200 sq. miles. The Titicaca, often called the Bolivian plateau, is the most remarkable of the high inclosed basins of the Andes. It is situated between the Eastern Cordillera, here called the Andes, and a broken and irregular western range, known collectively as the Cordillera Real; the latter includes the highest and most imposing mountains in Bolivia, but has comparatively low passes between Lake Titicaca and La Paz. Northward, the basin is separated from the plateau of Cuzco and the Amazonian watershed by the Vilcañota cross-range; southward, other cross-ranges mark its limits with smaller mountain basins near the boundary of the Argentine Republic. The Titicaca basin is thus completely inclosed. It is about 600 miles long from N. to S., 150 miles wide, and has an area of probably 100,000 sq. miles. The average elevation is about 13,000 feet, but the surface is irregular, with isolated hills and low mountains, and partial cross-ranges. Much of the land is sterile, and the climate is so cold that most cereals will not grow; yet the basin supports a considerable population, mainly of Aymará Indians, who plant potatoes, quinoa, etc. The most important Bolivian copper mines are situated in it, and it contains silver and other metals, and perhaps coal. Lake Titicaca is near the northern end. It is irregular in form, contains several small islands, and projecting peninsulas nearly cut off portions on the southern and eastern sides. Near the eastern shore it attains in some places a depth of over 700 feet; elsewhere, and especially at the southern end, there are extensive shallows, covered with tall reeds. For a long time the only navigation was by curious Indian rafts or boats, made of bundles of reeds; small steamboats now ply between the southern end and Puno on the W., whence a railway runs to Arequipa and Mollendo; this is one of the routes from the Pacific to La Paz. The islands, peninsulas, and shores contain many ruins, some of the Incan period, others (as the celebrated Tiahuanacu ruins in Bolivia) much older. Some of the most interesting remains are on the peninsula of Copacabana, near the southern end of the lake crossed by the boundary between Peru and Bolivia. This was a sacred place of the Incas, connected with many of their traditions. In modern times it has been celebrated for a chapel with an alleged miraculous painting of the Virgin, which is yearly visited by thousands of pilgrims. The reedy shallows were long the haunts of Uru Indians, who issued from their secret recesses to attack the Spaniards; the few who remain are harmless. From the southern end of the lake issues the Desaguadero, a deep and rapid river, 190 miles long, lying entirely in Bolivia. It empties into Lake Aullagas or Poopó, which is rather a swamp than a true lake, and has a much smaller area than Titicaca. Beyond this the waters are lost in swamps and sands. It is probable that the whole basin was formerly filled with water, forming an inland sea. See Squier, *Peru* (New York, 1877). HERBERT H. SMITH.

**Titiens**, or **Tietjens**, teet'yens, THERESE CAROLINE JOHANNA: singer; b. in Hamburg, Germany, of Hungarian parents, July 18, 1831. She appeared for the first time at the Hamburg Opera in 1849 as Lucrezia Borgia, and achieved an immediate success. She went to Frankfort, and in 1856 to Vienna, where she was also well received. Subsequently she was engaged for her Majesty's theater in London. She appeared as Valentine in *The Huguenots*, Apr. 13, 1858. Her impersonation was much admired and each repetition of the opera increased her reputation. She afterward sang at Covent Garden and at Drury Lane, as well as at her Majesty's theater, and remained in London until 1876, when she visited the U. S. In the same year she had a large benefit concert at the Albert Hall, London. Her last stage appearance was made May 19, 1877, as Lucrezia. Her voice was a rich and sweet soprano, extending to the highest register. Her versatility was remarkable, and she sang in such completely opposite *rôles* as Semiramide and Fides. Her voice was also well suited to sacred dramatic music and oratorio. D. in London, Oct. 3, 1877. B. B. VALLENTINE.

**Titin'ius**: a Roman comic poet, who, after the death of Terence, was the first to exhibit the so-called *Fabulæ Togatæ*, the scenes of which were drawn from Roman life, and not based upon Greek plays. He was especially skillful in the delineation of character. Fragments of his plays, over 180 verses and fifteen titles, are collected by Ribbeck (*Com. Rom. Frag.*), pp. 133–160. M. WARREN.

**Titlark**, or **Pipit** [*titlark* is *tit*, a small bird + *lark*; *pipit* is a name given on account of its note]: any bird of the genus *Anthus* and group or sub-family *Anthinæ*. The titlarks are generally associated with at least the wagtails (*Motacillinæ*) in a family, *Motacillidæ*, and contrasted with them by the comparative shortness of the tail (shorter than the wings), which is emarginated, and has the two central feathers shorter than the lateral, and all broadest near their ends, and boldly round at the extremities. They are

American titlark.

mostly grayish brown, and in the under parts variously streaked. Over fifty species are known, and almost every land has representatives of the group. They are birds of passage, insectivorous and graminivorous, rather fine songsters, and graceful in appearance and movements. Three species are found in the U. S.—namely, *Anthus pensilvanicus* (American titlark or pipit), *A. spraguei* (Missouri skylark), and *A. cervinus*; a fourth species (*A. pratensis*, or European titlark) sometimes straggles into Greenland and Alaska.

Revised by F. A. LUCAS.

**Title** [from O. Fr. *title* > Fr. *titre* < Lat. *ti'tulus*, inscription, label, title]: in law, a word often used as synonymous with property, or right of ownership, but in its technical signification denoting the sources of such right, or the facts and events whereby property in land or goods is acquired. In this sense the common law divides all titles to real property into two classes—*by descent* and *by purchase*. Title by descent includes the single mode of acquisition through inheritance; title by purchase embraces all other methods. A more convenient classification is that which places in one group the several methods of acquisition of property, real and personal, by acts *inter vivos*, and in a separate group the different modes of acquiring property on the death of the former owner. The first class will then include (*a*) *original acquisition* (accretion, finding, etc.); (*b*) *lapse of time* (prescription and limitation); (*c*) *eminent domain*, or the taking of land by or under the authority of the State; and (*d*) *conveyance* (including gift as well as sale), which may be effected in various forms, but is now, in the case of real property, usually accomplished by deed, known as a grant, and, in case of personal property, by delivery or writing. In case (*a*) it is assumed that there was no previous ownership of the property; in cases (*b*) and (*c*) the acquired title has no reference to such previous ownership as may have existed; while (*d*) presents the ordinary case of the transfer of the right of property from one to another.

The second class comprehends the various modes in which the death of the owner operates to transfer property, viz.: (*a*) *descent*, (*b*) *occupancy*, (*c*) *gift causa mortis*, and (*d*) *wills*.

For more detailed information concerning the several modes of acquisition above enumerated, the reader should consult the several articles bearing those titles. See also Digby's *History of the Law of Real Property*, chap. x.; Schouler's *Personal Property*, vol. ii.; and the treatises of Williams on *Real Property* and *Personal Property*.

GEORGE W. KIRCHWEY.

**Titmouse, Tit**, or **Tomtit** [*titmouse* < M. Eng. *titemose*, *titemase*; *tit*, small, small bird + O. Eng. *māse*, a kind of small bird; cf. Germ. *meise*, titmouse]: any bird of several species of the family *Paridæ*. They are small birds with soft and lax plumage, a stout conical bill shorter than the head, the wings rounded and short, and the sides of the toes expanded into a palm. The group belongs chiefly to the Northern hemisphere, and more to the Old World than to the New; North America possesses but thirty species and

The blue tit.

sub-species out of nearly a hundred. They are mostly birds of dull plumage, although there are some exceptions, like the blue tit of Europe (*Parus cæruleus*), which is blue and yellow. *Parus wollweberi*, the species found in the western parts of the U. S., and its eastern relative, *P. bicolor*, are crested. The CAPE TITMOUSE (*q. v.*) is found at the Cape of Good Hope. One of the most familiar species is the CHICKADEE (*q. v.*), which, like most of the group, is a hardy bird. Titmice feed on insects and seeds; some nest in holes of trees, others make curious, and for the size of the bird large, bottle-shaped structures; the eggs are numerous, eight or nine, and two broods are frequently raised in a season. F. A. LUCAS.

**Tittmann**, OTTO HILGARD: See the Appendix.

**Titus**: a disciple and companion of St. Paul, to whom one of the canonical epistles of the New Testament is addressed. He was a Gentile, but his native place is uncertain, the probability being in favor of Antioch, as he first appears as a delegate from the church of that city, accompanying Paul to Jerusalem. He was a companion of the apostle in his next missionary journey to Asia Minor and Macedonia, and was twice charged with important missions to the church at Corinth. At some time—whether before or after Paul's (first) imprisonment can not be ascertained—Titus took part with Paul in founding the churches in Crete, where he was laboring as an evangelist when Paul's pastoral Epistle was written. He appears to have rejoined Paul at Nicopolis in Epirus, and was thence sent into Dalmatia, from which time all certain traces of him disappear. Tradition makes him Bishop of Crete.

Revised by S. M. JACKSON.

**Titus**: Bishop of Bostra, in Arabia; d. during the reign of Valens; one of the most distinguished fathers of his time, and spoken of with the highest praise by Jerome. Of his life nothing is known but his conflict with Julian the Apostate, who accused him of inciting the Christians to use violence. His work against the Manichæans was published by P. de Lagarde in the complete Syriac version (Berlin, 1859); a partial Latin translation is found in Migne, with the Greek text of the first three books. S. M. J.

**Titus, Epistle to**: one of the so-called pastoral Epistles of the New Testament canon, written by Paul to convey instruction as to the work in Crete, with the execution of which Titus had been commissioned. If the hypothesis of

Paul's second imprisonment be true, this Epistle and the first to Timothy were written during Paul's journey to Asia Minor and Greece, before his last imprisonment. The Epistle, it is thought, was written from Nicopolis, probably the Epirote town of that name, and not the Macedonian city. See PAULINE EPISTLES. Revised by S. M. JACKSON.

**Titus Fla'vius Sabi'nus Vespasia'nus** (commonly called by his prenomen TITUS): Roman emperor (79–81); b. Dec. 30, 40 A. D.; a son of Vespasian and Flavia Domitilla. Titus was educated with Britannicus, the son of Claudius, with whom he formed an intimate friendship. He served under Vespasian in the Jewish war, and on Vespasian's return to Rome as emperor in 69 Titus was left as commander-in-chief, and finished the war by taking and destroying Jerusalem, Sept. 8, 70. After his accession to the throne (June 24, 79) Titus disappointed the general expectation by ruling justly and humanely. The *delatores* (informers) were punished, and prosecutions for treason came to an end. Many splendid public buildings, the Colosseum, the baths, etc., were finished and dedicated with magnificent festivals for the people; and the emperor showed a generous disposition to help the people under the great calamities which befell them during his reign—the destruction of Herculaneum, Pompeii, and Stabiæ by the terrible eruption of Vesuvius; the conflagration in Rome in the following year, by which the Capitol, the library of Augustus, and many of the most magnificent edifices of the city were destroyed; and, finally, the plague. Titus died Sept. 13, 81, at Reate, in the Sabine country, and was succeeded by his brother Domitian.
Revised by C. H. HASKINS.

**Titus Livius**: See LIVY.

**Titusville**: city (village founded in 1832, city incorporated in 1867); Crawford co., Pa.; on the Dunkirk, Alleg. Val. and Pitts. and the West. N. Y. and Pa. railways; 28 miles E. of Meadville, the county-seat, and 100 N. of Pittsburg (for location, see map of Pennsylvania, ref. 2–B). It is regularly laid out on a plateau which slopes to the S., affording natural facilities for drainage, of which advantage has been taken in the construction of an excellent system of sewerage. Water for domestic use and manufacturing purposes is obtained from inexhaustible wells, and is pumped directly to the places of consumption. The city owns the water-works and one of two electric-lighting plants, and contains illuminating and fuel gas plants. There are 10 churches and 2 synagogues, 5 large public-school buildings and a high school, several hotels, a national bank with capital of $300,000, a State bank with capital of $150,000, a private bank, and a daily, a monthly, and 4 weekly newspapers. Titusville has been an important oil-center since 1859, when E. L. Drake successfully drilled the first petroleum well in North America on Oil creek, 2 miles S. of the city. (See PETROLEUM.) The city has several pipe-line systems for conveying both crude and refined petroleum in different directions, and its principal manufactures are in connection with the petroleum industry. These include engines, boilers, car-tanks, oil storage-tanks, and the various kinds of machinery used in connection with petroleum; refineries for making illuminating oil, gasoline, etc.; and plants which turn out various products of paraffin, including soap. Other articles that are manufactured in this city are harness, steel, acids. furniture, novelty goods, steam-heaters and radiators, and leather. Pop. (1880) 9,046; (1890) 8,073; (1900) 8,244.
H. L. HERSHBERG,
SECRETARY TO THE BOARD OF TRADE.

**Tiuchev**, tē̆e-oo-chef', FEDOR IVANOVICH: poet; b. near the town of Briansk, Russia, Nov. 23, 1803. He filled diplomatic positions in Munich and Turin from 1823 to 1841; served in the bureau of censors in St. Petersburg from 1844 until his death July 15, 1873. His occasional short poems, which had long found little favor, suddenly became popular in 1854. Tiuchev may be regarded as a late member of the romantic school prevalent earlier in the century, though he had more dreaminess and delicacy than passion. He was an ardent Slavophil, but his patriotic pieces are not his best. His complete works were published in 1886. His writings have been translated into German (H. Noe, Munich, 1861). See biography of him (in Russian) by his son-in-law, I. Aksakov (1874), and article by M. de Vogüé in *Regards historiques et littéraires* (1892).
A. C. COOLIDGE.

**Tiumen**, tē̆e-ōō-men', or **Tyumen**: town of Siberia; government of Tobolsk; on the Thura, an affluent of the Ob; 90 miles S. W. of Tobolsk (see map of Asia, ref. 3–E). It is the oldest, but at the same time one of the handsomest and most prosperous, of the Siberian cities. It is a central point on the Trans-Siberian railway, an entrepôt for the traffic between Russia, Siberia, the Kirghiz territory, Bokhara, and China, and has extensive manufactures of leather, tallow, candles, pottery, mats, wooden articles, carpets, and coarse woolen fabrics. Pop. (1897) 29,588.
Revised by M. W. HARRINGTON.

**Tiv'erton**: town; in Devonshire, England; at the confluence of the Exe and Loman; 14 miles N. by E. of Exeter (see map of England, ref. 14–E). It has some fine buildings, including a church, portions of which date from the fifteenth century, and Blundell's free grammar school, the later buildings of which were erected in 1880 in the Tudor style at an expense of $20,000. Lace-making is the principal industry, employing about 1,800 people. Pop. (1891) 10,892.

**Tivoli**, tē̆e'vō-lē̆e (anc. *Tibur*): town; 19 miles E. N. E. of Rome, Italy; in a bend of the Anio, left-hand affluent of the Tiber; on the northern versant of Mt. Repoli, 1,060 feet above sea-level (see map of Italy, ref. 6–E). It is a station on the railway connecting with Rome. It is a busy town and manufactures woolens, thread, and wire. The falls of the Anio were utilized for the plant established in 1892 for the electric illumination of Rome. Tivoli was founded about 500 years before Rome, and is equally noted for its natural beauties and for its ruins and antiquities. It has long been a favorite pleasure resort for the Romans, and with it are associated the names of Mæcenas, Horace, Propertius, Catullus, Hadrian, and Zenobia. Among the objects of interest are the Temple of the Sibyl, the falls of the Anio, and the constructions to protect the city from the river, the ruins of the villa of Varus, of the so-called villa of Mæcenas, now believed to be the temple of Hercules the Conqueror, that of Hadrian, and that of Este. Pop. 10,950. M. W. H.

**Tixtla**, teest'lā̆a: a town and the former capital of the state of Guerrero, Mexico; in a valley 5 miles E. of Chilpancingo, the present capital; about 4,000 feet above sea-level (see map of Mexico, ref. 8–H). The valley here forms a fertile and well-watered plain, and the town is surrounded by gardens and fruit-trees. In 1811 Tixtla was captured by Morelos, and soon after he repulsed the royalists here; it was long a revolutionary center. Pop. 8,000. H. H. S.

**Tlaxcala**, or **Tlascala**, tlaath'kā̆a-lā̆a [Mex., liter., land of maize]: an interior state of Mexico, surrounded by Hidalgo, Puebla, and Mexico. Area, 1,595 sq. miles. It is the smallest of the Mexican states, and lies entirely on the plateau. The surface is much broken, and on the western and southern frontier there are high mountains—Malintzin or Malinche, on the S. E., attains 13,500 feet, and is crowned with snow. The principal occupation is agriculture, the most important crops being maize, wheat, and maguey from which the Mexican markets are supplied with pulque. There are few mines, though silver and coal deposits are known. The manufactures, especially of cotton and woolen cloths, are quite important. At the time of the Spanish conquest the territory of Tlaxcala was occupied by the Tlaxcalans, a warlike tribe of the Nahuatlecan stock, who had never submitted to the confederated pueblos of the Mexican valley. They resisted Cortés fiercely (1519), but finally sued for peace and became his allies in the march to Mexico, and the subsequent siege. Pop. of the state (census of 1895), 166,803; a large proportion are civilized Indians descended from the ancient Tlaxcalans. Tlaxcala, the capital and largest town, is on the railway between Puebla and Apizaco, in the valley of the river Atoyac, which here furnishes water-power for several factories (see map of Mexico, ref. 7–H). It exports grain, hides, cloths, etc. The town is on or near the site of the ancient Indian capital. Pop. about 8,000. H. H. S.

**Tlemcen**, tlem-sen': town; in the province of Oran, Algeria; 80 miles S. W. of the city of Oran. It is well built and is in a fine plain, sheltered against the scorching S. winds by a chain of lofty mountains, cultivated with great care, and producing olives, figs, grapes, and other kinds of fruit in abundance. Tlemcen has some manufactures of leather, carpets, and woolen fabrics, and a considerable trade in wool, grain, and fruit. It is on the railway running to Rahgun. Pop. (1891) 19,802. Revised by M. W. HARRINGTON.

**Tmesis** [Gr. τμῆσις, severance, deriv. of τέμνειν, cut]: a technical term of the old Greek grammarians applying to the Epic usage of separating the verb and its qualifying præverb in cases where the later Attic usage shows a compound verb; thus ὑπὸ δ' ἔσχετο μισθόν (for Attic ὑπέσχετο).

As the Epic really represents the more original usage, the term is a misnomer. The term is often given in modern grammar a wider application covering all cases in which a compound term appears with disjoined elements, as *to us ward, what place soever.* BENJ. IDE WHEELER.

**Toad** [M. Eng. *tode, tade* < O. Eng. *tādie*; cf. TADPOLE]: any one of various species of *Salientia*, or tailless batrachians, having a short body and legs and a warty skin. There are no ribs nor teeth, and the tongue is free behind. The young, like frogs, pass through a tadpole stage. Most of the animals thus characterized belong to the family *Bufonidæ*, although a few belong to other allied groups. Toads are found in all parts of the globe (save, of course, the colder portions) except the Australian region. They live upon insects, grubs, etc., which they catch in large numbers with their peculiarly arranged tongue, which can be rapidly protruded and withdrawn, and are of considerable service to gardeners. They either burrow in the earth at the approach of winter, and there hibernate, or pass the cold season in convenient holes. There is no foundation for the stories that toads are found imbedded in solid rock, or in the trunks of trees, nor are toads poisonous except to the extent that their skin secretes an acrid fluid, which is extremely unpleasant to carnivorous mammals, and is thus protective. The common toad of Europe (*Bufo vulgaris*) is found also in Asia and Northwestern Africa. It is about the same size as the common toad of the U. S. (*Bufo lentiginosus*), but the American species has ridges along the skull, while the European has none. Over 100 species are known. F. A. LUCAS.

**Toad-fish**: any fish representing either of the families *Batrachidæ* and *Antennariidæ*. These two forms belong to distinct orders, and have really little in common except a certain hideousness of aspect other than fishes generally have, although they were formerly associated together, even by scientific ichthyologists (e. g. Cuvier), and Günther (*The Study of Fishes*, pp. 467–469) still places them in adjacent families.

The *Batrachidæ* are carnivorous fishes inhabiting many tropical and temperate seas, but the species are not very numerous. They are bottom fishes, living mostly in the mud, and in some instances ensconce themselves in the empty valves of shells. Fish of the genus *Batrachus* are to be feared on account of their bite, as their teeth and jaws are quite strong, and those of *Thalassophryne* on account of the wounds which they can inflict with their opercular spines. The opercular spines of most of the species are solid, but those of *Thalassophryne* are hollowed, and at their bases are poison-glands. The species are generally of moderate size, but one (the so-called *Batrachus gigas*), made known by Günther in 1869 (*Ann. and Mag. Nat. Hist.*, vol. iii., p. 131), from the Seychelles islands, ranks among the largest of true fishes. Less than twenty species of the family are known, which have been generally distributed under three genera, *Batrachus, Thalassophryne*, and *Porichthys*, but the first is a heterogeneous group. The toad-fish of the Atlantic coast of the U. S. is from 10 to 18 inches long, brownish in color in the north and light yellow in the Gulf of Mexico. In spite of its repulsive appearance it is said to be sweet and palatable, by those fishermen and ichthyologists who have had the courage to eat it. See G. B. Goode, *History of Useful Aquatic Animals*, in *The Fisheries and Fishing Industries of the United States*, 1884.

The *Antennariidæ* (or *Chironectidæ*) belong to the order *Pediculati*. The family is quite rich in species, remarkable for their grotesque physiognomy and often rich colors. They are mostly inhabitants of the open or deep tropical seas. Not far from fifty species are known. They are divisible among three sub-families and six genera, viz: (1) *Antennariinæ*, with the genera *Pterophryne, Antennarius, Histiophryne*, and *Saccarius*; (2) *Brachionichthyinæ*, with the genus *Brachionichthys*; and (3) *Chaunacinæ*, with the genus *Chaunax*. The *Pterophryne lævigata* builds a nest in the floating seaweed of the open sea.

Revised by E. A. BIRGE.

**Toad-spit**: See FROG-SPITTLE.

**Toadstools**: a popular name for the plants of the order *Hymenomyceteæ* of the higher fungi. They are otherwise known as MUSHROOMS (*q. v.*). See also the article FUNGI.

**Tobacco** [from Span. *tabaco* = W. Ind. (Caribbean or Haitian) *tabaco*, tobacco, liter., the pipe or tube in which it was smoked]: a plant of the genus *Nicotiana* of the family *Solanaceæ*, first brought to the knowledge of civilized nations on the discovery of America, where it was found in use by the natives as far N. as Virginia. Comparatively little notice was taken of this plant until about 1650, when it entered largely into the trade of the American colonies with Europe. Although the genus contains some species that are shrubby, the cultivated plant is everywhere an annual; the best-known species, *N. tabacum*, is an upright plant, having a single stalk from 3 to 6 feet high. The leaves are broad ovate lanceolate, near the ground, and enlarge to 3 feet in length and 1 foot wide, in some varieties, but diminish in size as the stalk rises. The latter is surmounted by a loose panicle or raceme of funnel-formed flowers, usually with a long tube, bearing purple or light-red petals. The seeds are minute, brown or black, and very numerous. The only other species that is much grown is *N. rustica*, a much smaller plant, with greenish flowers and adapted to a cool climate.


Tobacco-plant in flower (*Nicotiana tabacum*).

The purpose to which tobacco is applied is almost wholly as a tonic, stimulant, or sedative through smoking, chewing, or snuffing. Though no form of direct nutrition is possible, its application to the palate and sensory organs of the mouth undoubtedly supports the strength of those accustomed to its use, calms nervous excitability, and relieves hunger, pain, constraint, and *ennui* in a remarkable manner. The common testimony of almost all nations and all races ascribes value to this singular plant, though it can not be taken into the stomach without injurious results, and is essentially poisonous in its general properties.

The distinctive and valuable properties are found only in the leaf, which is thick, heavy, and pubescent, becoming oily and semi-resinous as it ripens. This leaf, when the plant approaches maturity, is dried and cured by partial sweating, which effects a chemical change, removing the characteristics of the fresh leaves, and developing a powerful aroma, with strong narcotic and acrid properties. After curing, tobacco, either in leaf or manufactured, will remain a long time without decay or change other than drying, and of the vast quantities that enter into commerce very little is lost from such causes. The constituents that give tobacco its value are readily soluble in water and alcohol, but they have little value as an extract.

The analysis of partially cured and cured leaves of Connecticut tobacco showed the following composition:

| CONSTITUENTS. | Unfermented. | Fermented (sweated). |
|---|---|---|
| Water | 26·13 | 23·13 |
| Ash | 17·86 | 18·91 |
| Nicotine ($C_{12}H_{14}N_2$) | 1·51 | 1·14 |
| Nitric acid ($N_2O_5$) | 2·29 | 2·38 |
| Ammonia ($NH_3$) | 0·37 | 0·44 |
| Other nitrogenous matters | 10·06 | 10·58 |
| Fiber | 8·57 | 9·38 |
| Starch | 2·90 | 3·15 |
| Other nitrogen-free extracts | 27·06 | 27·74 |
| Fat | 3·22 | 3·13 |

The average of thirty analyses of the ash of American tobacco gave the following: In the cured leaves, water, 8·12 per cent.; ash, 24·48. In the ash, chlorine, 4·04 per cent.; carbon dioxide, 21·33; sulphuric acid, 5·18; soda, ·86; magnesia, 5·78; lime, 20·89; iron and alumina, 2·57; silica, 14·92; phosphoric acid, 2·45; potash, 20·90; carbon, 1.

*Production of Tobacco.*—The production of tobacco is greater in the U. S. than in any other country, and it may be fairly estimated to furnish one-half the quantity entering the general commerce of the world. According to census returns, the amount of tobacco produced in the U. S. in 1859 was 434,209,461 lb.; in 1869, 262,735,341 lb.; in 1879, 472,661,157 lb.; in 1889, 488,255,896 lb.

TOBACCO PRODUCTION IN U. S. (CENSUS OF 1890).

| STATES AND TERRITORIES. | Number of planters. | Area, acres. | Crop, pounds. | Value. |
|---|---|---|---|---|
| The United States........ | 205.862 | 692,990 | 488.255,896 | $34.844.449 |
| Alabama.................. | 3,556 | 679 | 162,430 | 17,173 |
| Arizona.................. | 1 | .... | 2 | ........ |
| Arkansas................. | 5,448 | 1,875 | 954,640 | 89,862 |
| California............... | 24 | 27 | 12,907 | 1,609 |
| Colorado................. | 4 | 2 | 120 | 12 |
| Connecticut.............. | 2,815 | 6,331 | 8,874,924 | 1,132.111 |
| Delaware................. | 7 | 20 | 29,680 | 1.778 |
| Florida.................. | 632 | 1,190 | 470,443 | 105.891 |
| Georgia.................. | 2,299 | 800 | 263.752 | 28.556 |
| Illinois................. | 2,499 | 4.155 | 3,042.936 | 116,340 |
| Indiana.................. | 4,457 | 9,373 | 7,710,297 | 384,370 |
| Iowa..................... | 501 | 124 | 74,396 | 6,897 |
| Kansas................... | 390 | 123 | 62,083 | 6,143 |
| Kentucky................. | 61,641 | 274,587 | 221,880,303 | 13,155,297 |
| Louisiana................ | 120 | 109 | 46.845 | 11,797 |
| Maine.................... | 1 | 1 | 200 | 20 |
| Maryland................. | 3,108 | 17,966 | 12,356,838 | 579,689 |
| Massachusetts............ | 786 | 2,012 | 2,794,848 | 339,074 |
| Michigan................. | 99 | 22 | 11,984 | 938 |
| Minnesota................ | 273 | 49 | 23,285 | 1.984 |
| Mississippi.............. | 1,330 | 232 | 61,511 | 4.930 |
| Missouri................. | 10,495 | 11,350 | 9,424,823 | 419,520 |
| Montana.................. | 1 | ...... | 25 | 2 |
| Nebraska................. | 101 | 46 | 11,049 | 859 |
| New Hampshire............ | 22 | 57 | 86,593 | 10,710 |
| New Jersey............... | 12 | 45 | 33,855 | 2,440 |
| New Mexico............... | 14 | 6 | 1.415 | 146 |
| New York................. | 3,532 | 8,629 | 9.316.135 | 836.067 |
| North Carolina........... | 27,250 | 97,077 | 36,375.258 | 5,175,833 |
| North Dakota............. | 9 | 2 | 590 | 30 |
| Ohio..................... | 12,929 | 44,303 | 37,853.563 | 2,642,858 |
| Oregon................... | 59 | 12 | 3,325 | 666 |
| Pennsylvania............. | 10,365 | 26,955 | 28,956,247 | 1,984,754 |
| South Carolina........... | 585 | 394 | 222,898 | 33,908 |
| South Dakota............. | 5 | 1 | 195 | 10 |
| Tennessee................ | 16,624 | 51,471 | 36,368,395 | 1,841,464 |
| Texas.................... | 1,861 | 423 | 175,706 | 15,131 |
| Vermont.................. | 37 | 50 | 70,518 | 7.843 |
| Virginia................. | 24,034 | 110,579 | 48,522,655 | 4,323,649 |
| Washington............... | 18 | 25 | 7,040 | 843 |
| West Virginia............ | 3,794 | 4,647 | 2,602,021 | 302.380 |
| Wisconsin................ | 4,124 | 17,241 | 19.389,166 | 1,260,565 |

The average production per acre in the U. S. for the year 1889 was 705 lb., and at that time 692,990 acres of the richest cultivated land were devoted to its growth. Its cultivation is possible in a range almost as great as that of Indian corn, but it is destroyed by frost, and the risk in this respect in the Northern States is very great. The largest-producing countries other than the U. S. are tropical or semi-tropical. Cuba may be estimated to produce 60,000,000 lb. a year, chiefly in the district of Vuelta del Abajo, a rich plain S. W. of Havana, 80 miles in length by 20 in breadth. A Government monopoly long existed in Cuba, but the production and trade were thrown open in 1820. The finest leaf is grown in Cuba for the manufacture of cigars both there and in the U. S. and Europe. Porto Rico produces tobacco in considerable quantity, but not of so good a quality as that of Cuba. Haiti produces more than Porto Rico, chiefly in its northeastern part. Mexico produces largely, and exports a small share only to Great Britain and France. The Central American states produce and export not more than Mexico; New Granada and Venezuela produce and export largely, furnishing 20,000,000 lb. to general commerce, and consuming freely in addition; the town of Varinas is a chief place of export. Peru furnishes a small quantity; Brazil has greatly enlarged its production, and with Uruguay and the Argentine Confederations contributes largely to the European supply—perhaps 20,000,000 lb. British India produces inferior tobacco, which is largely consumed there, and exported to a small extent to Europe. The Philippine islands produce 2,000,000 lb. for export, chiefly to Great Britain and Bremen, from Manila. Java furnishes 20,000 piculs (2,670,000 lb.) for annual export, and China and Japan together as much more, which is brought to Europe. Turkey produces a considerable quantity of fine tobacco, the best being sent from Latakia in Syria. Other localities on the eastern shores of the Mediterranean produce tobacco for the general European supply, and in Italy, Spain, France, and Germany a considerable quantity is grown which does not enter into general commerce, the several state or government monopolies taking practical charge of it, as well as of all that is imported. In the East Indies some of the finest tobacco is grown, which has an established reputation in American and European markets.

*Cultivation.*—The tobacco-plant is a strong-growing, gross-feeding herbaceous annual, requiring a warm, well-drained soil containing an abundance of available plant-food. As the plant has great leaf-development an abundance of nitrogen and potash in the soil is of the utmost importance, and it is also essential that the plant-food be comparatively free from chlorides for the production of the best quality of smoking-tobacco. The crop is exhausting in consequence of the large proportion of mineral elements and nitrogenous matter found in the leaves, the ash of the dried leaves yielding 24 per cent. of mineral constituents. The value of the tobacco being wholly in the leaves, great care is taken to increase their size and concentrate the strength of the plant upon them. Thin glossy leaves having a silky texture are most highly prized for cigar-wrappers. The seed is everywhere sown in beds, and the young plants transplanted to the tobacco-fields when 2 to 5 inches high. In the preparation of the seed-bed great care is taken to have the soil dry, warm, well supplied with plant-food, and protected from chilling winds. The plants are set in rows 2 to 4 feet apart, that usually admit of cultivation with a horse. As the tobacco-plant grows rapidly when once established, it is essential to give thorough cultivation as well as an abundance of available plant-food. The flower stem is broken out or topped, and the strength of the plant concentrated on ten to sixteen of the larger leaves. Shoots or suckers grow quickly from the axils of the leaves after topping, and these shoots must be frequently removed. About four months are necessary as the period of growth, and when the leaves are mature light-colored spots appear on them, and they crack or break when folded closely.

*Harvesting.*—The process usually is to cut the whole stem near the ground, allow the plants to wilt somewhat, and draw them to the shed or tobacco-house, where they are hung on poles to cure. Sometimes, however, the crop is harvested by removing the leaves from the stalk as fast as they ripen, and curing them in tightly made buildings by artificial heat.

*Curing and Sorting.*—Unless artificial heat is used it is important that the curing-houses be so arranged that the ventilation can be controlled. After the plants are once dried they may be taken down, and the leaves stripped from the stalks whenever the weather is damp. These leaves are tied into bundles, carried into the sorting-house, and sorted into three to seven grades, according to the kind and quality of tobacco. The leaves after sorting are tied into little bundles called hands; these hands are then packed tightly into hogsheads or boxes for the market. Care is used in handling the tobacco during the sorting process to expose the tobacco only in a damp atmosphere, in order to keep the leaves soft and pliable. After the tobacco is packed it is allowed to pass through a process of curing called sweating before it is used in the manufacture of chewing or smoking tobacco.

*Insect Enemies in the U. S.*—Among these are *Protoparca celeus*, the Northern tobacco-worm, and *P. carolina*, the tobacco-worm of the Southern States. The adults of these insects, called sphinx-moths, are strong. rapid flyers and at twilight are often mistaken for humming-birds. The eggs are deposited singly on the tobacco-leaves, where they soon hatch. The larva, known as hornworm, is a voracious feeder and does great damage, particularly to the varieties of tobacco used for cigar-wrappers. The larva burrows in the ground to pupate, where it moults and becomes a chrysalis and remains in the ground in this form until the following spring. The late broods of this insect feed almost wholly upon the tomato-plant. Hand-picking the worm is the chief remedy, although attempts to poison the adult insect have often proved successful. *Greasy cutworm* (*Agrostis ypsilon*), one of the commonest of American cutworms, feeds also on corn, cotton, and other plants. The eggs are laid on weeds or grass, hatch out in a day or two, the larvæ drop to the ground, burrow and feed on roots until the following spring when they come to the surface of the ground, and often do great damage by eating off the young plants; the damage is done almost wholly at night. The *flea-beetle*, or *tobacco-fly* (*Crepidodera cucumeris*), lives through the winter in a winged state, and attacks the young plants in the seed-bed and in the fields soon after transplanting. The remedies are covering the beds with netting and sprinkling the plants with a decoction of tobacco-water. The *boll-worm* (*Heliothis armigera*) sometimes damages tobacco when corn and cotton are scarce; the only remedy is hand-picking the larvæ. The *meadow-grasshopper* (*Orchelimum vulgare*) and the *locusts*, of which there are several species (*Melanoplus femur-subrum* is the most common), all do more or less damage, particularly if the tobacco-fields are near pasture or meadow land.

*Diseases.*—The tobacco-plant is subject to comparatively few diseases, and these rarely result in serious damages. The *brown rust* prevails to a greater or less extent every year, and is caused by an abnormal physiological condition of the leaf structure caused by excessive wet or drouth, or any cause that produces a weak growth. The *white speck* of tobacco is supposed to be caused by the fungus *Macrosporum tobacum*, although its history is not well understood. *White veins* occur in the cured product and have been attributed to a variety of causes.

*Manufactured tobacco* is technically distinguished from both the cured leaf and from cigars or snuff. It is made from ordinary or inferior leaf by twisting, pressing, or cutting, and assumes various forms and names. In the U. S., as elsewhere, sirups and licorice are largely used in its preparation, though adulteration with other leaves or deleterious substances rarely occur. In Great Britain adulteration is carried to great extremes, and stringent laws have been enacted to suppress it. Great improvements have taken place in cutting, preparing, and flavoring tobacco manufactured for chewing and smoking. Cavendish, navy, twist, negro-head, etc., are standard names or brands in the trade for that which is compressed in solid forms; "fine-cut" is shredded and loose in fibrous masses, cut by delicate machinery from leaf of good quality and flavored acceptably. Smoking-tobacco is prepared of every grade and quality, but usually from broken leaves, stems, and inferior parts. In the U. S. less of such grades, or of smoking-tobacco generally, is made or consumed than in Europe, and the tax being relatively higher compared with the small original cost of the materials, little is manufactured in this form for general trade.

The following table gives the number of pounds of manufactured tobacco produced in the U. S. during the year 1893:

| STATES. | Plug. | Fine-cut. | Smoking. | Snuff. |
|---|---|---|---|---|
| Alabama | 5,649 | ......... | 110 | ........ |
| Arkansas | 986 | ......... | 3,793 | ........ |
| California | 15,225 | ......... | 72,720 | ........ |
| Colorado | .......... | ......... | 28,488 | ........ |
| Connecticut | .......... | ......... | 23,577 | ........ |
| Florida | .......... | ......... | 17,727 | ........ |
| Georgia | 8,619 | ......... | 10,757 | 2,448 |
| Illinois | 614,079 | 1,656,258 | 7,755,739 | 343,559 |
| Indiana | 63,344 | ......... | 112,626 | ........ |
| Iowa | .......... | 26,280 | 358,328 | ........ |
| Kansas | 8,805 | ......... | 23,098 | ........ |
| Kentucky | 21,159,164 | 342,864 | 3,308,460 | ........ |
| Louisiana | .......... | ......... | 1,134,816 | 16,132 |
| Maryland | 350 | 448,557 | 10,513,999 | 645,095 |
| Massachusetts | .......... | ......... | 13,876 | 64,645 |
| Michigan | 4,550,618 | 4,140,444 | 7,255,827 | 9,871 |
| Minnesota | 2,061 | 2,371 | 103,519 | 38,211 |
| Missouri | 46,057,274 | 115,367 | 5,257,351 | 27,523 |
| Montana | .......... | ......... | 6,273 | ........ |
| Nebraska | .......... | ......... | 31,840 | ........ |
| New Hampshire | .......... | ......... | 4,128 | ........ |
| New Jersey | 11,877,905 | 3,292,353 | 4,443,923 | 4,643,527 |
| New Mexico | .......... | ......... | 4,250 | ........ |
| New York | 2,953,237 | 2,319,582 | 11,453,660 | 112,726 |
| North Carolina | 15,838,617 | ......... | 5,476,590 | 71,707 |
| Ohio | 13,005,653 | 1,107,996 | 3,617,674 | 9,185 |
| Oregon | .......... | ......... | 7,750 | 530 |
| Pennsylvania | 510 | 47,461 | 2,976,527 | 4,642,799 |
| South Carolina | 18,090 | ......... | 1,538 | ........ |
| Tennessee | 1,435,004 | 240 | 129,916 | 739,306 |
| Texas | .......... | ......... | 6,930 | ........ |
| Virginia | 30,316,865 | ......... | 3,667,991 | 583,200 |
| West Virginia | 45 | ......... | 3,531,984 | ........ |
| Wisconsin | 4,280 | 702,880 | 5,092,866 | 2,272 |
| Totals | 147,963,380 | 14,202,671 | 76,448,651 | 11,952,736 |

*Cigars* (Sp. *cigarro*; Fr. *cigare*) constitute the most important form in which tobacco is consumed for smoking, and in fact the largest aggregate in general consumption in any form; and their greater value induces every effort to produce leaves suited to covering cigars by the growers. The cigar is of Spanish or Spanish colonial origin, and it was long in use in Spain before its general adoption by other nations. The greatest skill in the manufacture of cigars has always been shown by Spanish or Cuban artificers, and Havana has been the seat of the best manufacture for a century or more. The materials used for filling must be good, and must be skillfully arranged and combined so as to secure a proper firmness with a good draught. The wrappers must be of elastic and moistened leaf, so applied as to form a perfect ovoid cylinder, one end of which is closed and the other open. Uniformity in size, length, weight, and color is essential. Cigars are tied in bundles of twenty-five to fifty each, and these are packed in boxes of Spanish cedar containing two, three, or four bundles, usually 100 in a box. The Spanish cedar is largely exported to the U. S. for making boxes, and is also imitated in American cedar, but the general form of tying and packing is tenaciously adhered to. Nearly one-half in value of all tobacco grown is made up into cigars.

*Cigarettes* are small rolls of fine smoking-tobacco inclosed in paper wrappers; they are largely made in Cuba and in the U. S. They are ranked and counted as cigars for revenue purposes. *Cigarrillos* is the Spanish term for cigarettes or small cigars.

POUNDS OF TOBACCO MANUFACTURED INTO CIGARS AND CIGARETTES IN 1893, AND THE NUMBER OF CIGARS AND CIGARETTES MADE.

| STATES. | POUNDS OF TOBACCO USED. | | Cigars manufactured. | Cigarettes manufactured. |
|---|---|---|---|---|
| | Cigars. | Cigarettes. | | |
| Alabama | 92,953 | 8 | 5,243,693 | 1,600 |
| Arkansas | 31,868 | ........ | 1,490,056 | ........... |
| California | 1,594,065 | 32,412 | 77,681,111 | 10,608,700 |
| Colorado | 267,051 | 521 | 13,289,431 | 152,000 |
| Connecticut | 923,257 | 982 | 42,508,518 | 339,510 |
| Florida | 2,796,193 | 3,150 | 134,967,443 | 1,077,162 |
| Georgia | 99,593 | ........ | 5,073,252 | ........... |
| Illinois | 5,244,177 | 13,216 | 275,082,289 | 5,014,330 |
| Indiana | 1,325,456 | 11 | 66,724,060 | 2,500 |
| Iowa | 1,263,098 | ........ | 68,550,277 | ........... |
| Kansas | 410,446 | ........ | 20,987,014 | ........... |
| Kentucky | 859,319 | ........ | 42,327,644 | ........... |
| Louisiana | 1,494,400 | 391,915 | 58,953,479 | 156,567,410 |
| Maryland | 1,744,791 | 172,755 | 95,751,718 | 39,642,335 |
| Massachusetts | 2,570,372 | 468 | 115,905,793 | 108,670 |
| Michigan | 2,270,779 | 612 | 121,367,765 | 308,000 |
| Minnesota | 795,277 | 391 | 42,595,379 | 130,300 |
| Missouri | 1,348,957 | 617 | 71,438,690 | 268,400 |
| Montana | 71,561 | ........ | 3,444,640 | ........... |
| Nebraska | 470,795 | ........ | 23,893,898 | ........... |
| New Hampshire | 379,046 | ........ | 16,737,591 | ........... |
| New Jersey | 1,510,679 | 4,214 | 73,153,940 | 1,535,895 |
| New Mexico | 4,308 | 138 | 211,585 | 84,000 |
| New York | 23,318,642 | 5,904,638 | 1,103,775,864 | 1,793,513,517 |
| North Carolina | 94,643 | 2 924,494 | 5,415,930 | 891,215,385 |
| Ohio | 6,933,724 | 10,918 | 370,410,333 | 2,102,160 |
| Oregon | 154,624 | ........ | 7,680,841 | ........... |
| Pennsylvania | 21,517,330 | 15,178 | 1,198,425,323 | 5,001,590 |
| South Carolina | 13,705 | ........ | 673,898 | ........... |
| Tennessee | 91,328 | ........ | 3,861,485 | ........... |
| Texas | 175,900 | 580 | 9,511,362 | 139,000 |
| Virginia | 1,527,589 | 3,019,931 | 103,482,527 | 802,929,195 |
| West Virginia | 1,121,362 | 34 | 67,342,256 | 13,400 |
| Wisconsin | 1,911,509 | ........ | 93,281,896 | ........... |
| Totals | 84,428,797 | 12,497,183 | 4,341,240,981 | 3,660,755,959 |

Average quantity of tobacco used for 1,000 cigars, 19·44 lb.; average quantity of tobacco used for 1,000 cigarettes, 3·41 lb.

*Snuff* has been made from a very early period, first and most largely by the Spanish, who prepared it with care and scented it with various materials. Next the Netherlands, Scotland, and England extended and popularized its use. For many years Scotch snuff has been the favorite in commerce, and large manufactures have existed in Great Britain, with a moderate production in the U. S. The export and import of snuff have not been usually distinguished from manufactured tobacco; the amount, however, has been large, and the consumption in Great Britain larger than all elsewhere. The manufacture was originally conducted by grinding the leaf in conical mortars, and more or less was produced in all tobacco-consuming countries. It is now ground in iron mills by steam-power. The old and standard brands of snuff were *maccaboy*, originally from Martinique and Spain; *rappee*, or the French; and that known as Scotch, or *Lundyfoot*. There has been a great decline in the use of snuff in Great Britain and Germany since 1850, and in the U. S., with local exceptions, an even greater decline.

Revised by George C. Watson.

Tobacco, Chemistry and Physiological Relations of.—The most important ingredient of the tobacco-leaf is the alkaloid *nicotine*, which is present, in the dried leaf, in quantities varying from 2 to 6 per cent. Pure nicotine ($C_{10}H_{14}N_2$) is a colorless, oily liquid of a strong alkaline reaction, disagreeable smell, and hot, acrid taste. It is volatile, inflammable, soluble in water, alcohol, ether, and oils. On exposure to light it turns to a reddish-brown color. With acids it forms crystallizable salts. Nicotine was first isolated by two German chemists, Posselt and Reimann, in 1828. It is a virulent poison, a single drop sufficing to kill a rabbit in less than four minutes. *Nicotianine*, or *tobacco-camphor*, is a principle obtained by distilling the leaves, whether fresh or dry, with water. This is a fatty substance, occurring in the form of minute acicular crystals, having little taste, but a tobacco-like smell. Besides these principles, tobacco contains albumen, resin, and gum, and an unusual quantity (from 16 to 18 per cent. and over) of inorganic ingredients. Lime composes from 25 to 50 per cent. of the ash, and potash about 30. Nitric, phosphoric, and malic are among the acids that occur. By dry distillation tobacco affords a dark empyreumatic oily substance (oil of tobacco), of the peculiar strong smell of old, foul tobacco-pipes, and an exceedingly acrid, sharp, disagreeable taste. This oil is apparently a complex substance, and, like nicotine, is an exceedingly powerful poison. *Tobacco-smoke*, according to careful analyses by Vohl and Eulenberg, contains no nicotine, but does contain the whole series of the pyridine (volatile) bases, whose conjoint effect upon the animal system is substantially the same as that of nicotine; and also, among other ingredients, ammoniacal compounds, hydrogen cyanide, a number of organic acids, and of hydrocarbons of the benzene or analogous series.

The *effects of tobacco upon the animal system* have been critically studied by experimenting with nicotine upon animals. This alkaloid is one of the most powerful of nerve-poisons, producing tetanic convulsions, followed by paralysis, and death through failure of respiration. The cerebrum is little affected, and the pulse-rate, while first lessened, is afterward quickened. The pupil is contracted. In man, tobacco taken in sufficient quantity to show poisonous effects produces giddiness, faintness, and an indescribable feeling of sinking and misery, followed shortly by intense nausea, severe and long-continued vomiting, and great relaxation and feebleness of the muscular system. The skin becomes pale and moist, and the pulse exceedingly feeble. More or less of these effects may persist for a day and more after the poisoning. They are familiarly seen in young lads when first beginning to smoke. As to poisonous dose, there is none, for not only do different persons vary in their susceptibility to tobacco, but habit also makes an enormous difference in the effect following a given dose; so that, as is well known, very large quantities of tobacco can be smoked or chewed without the development of any of the above-mentioned poisoning. In sufficient dose, tobacco proves a dangerous and even fatal poison. The symptoms are, in general, an intensification of those just described—namely, intense nausea and vomiting, faintness, muscular debility, cardiac failure, and general prostration. Often, too, there are violent pains in the abdomen, cramps, convulsions, and profuse purging. An injection *per rectum* of an infusion representing the strength of 30 grains of tobacco has several times killed, and death may take place within an hour from the time of receiving the poison. Extensive external applications of tobacco may also cause poisoning, and even death. There is no antidote, and in cases of acute poisoning the stomach or bowels should be evacuated by appropriate means, and restorative agents employed, such as alcoholics, ammonia, the application of heat, friction, and artificial respiration. *Chronic poisoning* by tobacco, such as occurs from undue indulgence in the weed as a luxury, shows itself in *dyspepsia*, the smoker experiencing loss of appetite, especially in the morning, dry foul tongue and thirst; and in *nervousness*, as evinced by a general physical and mental restlessness, with undue susceptibility to external impressions, and by tremulousness of the muscles and palpitation or irregular action of the heart. With smokers, also, a form of chronic irritability, and even inflammation, of the throat and tonsils is exceedingly common. Graver evils, such as paralysis, mental decline, and loss of sight from wasting away of the optic nerve, have been charged to excessive use of tobacco; but when we consider the enormous number of persons who indulge heavily in the weed, and the comparatively rare occurrence of the affections in question, where there is not some other obvious and valid cause for the same, the claim that tobacco is to blame for the disease must be received with caution. *Moderate* use of tobacco by persons with whom it "agrees" (i. e. does not produce obviously injurious effects) often calms and soothes the exhausted or irritated nervous system, helps digestion, promotes the function of the bowels, removes the sense of fatigue, and tends to compensate for an insufficient food-allowance. The popular question whether good or harm follows the habitual use of tobacco is too broad to admit of a single sweeping answer. According to present physiological knowledge the facts bearing on this subject are as follows: In the first place, tobacco is not a general necessity for the human race; for individuals, whole classes, and even entire races of men, have attained a very high physical and mental development without the use of the agent. In the second place, to young persons, under twenty-five years or so, tobacco, even in small quantity, is so apt to disorder health in some way or other that for such it should be considered generally harmful. Third, many persons, even adults, can never indulge at all in tobacco without being to some degree poisoned. For such individuals common sense teaches that the weed is to be regarded as wholly noxious. Fourth, an enormous number of persons can and do use tobacco (the actual quantity consumed varying with the individual) not only without apparent present disturbance of health, but with maintenance of as full physical and intellectual vigor, freedom from sickness, and longevity, as are found with non-consumers. To say that such individuals, did they abstain, would be still more hearty or long-lived is to assert that which obviously can be neither proved nor disproved. Finally, the exigencies of our artificial civilization often demand a continued overtaxing of either the physical, intellectual, or emotional faculties, and in some such cases, especially where the sufferer is past the most vigorous period of life, tobacco in moderation often seems to counteract in some measure the evil effects of the strain, disposing to emotional and physical calm, removing fatigue, assisting digestion, and supplementing a scanty food-supply. If, then, the abatement of morbid symptoms and restoration of the bodily functions to their normal status be beneficial, we must accord to tobacco in the present instances the right to be regarded as a useful agent. But in connection with this topic it is proper to bear in mind the fact, that while tobacco in due moderation may be often apparently harmless, and even, under some circumstances, useful, yet that to indulge in an excess which, for the individual, is injurious, is both easy and tempting, and, as a matter of fact, is an exceedingly common habit. Any tobacco-consumer, by reverting to the symptoms of chronic tobacco-poisoning detailed above, can easily determine for himself whether he is or not crossing the "poison-line" in his use of the luxury. As to the relative power of the various modes of consuming tobacco, it is probable that a given quantity of a given leaf will most promptly and powerfully affect the system if *chewed*, next if *smoked*, and least if taken as *snuff*. In the matter of smoking, again, less of the active principles will reach the mouth if the tobacco be smoked in a clean pipe than if a foul one be taken, and less with a pipe, if clean, of porous material, like meerschaum, and with a reasonably long stem, than where the same tobacco is smoked as a cigar or cigarette. With both pipe and cigar or cigarette, again, the last portion smoked is proportionately stronger than the first, for it becomes saturated with a certain percentage of the smoke-ingredients of the earlier portions, mechanically arrested in their passage. Actual *inhalation* of tobacco-smoke, as practiced by many cigarette-smokers, apart from an injurious irritation of the air-passages themselves, determines quick and full absorption of the volatile elements of the smoke, and so a maximum of effect from a given quantity of leaf. Partly for this reason, and partly because, from the convenience of the cigarette, cigarette-smokers are apt to keep their systems almost continuously under the influence of the weed, this class of consumers affords a proportionately high percentage of subjects of chronic tobacco-poisoning. There is no reason to charge deleterious effects upon the paper ordinarily used in cigarette-manufacture. The time of day and state of the stomach also modify the effect of tobacco, however used, the influence being comparatively stronger earlier in the day or upon an empty stomach than in the evening or after a meal.

*Medicinal Uses.*—In medicine tobacco is used solely for its relaxing influence upon the muscular system. Before the introduction of anæsthetics it was thus sometimes employed in cases of visceral spasm, or where hernias or dislocations were to be reduced, but its use in these circumstances is almost obsolete. In tetanus the drug has been tried, and shows, as might be expected, a certain power in blunting the irritability of the motor tract of the spinal cord, and thus reducing the severity of the spasms. It has been given in this disease in the form of nicotine, administered by subcutaneous injection in doses of a small fraction of a drop. In asthma some sufferers find relief from smoking tobacco, but as a rule the remedy is not of much use. The most common way of administering tobacco for medicinal purposes is by giving an infusion of the leaf by enema, but great prudence is necessary, as the drug thus introduced is a powerful and even dangerous remedy. Externally, lotions and ointments of tobacco have been used for various purposes, but extensive application is in the highest degree dangerous, fatal poisoning having more than once occurred in consequence. See TOBACCO in the Appendix. EDWARD CURTIS.

**Toba'go** (originally *Tabaco* or *Tabago*): an island of the West Indies, 20 miles N. E. of Trinidad. Length from N. E. to S. W., 26 miles; area, 114 sq. miles. It is essentially mountainous except at the southwestern end, but the highest peak hardly exceeds 2,000 feet; portions are still covered with forest, the valleys and lower lands are well cultivated, the principal products being sugar and cacao. The island is generally regarded as one of the Caribbean group, but by its structure, fauna, and flora it is, like Trinidad, an outlying portion of the South American continent. It was seen by Columbus in 1498, was first settled by the Dutch (1632 and 1654), passed into French possession, and in 1763 was ceded to Great Britain. Since 1889 it has been a dependency of the colony of Trinidad. Tobago is evidently the island which Defoe describes as the home of his imaginary Robinson Crusoe. Pop. (1891) 18,353; this includes less than 200 whites. The capital and principal port, Scarborough, has about 1,200 inhabitants. HERBERT H. SMITH.

**Tobikhar' Indians**: See SHOSHONEAN INDIANS.

**Tobit, Book of** [*Tobit* = Lat. = Gr. Τωβίτ, Τωβείτ, from (supposed) Heb. *Tōbhīth*, liter., goodness]: an Apocryphal book of the Old Testament, found in the Septuagint. Scholars differ as to the date when it was written, some making it as early as the fourth century B. C., and others as late as the second century A. D. Old texts of it are extant in Greek, Aramaic, Syriac, and Latin, and texts not so old in Hebrew. It is canonical with the Roman Catholics and some of the Orientals. R. G.

**Tobler**, ADOLF: Romance philologist; b. at Hirzel, in the canton of Zurich, Switzerland, May 24, 1835; studied especially at Bonn under the guidance of Diez; later visited Italy and Paris; was for a time a teacher in a cantonal school in Switzerland, and in 1867 at the University of Berne; but in the same year accepted a call to the University of Berlin as extraordinary professor, where he still remains, having been made ordinary professor in 1870. Since 1881 he has been a member of the Berlin Academy. Among his published works are *Darstellung der lateinischen Conjugation in ihrer romanischen Gestaltung* (1857); *Gedichte von Jehan de Condet* (1860); *Mittheilungen aus altfranzösischen Handschriften*, i. (1870); *Vom französischen Versbau alter und neuer Zeit* (1880; 3d ed. 1894); *Die altvenezianische Uebersetzung der Sprüche des Dionysius Cato* (1883); *Das Buch des Uguçon da Laodho* (1884); *Das Spruchgedicht des Girard Pateg* (1886); *Vermischte Beiträge zur französischen Grammatik* (1886; a second series 1894; both reprinted with additions from the *Zeitschrift für romanische Philologie*, in which he began in 1894 a third series), besides many articles in various periodicals and in the publications of the Berlin Academy. Here may be mentioned also the volume *Abhandlungen, Herrn Prof. Dr. Adolf Tobler zur Feier seiner fünfundzwanzigjährigen Thätigkeit als ordentlicher Professor an der Universität Berlin von dankbaren Schülern in Ehrerbietung dargebracht* (1895). All his work bears the marks of a wide and thorough scholarship, and perhaps no other scholar has thrown so much light on questions of historical syntax in the Romance languages, notably for Old and modern French. E. S. SHELDON.

**Tobolsk'**: a government of Siberia, bounded W. by the Ural Mountains, and extending from the Kirgheez territory to the Arctic Ocean. Area, 539,659 sq. miles. The western and southern part of the country is occupied by spurs of the Ural and Altai Mountains, from which the land slopes toward the Arctic Ocean in one extensive plain. The northern portion of this plain, between lat. 66° N. and the ocean, is a frozen swamp during nine months of the year; the middle portion, between lat. 58° and 66° N., is a forest region, inhabited by hunters and producing excellent fur; the southern portion is good agricultural land, where rye, barley, oats, and the fruits of Middle Europe are raised. Iron, copper, silver, gold, and platinum abound in the Ural Mountains, and mines are extensively worked. Manufactures of leather, soap, and woolen fabrics, and an important transit trade between Europe and Asia, are carried on. Pop. (1897) 1,438,655. Revised by M. W. HARRINGTON.

**Tobolsk**: capital of the government of Tobolsk, Siberia; at the confluence of the Tobol and the Irtish, in lat. 58° 12' N. (see map of Asia, ref. 3–E). It is a handsome town, though most of its houses are built of wood, and it carries on manufactures of leather, soap, and tallow, besides fishing and ship-building. Pop. (1897) 20,427.

**Tocantins**, tō-kaan-teens': a river of Brazil, rising in Southern Goyaz, flowing with a general northerly course, and entering the Atlantic through the Pará, which may be regarded as its estuary. The Pará receives, through the network of channels S. W. of the island of Marajo, a large volume of Amazonian water, exceeding the outflow of the Tocantins proper; hence the Tocantins is commonly called a branch of the Amazon, and commercially it belongs to the Amazon system. The lower portion is very broad and lakelike. About 200 miles above the city of Pará navigation is interrupted by a series of rapids; above these it is freely navigable for many hundred miles. On the western side it receives the great river ARAGUAY (*q. v.*), which is also navigable for a long distance, and by its length, volume, and direction may be considered the true head. The upper Tocantins (so called above the junction of the Araguay) receives many tributaries, the most important being the Manuel Alves, which, with the main river, forms part of the boundary between Goyaz and Maranhão. Small steamers ply on the upper Tocantins and Araguay, and canoes pass the rapids to Pará; ultimately this river system must form the outlet of Goyaz and Eastern Matto Grosso. The banks have hardly any inhabitants except Indians; rubber and Brazil-nuts are brought down to Pará. Length (from Pará), by the upper Tocantins, about 1,700 miles; by the Araguay, 1,900 miles. HERBERT H. SMITH.

**Tock**: another spelling of TOK (*q. v.*).

**Tocology**: See OBSTETRICS.

**Tocqueville**, Fr. pron. tōk'veel', ALEXIS CHARLES HENRI CLÉREL, de: publicist; b. at Verneuil, Seine-et-Oise, France, July 29, 1805; studied law, and in 1830 became an assistant magistrate. In 1831 he was commissioned to investigate the penitentiary systems of the U. S., which he visited in company with Gustave de Beaumont. In 1832, having returned from the U. S., he resigned his office, and in 1835 gave to the public the first volume of his work *De la Démocratie en Amérique* (On Democracy in America, 4 vols., 1835–40), which met with a brilliant success. About this time he married Mary Mottly, an English lady. De Tocqueville, though himself opposed to democracy, foretold its rapid growth in the world, and was the first to write a systematic work of political science on the facts of democratic government as observed in the U. S. In 1838 he was made a member of the Academy of Moral and Political Sciences, and in 1839 he was elected to the Chamber of Deputies. He became a member of the French Academy in 1841. In 1848, having been elected to the Constituent Assembly, he lent his support to the cause of order. In 1849 he was Minister of Foreign Affairs from June 2 to Oct. 31. The *coup d'état* of Dec. 2, 1851, drove him from the public service. He published *L'ancien Régime et la Révolution* in 1856. His complete works, including his correspondence, were published in 9 vols. (Paris, 1860–65). D. at Cannes, Apr. 16, 1859.

**Tocu'yo**: a town of the state of Lara, Venezuela; on the Tocuyo river; 40 miles S. W. of Barquisimeto and 2,067 feet above the sea (see map of South America, ref. 1–C). It is finely situated in a wide valley, and is the center of one of the most important agricultural districts of Venezuela; the exports are coffee, hides, sugar, etc. It was founded in 1545. There are several tanneries. Pop. (1889), with the immediate vicinity, 15,383. H. H. S.

**Toda, Tuda**, or **Tudawa**: a singular race of people of Dravidian stock, inhabiting parts of the Neilgherry Hills in Southern India. In 1858 they numbered only 337 persons and they do not now exceed 750, yet they are the dominant people of their region, and receive from the inferior tribes a heavy tribute. They have a peculiar language, of doubtful relationship, which is unwritten. Their religion is the worship of departed spirits and of the sun. Their only industry is the herding of buffaloes for their milk and butter. They practice polyandry, all the brothers of one family having but one wife in common. The men, however, claim and receive, at certain seasons, the rights of temporary husbands to the women of the subject villages. The Toda men are tall and well-proportioned, and in many respects are a superior race of men. See Marshall, *Phrenologist among the Todas*, containing a grammar by Pope (1873); Grigg, *Manual of the Nilgiri Hills* (1880).

**Todd**, CHARLES BURR: See the Appendix.

**Todd,** Charles Scott: soldier; son of Judge Thomas Todd; b. near Danville, Ky., Jan. 22, 1791; graduated at William and Mary College 1809; became a lawyer at Lexington 1811; took part as brigade quartermaster and judge-advocate of Gen. Winchester's division in the war of 1812; became captain in the Twenty-eighth Infantry May, 1813; aide to Gen. Harrison at the battle of the Thames; assistant inspector-general Nov. 1, 1813, inspector-general Mar. 2, 1815; settled at Frankfort, Ky.; secretary of State of Kentucky 1817, member of the Legislature 1817–18; editor of *The Cincinnati Republican* 1840, in which capacity he took a leading part in the campaign in favor of his former commander, Gen. Harrison, to whose biography, prepared by Benjamin Drake (1840), he also contributed; and was minister to Russia 1841–45. D. at Baton Rouge, La., May 14, 1871.

**Todd,** David Peck: See the Appendix.

**Todd,** Henry John: clergyman and man of letters; b. in England in 1763; graduated at Oxford about 1785; took orders in the Church of England; became successively a minor canon of Canterbury, vicar of Milton 1792, rector of All Hallows, London, keeper of the MSS. at Lambeth Palace 1803, rector of Settrington, Yorkshire, 1820, prebendary of York 1830, and Archdeacon of Cleveland 1832. He edited *Johnson's Dictionary* (1814), and the works of Milton (1801; 4th ed. 1843) and of Spenser (1805); wrote biographies of Milton, Spenser, Gower, Chaucer, Cranmer, and Bishop Walton; and *An Authentic Account of our Translation of the Bible, and of the Translators* (1834). D. at Settrington, Dec. 24, 1845. Revised by Benj. Ide Wheeler.

**Todd,** John, D. D.: clergyman and author; b. at Rutland, Vt., Oct. 9, 1800; graduated at Yale College 1822 and at Andover 1826; was pastor of the Congregational church at Groton, Mass., 1827–31, of the Edwards church at Northampton 1833–36, of the First Congregational church in Philadelphia 1836–42, and of the First church at Pittsfield, Mass., 1842–72; was one of the founders of Mt. Holyoke Female Seminary, and for some years president of the trustees of the Young Ladies' Institute at Pittsfield, where he died Aug. 24, 1873. He was the author of *Lectures to Children* (Northampton, 2 vols., 1834; 2d series 1858); *Student's Manual* (1835); *Truth made Simple* (1839); *The Young Man* (1843); *The Daughter at School* (1854); *Mountain Gems* (4 vols., 1864); *Woman's Rights* (1867); *Sunset Land, or the Great Pacific Slope* (1869); *Old-fashioned Lives* (1870), and other popular works, some of which, especially the *Student's Manual*, have had a large circulation, and exerted great influence in the U. S. and in Great Britain. See *John Todd, the Story of his Life, told mainly by himself* (New York, 1876). Revised by H. A. Beers.

**Todd,** Thomas: jurist; b. in King and Queen's co., Va., Jan. 23, 1765; received a good English education; was a soldier in the war of the Revolution; emigrated to Kentucky 1786; became a lawyer at Danville; was several years clerk of the district court, and subsequently of the court of appeals, of which he was judge 1801–06; was chief justice of Kentucky 1806–07, and a justice of the U. S. Supreme Court from Mar. 3, 1807. D. at Frankfort, Feb. 7, 1826.

**Todhunter,** Isaac: mathematician; b. at Rye, England, in 1820; studied at University College, London; graduated in 1848 as senior wrangler at Cambridge, where he became a fellow and mathematical lecturer of St. John's College. He was the author of a series of text-books in elementary and higher mathematics which are remarkable for their clearness of exposition. D. at Cambridge, Mar. 1, 1884.

**Tod'idæ** [Mod. Lat., named from *To'dus*, the typical genus, from Lat. **to'dus*, plur. *to'di*, a kind of small bird]: a family of birds peculiar to the tropical regions of America. They resemble in physiognomy and form the kingfishers (*Alcedinidæ*), to which they are allied; the bill is moderately long (at least as long as the head) and much depressed, with the tip rounded or pointed; the wings short and rounded; the tail rather short; the tarsi quite slender and long; toes three in front and one behind; and the anterior syndactylous, i. e. united by their first joints; claws short and well curved. In most details of structure of the skeleton and other parts, so far as examined, they resemble the *Momotidæ* and *Alcedinidæ*. They dwell mostly in damp places in South and Central America and the West Indian islands. Except in the breeding season, they remain generally single and alone. When at rest they sit in a crouched manner on the branches, with the head drawn in between the shoulders, and are so dull and stupid that they are easily approached and caught with the hand. They are nevertheless sufficiently spry to catch insects that come near them. They are said to make their nests generally in holes in the ground, and to lay three or four eggs. Revised by F. A. Lucas.

**Todleben,** tōt'lā-ben, Franz Eduard Ivanovich, Count: soldier; b. at Mitau, Courland, May 20, 1818; educated in the schools at Riga and at the School of Engineering in St. Petersburg; served in the Caucasus against Schamyl 1848–51; was distinguished in the campaign on the Danube 1853–54, and on the outbreak of the Crimean war in the latter year was ordered to Sevastopol on the invasion of the allies. To his genius in developing the inchoate works and in improvising defensive expedients adapted to the peculiar circumstances is attributed the successful defense by which the place resisted for nearly a year (349 days) the efforts of the allied armies. (See Sevastopol.) For his distinguished services at the siege he was breveted major-general and afterward held important positions in the Engineer department. In 1860 he became lieutenant-general and in the following year inspector-general of the Engineer service. When the Russo-Turkish war broke out in 1877, he at first received no command in the field, being passed by for men of inferior ability, but the repeated disasters before Plevna caused him to be summoned to give advice as to the best method of taking the city. Under his direction a regular siege was begun and the garrison cut off from supplies. In December the city capitulated and the entire army surrendered to the Russians. After the peace he was appointed governor-general of Odessa. D. at Soden, Germany, July 1, 1884. He wrote a valuable account of the defense of Sevastopol (French trans., *Défense de Sévastopol*, etc., 1864), and a work on fortifications. See Kinglake, *The Crimean War*, and *Life*, by Krähmer (Berlin, 1888).

**Tody**: any bird of the family Todidæ (*q. v.*).

**Tofana**: See Aqua Tofana.

**To'goland**: the smallest of the German protectorates; on the Slave Coast, West Africa. It was placed under the German flag by Dr. Nachtigal (1884), and is, so far, the most prosperous of the German possessions in Africa. Wedged in between French territory on the E. and the British Gold Coast on the W., it has about 35 miles of coast, and an approximate area of 16,000 sq. miles. Pop. about 500,-000. Its roads to the interior are important routes to and from the thickly populated portion of the Sudan. The commerce is chiefly confined to a barter trade for palm oil and ivory, but all tropical products may be grown, and the forests abound with oil palms, caoutchouc, and valuable woods. An imperial commissioner controls public affairs; the local laws are made by a council of merchants. Thirty Negro policemen maintain order. About 100 vessels annually visit the coast trading-towns, of which the most important are Little Popo, Bagida, and Lome. C. C. Adams.

**Togrul Beg**: See Seljuks.

**Tok**: any one of the small black and white hornbills (*Bucerotidæ*) of the genus *Toccus*, a group distinguished by

The crowned tok.

a thin, compressed beak, and only elevated into a low, sometimes obsolete, crest. These birds are mostly found in

Africa, occurring throughout the larger portion of the wooded districts, the exceptions being *Toccus gingalensis* of Ceylon and *Toccus griseus* of Malabar. They live on fruit and insects and nest in holes of trees. The typical species, *Toccus erythrorhynchus*, is about 18 inches long, and has a bill of a deep-red color. F. A. L.

**Tokaido**, tō-kī'dō: the great coast highway between the two capitals of Japan, noted for its fine trees and picturesque views. Leaving the Nihon bridge in Tokio, from which point distances in the empire are measured, it proceeds S. to Kanagawa, thence to Odawara, whence it ascends the Hakone pass (2,970 feet) and descends on Mishima. Afterward it keeps to the coast, passing through Shidzuoka, the residence of the deposed Tokugawas (see TOKUGAWA), until it reaches Nagoya. Thence it strikes inland across the Kisogawa valley, by Gifu and Ogaki to Hikone on Lake Biwa, follows the southeast shore line to Otsu, and reaches Kioto after traversing 132¾ ri (317 miles). The name is also applied to the provinces through which the highway runs. The inland or mountain road is known as the Nakasendo. J. M. DIXON.

**Tokat'**: town; in Asia Minor, in the vilayet of Sivas; in a beautiful and fertile valley on the Yeshil Irmak (anc. *Iris*), about 65 miles from the Black Sea (see map of Turkey, ref. 4–G). Founded in the Middle Ages, it became an important trade center, but within a generation the main route has been directed to Trebizond, and Tokat has greatly declined. Its population of over 50,000 has diminished to less than 10,000. Manufacture of copperware is its chief industry. At Guemelek (Comana), 3½ miles to the N., Chrysostom died in exile (407). E. A. GROSVENOR.

**Tokay'**: small town of Northeastern Hungary, county of Zemplin; on the right bank of the Theiss, at the influx of the Bodrog (see map of Austria-Hungary, ref. 5–I). It is famous as the entrepôt of the celebrated Tokay wines, produced in the neighborhood. Annual product about 260,000 gal. Pop. 4,480. Revised by M. W. HARRINGTON.

**Tokay Wines**: See WINE and WINE-MAKING.

**To'kio**: the modern capital of Japan; situated in lat. 35° 40' N., lon. 139° 45' E. from Greenwich; area, nearly 30 sq. miles; pop. 1,150,011 (see map of Japan, ref. 6–E). Since IYEYASU (*q. v.*) set up his residence here in 1590 it has been the real government center of Japan, and is associated with all the traditions of modern Japanese bureaucracy. Its former name was Yedo (Estuary Gate); changed to Tokio (Eastern Capital) when the emperor removed his court hither in 1869. Up to the year 1400 its site was a swampy wilderness, but during the following century a castle was built, and a village arose about it. Iyeyasu enlarged the castle, had the marsh drained, and when, after the battle of Sekigahara, he became complete master of Japan, he converted Yedo into one of the most populous cities in the world by compelling the territorial nobles to spend half of the year within its bounds. The city became a congeries of fenced inclosures, within which the several daimios, with their retainers and servants, established themselves. At this period the waters of the bay approached much closer to the castle walls than they do at present, the siltings of the Sumida river having gradually formed the district known as Tsukiji, i. e. made ground, where the foreign settlement is, and the process continues. The center of the city is the castle, the moat of which, in the form of a spiral, incloses many square miles of the city and encircles the central building two and one-eighth times. This moat is a favorite winter haunt of wild fowl, while in summer the pink lotus makes a gorgeous display of color. In the troubles of the restoration in 1868 the central building of the castle, where the shoguns held their court, was burned down, and the emperor, after leaving Kioto, was obliged to make use of a daimio's residence in the vicinity as a palace. In 1889, however, the court removed to a new palace, in which the Japanese and Western styles of architecture are somewhat bizarrely mingled. This palace is on a less elevated but more extensive site within the inner walls of the castle. As a city, Tokio is loosely built, being, in fact, a collection of villages and inclosures. Many of the houses, even in the heart of the city, have small gardens attached. Lying in an exposed position on the sea edge of a large plain, Tokio is a wind-swept city, and as the houses are mostly (formerly altogether) built of wood, disastrous fires sweep over it from time to time. In 1880, 1881, and again in 1892—to mention only more recent disasters—whole districts were laid in ashes. The authorities insist on the houses which line the main streets being built fire-proof. The business portion of the city lies in the flat ground between the castle and the sea, and is a network of canals. The Nihon bridge over the Yedo-gawa, a tributary of the Sumida, is the busiest spot in the empire, of which it is the center for purposes of mileage measurement. Here are the fish-market, the warehouses of the steamship companies, the general post-office, etc. The two main parks of the city—Uyeno to the N. and Shiba to the S.—are connected by a long thoroughfare, the backbone of the city. Along this route street-cars and omnibuses ply; elsewhere most of the passenger traffic is carried on in jinrikishas. At Uyeno and Shiba are two fine temples where the Tokugawa shoguns were buried alternately. Between the castle and Shiba lies the official quarter of the city, where cluster the Foreign Office, the War Office, the houses of Parliament, most of the foreign legations, the residences of the princes of the blood royal, etc. This quarter is quite European in its aspect. The central barracks and parade-ground, formerly here, have been moved out farther W. To the N. of the castle is the educational quarter, where is situated the university with four handsome colleges and a library in brick, the grounds extending to 10 acres; here also are the higher Normal School and numerous private schools. All the ground W. of the castle is undulating, frequently with steep bluffs. The Sumida river, which skirts the city on the N. E., is spanned by five long bridges, one of them of iron. On the flat ground across the river there is an extensive suburb. Tokio is a great commercial entrepôt, its situation at the head of its landlocked bay and near the mouths of three large rivers favoring its growth; but Osaka still remains the commercial center of the empire. Politically and socially, however, the influence of Tokio is paramount. The youth of the empire flock here in crowds, to attend schools where they may acquaint themselves with foreign learning and see the wonders of modern civilization; indeed, there is said to be a floating population of this kind numbering at least 70,000. The garrison numbers 7,000. At Tsukiji there is a naval college; the anchorage is off the extreme southern suburb of the city, at Shinagawa, only vessels of light draught being able to make use of the harbor in the river. The city is lighted with electricity, and extensive waterworks are in course of construction, the supply being taken from the TAMAGAWA (*q. v.*). A small river, the Yodogawa, flows into the moat at the northern suburb of Koishikawa, where is situated the imperial burying-ground. The crematories of the city are found on the right bank of the Sumida E. of Uyeno. There are two terminal railway stations—at Shiba and Uyeno—connected by a loop suburban line. J. M. DIXON.

**Tokugawa**, tō'kōō'gaa'waa: a distinguished family which furnished a dynasty of rulers to Japan. Founded in the twelfth century, it rose to greatness in the sixteenth century in the person of IYEYASU (*q. v.*). From 1603 to 1868 a succession of Tokugawa rulers held sway in Tokio, securing tranquillity for the country and encouraging those arts for which Japan is now famed. The representative of the line has filled the post of ambassador to Italy. J. M. D.

**Toland**, JOHN: deistical writer; b. near Redcastle, Londonderry, Ireland, Nov. 30, 1669, of Roman Catholic parents; was originally called JANUS JUNIUS, but changed his name while at school at Redcastle, where he also became a zealous Protestant, and under the patronage of some Dissenters entered the University of Glasgow 1687; removed to that of Edinburgh, where he graduated M. A. 1690; studied theology two years at Leyden, with a view to becoming a Dissenting minister; his first work, *Christianity not Mysterious* (London, 1696; 2d ed. Amsterdam, 1702), was censured by convocation, replied to by Stillingfleet and many others, and burned by the hangman at Dublin; published an *Apology for Mr. Toland* (London. 1697); went to Amsterdam; published there the first edition of Milton's *Works, Historical, Poetical, and Miscellaneous, with a Life* (3 vols. fol., 1697–98), in which he made an indirect attack on the Gospels, which was replied to by Rev. Dr. Offspring Blackall, Bishop of Exeter, in a sermon preached before the House of Commons; wrote a rejoinder entitled *Amyntor, or a Defense of Milton's Life* (1699), which occasioned a polemic with Dr. Samuel Clarke and others; turned his attention to politics; wrote a pamphlet entitled *Anglia Libera* (1701) in favor of the succession of the house of Brunswick, which procured him the favor of the Princess Sophia at the court of Hanover, and employment in a quasi-diplomatic capacity at Berlin and other German courts; held a theological discussion with Beausobre; returned to England and published *Vindicius Liberius* (1702), a new defense of his first book, in which he asserted his claim to be "a true Christian" and "a good Churchman," but in his *Socinianism truly Stated* (1705) avowed himself a pantheist; in 1704 published *Letters to Serena* (that is, the Queen of Prussia); resided abroad in the employ of Harley 1707–10, and was subsequently a voluminous pamphleteer in London. D. at Putney, Mar. 11, 1722. Among his numerous works were *State Anatomy of Great Britain* (1714); *Nazarenus, or Jewish, Gentile, or Mahometan Christianity, containing the History of the Ancient Gospel of Barnabas, etc.* (1718); *Tetradymus* (four treatises, 1720); and a *Life* of Servetus (1724). A biography appeared in 1722, and a collection of his miscellaneous pieces, with a memoir, was published in 1726 by Peter des Maizeaux (again in 1747).

Revised by S. M. JACKSON.

**Toledo**, Span. pron. tō-lā'dō: one of the oldest cities of Spain, and the capital of a province of the same name (see map of Spain, ref. 16–E). It is built on a circle of seven hills 2,400 feet above the level of the sea, and inclosed on three sides by the Tagus, toward which the town presents steep and abrupt sides, while on the fourth side, where the ground slopes gently, it is defended by two walls—an inner wall built by the Goths in the seventh century, and an outer built by Alfonso VI. in 1109—both profusely adorned with towers and gates. From 467 to 714 it was the capital of the Goths, from 714 to 1085 that of the Moors, and after 1085 it was the residence and capital of the kings of Castile. Its most remarkable edifice is the cathedral, the metropolitan church of Spain, founded in 587, and one of the most magnificent church buildings in the world, 404 feet long, 204 feet wide, and having its chief nave almost overloaded with sculpture. Besides the cathedral, the city contains 26 other churches, 37 monasteries, and other architectural monuments; but its general aspect is gloomy and almost desolate. It contains a royal palace that was originally built by King Wamba, rebuilt by Charles V., altered by Philip II., then changed into a military academy, and burned in 1887. The splendor has become sepulchral; the place, which once contained about 200,000 people, had in 1887 only 20,837. Its once flourishing industry has also died out, the only two branches of manufacture alive being those of sword-blades and confectionery. Revised by M. W. HARRINGTON.

**Tole'do**: town (founded in 1853); capital of Tama co., Ia.; on the Chi. and N. W. Railway; 20 miles E. of Marshalltown, and 50 miles W. of Cedar Rapids (for location, see map of Iowa, ref. 5–I). It is connected with Tama by electric railway; contains 5 churches, 2 public-school buildings, 2 State banks, and 2 weekly newspapers; and has brick and tile works, scale factory, and other manufactories. Toledo is the seat of Western College (United Brethren, chartered in 1856). Pop. (1890) 1,836; (1900) 1,941.

EDITOR OF "CHRONICLE."

**Toledo**: city (incorporated in 1837); capital of Lucas co., O.; on the Maumee river near its entrance into Maumee Bay; 53 miles S. W. of Detroit, and 92 miles W. of Cleveland (see map of Ohio, ref. 1–E). At Turtle Light, 7 miles out, the bay expands into Lake Erie, within its limits affording one of the best harbors on the lakes. The water of the river is 573 feet above sea-level.

*Lake Traffic.*—The city covers an area of 28½ sq. miles, extending for 9 miles on the eastern and western banks of the Maumee, with a dock front of 20 miles. The largest steamers reach these docks with cargoes of iron and copper ore, lumber, salt, fish, and other merchandise from the northern and western ports of Lakes Superior, Michigan, and Huron, and with goods and other traffic from the southern and eastern ports of Lakes Erie, Ontario, and the St. Lawrence river. There are twenty-four important railway lines, bringing hither for manufacture or distribution the coal deposits of Southwestern and Central Ohio, wheat and other cereals from the grain-fields of Indiana, Illinois, Michigan, and Ohio, and ship-timber from the lumber regions of Northern Michigan and Canada. Toledo is also the terminus of the Miami and Erie Canal. The receipts of wheat, corn, oats, rye, and barley in 1900 amounted to 55,000,000 bush. The city is one of the largest soft-coal markets in the U. S.

*Manufactures.*—The manufacturing interests are important and diversified. There are extensive works for the manufacture of malleable iron and furnaces for the casting of plows, steam-boilers, and car-wheels. One of the largest wagon-works in the U. S. is located here, and several bicycle-works, besides factories for the manufacture of carriage-wheels and bent work. There is also an automobile company. The Edward Ford plate-glass factory is said to be the largest glass plant in the world. The Libbey Cut Glass Works have an international reputation. The milling interests are led by the winter wheat flour-mills of the National Milling Company, with an output of from 3,000 to 4,000 barrels daily. The grain interests are represented by 13 elevators, the largest of which has a storage capacity of 1,700,000 bush. Ship-building is carried on extensively.

*Local Interests.*—Toledo has an extensive system of water-works on the stand-pipe plan, constructed at a cost of more than $1,340,000. It has two natural-gas companies furnishing fuel to the city through 200 miles of distributing-pipe. There are 100 miles of electric street-railways. An electric belt-line on both shores of the river connects the villages of Maumee and Perrysburg, bringing them into rapid communication with the city. Three additional suburban electric lines are in operation.

Toledo has an extensive park system in process of development. The most popular of these parks is Walbridge Park, in the southeastern part of the city, on the bank of the river. Riverside Park, also extending along the river, has a fine yacht anchorage. Toledo has 390 miles of avenues and streets, with many fine pavements of asphalt and stone. It has 42 public-school buildings and 23 private and parochial schools, a manual training-school, which, under the name "The Toledo Polytechnic School," maintains co-ordinate literary and scientific courses. It has a central high school and a city normal school. It has a public library, containing 48,000 volumes. There are 18 banks, 91 churches, 4 hospitals, a soldiers' memorial building, an armory, new court-house, and a U. S. Government building.

*History.*—The name The Lady of the Lakes, by which Toledo is widely known, succeeded an older title, The Miami of the Lakes, by which it was known in its early history. The equable climate, with its superior fishing-grounds, made its site a favorite resort of the Miami Indians before its occupancy by the whites. Later it became an important trading-post, but it was not till the famous victory of Gen. Anthony Wayne at Fallen Timbers, in 1794, that peaceful possession by white settlers became possible. Pop. (1880) 50,137; (1890) 81,434; (1900) 131,822.

FLORENCE KENDRICK COOPER.

**Toledo**, tō-lā'dō, FRANCISCO, de: Viceroy of Peru; b. in Spain about 1515. He was a younger son of the third Count of Oropesa, was major-domo to the king, and later was sent to Peru as viceroy, entering Lima Nov. 26, 1569. During his administration he settled the disorders which had resulted from the civil wars, and a code of laws, partly founded on those of the Incas, was prepared; this code, known as the *Libro de Tasas*, was in force during the colonial period. The Inquisition was introduced in 1569. The persecution and death of the Inca TUPAC AMARU (*q. v.*) removed the last focus of opposition to the Spaniards, but the narrow and cruel policy shown in this affair produced a burst of indignation against the viceroy. He was relieved Sept. 23, 1581, and on his return to Spain was severely rebuked by the king and imprisoned. D. at Seville, Sept., 1584. H. H. S.

**Toledo War**: a term popularly given to a contest extending from 1835 to 1837 in regard to the boundary-line between the State of Ohio and the Territory of Michigan. According to the ordinance of 1787 for the government of the Northwest Territory, the line between the States of Ohio, Indiana, and Illinois on the S. and the territory on the N. was to be an east and west line running through the southern point of Lake Michigan. An old map showed the southern end of the lake at 42° 32′ N., while the true location is 41° 37′ 19″, or about 64 miles farther S. When, in 1805, the Territory of Michigan was organized, the line through the southern point of the lake was adopted; but when Indiana and Illinois were organized as States, the northern line was the one chosen. In 1812 Congress ordered a survey, which was completed in 1817, establishing what was known as the Harris line. The line of the ordinance, claimed by Michigan, was known as the Fulton line. The people of Michigan were especially persistent, as the town, now the city of Toledo, was in the disputed belt. In 1836 the Legislature of Ohio passed an act organizing townships in this territory, which for many years had been under the control of Michigan. Both State and Territory appealed to President Jackson in vain. The Governor of Ohio called out the militia, and Gov. Mason of Michigan took possession of Toledo. While matters were in this condition Congress, June 15, 1836, admitted Michigan as a State on condition of the acceptance of the Harris line and the northern peninsula, which formed a natural part of the Territory of Wisconsin. This addition, subsequently bringing such great wealth of copper and iron to the State, was finally accepted as an equivalent for the disputed strip at the S., which went to Ohio and Indiana. After formal acceptance of these conditions, Michigan entered the Union as a State Jan. 26, 1837, and peace was restored. C. K. ADAMS.

**Toleration**: See LIBERTY, RELIGIOUS.

**Tolima**, tō-lee'mâă: a southern interior department of Colombia; between Cauca, Cundinamarca, and Antioquia. Area, 18,434 sq. miles. It embraces the upper portion of the valley of the MAGDALENA (*q. v.*) between the Central Cordillera on the western frontier and the Eastern Cordillera on the E. Peaks in both these ranges, especially near their junction southward, rise above the snow limit, and nearly the whole surface of the department is mountainous. The climate ranges from tropical, near the river, to cold on the mountains, where there are wide stretches of bleak *paramo*. Gold, silver, and a little copper are mined, but agriculture and grazing are the principal occupations. The roads are very bad. Pop. about 230,000. Capital, Ibagüé. H. H. S.

**Tolima**: a quiescent volcano of Colombia; in the central Cordillera of the Andes, near the confines of Tolima, Cauca, and Antioquia, and N. W. of Ibagué. It is the highest mountain in the republic, attaining 18,425 feet; around the central peak and crater are other volcanic vents. Tolima is especially interesting to geologists as one of the few volcanoes at a considerable distance from the sea. It showed signs of activity in 1595 and 1826 to 1829. H. H. S.

**Tollens**, HENDRIK CAROLUSZOON: poet; b. in Rotterdam, Holland, Sept. 24, 1780. His education was not extensive, and all but the last ten years of his life were occupied by the necessities of his mercantile pursuits. In 1846 he was able to withdraw to a country estate at Ryswick, where his last years were given to letters alone. D. at Ryswick, Oct. 21, 1856. Tollens is perhaps the most generally popular of all the Dutch poets of the nineteenth century. He began writing very young, at first translating and imitating French plays; but later he grew discontented with his compositions of this time—the comedies *De Bruiloft* (1799) and *Gierigheid en baatzucht* (1801), and the tragedy *Konstantijn*—and refused to admit them among his works. From 1801 to 1805 appeared the first poems in which he showed his true bent—*Idyllen en minnezangen*. In these we have the sentiment and reflection of the Dutch bourgeois clothed in a style often exaggerated, yet always such as to go to the popular heart. In 1808–15 appeared his *Gedichten*; in 1816, *Tafereel van de overwintering der Nederlanders op Nova Zembla*; in 1818, *Romancen, balladen, en legenden*; in 1821, *Nieuwe Gedichten*; in 1840, *Verstrooide Gedichten*; in 1848 and 1853, *Laatste gedichten*. A. R. MARSH.

**Tolstoĭ'**, ALEKSEĬ KONSTANTINOVICH, Count: author; b. in St. Petersburg, Aug. 24, 1817. He was well educated, was for a short time in the diplomatic service, traveled extensively, served as a volunteer in the Crimean war, and for the last eighteen years of his life held a high position at court. He wrote but one novel, *Kniaz* (Prince) *Serbrianyi* (trans. by J. Curtin, 1893), a work somewhat in the style of Scott, with a well-told story, strongly drawn characters, and presenting a vivid picture of one of the most striking periods of Russian history. This same wild time is portrayed in Tolstoĭ's fine trilogy, *The Death of Ivan the Terrible* (1865), *Tsar Fedor Ioanovich* (1868), and *Tsar Boris* (1870). The first and the best of these plays has been translated into English verse (F. Harrison, London, 1869). Tolstoĭ also wrote a short, strong drama called *Don Juan*, besides another unfinished one, *Posadnik*. As a lyric poet he ranked with the best of his day, being especially successful with his ballads and popular verses. D. near St. Petersburg, Sept. 28, 1875. Complete works, 4 vols., 1890–91. A. C. C.

**Tolstoĭ**, Count LEV (or LYOFF) ALEKSEEVICH (LEV, pronounced lyoff, = English LEO, which is sometimes used): novelist; b. on the family estate of Iasnaïa Poliana, in the government of Tula, Russia, Sept. 9 (N. S.), 1828; entered the University of Kazan in 1843; left without graduating after three years. Having visited the Caucasus in 1851, he joined the army and took part in various guerrilla expeditions. It was now that he began to write. After the war in the Crimea, in which he served, he gave up military life and resided for a time in St. Petersburg and Moscow, traveled twice in Europe, then in 1861, the year before his marriage, retired to his country estate, which has since been his permanent home. His works fall into three distinct periods. To the first belong his *Detsvo* (Childhood), *Otrechestvo* (Boyhood), and *Iunost* (Youth), also his *Kazaki* (Cossacks), a description of life in the Caucasus, his *Sevastopol*, and other military sketches. The second period is that of his two great novels *Voïna i Mir* (War and Peace, 1865–68), an epic of Russian life, national and individual, at the time of the great struggle with Napoleon, and *Anna Karenina* (1875–78), a marvelous study of passion and its consequences. Soon afterward Tolstoĭ began to give himself up to the mystical religious and philanthropic ideas which have so completely mastered him that it has been doubted whether he is to be regarded as perfectly sane. His doctrines have been proclaimed in *My Confession*, *In what my Faith Consists* (more usually known as *My Religion*), a *Commentary on the Gospel*, and other works, many of them forbidden in Russia by the censors. As he believes not only in non-resistance to evil and in asceticism, but in communism, the duty of manual labor, and of every one to live like the peasants, it is only with misgivings that he has continued to write, hence all he has done has been with a didactic or polemical aim which has often detracted from its value. Still nothing can entirely quench his genius. Many of his tales for the peasants are admirable, and in even the poorest of his productions we often find pages of splendid power. The best known of his later works are the *Death of Ivan Ilich* (1884–86); *The Kreutzer Sonata* (1888); and his drama, *Vlast Tmy* (Power of Darkness). Although the influence of his later ideas has created a sect, his reputation will probably depend on his earlier works, and especially on the two novels. Both of them, as well as the shorter productions that preceded them, display a combination of keenness of realistic insight and wealth of poetical imagination, of a wonderful breadth of view with perfect handling of minute detail, seldom rivaled in all literature. The mastery of style is complete, though the author takes no pains to polish it, any more than he cares to spare us trivial incident. In his story *Khozïain i Rabotnik* (Master and Man, New York, 1895) he seems to have returned to his former manner and to show no diminution of power. Most of his works have been translated into English and other modern languages (in English by Dole, Miss Hapgood, etc.). Among the best-known studies of them are those of de Voguë, Ernest Dupuy, Lemaitre, G. Brandes, Matthew Arnold, Rallston, etc. A. C. COOLIDGE.

**Tol'tecs**, or **Toltec'as** (so called from their principal city, Tollan, supposed to be Tula, in Hidalgo): an Indian tribe, said to have occupied portions of the Mexican plateau during several centuries prior to the advent of the Aztecs. The little that is known of this race comes from Aztec traditions or pictographic records as they were collected by Spanish writers soon after the Conquest. It is related that they came from the north, making temporary settlements at various points, and finally fixing themselves at Tollan about A. D. 661. Lists of their chiefs or "kings" are extant, but these are of very doubtful value; the hero-god, Quetzalcohuatl, is said to have lived in their cities before his final disappearance. About 1013 the Toltecs were overthrown by savage tribes. They then migrated southward and do not appear further in the Aztec accounts, but the Quichés and other Maya nations which appear in Guatemala about this time are supposed by some to be their descendants. The accounts of the Toltecs are so vague and contradictory and so mixed with evident fable that many ethnologists have been inclined to deny their existence altogether; others suppose that they were a small Nahuatl tribe settled at Tula. Those who accept the traditions in their fullest sense claim that the Toltecs ruled a powerful empire extending over a great part of the plateau, and that the Aztec civilization, religion, arts, and picture-writing were derived from them. Probably the truth lies between these extreme views. It is certain that some of the Mexican monuments, notably the great pyramid or mound at Cholula, are older than the Aztec period, and traditions generally assign these to the Toltecs. Ruins near Tula indicate communal structures similar to those of Arizona. Unfortunately nothing is known of the Toltec language, hence the supposed relationship with the Maya race is conjectural, and the semi-mythical Quiché records adduced in its support have only thrown the whole subject into more confusion. HERBERT H. SMITH.

**Tolu' Balsam** [named from *Tolú* (or Santiago de Tolú) in Colombia, South America, whence it is obtained]: a balsamic juice obtained from *Myroxylon toluifera*, a lofty tree of the family *Leguminosæ*. The tree averages 70 feet in height, with a straight trunk rising 40 feet without branching. The balsam is obtained by slashing the bark of the stem through to the wood in many places, and allowing the juice which spontaneously exudes to collect in small calabashes fixed to the tree. The balsam when fresh is a light-brown, thick, resinous substance, but by keeping concretes into a solid, brittle in cold weather, but easily softened by slight warmth. It has a delicate and fragrant odor, most perceptible when the balsam is warmed, and a correspondingly pleasant taste. Its most important constituents are an amorphous resin and cinnamic acid. Balsam of tolu was used by the natives when South America was first explored, and was introduced into Europe in the latter part of the sixteenth century. This balsam has scarcely any medicinal virtue, but is largely used in pharmaceutical preparations and extemporaneous prescriptions to impart to mixtures its agreeable odor and taste. The official preparations of it are a sirup and a tincture, and it is an ingredient of the compound tincture of benzoin. Revised by H. A. HARE.

**Tolu'ca**: capital of the state of Mexico, in the republic of that name; 32 miles W. S. W. of Mexico city (45 miles by railway); in a basin of the plateau; separated from the lake valley by a range of mountains (see map of Mexico, ref. 7–G); 8,653 feet above the sea. It is well built and clean, and the climate is cool and salubrious. The town has considerable manufactures. At the time of the conquest it was an important Aztec pueblo, and tradition assigned its foundation to the Toltecs. Pop. (1892) about 17,000. The Nevado de Toluca, a few miles S. of the city, is an extinct volcano over 15,000 feet high and capped with snow. It has been frequently scaled. It is said that on a clear day both the Pacific and the Gulf may be distinguished from its summit. HERBERT H. SMITH.

**Tol'uene**, also called **Toluol, Hydride of Benzyl, Hydride of Tolyl,** and **Methyl Benzene** [*toluene*, etc. are derivs. of *tolu*]: a hydrocarbon, formula $C_7H_8$, discovered in 1837 by Pelletier and Walter in the oily product of the dry distillation of resins. It is obtained by the dry distillation of tolu balsam and many resinous bodies, by the action of potash on benzylic alcohol, and by heating toluic acid with lime; but is most readily prepared by collecting the portion of coal-naphtha which distills between 212° and 248° F., agitating it with sulphuric acid, and redistilling, and collecting the part that goes over between 226° and 230° F. Toluene is the second member of the benzene series of HYDROCARBONS (*q. v.*), as is shown by its formation from monobrom-benzene by the action of methyl iodide. It forms a mobile liquid of sp. gr. 0·883 at 32° F., and boils at 230° F. It is soluble to some extent in alcohol, in ether, and in the fixed and volatile oils, and dissolves iodine, sulphur, and many resins. A large number of substitution products of toluene are known, the most interesting of which are those of chlorine and nitric acid. Revised by IRA REMSEN.

**Tolu'ic Acid**, also called **Toluolic Acid** and **Toluylic Acid** [*toluic* is deriv. of *tolu*]: an aromatic homologue of benzoic acid and an isomer of methylic benzoate, formula $C_8H_8O_2$; produced by the action of nitric acid on cymene or xylene, and by the action of sodium and carbonic acid on bromotoluene. In a pure state it is colorless and tasteless. The fusing-point of the acid is 347° F.; at a higher temperature it sublimes without decomposition, forming fine needles. When heated with lime, toluic acid is decomposed into TOLUENE (*q. v.*) and carbonic acid. It is monobasic, and forms crystalline salts.

**Tolu'idine**, or **Amido Tol'uene** [*toluidine* is deriv. of *tolu*]: an isomer of benzyl-amine, produced by reducing nitro-toluene with ferrous acetate or sulphuretted hydrogen; formula $C_7H_9N$. It dissolves in boiling water, and in alcohol, ether, and chloroform. From a dilute alcoholic solution it crystallizes in large colorless laminæ, which evaporate somewhat at the ordinary temperature of the air, and possess a burning taste. Toluidine fuses at 104° F. to a liquid which boils at about 388° F. It imparts a slight blue color to reddened litmus, and forms a series of compounds with many of the acids.

**Tomah**: city; Monroe co., Wis.; on the Chi., Mil. and St. Paul Railway; 42 miles E. of La Crosse, and 47 miles S. W. of Grand Rapids (for location, see map of Wisconsin, ref. 6–C). It is in an agricultural, lumbering, and cranberry-growing region, and contains 10 churches, the U. S. Government school for the Winnebago Indians, railway-bridge works, a private bank, and 2 weekly newspapers. Pop. (1880) 1,245; (1890) 2,199; (1900) 2,840. EDITOR OF "JOURNAL."

**Tomahawk** [from Amer. Ind.; cf. Algonkin *tomehagen*: Mohegan *tumnahegan*: Delaware *tomoihecan*]: strictly, the war-club of the North American Indians, but for a long time the name has been given, probably through misapprehension, to the war-hatchet, originally of stone. Europeans introduced steel tomahawks, which were sometimes so made as to serve as tobacco-pipes, the handle forming the stem. The natives used them as battle-axes, and possessed great skill in throwing them so that the edge would strike first.

**Toma'to** [from Span. *tomate*, from Mex. *tomatl*]: any plant of the genus *Lycopersicum* of the family *Solanaceæ*, indigenous to the Andean region. The common tomatoes are offspring of *L. esculentum*, which was introduced into Europe in the middle of the sixteenth century. The fruit, also called tomato, although formerly known as love apple, was at first regarded with suspicion and was grown for ornament, although there is a record of its having been eaten as early as 1583. The suspicion arose from its relationship to henbane, belladonna, nightshade, and other virulent poisons of the *Solanaceæ* (nightshade family). This fear of the plant was not wholly overcome until well into the nineteenth century, and even in the last quarter of the century the fruit has been considered to be associated with the production of cancer. Few fruits are more healthful than the tomato, and it ranks next the potato in economic importance among garden products. A chief reason for the popularity of the plant is the excellence of the canned tomatoes, which are consumed in enormous quantities. The output in the U. S. in 1893 was 4,456,443 cases, of two dozen cans each. The tomato needs a warm, quick soil, and the fertilizers should be such as give much available food, in order that the plant may make the most of the early season. There are a number of books and bulletins upon tomato-growing, some of the latter dealing with the forcing of the crop under glass, which is a growing industry. The leading books are *Tomato Culture*, by Day, Cummins, and Root, and *Livingston and the Tomato* (Columbus, O., 1893).
L. H. BAILEY.

**Tomato Blight**: See BLIGHT.

**Tomb**: a burial-place of permanent character or of some pretension, especially a structure destined to contain or to cover the body of one to whom some honor is intended to be done; therefore generally a somewhat ornamental monument. In the widest sense, cenotaphs are also tombs because standing for the actual tomb itself, or, in the case of persons lost at sea or the like, as being the only tomb possible. Tombs are often arranged to contain or to cover a number of burial-places; thus the Roman COLUMBARIUM (*q. v.*) is the tomb of a large number of persons; the tomb of Augustus and that of Hadrian were arranged with many burial-places, and modern funeral structures set up in the large cemeteries are intended for the burials of a whole family. The great pyramids of Egypt were tombs, and the tombs of another type, the mastabas (see MASTABA), though less in size were more elaborate in decoration. Grecian tombs were simple and tasteful, as became a race of such strong common sense and such exceptional gifts in art. The simple flat stone set up at a grave was often carved with all the skill that the time could afford, and these stelæ are found with inscriptions and decorative sculpture. In Athens, after the Peloponnesian war, unusually large gravestones were set up, and some of these are decorated with sculpture of the greatest beauty. The famous stele of Dexileos, upon which is represented in high-relief the young warrior mounted, riding down his enemy, is over 6 feet wide and nearly as high; and others are nearly of the same dimensions. The reliefs upon these very often represent peaceful groups, where personages sit or stand as if in conversation. Sometimes the idea of a farewell, or of regret, is suggested. Sometimes a marble vase with delicate reliefs carved upon it was set up at the grave. Large edifices built as monuments to the dead are not found in Greece, but were common in semi-Greek lands of Asia. The most famous of them was that of King Mausolus of Caria. See MAUSOLEUM.

The monuments erected by the Romans are celebrated in story and tradition, but their form is often altered beyond recognition, even when their mass remains. The Castle of St. Angelo (that is, of the holy angel), in Rome, is the mausoleum of the Emperor Hadrian, stripped of its sculptures, its marble colonnades, and its probably conical superstructure, and crowned with defensive works which make of it a very defensible citadel. The older mausoleum of Augustus, some vestiges of which exist half a mile away, had received the remains of the emperors who succeeded him, until its niches were filled; so Hadrian erected the still more gigantic structure for himself and his successors in office. Private tombs, only inferior in splendor to these imperial ones, remain for study outside the walls of Rome, and the round tower known as the tomb of a Cæcilia Metella had been robbed of its roof and built up into a fortified tower with mediæval battlements, exactly as has been done with the great imperial structures within the walls. Smaller private tombs lined the great highways of approach to the city gates. At Rome those of the Appian Way are well known, ruined as they are. At Pompeii a long street of tombs is found outside of the gate leading to Herculaneum, and others like it are known to exist near other gates. This means that, as burial within the walls was forbidden or made difficult, the place next easiest of access was chosen for the erection of showy memorial structures. For smaller receptacles and such as were deposited within the greater tombs, see SARCOPHAGUS, ROMAN ARCHÆOLOGY, and CATACOMBS.

The tombs of the Middle Ages and of the Renaissance are often of a refined beauty which no Roman work could approach. Both in Northern Europe and in Italy the burial monuments of the later Gothic style are of wonderful interest, and the art of the period can not be understood without a serious study of these structures. What are known as altar-tombs are large sarcophagus-like masses set on the church-floor, and commonly having a life-size effigy of the departed in bronze or stone lying upon the top. These were simple in early times, as may be seen in the Temple church in London, the cross-legged knight in his chain mail forming the only adornment; but in the fifteenth century such tombs become splendid combinations of decorative art of many kinds, as in the Burgundian monuments of about 1400, now in the Dijon Museum, and those which remain where they were first set up in the Church of Brou a century later, at Bourg-en-Bresse. The famous monument of Ilaria del Carreto (1406) in the cathedral at Lucca is made of a Roman sarcophagus upon which the lovely recumbent statue of the lady by Jacopo della Quercia is placed. Tombs of this character and only less beautiful than these exist by hundreds in Italy, France, Spain, England, and parts of Germany. Still more stately are the out-of-door tombs, but there are few of these. The most important group of them is in Verona, in the crowded little churchyard of Santa Maria Antica, where splendid pillared canopies crowned with blunt spires, which in their turn carried equestrian statues aloft, cover the sarcophagi of the princes of the house of La Scala. Nowhere is the beautiful sculptured detail of Italian Gothic more perfectly seen than here. The Castelbarco monument, standing upon the wall of the churchyard of San Pietro Martire, also in Verona, is worthy of comparison with the La Scala tombs. Verona is rich in Gothic wall-tombs as well; and these exist in great number in Venice and Florence, and in scores of smaller towns in North Italy. Wall-tombs of the Gothic period are known in the north, but here they approach rather the type of the altar-tomb with a canopy over it; they project more into the church, they are rarely confessed as upright wall-pieces. There are a few such, however, and these are of great beauty and value.

The wall-tomb reached its highest development during the Italian Renaissance. In Florence the Marsuppini monument in Santa Croce and that of Lionardo Bruni in the same church, and the two monuments by Mino da Fiesole in the Church of Badia; Mino's tomb of Bishop Salutati in the Cathedral of Fiesole; the tomb of Alessandro Tartagni in San Domenico, Bologna; and finally the two superb structures in Sta. Maria del Popolo at Rome, the tombs of Cristoforo della Rovere and the Cardinal di Castro, are enough to cite. All these were sculptured and put up between 1450 and 1505; and a long list might easily be made of such splendid structures still existing and another list of equally precious ones destroyed.

A complete treatise on tombs would require an analysis of the sculpture with which they are adorned. This is peculiarly the case with those of the post-Renaissance times, for the architectural design grows feeble and meaningless in the sixteenth, seventeenth, and eighteenth centuries, and the statues, busts, and groups in marble are by far the most important part of these works of art. The same conditions obtain in the nineteenth century. The diminished power of decorative design, characteristic of the epoch, makes it especially difficult to secure a fine monument, because there is no practical purpose to be served, and no strong leading in one or in another direction afforded the architect. But good sculpture can be had. Accordingly, the tombs in modern cemeteries are generally without merit, although some memorial statues and groups are valuable.

With respect to modern structures the term is generally used in the sense of a somewhat large interior, opening out of which are receptacles for coffins, the whole being either excavated in a hillside with a front of masonry in which the door is arranged or built above ground like a chapel or made by a combination of the two systems. In some cases a similar chapel-like structure is erected above or in connection with a single grave; but as a general thing the term is confined to family vaults of some pretension. Memorial structures erected in cemeteries above or near a grave are more often called monuments (see MONUMENT); but when these are long and low, in general shape like the altar-tombs of the Middle Ages, the word tomb is sometimes employed to describe them. In some cases a family burial-place is merely excavated and built below ground, with a slab on the surface which can be raised, and to these also the word tomb may be applied. In short, any structure which is essentially the receptacle of dead bodies or which contains and covers such receptacles, is, if built in advance, permanent, and of some pretension, a tomb. The difference between a grave and a tomb is, then, that the grave is a simple excavation to be filled up when the coffin has been deposited and the tomb is more elaborate, including something of the nature of a building. The large modern cemeteries contain many tombs in addition to the more numerous gravestones and monuments. Some of the larger tombs are occasionally used for divine service on set occasions, such as anniversaries. These buildings are more commonly a parallelogram in plan, with receptacles for coffins built at one end, the space not so occupied being reserved for vestibule, chapel, and the like. The form of an octagon has also been used, the entrance occupying one of the sides, while the receptacles for coffins are arranged, three or four in the height of the wall, on the other sides. The light in such a case comes from above and the central chamber is covered by a cupola or similar roof. All such chapel-like tombs need to be built in a permanent way of solid materials which defy weather, because such a structure is not certain to be cared for or even visited frequently after the lapse of a few years. It results from this that a certain unusual architectural pretension is common to them, and that in the U. S. tombs may be built of cut stone or marble with vaulted roofs and bronze or wrought-iron doors in the neighborhood of towns whose houses and churches are generally of wood. RUSSELL STURGIS.

**Tom'bac** [from Portug. *tambaque*, from Malay *tambāga*, copper, from Sanskr. *tāmrika*, made of copper, deriv. of *tāmra*, dark red, copper-colored, copper]: any one of several different alloys of copper and zinc, with about 85 per cent. of copper. An English tombac gave copper 86·38 and zinc 13·61. A German tombac gave copper 84 and zinc 15·5. The alloy of copper 84·5 and zinc 15·5 is very malleable and ductile. Dutch metal, pinchbeck, imitation bronze, prince's metal, and Mannheim gold are similar alloys. A *white tombac*, or *white copper*, has been made, containing copper 75 and arsenic 25.

**Tombig'bee River**: rises in Northeastern Mississippi, and after a very indirect S. by E. course of 450 miles in Mississippi and Alabama, joins the Alabama river 45 miles above Mobile, and the stream below the junction is called Mobile river. It is navigable to Aberdeen, Miss., 410 miles from Mobile Bay. Revised by I. C. RUSSELL.

**Tombs**, Sir HENRY, K. C. B., V. C.: b. in Gloucestershire, England, in Nov., 1824; educated at the Sandhurst Military College and at Addiscombe; entered the service in 1842, when ordered to join the Bengal Artillery, and soon engaged in the Gwalior campaign 1843–44, and subsequent active operations; appointed to the artillery staff and engaged in the Sutlej campaign 1845–46; and the Punjaub campaign of 1848–49. On the outbreak of the Indian mutiny, Tombs was a brevet major in command of a troop of horse artillery; ordered to join the army for besieging Delhi, he led the force which captured the Eedgah and commanded the horse artillery at the final assault. Under Sir Colin Campbell he was then engaged in the Oude campaign at Lucknow, etc. He was made lieutenant-colonel Jan., 1858; colonel the following July, and named Commander of the Bath. Besides the many medals of honors heretofore won, the Victoria Cross was now added. He commanded the Bhutan expedition, and was named K. C. B.; major-general 1867. D. at Newport, Isle of Wight, Aug. 2, 1874.

**Tombstone**: city; capital of Cochise co., Ariz.; on the Ariz. and S. E. Railroad; 19 miles S. by E. of Benson, and 30 miles N. by W. of Bisbee (for location, see map of Arizona, ref. 15–O). It is in an agricultural and a rich silver and gold mining region, and has a daily and 2 weekly newspapers. Pop. (1880) 973; (1890) 1,875; (1900) 646.

**Tomcod** [either *Tom* + *cod*, or (by analogy of *Tom* and *cod*) from Fr. *tacaud*, whiting pout = Amer. Ind., liter., plenty-fish]: in the U. S., any small codfish of the genus *Microgadus*. The tomcods, in external characters, do not differ from the large codfishes; the anus, however, is under the last rays of the first dorsal fin, instead of being under the first ones of the second, and the skull is essentially different. The species on the eastern coast is the well-known *M. tomcodus*, that on the western *M. proximus*.

**Tomlins**, William Laurence: See the Appendix.

**Tomlinson**, Charles, F. R. S.: scientist and author; b. in London, Nov. 27, 1808; received an elementary education (all his widowed mother could afford), and at twelve set out to earn his own living; was fond of reading and study, and while serving in many subordinate capacities carried on his own education; taught modern languages and science in a school established at Salisbury by his brother and himself, and in 1838 published the *Students' Manual of Natural Philosophy*; removed to London and became science lecturer at King's College School. He presented to the Royal Society many original memoirs and papers on scientific matters, and wrote many treatises and articles for cyclopædias and magazines, as well as several scientific text-books. Author of Goethe's *Herman and Dorothea* (1849); *The Sonnet* (1874); and a translation of Dante's *Inferno* (1877); author also of *Amusements in Chess*, and *Essays Old and New* (1887). D. Feb. 15, 1897.

**Tomlinson**, Herbert: physicist; b. at York, England, Nov. 18, 1845; educated at Christ Church, Oxford, and took honors both in mathematics and natural science at his degree in 1868; was appointed demonstrator of natural philosophy at King's College, London, in 1870. He has presented a number of memoirs to the Royal Society, *The Philosophical Magazine*, etc., on magnetism, electricity, elasticity, internal friction of metals, torsional vibrations, viscosity of air, etc.

**Tommase'o**, Niccolà: author; b. at Sebenico, Dalmatia, Oct. 9, 1802; went in 1818 to Padua, where he studied law; later for a time in Milan, and then in Florence, where he enjoyed the friendship of Vieusseux and contributed articles to the *Antologia*. On account of an article wrongly supposed to be written by him he was obliged in 1834 to leave Florence, and went to France, where he published various writings, notably *Dell' Italia* (2 vols., 1835), the novel *Il duca d'Atene* (1837), and *Relations des ambassadeurs vénitiens sur les affaires de France au XVI*e *siècle* (2 vols., 1838). In 1838 he went to Corsica, where he collected material for his *Lettere di Pasquale Paoli* (1846), and the Corsican songs published in his *Canti popolari toscani, corsi, illirici, greci* (4 vols., 1841–42). He then went to Venice, where he remained about ten years. Early in 1848 he was arrested, but was liberated by the people, and became minister of instruction in the provisional government and later went as an envoy to Paris. The return of the Austrians to Venice in 1849 caused his retirement to Corfu. In 1854 he went to Turin, where he undertook work on the great *Dizionario della lingua italiana*, published under his name and that of Bellini, but not completed till some years after his death. In 1860 he was elected a deputy, but resigned, refusing to hold any public office. In 1861 he established himself in Florence, where, in spite of blindness, he continued his literary labors. D. May 1, 1874. Among his numerous publications, religious, philosophical, philological, critical, and political, to say nothing of verse and fiction, besides what has been mentioned above, are the *Dizionario dei sinonimi* (1830 and since); *Commento a Dante* (1837); *Studi critici* (1843); *Rome et le monde* (1851); *Le Lettere di Santa Caterina da Siena* (4 vols., 1860); *Il secondo esilio* (1862); *Nuovi studi su Dante* (1865); *Storia civile nella letteraria* (1872), etc. E. S. Sheldon.

**Tompkins**, Daniel D.: Vice-President of the U. S.; b. at Scarsdale, Westchester co., N. Y., June 21, 1774; graduated at Columbia College 1795; was admitted to the bar of New York city 1796; was elected to the Legislature, and also to the convention for revising the State constitution 1801; was a member of Congress 1804–05; appointed judge of the New York Supreme Court 1804; was Governor of the State 1807–17; was conspicuous as an advocate of Jeffersonian principles and an opponent of the banks; commanded the third military district during the war of 1812–15, to the success of which he contributed by his energy in calling out troops and equipping them for service, but by his carelessness in keeping accounts was afterward charged with being dishonest; recommended by a special message of Jan. 28, 1817, the abolition of slavery in New York, which was effected by an act to take effect July 4, 1827; was chosen Vice-President of the U. S. 1816 on the ticket with Monroe, and re-elected 1820, when he was an aspirant for the presidential nomination; was chancellor of the University of New York; delegate to the State constitutional convention of 1821, and for a time its president. D. on Staten Island, June 11, 1825.

**Tompson**, Benjamin; poet; b. at Braintree, Mass., July 14, 1642, graduated at Harvard and taught school at Cambridge. He is remembered as the author of *New England's Crisis*, a long poem on King Philip's war, written about 1675, the prologue of which has been often reprinted. D. at Roxbury, Mass., Apr. 13, 1714. H. A. B.

**Tomsk**: government of Siberia, bounded W. by Tobolsk, E. by Yeniseisk, and S. by China, between lat. 49° and 61° N., and between lon. 75° and 90° E. The surface is one vast plain sloping from the Altai Mountains, which occupy the southernmost part. The foot of the mountains is covered with extensive forests of oak, cedar, and pitch trees, and on the adjacent steppes live large droves of wild horses and herds of oxen. Where agriculture is pursued, in the central parts of the government, good crops of rye, barley, oats, hemp, and flax are raised, as the climate generally is mild. The northern part is marshy, and partly covered with somber forests of fir and pine. The inhabitants live as nomads; hunting and fishing form important occupations. In the southern part an extensive mining business is carried on. Gold-washing is in many places very remunerative. The mineral wealth is considerable, and an important transit trade between Russia and China is carried on on the large system of lakes and rivers which the government contains. Area, 331,159 sq. miles. Pop. (1897) 1,917,527. Revised by M. W. Harrington.

**Tomsk**: capital of the government of Tomsk, Siberia: on the Tom, an affluent of the Obi; in lat. 56° 29′ N.; 2,809 miles E. of St. Petersburg (see map of Asia, ref. 3–F). It is well built, has some handsome edifices, important foundries, tanneries, soap-factories, and other manufactures, and carries on, besides its transit trade, an active trade in furs, grain, and cattle. The Siberian University was opened here in 1886. Snow falls in October, and in December mercury freezes, but the summer is beautiful and the climate generally healthful. It was almost destroyed by flood and fire on May 16, 1890. Pop. (1897) 52,430.

Revised by M. W. Harrington.

**Tom's River**: village; capital of Ocean co., N. J.; on Tom's river, and the Cent. of N. J. and the Penn. railways; 4 miles from Barnegat Bay, and 52 miles E. of Philadelphia (for location, see map of New Jersey, ref. 5–E). It is a popular summer resort; contains 5 churches, graded public schools, 3 hotels, national bank with capital of $50,000, and 2 weekly papers; and is engaged in agriculture, cranberry-culture, coasting trade, and the shipment of fish, oysters, and clams. The village was founded in early colonial days, contained large salt-works, was a noted retreat for privateers in the Revolutionary war, and was burned by the British Mar. 24, 1782. Pop. (1890) 1,147; not returned separately in 1900. Editor of "New Jersey Courier."

**Tomtit**: See Titmouse.

**Ton** [O. Eng. *tunne*, tun, large vessel; O. H. Germ. *tunna* > Mod. Germ. *tonne*]: a measure of weight and capacity in Great Britain and the U. S. As the former it is equivalent to 20 cwt., and as, in Great Britain, and in the U. S. custom-houses, the hundredweight is reckoned at 112 lb., the ton contains 2,240 lb. In the domestic commerce of the U. S., however, it has become customary to reckon only 100 lb. to the cwt. and 2,000 lb. to the ton; and this usage, in some of the States, has received the sanction of law. Thus in the Revised Statutes of the State of New York it is provided that "the hundredweight shall consist of one hundred avoirdupois pounds, and twenty hundredweight shall constitute a ton." This law was passed in 1851. By act of Congress, when not specified to the contrary, the ton is to be construed as meaning 2,240 lb. The ton of 2,240 lb. is commonly called "the long ton," that of 2,000 lb. "the short ton." The old shipping ton of France was 2,158·43 lb., and the metric ton is 2,204·6 lb. As a measure of the carrying capacity of a ship the ton is 40 cubic feet. This is called actual tonnage. The register ton is 100 cubic feet.

The words *ton* and *tun* are etymologically the same, but the former orthography is usually applied to weights and the latter to liquid measure. The tun in old British ale or beer measure was equal to 216 gal. of 282 cubic inches each, and in old British wine measure to 252 gal. of 231 cubic inches each. A tun of water of the larger of these measures weighs a little over 2,200 lb.; and hence it is supposed that the ton weight was originally derived from the tun measure, of which it is a rough equivalent.

**Tonawan'da**: village; partly in Erie and partly in Niagara cos., N. Y.; on the Niagara river, the Tonawanda creek, the Erie Canal, and the N. Y. Cent. and Hud. River Railroad; 11 miles N. of Buffalo (for location, see map of New York, ref. 5–C). It contains a number of manufactories, principally of lumber, and a union school with library, a national bank with capital of $100,000, a State bank with capital of $200,000, and a weekly newspaper.—The village of NORTH TONAWANDA (post-office, Tonawanda) has lumber interests, manufactures of merry-go-rounds, etc., and has a daily paper and 2 State banks with combined capital of $200,000. Pop. Tonawanda (1880), 3,864; (1890) 7,145; (1900) 7,421; North Tonawanda (1890), 4,793; (1900) 9,069.

**Tone** [from Fr. *ton* < O. Fr. *ton* < Lat. *to'nus* = **τόνος**, a stretching, tension, cord, tone, sound, deriv. of **τείνειν**, stretch]: in music, a word having for its primary meaning a *sound*, or the impression made on the ear by a vibrating string or other sonorous body. The derivative meanings of the term relate to the qualities, relations, or conditions of such sounds, as (1) their place on the scale, a high tone or a low tone; (2) the interval made by two sounds, as a major or a minor tone; (3) any special quality of a sound, as a fine, clear, rich, sweet, or feeble tone. In a more technical sense a tone (or whole tone) means one of the steps of the scale, as C—D, G—A, etc. The words step and half-step are much better as scientific terms than whole tone and semi-tone, as the former are not easily confounded in a student's mind with the idea of quality of sound, as is the case with the word tone. Revised by DUDLEY BUCK.

**Tone**, THEOBALD WOLFE: patriot; b. in Dublin, Ireland, June 20, 1763; educated at Trinity College, Dublin; studied law in London; was called to the bar at the Middle Temple 1789; wrote a number of pamphlets to expose English misgovernment in Ireland; was an ardent sympathizer with the doctrines of the French Revolution; promoted the combination of the Irish Roman Catholics with the Protestant Dissenters in opposition to the British Government; founded at Belfast the first society of United Irishmen 1791; became secretary and agent of the Roman Catholic committee 1792; was involved in secret negotiations with France, on account of which he went to the U. S. 1795; resided a few months at Philadelphia and at Princeton, N. J.; sailed for France Jan., 1796; aided the French Directory in fitting out Hoche's projected expedition to Ireland, in which he was appointed brigadier and adjutant general; served in the Bavarian army 1797; was captured in Sept., 1798, on board a French squadron bound for Ireland; was taken to Dublin, tried by court martial, and sentenced to death, but committed suicide by cutting his throat Nov. 19, 1798.—His eldest son, WILLIAM THEOBALD WOLFE TONE (b. in Dublin, 1791), was educated by the French Directory; served in the French army; emigrated to the U. S. in 1816; served a few years in the army; d. in New York, Oct. 10, 1828. He published several works, including the *Autobiography* of his father (Washington, D. C., 1827; new ed. London, 1892).

**Toner**, JOSEPH MEREDITH, M. D.: physician and author; b. in Pittsburg, Pa., Apr. 30, 1825; graduated at the Jefferson Medical College in 1853; in 1855 took up his residence at Washington, D. C.; in 1872 founded the Toner lecture, in charge of the Smithsonian Institution, to encourage the discovery of new truths in medicine; contributed largely to medical literature and to medical biography; and devised a system of symbols to indicate geographical localities, which has been adopted by the Post-office Department. He was a member of many medical societies and learned associations. D. Aug. 1, 1896. Among his numerous publications are *Abortion in its Medical and Moral Aspects* (1859); *Maternal Instinct, or Love* (Baltimore, 1864); and a *Dictionary of Deceased American Physicians*.
Revised by S. T. ARMSTRONG.

**Tonga Islands**: See FRIENDLY ISLANDS.

**Tongaland**: another spelling of AMATONGALAND (*q. v.*).

**Tongue** [O. Eng. *tunge*: O. H. Germ. *zunga* (> Mod. Germ. *zunge*): Icel. *tunga*: Goth. *tuggō* < Teuton. *tung-*: O. Lat. *din'gua* > Lat. *lin'gua* < Indo-Eur. *dngh-*]: the organ of the special sense of taste, situated on the floor of the mouth. This body consists of muscles by which it can be protruded, retracted, and curved upward, downward, and laterally. The base or root of the tongue is attached below to the hyoid bone, and the tip of the tongue, when inactive, rests forward against the inner surface of the lower incisor teeth. The tongue consists of two symmetrical halves, with a fibrous middle septum; hence one side may be paralyzed and the other active, as in cases of apoplexy. The upper surface or dorsum of the tongue is essentially the seat of taste. (See figure of taste-bulbs in HISTOLOGY.) It is covered by delicate processes or papillæ, which contain the ultimate ramifications of blood-vessels and the terminal fibers of the nerves of sensation and taste. The fore part and sides of the tongue derive their sense of taste from the gustatory branch of the fifth nerve. The base of the tongue and sides and the larger papillæ receive their special sense through the lingual branch of the glosso-pharyngeal nerve.

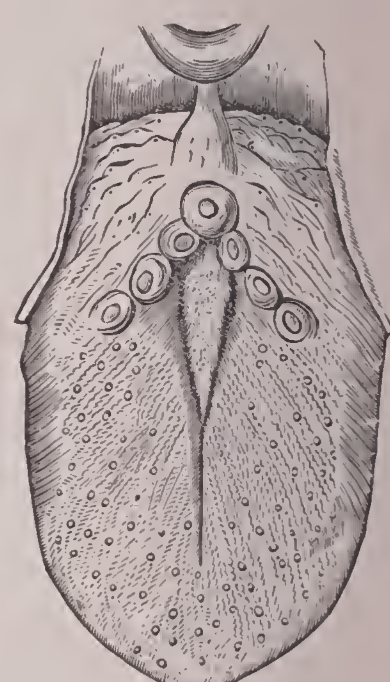


FIG. 1.—The tongue.

The facial nerve also has an influence upon taste, paralysis of this nerve impairing the special sense. The papillæ vary in size and length on different parts of the tongue—broad, circumvallate near the base, fungiform and filiform on the anterior part. Food and viands of decided flavor can be definitely tasted and distinguished by a single papillæ, as found when applied through cylindrical glass rods. It is claimed that only the circumvallate and fungiform papillæ contribute to the sense of taste, the filiform to sensation. Sensation (tactile) is more acute in the tongue than elsewhere in the body. Thus Valentin found that distinct perception of two

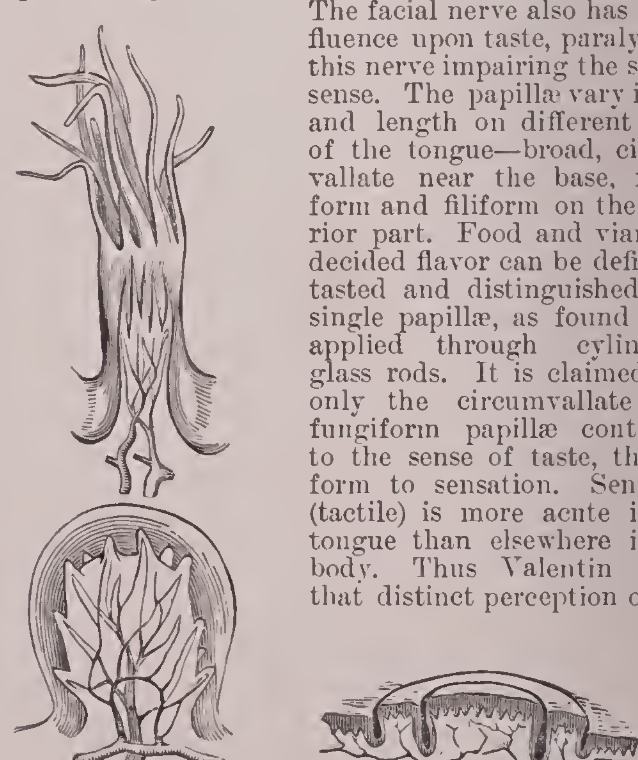


FIG. 2.—Papillæ of tongue: loops of vessels and nerves.

needle-points was obtained at the tip of the tongue when the points were separated only ·483 of a Paris line ($\frac{1}{12}$ inch), the most sensitive part elsewhere, the tip of the finger. requiring ·603 of a line. The several papillæ are imbedded in the corium or body of the mucous membrane, which corresponds to the cutis vera of the skin, and are covered with scaly epithelial cells. The tongue may be inflamed from various causes, as hot drinks and irritants. It is often the seat of apthæ, ulcers, cankers, the result of catarrh of the mouth. A curious form of inflammation sometimes occurs on one lateral half, usually the left, of the tongue (hemiglossitis). There is decided swelling of the affected side. The disease seems of nervous origin. The coated tongue may be due to a relaxed, flaccid, and pale condition of the papillæ, and when noticeably coated has an accumulated stratum of thickened saliva and rapidly exfoliated epithelial cells; the yellow color is the result of the fatty metamorphosis which the cast-off cells speedily undergo. When the stomach is inflamed or irritable, the papillæ of the tongue will often appear as distinct points. The tongue is occasionally attacked by epithelial cancer. Ranula is a cystic tumor beneath the tongue, due to occlusion of some one of the salivary ducts. Exceptionally, in infants the frænum or fibrous cord beneath the tongue is too short; the tongue-tied infant can not nurse well, and when older speaks imperfectly; the cure is by cutting.

Revised by W. PEPPER.

**Tonic**: in music, the keynote, or prime of a scale.

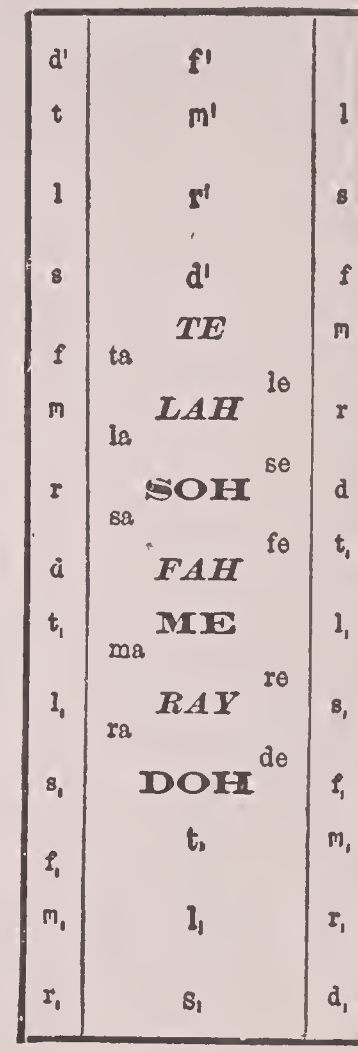
**Tonics** [from Gr. τονικός, deriv. of τόνος, tension, force, strength, tone, deriv. of τείνειν, stretch. See TONE]: in medicine, a term used to refer generically to the means employed by the physician to remove the condition of debility, general or special. Nourishing food, fresh air and exercise, cold bathing, etc., are thus spoken of as having a tonic effect. Drugs, such as directly improve nutrition, or indirectly accomplish the same end by exciting the appetite and increasing digestive power, are called tonics. The most prominent examples of the former are *iron*, which in anæmia directly stimulates the manufacture of the red blood-corpuscles; *cod-liver oil*, which operates as a fatty food of unusually easy assimilation; *phosphorus*, which in some cases of nervous exhaustion or functional nervous derangements seems to improve the nutrition of the nerve-structures; and preparations of some of the metals, as silver, zinc, mercury, arsenic, which in peculiar conditions of malnutrition tend in some unknown way to determine the nutritive processes back into the healthy channels. Of the drugs which are tonic by improving digestive power, the most serviceable are vegetable bitters, as cinchona and its alkaloids, gentian, columbo, quassia, nux vomica, etc.; aromatics and spices; acids, both mineral and organic; and weak alcoholic beverages in very moderate quantity. The list might be greatly extended, for it is a general property of irritants that, taken internally in small doses, their irritation tends to increase the activity of the digestive organs and the secretion of the digestive fluids. Revised by H. A. HARE.

**Tonic Sol-fa System**: a musical notation, and the method of teaching music which grows out of it. It is called a natural system, because it treats music properly as having but one scale or alphabet of seven tones. The other scales are but replicates of this. No lines and spaces are used. It consists of the letters d, r, m, f, s, l, t, which are the initials of the Guidonian syllables doh, ray, me, fah, soh, lah, te (the last changed from se). These notes are applied to all keys alike, in accordance with the tonic principle in music. Tones above the octave are represented by a figure at the top of the letter ($d^1$, $d^2$, etc.); tones below the octave by a figure at the bottom of the letter ($s_1$, $s_2$, etc.). The signs for time (rhythm) are based upon the law of accent. A strong accent is represented by a perpendicular line before a note (|); the weak accent is represented by a colon (:); a medium accent by a shorter, thinner line (¦). The space between any two accents represents a beat or pulse. The space between two strong accents represents a measure. A dash between two accent-marks shows that the previous tone is to be continued. The four principal forms of measure are herewith given as illustrations:

| Two-pulse measure. | Four-pulse measure. |
|---|---|
| {\|d : m \|d : — \|} | {\|d : m ¦ s : m \|d : — ¦ — : — \|} |

| Three-pulse measure. | Six-pulse measure. |
|---|---|
| {\|d : m : s \|d : — : — \|} | {\|d : m : s ¦ $d^1$ : s : m \|d : — : — ¦ — : — : — \|} |

In these measures each pulse is supposed to represent a quarter-note. The shorter notes are represented by divisions of the spaces; eighth-notes by a dot in the middle of the space (\|d . d :); sixteenth-notes by a comma in the middle of the half-space (\|d , d . d , d :); triplets by inverted commas (\|d ‘ d ‘ d :). Other forms are shown by combinations of these signs. Silences (rests) are indicated by the absence of notes in the pulse divisions (\|d :   \|). In the tonic sol-fa system the world's standard of keys is recognized, but no sharp or flat signatures are required. The pitch of a tune is indicated thus at the beginning: Key C, Key G, Key F, etc. Chromatic tones are represented by the old chromatic names written out. The sharps are de, re, fe, se, le; the flats are ra, ma, sa, la, ta. No naturals, double sharps, or double flats are required in tonic sol-fa, as they are only necessitated by the complex nature of the staff notation.




The germs of the tonic sol-fa notation were first used by Miss Sarah Glover, of Norwich, England, as early as 1812. In 1841 John Curwen, a young Congregational clergyman of London, saw its educational value, and thereafter devoted his life chiefly to its development. Through his genius the tonic sol-fa system became not only a complete musical notation, but also a perfect educational method. He introduced many original devices. One was that of indicating each tone of the scale by a position of the hand, which enables the teacher to exercise a class in one and two parts in all keys. Another device is the modulator, by which scales and keys are represented or pictured in their true relationships, as shown in the diagram. This device, combined with the simplicity of the notation, reduces to a minimum the difficulties of modulation, or transition, as the tonic sol-faists prefer to call it. If the key is changed to the dominant (fifth) the *soh* is changed to *doh*, and the other syllables to correspond; thus with any passing change of key that may occur. As a result of this simplicity the tonic sol-fa notation becomes a revelation of the harmonic mysteries of classical music. All vocal music (oratorios, masses, glees, etc.) is printed in this notation in England, and is sung with facility by the common people. Whether the notation is of equal value in instrumental music is a question that is not yet decided. Its value in that is not so self-evident; yet time may prove that its educational power is equally needed with the keyboard as with the voice.

The introduction of tonic sol-fa into the U. S. dates from the publication of a monthly journal, the *Tonic Sol-fa Advocate*, by Theodore F. Seward, in 1881 (since discontinued), and the preparation by him of text-books of the system adapted to the needs of the American public. The relation of tonic sol-fa to the staff notation may be aptly compared with the relation of the Arabic figures to the Roman numerals. As these figures reduced mathematics to a simple expression, and brought its principles within reach of the common mind, so does the tonic sol-fa notation change the relation of music to the entire human race.

THEODORE F. SEWARD.

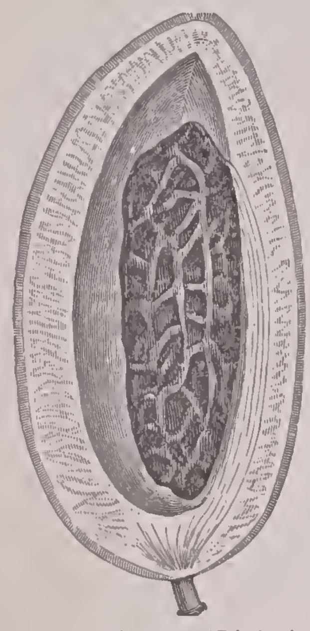
**Ton'ikan Indians**: a linguistic stock of North American Indians, whose historically known tribes lived in close proximity to one another, and appear to have spoken dialects not widely differing. About the year 1700 one tribe lived in Avoyelles parish, La.; another, E. from there, at the Tonica Bluffs, on the eastern bank of the Mississippi river; and a third, near the junction of the Yazoo and Mississippi. Politically, these latter belonged to the Chicasa confederacy. The Tonicas on Tonica Bluffs were steadfast allies of the French colonists. All Tonicas had the reputation of being warlike. A connected history of their migrations, wars, and other deeds can not be composed from documents now extant, and the Tonicas now living are all to be found in Avoyelles parish, about a mile from Marksville. In 1886 the number of those who spoke or remembered their paternal language did not exceed twenty-five. See Pierre Margry, *Découvertes*, iv., 180, 362, 398, v., 401 (Paris, 1883); B. French, *Historical Collections of Louisiana*, iii., 35 (New York, 1846); and T. Jefferys, *History of the French Dominions in North and South America*, i., 145, 146 (London, 1760). See also INDIANS OF NORTH AMERICA.

J. W. POWELL.

**Tonk**: city and state of Rajputana, British India. The state is of very irregular outline, occupying the western slope of the basin of the upper Chambal river. Area, 2,839 sq. miles. Pop. (1891) 380,069, mostly Hindus. The rajah is a Mohammedan Pathan. The city is in lat. 26° 11′ N., lon. 75° 50′ E.; 1,463 feet above sea-level, and a mile from the banks of the Banas river, an affluent of the Chambal (see map of Northern India, ref. 6–D). It is a large town, capital of the state, surrounded by a wall, and protected by a fort. It is a progressive city, and many important hygienic improvements have been introduced. Pop. (1891) 46,069.

MARK W. HARRINGTON.

**Ton′ka Bean** [*tonka* is from Guianan *tonca*, the native name]: the seed of a noble leguminous tree of Guiana, the *Dipterix* (or *Coumarouna*) *odorata*. The tree grows to from 60 to 90 feet in height; the pods, about 2 inches long, are almond-shaped, and the single seed, over an inch long, is shaped like a large kidney bean and shiny black in color. It abounds in the fragrant principle coumarine, with the composition $C_{18}H_6O_4$; is used in scenting snuff and tobacco, and in perfumery. It is also employed to keep moths from woolens. In medicine, it relieves the paroxysm of whooping-cough. Revised by H. A. HARE.



Tonka bean (*Dipterix odorata*). Half of the one-seeded pod.

**Ton′kawan Indians** [so named from a word of the Weko or Hueco language, *tonkaweya*, which is said to signify *many staying together*]: a linguistic stock of North American Indians calling themselves Titskan watitch, *indigenous people* (of Texas). Besides the main Tonkawa, two tribes are reported to have spoken dialects of their language, the Mayeyes and the Yakwal, or *drifted people*.

Fragments of this people appear in many parts of Central and Southern Texas—on the Brazos river, in Fayette County, and near Corpus Christi. Before they removed to the Oakland reserve, Oklahoma (1884), they were living around Fort Griffin, Shackleford County, the men serving as scouts to the U. S. troops stationed there. Their pristine home may have been nearer the Rio Grande. In their language they distinguish certain terms used by "old people" from those employed by the younger generation. They have thirteen clans, partly with totem names. They are first mentioned as Tancaoye, in 1719. In 1862 half of their number were massacred 3 miles S. of Anadarko, Indian Territory (now Oklahoma), by surrounding hostile tribes. Their population in 1890 was seventy-eight and in 1892 they were settling on farms allotted to them by the U. S. Government. They are nicknamed Man-eaters by all the tribes living around them.

The pronunciation of the Tonkawan language is easily acquired by Americans and Mexicans. The inflection of their verb is complex and polysynthetic. Verbs and adjectives reduplicate their first syllable to assume a distributive signification. The personal pronoun possesses a dual, and the substantive is inflected by a number of case post-positions. See INDIANS OF NORTH AMERICA.

J. W. POWELL.

**Tonnage**: a measure of the capacity of a ship, used for the purpose of registry at her port and for levying harbor and other dues. According to the rule of measurement prevailing in Great Britain prior to the year 1835, it was arbitrarily assumed in the so-called "old measurement" (O. M.) that the depth and the breadth of the ship were equal. One step in obtaining the cubic contents of a ship was to multiply the length by the square of the breadth, and the tonnage dues were levied accordingly. This rule led ship-builders to build vessels that were narrow and deep, and accordingly dangerous in rough weather, as well as highly faulty in their plan of structure. The British Parliament adopted in 1835 a new plan, suggested by Mr. Riddle of the Royal Hospital, Greenwich. The statute of 1835 was modified in 1854, and the Merchant Shipping Act of that year (17 and 18 Vict., c. 104) is the basis of the legislation existing in the U. S. The rules established by law in 1799 in the U. S. continued in force until they were superseded by the act of May, 1864. The principle of the latter is to establish at the outset a mode of ascertaining the length, breadth, and depth of the ship, as well as a *tonnage deck* for the purpose of measurement. This is the upper deck of ships of less than three decks, and the second from below in those having three or more. The length of the "tonnage deck" is then ascertained by the following rule: Measure the length of the vessel in a straight line along the upper side of the tonnage deck from the inside of the inner plank, average thickness, at the side of the stem, to the inside of the plank on the stern timbers, average thickness, deducting from this length what is due to the rake of the bow in the thickness of the deck, and what is due to the rake of the stern timber in the thickness of the deck, and also what is due to the rake of the stern timber in one-third of the round of the beam. The "tonnage length" as thus ascertained is then divided into a number of equal parts, depending upon that length. The statute thus creates six classes of ships (five in the British system) for the purpose of measurement. The principle of the classification is to begin with vessels not exceeding 50 feet in "tonnage length" (measured by the prescribed method), and to divide them into six equal parts (four in the British system), increasing the number of parts by two for each increment of 50 feet. Vessels belonging to these classes are then respectively divided into six, eight, ten, twelve, fourteen, and sixteen parts, according to their length.

The next thing is to find the "transverse area" of the vessel. For this purpose the depth of the ship is to be measured at each point of division as above given, according to a prescribed rule. If the depth at the midship division of the length do not exceed 16 feet, each depth is to be divided into four equal parts. "Then measure the inside horizontal breadth at each of the three points of division, and also at the upper and lower points of the depth, extending each measurement to the average thickness of that part of the ceiling which is between the points of measurement. Number these breadths from above, numbering the upper breadth one, and so on down to the lowest breadth; multiply the second and fourth by four, and the third by two; add these products together, and to the sum add the first breadth and the last or fifth; multiply the quantity thus obtained by one-third of the common interval between the breadths, and the products shall be deemed the transverse area." When the midship depth exceeds 16 feet, the "transverse area" is obtained by dividing each depth into six equal parts, instead of four, and with corresponding changes in other respects. This mode of reckoning gives the "transverse area" at each point of division of the length of the vessel, as already noticed.

The final step is to obtain the register tonnage. For this purpose the "transverse areas" found as above are numbered, beginning with the extreme limit of the length at the bow. The even-numbered areas are multiplied by four, and the odd, with the exception of the first and the last, by two. These products are added together, and to the sum the first and last "transverse areas," if they "yield anything," are added. The quantities thus obtained are to be multiplied by one-third of the common interval between the areas. This product is the cubical contents of the space under the tonnage deck. Divide it by 100, and the quotient is the "register tonnage," subject to certain special additions now to be named. Additions (in accordance with a fixed rule) are made to the tonnage under deck, as above ascertained, in case there be a break, a poop, or any other permanent closed-in space on the upper decks or spar deck available for cargo or stores or the "berthing" or accommodation of passengers or crew. The same addition is to be made when a vessel has a third deck or a spar deck, the tonnage of the space between it and the *tonnage deck* being ascertained in a specified way.

In ascertaining the tonnage of open vessels the upper edge of the upper "strake" (line of planking extending from stem to stern) is to form the boundary-line of measurement, and the depth is to be taken from an athwart-ship line extending from the upper edge of such strake at each division of the vessel's length.

The register of the vessel at the custom-house must express the number of decks, the tonnage under the tonnage deck, that of the between decks above the tonnage deck, and that of the poop or other inclosed space, each separately. It is deemed of such importance that the registered tonnage should be known that the law provides that it shall be deeply carved or permanently marked upon the main beam of the vessel, and so continued, or it shall no longer be recognized as a registered vessel of the U. S. No vessel need be registered for tonnage that is used for cabins or state-rooms, and constructed entirely above the first deck, which is not a deck to the hull; nor do the provisions concerning this kind of measurement apply to any vessel not required by law to be registered or enrolled or licensed, unless otherwise specially provided.

This system has been adopted with slight modifications by nearly all European countries, and by Haiti in 1882 and Japan in 1884. It was adopted essentially by the International Tonnage Commission at Constantinople in 1873, which fixed the dues to be levied on ships passing through the Suez Canal, the main point of difference being in the rules with regard to the deduction of engine-room. Displacement tonnage is found in the same way as regular tonnage, except that the measurements are made along and from the load water-line, and the final cubic contents are divided by 35. This system is generally considered the fairest measure for the tonnage of naval ships. It has been adopted officially for the war-ships of France, Great Britain, the U. S., and other nations. For yachts, tonnage is measured according to rules which are framed for the purpose of determining time allowances in racing. The rules vary with each yacht club and association, but are mainly modifications of the old measurement tonnage. Revised by R. A. Roberts.

**Tonnage and Poundage**: an ancient tariff on imports and exports levied by the sovereigns of England, nominally for the defense of the realm and the maintenance of the sea-power of the kingdom. This tariff had its origin in the royal dominion over the ports and waterways of the kingdom, which involved the right to regulate commerce and to impose such restrictions and charges upon the same as the public safety and interests should require. (See Tonnage Dues.) By virtue of his royal prerogative, Edward I. (A. D. 1303) levied on all foreign merchants trading in English ports a duty of 2*s.* per tun on imported wine (which went by the name of *butlerage* or *tunnage*), and 3*d.* per pound sterling on all other imported and exported merchandise. This tariff was in the reign of Edward III. converted by Parliament into a *subsidy* granted to the king, and British as well as foreign merchants were subjected to its operation. From that time on to the final destruction of the royal prerogative in the matter of customs and revenue by the Long Parliament, the legal status of this tariff remained unsettled. It was, as a matter of fact, habitually voted to the sovereign, usually for life, by Parliament, and, on the other hand, it was as regularly exacted during the earlier years of reigns in which Parliament neglected—some times for several years—to take such action. During the Tudor *régime* no question was raised as to the right of the crown to levy tonnage and poundage. It was only when the conflict between the Commons and the royal prerogative reached an acute stage, in the reigns of the first and second of the Stuarts, that the legal and constitutional right of the king to levy this tribute was seriously called in question. The tax derives its great historical importance from the part it played in the downfall of Charles I., who, in consequence of the refusal of the Commons to make him the usual life grant thereof, levied it without parliamentary sanction. The Commons remonstrated, and even went so far as to denounce as a traitor any one who should presume to collect or to pay the tax (A. D. 1628–29), but the remonstrance was disregarded and the imposition continued. The Long Parliament succeeded, however, in breaking up this practice by the Tonnage and Poundage Act, which received the royal assent on June 22, 1841, and the right of Parliament to grant or withhold the tax has been practically undisputed ever since. Tonnage and poundage continued to be levied, under the authority of parliamentary grants, for longer or shorter periods, until the final abolition of the tax by the Customs Consolidation Act (passed in 1787).

A good, brief statement of the origin and history of this tax is given in Medley's *English Constitutional History.* For its bearings on the constitutional struggle of the seventeenth century, see S. R. Gardiner's admirable *History of England* (especially vols. vi., vii., and ix.) and his *Constitutional Documents of the Puritan Revolution.*

George W. Kirchwey.

**Tonnage Dues**: a duty or impost levied by the state on merchant vessels as a fee for the privilege of using the harbors of the state. This tax was formerly based on the number of tons of freight actually carried by the vessel, and was assessed separately for every time that a harbor was actually entered, but it is now measured by the registered tonnage of the vessel, ascertained in the manner set forth in the article Tonnage (*q. v.*), and is usually commuted into an annual tax.

Duties levied by maritime states, by way of toll or tribute, upon all vessels using the territorial waters of the state, are of great antiquity, and flow doubtless from the proprietary rather than the political conception of sovereign rights. From this—which was strictly the ancient and mediæval—point of view the sovereign was looked upon as a great property-owner, owning the bays, straits, and harbors, as well as the seashore and the highways, as portions of the royal domain, and he had the same right to exclude a stranger that any land-owner has to protect himself and his property against trespass. The principle is thus laid down by Azuni, the distinguished author of *The Maritime Law of Europe* (1795): "As the right of sovereignty along the seashore flows from the territorial domain, the sovereign exercises his natural and legitimate empire when he forbids the vessels of strangers to enter his ports or roads, or prescribes to them certain limits for their approach. He has acquired this right by the sacred and inviolable law of property." This right to exclude strangers from the proprietary waters of the state was ordinarily commuted into a tribute arbitrarily exacted for the use of those waters, and this tribute ultimately took on the form of a toll or custom for the maintenance of the guard of the sea and to defray the cost of maintaining the roads and harbors. Accordingly, in the work above referred to, the rule is laid down as follows: "Maritime nations have also a right to impose such contributions and imposts on the territorial sea as they may judge necessary to defray all the charges and expenses which the public security and the convenience of navigation require." It is to this principle that the practice of the Athenians in levying tribute on all ships passing through the Hellespont, and of the Byzantines upon all ships entering the Euxine, is to be referred. In the parliamentary records of the reign of Richard II. (1377–99) in England it appears that a tribute or custom was imposed on every ship that passed through the Northern Admiralty (i. e. "in the sea stretching itself from the Thames mouth all along the eastern shore of England toward the northeast") for the pay and maintenance of the guard or protection of the sea. This was imposed on strangers as well as upon subjects, and was at the rate of 6*d.* a ton upon every vessel that passed by. In modern times all of these exactions have generally been reduced to the single duty or tax imposed on vessels for the use of harbors, the term "tonnage dues" being now usually coextensive in meaning with harbor dues or port dues, although there is nothing in the rules of international law to prevent the imposition of maritime dues for other purposes. The principle is recognized by all of the authorities from Grotius to Hall. It is thus laid down by Sir Travers Twiss: "Every vessel which casts anchor within the jurisdictional waters of a nation becomes liable to the jurisdiction of that nation in regard to all reasonable dues levied for the maintenance of the general safety of navigation along its coasts."

The laws of the leading commercial nations vary a good deal in respect to the amount and the manner of levying tonnage dues, the tendency of modern legislation being strongly in the direction of the reduction and ultimate abolition of imposts of this character, as constituting a serious restraint on free commercial intercourse. The most noteworthy step in this direction is that which was taken by the Congress of the U. S. in 1886, in passing the Reciprocity Act of that year. By that act the U. S. invited the other commercial nations to adopt the policy of abolishing all lighthouse dues, tonnage taxes, and similar burdens on commerce, and agreed to abolish tonnage taxes on vessels from the ports of any country which should grant immunity from similar burdens to vessels from ports of the U. S. This generous and enlightened policy has thus far (1895) been adopted only by Germany and the Netherlands, though it can not be doubted that it will soon become the rule of commercial intercourse throughout the civilized world. By virtue of earlier legislation, reciprocal arrangements for the remission of port charges or harbor dues have been entered into by the U. S. Government with most of the West Indian and Central American nations and colonies, and, so far as the mail-steamships between the U. S. and Brazil are concerned, with the latter country also.

With these exceptions, every vessel belonging to the mercantile marine of the U. S. engaged in foreign trade—vessels employed in the fisheries alone excepted—must pay annually into the Federal Treasury a tonnage tax or duty at the rate of 30 cents per ton. Vessels belonging to foreign states between whom and the U. S. ordinary commercial relations exist pay at the same rate as domestic vessels. But such vessels, not of the U. S., are also subject to a further duty, denominated "light money," of 50 cents per ton. This is levied and collected in the same manner as strict tonnage duties. Ships built within the U. S., but belonging wholly or in part to subjects of foreign powers, are required to pay at double the above rate. This anomalous provision has been much criticised as being a part—and perhaps the least consistent and defensible part—of the illiberal shipping laws of the U. S. (See David A. Wells, *Our Merchant Marine.*) Vessels of the U. S. engaged in domestic commerce are exempt from tonnage duty. This is the case even though such vessels, trading on the northern frontiers, should touch at intermediate foreign ports. Yachts belonging to a regularly organized yacht club of a foreign nation extending like privileges to yachts of the U. S. are also admitted free. (See U. S. Rev. Stat., secs. 1722, 2793, 2931, 3110, 4150–4154, 4216, 4219–4227, 4320, 4335.) From the report of the commissioner of navigation on Oct. 18, 1894, it appears that the amount collected and paid into the Federal Treasury as tonnage tax during the fiscal year ending June 30, 1894, was $539,028.47. The proceeds of the tax are applied to the support of the Marine Hospital service.

The supreme control over the public territorial waters of the U. S., which belonged primarily to the several States, was by the Constitution surrendered by them and conferred upon the Federal Government. That instrument (Art. I., Sec. 10) expressly forbids any State to levy tonnage duties without the consent of Congress. This consent has never been given nor, it is believed, has it ever been invoked. The best authorities regard the present state of congressional legislation as open to grave objection, as being unnecessarily vexatious, unequal, and therefore unjust in its operation, and not based on sound scientific and commercial principles. In particular it is urged that the tax should be levied on the gross rather than the net tonnage of vessels, and that the same rate of duty should be adopted by all the leading commercial nations. For a particularly intelligent discussion of the subject, with a draft of proposed legislation, the reader is referred to the report of the commissioner of navigation for 1894, above referred to.

George W. Kirchwey.

**Tonquin**, ton'keen', **Tonkin**, or better **Tongking** (lit., Eastern Capital): a French dependency of Indo-China, on the Gulf of Tonquin, S. of China, N. of Annam, and E. of the Shan States, but the latter boundary is uncertain. Area about 34,740 sq. miles. It consists of a delta which is densely populated and highly cultivated, and a mountain region which is covered with forests and very sparsely inhabited. The delta is that of the Song-Koi or Red river, which bifurcates at Sontai and incloses between its numerous arms grassy level fields, easy to cultivate, fertile, and covered with villages, cities, and rice-fields. The northern branches connect by canals with the Tai-Bin river, thus combining the two deltas into one, and the latter stream is the more navigable. The capital is Hanoi, a city of Chinese aspect, having about 150,000 inhabitants. The chief port is Haiphong, near the coast. The principal crop is rice, but the sugar-cane, cotton, and tobacco are extensively cultivated. There are copper and iron mines of good promise, and coal mines are worked at Hongay, near Haiphong, and at Kebao. In 1899 the imports were valued at 45.016.918 francs, and the exports at 19.335.971 francs. The transit trade to and from Yunnan amounted to 4.990.000 francs in imports, and 3.180,000 francs in exports. The latter trade is by the Song-Koi, and great expectations are entertained as to its future. Tonquin is yet commercially dependent on the British colonies of Hongkong and Singapore. A railway is under construction from the head of navigation on the Song-Thuong northward to Langson, near the Chinese frontier, which, when opened, is expected to furnish another important trade route. The road begins at Phu-lang-Thuong, 12 miles N. E. of Bac-ninh, and is to be about 60 miles long. The climate of Tonquin is hot, but not unwholesome; the people are very poor, suspicious, avaricious, industrious, and skillful. The interior trade is largely in the hands of Chinese. The country was annexed by France in 1884, but remains turbulent. Pop. about 12,000,000, divided among fourteen provinces and 8,000 villages. Mark W. Harrington.

**Tonsilli'tis**, or **Tonsilitis** [*tonsillitis* is Mod. Lat., from Lat. *tonsillæ*, tonsils (as the form *tonsilitis* is from Eng. *tonsil*) + *-itis*, a medical termination used to denote inflammation]: an acute or chronic inflammation of one or both tonsils, involving the epithelial, glandular, or connective-tissue structures, or more than one of these. The inflammation may be excited by some infectious micro-organism that gains access to the tonsils by the nasal passages or by the mouth; or it may be due to the effects of some specific disease, such as scarlatina, smallpox, or syphilis, which lowers the resistance of the tissues; or it may be due to some constitutional disease, such as gout; or it may be caused by a fungus.

In acute tonsillitis the affected glands become red and enlarged, and if suppuration occurs (see Quinsy) the swelling may be so great as almost completely to block the throat. In chronic tonsillitis the symptoms are similar to those mentioned, but the course of the disease is slower, and often the distended gland vesicles, filled with a yellow secretion, present the appearance of small abscesses. The disease is usually preceded by malaise, chill, and fever; there are a sense of constriction in the throat, a difficulty in swallowing, a thick voice with pain on talking, and often inability to open the jaws. The pain in swallowing may be intense, and the enlargement produced by the inflammation may stretch a muscle (staphylo-salpingeus) which is attached to the orifice of the Eustachian tube and cause pain in the ear and impairment of hearing. The inflammation may extend from the tonsils and involve the anterior and posterior palatine folds, the soft palate, the uvula, and sometimes the epiglottis or the larynx. The salivary secretion becomes viscid and is expectorated with difficulty. The tongue is heavily coated, the breath is foul, there is no appetite, and there is often severe aching pain in the limbs. A first attack is more severe than a subsequent one, and a case that ends in suppuration is more severe than one that terminates by resolution. If the inflammatory symptoms do not subside within five or six days the condition is likely to be that known as quinsy; often resolution will terminate the inflammation in the period mentioned, but a chronic enlargement of the tonsils remains.

Catarrhal tonsillitis is an inflammation of the mucous membrane covering the gland, and if the lacunæ are involved it is called follicular or lacunar tonsillitis; the lacunæ becoming filled with an inspissated yellow or cream-colored mass of epithelial cells, pus, and micro-organisms, and in rare cases these masses undergo calcareous degeneration. If the gland tissue itself is inflamed the disease is called parenchymatous tonsillitis. If there is an eruption of small vesicles on the tonsils the condition is called herpetic tonsillitis. A circumscribed or general membrane may be formed on the tonsils in diphtheritic tonsillitis caused by the Klebs-Loeffler bacillus, as well as in the mycotic tonsillitis caused by the *Leptothrix buccalis* and other fungi.

The diagnosis of the disease is usually easy because the symptoms indicate that the throat is affected, though occasionally rheumatic pains involving the entire body are so severe that the throat pain sinks into insignificance and is not mentioned. If a membrane has formed on the tonsils its characteristics can only be determined by bacteriological examination.

While, as a rule, the prognosis is favorable, there may be serious complications in consequence of suppuration and ulceration into the internal carotid or external maxillary artery, with hæmorrhage; or there may be suffocation from œdema of the larynx or from a discharge of the pus into the air-passages. Rarely there are complications of the kidneys, or paralysis similar to that following diphtheria.

The disease is treated by keeping the patient quiet, giving from 5 to 10 grains of sodium salicylate made from oil of wintergreen every one or two hours until the fever and muscular pains are relieved, and disinfecting the throat by gargles of hot water containing five drops of carbolic acid and a teaspoonful of sodium bicarbonate (cooking-soda) in a cupful of water. If the throat is too painful to gargle, inhalations of five drops of tincture of benzoin poured on boiling water may be taken. In chronic tonsillitis the patient may be given cod-liver oil, or sirup of the hypophosphites made according to Dr. Churchill's formula; generous diet and bathing should be associated with the treatment; and if the tonsils do not become smaller it is necessary to cut them or to apply the galvano-cautery as recommended by Dr. Charles H. Knight. Chronic enlargement of the tonsils should not be allowed to take care of itself, as it is a fruitful source of ear trouble and of recurrent inflammation.

S. T. Armstrong.

**Tonsils**: See Histology (*The Digestive Organs*).

**Tonson**, Jacob: publisher; b. at Holborn, London, England, in 1656; was apprenticed to a bookseller; set up business for himself as a stationer in Chancery Lane, near Fleet Street, in 1678; published that same year some of Otway's and Tate's plays and Dryden's *Troilus and Cressida*; was thenceforth the regular publisher of the writings of Dryden, who edited for him the famous *Miscellanies*; brought out the first good edition of Milton's poems; in 1703 a *Cæsar*, admitted to be the handsomest specimen of English typography to that date, and in 1709 the first complete octavo edition of Shakspeare; established his shop at Gray's Inn Gate 1697, and at the Shakspeare Head in the Strand 1712; had a warehouse in the Savoy and a printing-office in Bow Street; was printer to the excise, publisher to most of the fashionable authors of the day, and stood at the head of his trade; was secretary to, and one of the founders of, the famous Kit-Kat Club, for whose use he built a room at his villa at Barn Elms on the Thames, which became a place of assembly for the wits. He retired from business in 1720, and devoted himself to the management of an agricultural estate. D. at Ledbury, Apr. 2, 1736. His collection of portraits of the members of the Kit-Kat Club, by Sir Godfrey Kneller, is kept intact by a descendant at Bayfordbury Park, Hertfordshire.

**Tonsure** [viâ O. Fr. from Lat. *tonsu'ra*, a shearing, clipping, deriv. of *tonde're*, *ton'sum*, shear, shave]: in the Roman Catholic and Oriental Churches, the shaving of a portion of the hair from the head of an ecclesiastic. In the Roman Catholic Church the size of the tonsure is not uniform, but its place is at present upon the crown of the head. This is the tonsure of St. Peter. In the ancient Irish and British churches the tonsure of St. James, in which the front part of the head was shaved as far back as a line passing over the top of the head from ear to ear, formerly prevailed. In the Eastern churches anciently the whole head was shaved. The tonsure is one of the preparations for orders, and it is regarded as symbolizing the crown of thorns worn during our Lord's Passion. Revised by J. J. Keane.

**Tontine**: the name applied to a financial scheme for securing to the surviving members of an association a proportional share of the profits of those who have died within a stated interval. The name is derived from Lorenzo Tonti, a Neapolitan banker, who proposed to apply this principle in order to raise a fund for the French Government in 1653. The subscribers to the loan were to receive interest from the first, and as deaths occurred the shares of the survivors would be continually increased. The French parliament refused to permit the scheme, but subsequently public tontines were established in France and Great Britain, and private tontine enterprises were carried out in these and other countries. A tontine insurance policy is one in which the policy-holder agrees in common with others to receive no profits till after a certain number of years, and to forego surrender value if he gives up his policy. See Life-insurance (*Tontine Dividend*).

**Tonty**, Henry, Chevalier de: explorer; son of Lorenzo Tonti; b. at Gaeta, Italy, about 1650; accompanied La Salle to Canada 1678 and in his exploration of the Mississippi; was left in command of a fort near Peoria 1680; made an unsuccessful attempt to found a settlement in Arkansas; took part in an expedition of the Western Indians against the Senecas 1685; twice descended the Mississippi to its mouth in search of La Salle, and a third time to meet Iberville; remained in that region and died at Fort Louis (now Mobile) in Sept., 1704. He contributed to Margry's *Relations et Mémoires* an *Account of La Salle's Last Expedition*, of which an English translation appeared in London 1698, was republished in New York 1814, and is included in vol. i. of Benjamin F. French's *Historical Collections of Louisiana and Florida* (1846). See Justin Winsor, *Cartier to Frontenac* (1894).

**Tooke**, John Horne: political writer and grammarian; b. at Westminster, England, June 25, 1736; son of John Horne, a wealthy poulterer; educated at Westminster and Eton schools and at St. John's College, Cambridge, where he graduated in 1758; became usher in a school at Blackheath, Kent; took orders in the Church of England at his father's desire, but much against his own wishes: became incumbent of a chapel at New Brentford 1760; began his political career in 1765 by writing in defense of Wilkes in the newspapers, but his chief work at this period was a pamphlet entitled *The Petition of an Englishman*; became intimate with Wilkes, whose election to Parliament he strongly advocated, and aided him in founding the Society for Supporting the Bill of Rights 1769, but soon afterward had a bitter quarrel with him; was in consequence denounced in the *Junius* letters, and defended himself with vigor 1771; resigned his living and resumed the study of the law at the Middle Temple 1773; started a subscription for the widows and orphans of the Americans "murdered by the king's troops at Lexington and Concord 1775," for which he was prosecuted by the ministry for libel July, 1777; conducted his own defense; was found guilty of libel, sentenced to a year's imprisonment and a fine of £200; wrote while in prison a *Letter to John Dunning, Esq.* (1778), in which he examined the legal aspects of his trial, and incidentally started upon a grammatical disquisition on the irregularities of the English language; was refused admission to the bar 1779 on the ground of being a clergyman; assumed his additional name in 1782 out of regard to Mr. Tooke, of Purley, who made him his heir; published his chief work, *Epea Pteroenta, or The Diversions of Purley* (1786; vol. ii., 1805), an ingenious treatise on etymology which occasioned much controversy, and has been widely read; was an unsuccessful candidate for Parliament at Westminster 1790 and 1796; was an active member of the Society of Correspondence formed by the admirers of the French Revolution, on which account he was committed to the Tower, tried for high treason 1794, but acquitted; obtained a seat in Parliament for Old Sarum 1801, and passed his later years in affluence at Wimbledon, where he died Mar. 18, 1812. He was never married, but had several natural children, to one of whom he left his estate. See his *Memoirs*, by Alexander Stephens, 2 vols., 1813.

**Tooke**, Thomas: economist: son of William Tooke, the historian; b. in St. Petersburg, Russia, in 1774; was for more than forty years successfully engaged in the Russian trade; was a pioneer of free-trade doctrines, and drew up the famous "Merchants' Petition" for free trade in 1820. He was the author of numerous writings on the currency, corn-laws, finance, and banking, including a valuable *History of Prices and of the State of the Paper Circulation from 1798 to 1856, etc.* (6 vols., 1838–57); was the founder of the Political Economy Club (1831), and the promoter of many public enterprises connected with industrial and philanthropic reforms. D. in London, Feb. 26, 1858. After his death his admirers raised a subscription with which they endowed in King's College, London, a "Tooke professorship" of economic science and statistics. F. M. C.

**Tooke**, William: clergyman and historian; b. at Islington, London, England, Jan. 18, 1744; originally a printer, took orders in the Church of England 1771; became soon afterward minister of the English church at Cronstadt, Russia, and was chaplain to the factory of the Russia Company in St. Petersburg 1774–92. D. in London, Nov. 17, 1820. Author of *Russia, or A Complete Historical Account of all the Nations which compose the Russian Empire* (4 vols., 1780–83); *Life of Catharine II., Empress of Russia* (3 vols., 1797); *A View of the Russian Empire during the Reign of Catharine II.* (3 vols., 1799); *A History of Russia A. D. 862–1762* (2 vols., 1800); *Varieties of Literature* (London, 1795, 2 vols. 8vo); *Extracts from Foreign Literary Journals and Original MSS.* (London, 1796, 2 vols. 8vo); of several volumes of sermons, novels, and translations, among which was *The Works of Lucian*, from the German translation by Wieland (2 vols. 4to, 1820); and editor of vols. i.–v. of the *General Biographical Dictionary* (1798).—His son William, b. at St. Petersburg in 1777, was a London solicitor, a Liberal member of Parliament 1835–37, and one of the founders and long the treasurer of the Society for the

Diffusion of Useful Knowledge. D. in London, Sept. 20, 1863. He edited the *Works* of Charles Churchill (2 vols., 1804), and wrote *The Monarchy of France* (1855).

**Toole**, John Lawrence: actor; b. in London, Mar. 12, 1832; made his first appearance on the stage at the Ipswich Theater Royal, and in 1852 adopted the stage as a profession, accepting during that year an engagement at the Queen's theater, Dublin. He made his *début* in London at the Haymarket theater as Simmons in *The Spitalfields Weaver.* At the St. James's theater Oct. 2, 1854, he played Samuel Pepys in *The King's Rival.* He became a great favorite with the British public, and for twenty years appeared every season in London. In 1875 he visited the U. S., but his peculiar style of humor was not appreciated and his tour was not successful. He returned to England, and, with the exception of a visit to Australia in 1891, has played regularly in London at a theater under his own management. *A Fool and his Money* was one of his most successful plays. In 1892 he made a great hit at Toole's theater in *Walker, London.* B. B. Vallentine.

**Toombs**, Robert: b. in Wilkes co., Ga., July 2, 1810; educated at the University of Georgia and at Union College, Schenectady, N. Y.; graduated at the latter institution in 1828, and studied law at the University of Virginia. In 1830, before his majority, he was admitted to the bar by special act of the Legislature, and opened an office at the town of Washington in his native county. When the war with the Creek Indians broke out in Alabama in 1836, Toombs raised a company of volunteers, and led them, as captain, to the field, serving under Gen. Scott until the close of the conflict. In 1837–40 and 1842–43 he was a member of the State Legislature, where from the beginning he took a most conspicuous position. He was brought up in the Jeffersonian school of politics, to which creed he always adhered. In 1844 he was elected a member of Congress. He then belonged to the party known as Southern Whigs, and as such supported Harrison for the presidency in 1840, and Clay in 1844. He remained a member of the House until Mar., 1853, when he took a seat in the Senate. While a member of the House the most conspicuous part he acted was on the adjustment measures of 1850, whose passage he helped actively to bring about. He was re-elected to the Senate in 1859, and continued to hold his seat in it until Georgia passed her ordinance of secession in 1861. He was a member of the State secession convention, where he acted a conspicuous part, and was chosen a delegate to the Confederate congress at Montgomery. In that body, as in all other assemblages of which he was a member, he stood among the ablest and most eloquent. He was for a short time Secretary of State in the Confederacy, but resigned that office and took a commission as brigadier-general in the army. He distinguished himself at the second Bull Run and Antietam battles. He resigned his commission and returned to Georgia, where he was made a brigadier-general of the State militia upon the invasion of the State by Sherman in 1864. After the close of the war he left the country, spending his time in Cuba, France, and England, remaining abroad until after the restoration of the privilege of the writ of *habeas corpus* in 1867. He then returned home, but refused to take the oath of allegiance to the U. S., and was in consequence debarred from the rights and privileges of citizenship. He resumed the practice of law, which he pursued with great success. The reconstruction measures of Congress he denounced in the beginning, and continued to denounce, with all the force and power of language he could command. D. at Washington, Ga., Dec. 15, 1885. Revised by F. M. Colby.

**Tootel**, Hugh or Richard: See Dodd, Charles.

**Tooth**: See Teeth.

**Toothache-tree**: See Prickly-ash.

**Tooth-shells**: a popular name given to the mollusks of the order *Scaphopoda* on account of their long, cylindrical, slightly curved shells. See Dentalium and Mollusca.

**Topaz** [M. Eng. *topas*, from O. Fr. *topaze* < Lat. *topa'zos*, *topa'zion* = Gr. τοπάζιον]: a gem-stone, but not the τοπάζιον of Pliny, which is described as opaque and green, was probably some variety of agate or jasper, and was named from its locality, an island in the Red Sea. The *chrysolite* of Pliny and later writers is generally believed to have included the topaz. The mineral species *topaz* is orthorhombic in crystallization, with a fine basal cleavage which causes it to split into lustrous plates—a feature which distinguishes the white transparent topaz from quartz. Its hardness is 8, between that of quartz and sapphire, and diamond and sapphire scratch it easily. It contains silica, alumina, and fluorine, but the proportions are somewhat uncertain. Groth's formula and Dana's deductions make it $Al_{12}Si_6O_{25}F_{10}$, which yields the following composition: Silicon, 15·5; aluminium, 29·9; fluorine, 17·6; oxygen, 36·9. This is the true topaz, but the name is much confused among jewelers and collectors by being applied to other transparent yellow stones. Thus *Oriental topaz* is yellow Sapphire (*q. v.*), and the names *Scotch topaz* and *Spanish topaz* are given to yellow quartz. (See Quartz.) This latter is the stone commonly sold as topaz by jewelers, and is usually produced by heating smoky quartz, which is thus partially decolorized. The true topaz is of various light colors—yellow, pale green, or blue, and pure white. The finest deep-yellow ones come from the province of Minas Geraes, in Brazil; on heating, these are altered to pink, and are then sometimes called Brazilian rubies. Sherry-colored stones come from Siberia, Colorado, and Texas, and fine green and blue topazes from the Ural Mountains, Ceylon, Japan, and New South Wales. G. F. Kunz.

**Topazolite**: See Garnet.

**Tope**: the English name of the *Galeus canis*, a shark common in the British seas, and widely distributed elsewhere, but not found in the American waters. It belongs to the family *Galeorhinidæ*, and is distinguished by the following combination of characters: The teeth are nearly alike in both jaws, oblique, and notched and serrated ($\frac{3}{3}\frac{4}{4}$ in number); the first dorsal is opposite the space between the pectorals and ventrals; the caudal fin has a single notch, and there are no median pits at its base; the color is the usual slate gray above and lighter beneath. It attains a length of about 6 feet.

**Tope'ka**: city; capital of Kansas and of Shawnee co.; on both sides of the Kansas river, and on the Atch., Top. and S. Fé, the Chi., Rock Id. and Pac., the Mo. Pac., and

State Capitol, Topeka, Kan.

the Union Pac. railways; 67 miles W. of Kansas City; elevation, 800 to 890 feet above sea-level (for location, see map of Kansas, ref. 5–I).

*Public Improvements.*—The city is built on three ridges at right angles to the course of the river, insuring it excellent drainage. There are 118 miles of streets, 26 of which are paved, the pavement averaging 30 feet in width, with a 20-foot parkway for trees between the sidewalk and pavement on each side, and the streets are lighted with 185 2,000-candle-power arc lights. Local transit is accommodated by 30 miles of electric street-railway. The sewerage plant has 39 miles of mains, the gas plant 25 miles, and the waterworks over 33 miles. There are four electric-light and motor plants for commercial uses.

*Notable Buildings.*—Topeka contains the State Insane Asylum (cost $700,000), the State Reform School for Boys (cost $120,000), State Capitol (cost $2,000,000), county court-house (cost $150,000), U. S. Government building (cost $300,000), city buildings (cost $100,000), three large hospitals, an Orphans' Home, and a Home for Friendless Women, besides several costly business blocks and the Santa Fé railway offices and shops.

*Churches, Schools, etc.*—There are 66 church organizations, with a membership of 13,569, owning 87 buildings valued at $668,400. The churches are divided denominationally as follows: Methodist Episcopal, 15; Baptist, 12; Presbyterian, 10; Lutheran, 5; Christian, 4; Congregational, 4; Protestant Episcopal, 4; Roman Catholic, 2;

and ten other denominations, 1 each. The city has an excellent system of public schools, with an enrollment of 10,264 pupils, employing 115 teachers, and costing $174,000 in 1894. It includes a high-school building which cost $85,000. The institutions for higher instruction comprise Washburn College (Congregational, chartered in 1865), coeducational, on a tract of 160 acres, and having buildings which cost $175,000; the College of the Sisters of Bethany (Protestant Episcopal, opened 1861, chartered 1870), occupying four squares in the center of the city, and having buildings which cost $150,000; and the Seminary of the Assumption (Roman Catholic), for both sexes. There are also 4 private schools and academies. In 1895 there were 3 daily, 16 weekly, 8 monthly, and 3 other periodicals.

*Banking and Insurance.*—In 1895 there were 3 national banks with combined capital of $650,000, 3 State banks with combined capital of $413,775, and 2 private banks; 8 investment and loan companies with authorized capital of $6,810,000; and a fire-insurance company with capital of $100,000, assets of $252,502, and surplus over liabilities of $171,976.

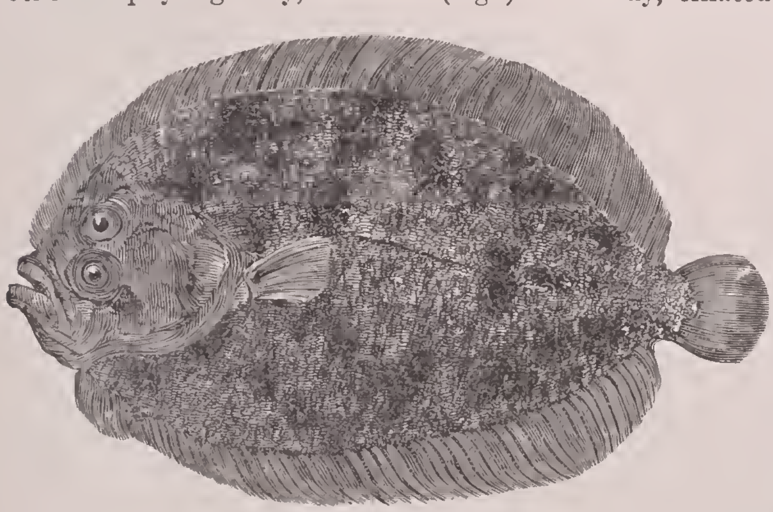
The city was laid out in 1854, incorporated in 1857, and made the State capital in 1861. Since 1885 there have been no saloons in the city. The financial condition of Topeka is exceptionally good. Pop. (1880) 15,527; (1890) 31,800; (1900) 33,608. H. G. LARIMER.

**Topel'ius**, ZACHARIAS: poet and novelist; b. near Ny Karleby, Finland, Jan. 14, 1818. After graduating at the University of Helsingfors (1840) he became editor of the *Helsingfors Tidningar* (1842), which he made a great force in Finnish literature, retaining his connection with it until 1860. He was Professor of Finnish History at his *alma mater* from 1854 until 1878. His earliest publications, which appeared in his journal, consisted of tales and lyrical poems, the latter of which were collected under the title of *Ljungblommor* (Heather Flowers, 1845–54). In these as well as in *Sånger* (1861) and *Nyt blad* (New Leaves, 1870), the influence of RUNEBERG (*q. v.*) is marked. Topelius also wrote a number of dramas—*Efter femtio år* (Fifty Years Later, 1851); *Regina af Emmertz* (1854); and a volume of *Dramatiska dikter* (1863). Many of his children's stories have been translated into English. But the work by which he is best known at home and abroad is *Fältskärens Berättelser* (The Surgeon's Stories, 6 vols., 1872–74), a collection of tales dealing with the history of Sweden and Finland during the seventeenth and eighteenth centuries. D. Mar. 14, 1898. D. K. DODGE.

**Tophet**: See GEHENNA.

**Tophi**: See GOUT.

**Topknot**: a name given in Great Britain, or at least in British books, to flat fishes (*Pleuronectidæ*) of the genera *Zenogopterus* and *Scophthalmus* (or *Phrynorhombus*). They are so called from a long filament on the head. These do not agree in special characters, although they resemble each other in physiognomy, the wide (high) oval body, ciliated



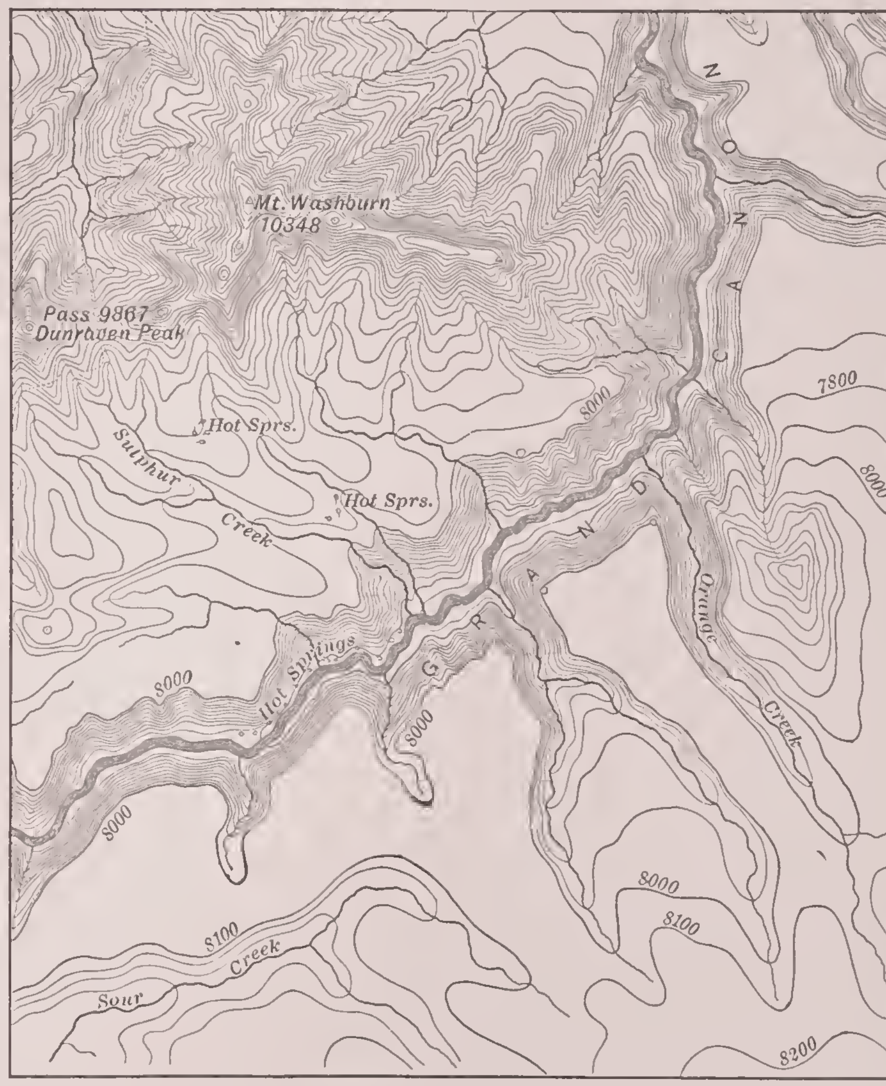
Müller's topknot.

scales, sinistral and fringed eyes, narrow interorbital ridge, and long based ventrals. They rarely exceed 7 or 8 inches in length. Some of the topknots are of the same genus as the turbot, as Eckstrom's *Rhombus norvegicus* and Müller's topknot, *Rhombus punctatus*.

**Toplady**, AUGUSTUS MONTAGUE: clergyman and hymn-writer; b. at Farnham, Surrey, England, Nov. 4, 1740; was educated at Trinity College, Dublin; took orders in 1762; became vicar of Broad Hembury, Devonshire, 1768; preached at the chapel of the French Calvinists, in Leicester Fields, London, from 1775 to his death there Aug. 11, 1778. He was editor of *The Gospel Magazine* and author of many hymns, chief of which is *Rock of Ages*. His Calvinistic partisanship led him into unhappy controversy with John Wesley. His complete works were published in London 1794 and 1825; his verses, best by D. Sedgwick (1860). See his *Life*, by W. Winters (London, 1872). Revised by S. M. JACKSON.

**Töplitz**: See TEPLITZ.

**Topog'raphy** [from Gr. τόπος, place + γράφειν, write]: the representation of the natural features of a portion of




the surface of the earth on a map, or the natural features themselves. The construction of a topographical map involves the field and office operations of surveying, and the delineation on paper, by means of shading or signs, of the outlines and elevations of the surface.

For popular purposes the representation of hills and mountains by lines drawn along the declivities is very common, the steepest slopes being made the heaviest. While this indicates at once to the eye the elevations, it gives little idea of their absolute or relative heights, and hence the method of contours is more generally employed by engineers. In this method the surface is supposed to be intersected by a series of horizontal planes, and the lines of intersection, called contours, are determined in the field by levels and measurements and then plotted on the map. The figure, which shows a portion of the Yellowstone Park about 7 miles by 8 miles in area, illustrates the contour method of representing topography, all points on the line marked 8,000 being 8,000 feet above ocean-level. The contours are drawn at intervals of 100 feet in vertical height, and the closer together they are the steeper is the slope. If lines be imagined to be drawn perpendicular to the contours they will indicate the direction of the drainage, and it will be seen that all of the creeks cross the contours at right angles. By the help of accurate contour maps profiles in any direction can be constructed, and much preliminary work in the location of roads be advantageously done.

In addition to the representation of the elevations and streams, topographical maps generally include roads, houses, swamps, and cultivated land. Special signs, mostly conventional, are used for different kinds of crops, as also for sand, grass, and trees, so as to furnish a picture somewhat similar to that which the country would present if viewed from a balloon. Along the coast are shown the shoals, reefs, high and low water lines, together with contours of the beds of the harbors and sounds. Colored topographical maps, in which water is represented in blue, streets in yellow, fields in green, and houses in red, are frequently made when not intended for reproduction.

The field work of topography is usually based on a triangulation, while the details are mapped by means of the plane-table or stadia. The topography and hydrography of the coasts of the U. S. has been mostly done by the U. S. Coast and Geodetic Survey, and a portion of that of the interior by the U. S. Geological Survey. Several States have made topographical maps in connection with their geological surveys. The cost of topographical work ranges from $5 to $25 per sq. mile, depending on its accuracy and completeness. See COAST AND GEODETIC SURVEY, GEODESY, HELIOTROPE, HYPSOMETRY, LEVELS AND LEVELING, MAP, PLANE-TABLE, STADIA MEASUREMENT, SURVEYING, and TRIANGULATION. MANSFIELD MERRIMAN.

**Topolias**: See COPAIS.

**Topolobam'po Bay**: a bay of the Gulf of California, in the northwestern part of the state of Sinaloa, Mexico. It forms an excellent landlocked harbor, and is bordered by plains which could be profitably cultivated but for their dryness; there is no fresh water, and the nearest stream available for irrigation is the Rio Fuerte, 25 miles N. It has been proposed to make the bay the terminus of a railway line from Eagle Pass. In 1886 several prominent socialists of the U. S. planned to establish a socialistic colony on or near the bay. A company called the Credit Foncier of Sinaloa was chartered under the laws of Colorado, the leading promoter being A. K. Owen, an engineer who had already been interested in the railway scheme. It was proposed to sell shares to colonists, who should all be employed by the company, receiving in payment scrip which could be used in purchasing supplies, etc., under the principle of state socialism. The company, or community, was to own all lands and conduct all business; a model town was planned, and it was expected that the company would build the railway or a part of it. Several hundred colonists joined the enterprise and went to the bay at different times, beginning in Dec., 1886. They suffered greatly, owing to the difficulty of procuring water and food; an attempt to make an irrigation ditch failed; the colony was divided, part of it joining a company which had been formed in Kansas, and most of those who remained (1895) are settled near the Rio Fuerte. The company's scrip is now nearly or quite worthless, and as a socialistic scheme the plan has failed. It is fair to say that this was partly owing to the unsuitable nature of the land. H. H. SMITH.

**Top-shells**: a collector's name for species of shells of the family *Turbinidæ*, especially *Turbo marmoratus*, which has a turbinated solid shell with convex whorls. They are found in tropical seas. The family name is derived from the Latin *turbo*, a whipping-top, in allusion to the shape of the species, which is more or less conical or pyramidal.

**Top'söe**, VILHELM CHRISTIAN SIGURD: novelist; b. in Denmark, 1840. His best-known work is *Jason med det gyldne Skind* (Jason with the Golden Fleece, 1875), the authorship of which was for a long time kept secret. In *Nutidsbilleder* (Contemporary Pictures, 1876) he portrays with marked force some of the social abuses of our time. *Fra Amerika* (1872) gives impressions of the U. S. with greater fullness and insight than are commonly displayed by Danish travelers. Three volumes of *Collected Tales* were published in 1890–91. D. K. DODGE.

**Toqueville**: another spelling of TOCQUEVILLE (*q. v.*).

**Torbanite**: See FUEL.

**Torbay**: a fishing-town of Newfoundland, 7 miles N. of St. John's. The anchorage is poor. Pop. about 1,300.

**Torbert**, ALFRED THOMAS ARCHIMEDES: soldier; b. at Georgetown, Del., July 1, 1833; graduated at the U. S. Military Academy July 1, 1855; assigned to the Fifth Infantry; served on frontier duty in Texas and Florida 1856–57, on Utah expedition 1857–60. In the civil war he was engaged, Apr.–Sept., 1861, in mustering New Jersey volunteers into service, and Sept. 16 was appointed colonel of the First Regiment, which he led in the Virginia Peninsular campaign of 1862; assigned to command of a brigade in the Sixth Corps Aug. 28, 1862, and engaged in the second battle of Bull Run, at South Mountain (wounded), and Antietam. Promoted to be brigadier-general of volunteers Nov. 29, 1862, he was on sick leave until June, 1863, when again in command of brigade in Sixth Corps, and engaged in the battle of Gettysburg July 2–3, and subsequent operations of that corps during the winter of 1863–64. In the Richmond campaign of 1864 he commanded the cavalry, remaining with Gen. Grant's army during Gen. Sheridan's raid on Richmond, and first division on the latter's return May 25, being engaged in the frequent actions from May 15 to Aug., 1864. He was chief of cavalry of the middle military division, and engaged in all the operations in the Shenandoah campaign Aug., 1864–Jan., 1865, and frequently in command; in command of the Army of the Shenandoah Apr.–July, 1865, and of various districts in Virginia till mustered out of the volunteer service Jan. 15, 1866. Brevet major for gallantry at Gettysburg, lieutenant-colonel for Hawes's Shop, colonel for Winchester, brigadier-general for Cedar Creek, and major-general for gallant and meritorious services during the war. Resigned his commission of captain Fifth Infantry Oct. 31, 1866; was U. S. minister resident to Central American states 1869–71; consul-general to Havana 1871–73; and U. S. consul-general in Paris 1873–78; was lost at sea off the coast of Florida, Aug. 29, 1880.

**Torch-wood**: the *Amyris floridana*, a small tree or shrub of South Florida, having shining leaves, clusters of yellowish-white flowers, and a resinous juice. It belongs to the family *Burseraceæ*.

**Tordesillas**, tōr-dā-sēel'yăăs (in Portug. *Tordesilhas*), **Convention of**: an important treaty signed by the envoys of Spain and Portugal, at the town of Tordesillas in the former country, June 7, 1494. It related to the rights of conquest of the two countries, and had the most important results. The popes, in several bulls, had given authority to Portugal to conquer and settle Africa and the East Indies. Soon after the discovery of western lands by Columbus, Pope Alexander VI. issued his celebrated bull of May 3, 1493, in which he divided the world by a meridian "100 leagues west of the Azores and Cape Verde islands," and gave to Spain authority to conquer all lands W. of this line, reserving those E. of it for Portugal. By the convention of Tordesillas it was agreed that the divisional meridian should be moved to "370 leagues west of the Cape Verde islands." Very unexpectedly this gave to Portugal the coast of Brazil discovered a few years after. Spain could not reasonably contest the claim, and Brazil was settled by Portuguese. Unfortunately, the terms of the treaty were vague in not mentioning any particular point of the Cape Verde islands from which measurements could be taken, and in not specifying the length of the leagues, several being then in common use; thus disputes arose as to the position of the meridian, and remains of these have come down to our time. Again, as conquests were pushed E. and W., the two nations eventually met on the opposite side of the globe, and here the uncertainty was increased by the defective means then available for determining longitude. For example, the Philippine islands were claimed and held by Spain on the supposition that they lay within her hemisphere; in reality, they were in that assigned to Portugal. H. H. SMITH.

**Tore'no**, tō-rā'nō, JOSÉ MARÍA QUEIPO DE LLANO RUIZ DE SARAVIA, Count of: statesman and historian; b. at Oviedo, Spain, Nov. 26, 1786; took an active part in promoting the uprising of Spain against Napoleon 1808; was sent to England to negotiate for assistance; was a prominent member of the Cortes at the restoration of Ferdinand VII., but, like most of his companions of liberal opinions, was soon driven into exile; was recalled to Spain by the revolution of 1820; again went into exile on the triumph of absolutism 1823; returned to Spain after the death of Ferdinand 1832; became Minister of Finance under the regency 1834, president of the council and Minister of Foreign Affairs 1835, but retired in September and went into voluntary exile. D. in Paris, Sept. 16, 1843. He was the author of an important work on the Spanish war of independence, *Historia del Levantamiento, Guerra y Revolución de España* (Madrid, 5 vols., 1835–37). F. M. COLBY.


TORONTO
A. Union Station, 2 C
Canadian Pacific Railway
Grand Trunk Railway
B. Steamboat Landings, 2 D
Foot of Yonge St.
Hotels.
1. Queen's, 2 C
2. Rossin House, 2 C
3. Palmer House, 2 C
4. Walker House, 2 C
5. Arlington, 2 C
6. Metropole, 2 C
7. Elliott House, 2 D
Theaters, Etc.
8. Grand Opera House, 2 D
9. Toronto Opera House, 2 D
10. Academy of Music, 2 C
11. Massey's Music Hall, 2 D
12. Pavilion, 1 D
Public Buildings, Etc.
13. Parliament Buildings, 1 C
14. Old Parliament " 2 C
15. Government House, 2 C
16. St. Lawrence Market, 2 D
17. St. Andrew's Market, 2 C
18. Exhibition Buildings, 3 A
19. Post-Office, 2 D
20. City Hall and Court-house, 2 D
21. Old City Hall, 2 D
22. Osgoode Hall, 2 C
23. Provincial Lunatic Asylum, 2 B
24. Mercer Reformatory, 2 A
25. Central Prison, 2 B
26. Free Public Library, 2 D
27. General Hospital, 1 E
28. Custom House, 2 D
29. House of Providence, 2 E
30. Toronto University, 1 C
31. Knox College, Pres., 1 C
32. Wycliffe College, Epis., 1 C
33. St. Michael's College, R. C., 1 D
34. Victoria College, Meth., 1 C
35. McMaster Hall, Bapt., 1 C
36. Old Upper Canada College, 2 C
37. New Upper Canada College, North of 1 C
38. Trinity College, 2 B
39. Toronto Collegiate Institute, 1 D
40. Canadian Institute, 2 D
41. Normal School, 1 D
42. Loretto Abbey, 2 C
43. St. James Cathedral, Epis., 2 D
44. Trinity Church, Epis., 2 D
45. St. Michael's Cathedral, R. C., 2 D
46. St. Andrew's Church, Pres., 2 C
47. Metropolitan Meth. Church, 2 D
LAKE ONTARIO
HARBOR
ASHBRIDGE'S BAY
Scale
1 Mile

**Torfæ'us**, THORMODUS [Latinized form of Icel. *Thormodr Torfason*, his true name]: antiquary; b. at Engö, Iceland, May 27, 1636: studied at the University of Copenhagen; was sent by Frederik III. to Iceland in 1662 to collect manuscripts of the sagas; made royal antiquary in 1667 and royal historiographer for Norway in 1682, but was compelled to resign on account of having committed manslaughter in self-defense. He was the first to apply the Icelandic literature to the study of Scandinavian antiquities and history. The most remarkable of his writings are *Series regum Daniæ* (1702); *Historia Vinlandiæ antiquæ* (1705); *Grœnlandia antiqua* (1706); *Historia Rerum Norvegicarum* (4 vols., 1711). D. Jan. 31, 1719. Revised by D. K. DODGE.

**Torgau**, tōr'gow: town: in the province of Saxony, Prussia; on the Elbe; 70 miles S. S. W. of Berlin by rail (see map of German Empire, ref. 4-G). It is strongly fortified, and contains barracks, hospitals, magazines, and other military establishments; also manufactures woolen and linen fabrics and hosiery. Pop. (1890) 10,860.

**Torii**, tō'rēe-ee' [lit., bird-perch, or bird-rest]: a construction in wood, stone, or bronze, found in front of every shinto shrine in Japan. It consists of two pillars, set one on each side of the roadway, and joined at the top by two cross-bars, the uppermost of which projects at either end, usually with an upward curve. In all pure Shinto shrines the torii is of unpainted wood; it was originally a perch for the sacred fowls who gave warning of daybreak. Later, especially under the sway of Buddhism, the torii came to be looked upon as a mere portal. The Buddhists were fond of painting it red. J. M. DIXON.

**Torna'do** [Span., meaning turned, twisted]: a small, local, short-lived, but very violent storm, occurring in the warm season, in the warmer hours of the day, and in very moist air. The tornado is most noteworthy for the very high velocities attained by the innermost part of its whirl, reaching, as far as can be judged by its effects, a speed of 200 or more miles an hour, and consequently exerting a pressure of 200 lb. or more to the square foot on structures opposing the motion. The conditions preceding a tornado are generally those of a thunder-storm exaggerated, and active agitation is sometimes seen beforehand in the clouds. When the storm is formed it has a long, slender funnel extending from the clouds toward the ground. This defines the area of greatest velocity of wind, and where it reaches the ground the destructive effects are greatest. The tornado is often accompanied by intense electric phenomena, and accompanied or followed by torrential rain, sometimes by hail. The path is usually but a few rods wide and a few miles long, and it is generally directed from S. W. to N. E. The destructive effects are experienced only close to the path of the funnel, and are somewhat more severe on the south side of the central path than on the north side. The duration at any spot is but a few seconds. Definite forecasts of storms whose entire destructive area is not a square mile are hardly practicable, but the smallness of this area makes the probability very small that any given spot will ever be traversed by a tornado. Tornadoes occur in the temperate regions generally, where there is enough moisture. In the U. S. they are most usual E. of the Great Plains, in early spring in the South, in late spring and early summer in the Northern States. The alleged greater frequency of tornadoes in late years is an illusion due to the greater perfection of the news-collecting and distributing agencies, and to the greater attention paid by the public to meteorologic phenomena.

The theory of tornadoes presents many difficulties, but they are undoubtedly small vortical wind systems, with a long vertical axis, with contra-clockwise rotation at the ground. Many other local storms are erroneously classed with them, as squalls, derechos, riband-winds, rolls with horizontal axes, etc. A serious source of confusion is to be found in the fact that these local storms are popularly called cyclones. A cyclone is several hundred miles in diameter and only a mile or two deep, with a thickness, therefore, only $\frac{1}{500}$th part or so of its diameter. A tornado is only a few scores of feet in diameter and at least several hundred feet high. The first is general, large, and may last several days; the second local, small, lasting at most only an hour or two. MARK W. HARRINGTON.

**Tor'neå**: river of Northern Europe, forming the boundary between Sweden and Russia; rises in Lake Torneå, in Sweden, flows southward, and enters the head of the Gulf of Bothnia after a course of 230 miles. It is rapid, and celebrated for its beautiful cataracts and salmon-fisheries.

**Toron'to**: the capital of the Province of Ontario, and the largest city on the Canadian side of the Great Lakes; on a large and finely sheltered bay on the north shore of Lake Ontario, in 43° 39' N. lat. and 79° 23' W. lon. (see map of Ontario, ref. 4-D). The city was founded in 1794 by Maj.-Gen. John Graves Simcoe, first governor of Upper Canada, who gave it the name of York, in honor of the Duke of York, second son of George III. About fifty years earlier the French had built a trading-post (Fort Rouillé) close to the site of the city, but this was subsequently destroyed. Even in Simcoe's day little trace of the stockade remained, if we except the name Toronto—"the place of meeting"—which the Indians gave to it and the region about, and which was adopted for the city in 1834.

The determining factor in the location of the city was obviously the spacious harbor, which gave promise of safe shelter for the fleet and shipping of the lakes, besides the advantages of fine central position, lying directly northward of the mouth of the Niagara river, and close to the Indian highway, by the Humber and Holland rivers, to the Huron country and the trapper's and *voyageur's* lake route to the far West. Later years have justified the selection of the site, and made tributary to the city's commerce the trade of the Ontario Peninsula and of the vast and fertile plains of the Canadian Northwest. Toronto is 39 miles S. E. of Hamilton, at the head, and 160 miles S. W. of Kingston, at the foot, of Lake Ontario. It is 330 miles from Montreal and 500 miles from New York.

*Area, Plan, and General Features.*—Although not picturesque, in the sense that Montreal and Quebec are picturesque, for it lies too flat, Toronto is not lacking in natural and artistic beauty. Its chief adornment is its fine water front, as seen from the harbor or from the island, a large sandbank 6 miles long, which protects it from the lake. It covers an area of nearly 13 sq. miles, and includes within its municipal boundary, besides the city proper, the once outlying suburbs of Brockton, Parkdale, Seaton Village, and Yorkville. The site has a rising inclination toward the northern limits, $2\frac{1}{2}$ miles from the water front. The shore front extends from the river Humber, on the W., to Norway, in rear of Scarboro Heights, on the E., a distance of $5\frac{1}{2}$ miles.

*Streets, Parks, and Buildings.*—There are 260 miles of streets within the compass of the city, the names of many of them denoting an English origin. As a rule, they are well paved and lighted, are neatly laid out, regularly built, and cross each other, almost without deviation, at right angles. The business area lies adjacent to the water front and the esplanade, which is monopolized by the lake traffic and the railways. The residential portion lies chiefly to the northward, bisected by the city's great artery—Yonge Street—which extends to the northern limits of the county of York. This part is adorned by many attractive streets, the chief of which are Jarvis, Sherbourne, Church, Bloor, St. George, and Beverley Streets, all of which contain many fine churches, elegant villas, and prettily ornamented grounds. The business section is chiefly between Front and Queen Streets, and, extending parallel with the lake, from York Street to the market. The notable buildings within this area are the court-house and municipal buildings (completed and opened in 1900, having cost about $2,500,000), the custom-house, the post-office the Board of Trade building, the Bank of Montreal, Dominion Bank, Canadian Bank of Commerce, Canada Life, and Confederation Life buildings, Union Station (general railway terminus), the offices of the leading newspapers, several fine hotels and clubs, and the varied marts of industry, exchange, and wholesale and retail commerce. Toronto is rich in public parks, gardens, drives, theaters, and places of recreation and resort. High Park, in the western section, is the largest, and Queen's Park is the most accessible and attractive. One of the most popular summer places of amusement is the island which lies off the city front, and which bears the same relation to Toronto that Coney Island does to New York or New Brighton to Liverpool. The other open-air resorts, other than the public squares, comprise the Horticultural Gardens, Riverdale, Bellwoods, Ketcham, and Stanley Parks, and the exhibition-grounds and garrison common.

*Institutions.*—The principal educational institution is the Provincial University. In St. James's Square are situated the Provincial Educational Department, the Museum and Art Rooms, and the Normal and Model School buildings. Here are the headquarters of the educational system of Ontario. In the Queen's Park, approached by a wide street, a mile long, lined with chestnut-trees, is the Provincial University known as the University of Toronto. Affiliated with the university are the theological colleges adjoining, viz.: the Roman Catholic College (St. Michael's), the Presbyterian College (Knox), the Methodist (Victoria), and Wycliffe College, the theological training-school of the Evangelical section of the Church of England. There is also a School of Science affiliated with the university. Besides Wycliffe College, the Anglican communion has, in Trinity University, a fine academical institution and training-college, giving instruction in divinity, law, arts, music, and medicine. Higher education has an historic institution in Upper Canada College, at Deer Park. It was founded in 1829, and was modeled after the great public schools of England. Law has its representative home in Osgoode Hall, situated on Queen Street West, where are the great law courts of the province, together with the Convocation Hall and library of the Law Society of Upper Canada. The public and high schools are fifty-three in number, and the city's annual assessment for their maintenance is, independently of the provincial Government grants, about $600,000. These schools employ 588 teachers, two-thirds of whom are women, besides 128 teachers in kindergartens. The total registered attendance in 1900 was 35,189; the average daily attendance, 24,516; and the cost per pupil, on the basis of average attendance, $12.98. Besides the cost of education proper, the city taxes itself heavily on behalf of art, industrial, and night schools, and has equipped and maintains, on a liberal scale, a large number of hospitals, charities, and other eleemosynary institutions. The more important of these are the Toronto General Hospital and several smaller hospitals of a general character, the Protestant Orphans' Home, the Girls' and the Boys' Home, the Sick Children's Hospital, the Home for Incurables, the House of Industry, the House of Providence, the Convalescent Home, the Homœopathic Hospital, Women's Medical College, Industrial Refuge, and Mercer Reformatory. The parliament buildings of the province, a massive structure in the Queen's Park, contain, besides the single-chambered legislature, the library, the parliamentary committee-rooms, and departmental offices. Government House, the residence of the lieutenant-governor of the province (at present Sir Oliver Mowatt), is on King Street, at the intersection of Simcoe Street. The churches are many and beautiful. The older representative places of worship include St. James's Cathedral and St. George's church (Episcopal), St. Michael's (Roman Catholic), Knox and St. Andrew's (Presbyterian), Jarvis Street (Baptist), and Zion church (Congregational). There are not less than 160 places of worship, exclusive of mission-houses and the headquarters and branch barracks of the Salvation Army. The handsomer structures of a later date include St. Alban's Cathedral (Episcopal); St. James's, St. Andrew's, Central, Westminster, and Bloor Street (Presbyterian); St. Alban's, St. Paul's, and Broadway Tabernacle (Methodist); Bond Street and Hazleton Avenue (Congregational); and College Street, Immanuel, Bloor Street, and Walmer Road churches (Baptist).

*Government and Finance.*—The municipal affairs are administered by a mayor and board of twenty-four aldermen, representing the six wards into which Toronto is divided, aided by a board of control, composed of three salaried aldermen, and the mayor *ex officio*, in addition to which are committees in charge of the various civic departments. The annual civic disbursements exceed $6,000,000, about half of which is raised by taxation, a considerable sum in addition from fees, licenses, water-rents, and rentals from corporation property. The deficiency is made good from the sale of the city's debentures. Toronto's total net debt at the close of 1900 was about $16,285,309, against which the city owns property and other assets to the estimated value of $13,000,000, a large amount of which (the city waterworks) is revenue-producing. The value of the assessable real and personal property rose from about $62,000,000 in 1883 to $128,573,038 in 1900, on which, in 1900, the tax rate was 19½ mills. The gross revenue from taxation in 1900 was $2,855,597, from other sources $672,000.

*Commerce and Banking.*—Toronto shares with Montreal the repute of being the center of Canadian finance. In these two cities are the headquarters of the great banks of the Dominion, whose total assets, available in the main for the transactions of commerce, exceed $240,000,000. The city is the chief field of operation for twenty-eight loan companies and building societies, with a combined paid-up capital of over $20,000,000. Of great service also to the industrial and commercial interests of the city are the operations of the great Canadian and foreign fire and life insurance and loan and savings companies. As a commercial center the city has, if we except Montreal, at the head of tide water, no rival in the Dominion. The richest province in Canada is tributary to Toronto, and her trade ramifications extend not only from the Atlantic to the Pacific, but to other colonies of Britain, as well as to the chief foreign ports. It is difficult to ascertain with accuracy what is the aggregate volume of the annual trade. According to an official report, the value of imports for the fiscal year ending June 30, 1900, was $31,787,053, and the value of exports $9,506,811.

*Communications, Manufactures, etc.*—The industries include the manufacture of ships, marine engines, boilers, furnaces, stoves, heaters, safes, track and bridge spikes, bolts, nuts, carriage-irons, forgings, lead-piping, shot, saws, barbed wire, farm and factory implements, tools, threshers, white lead, paints, colors, sewing-machines, bicycles, pianos, organs, silver-plate ware, domestic, church, and office furniture, paper-hangings, window-shades, etc. There are excellent facilities for shipping and transport, and throughout the season of navigation steamers maintain communication with the principal routes of travel, and trade is carried on over the whole chain of lakes. Railways radiate also from the provincial capital in all directions.

*History.*—In 1884 Toronto commemorated the fiftieth year of its incorporation as a city, and in 1894 it commemorated the hundredth anniversary of the passing of the Constitutional Act of 1791, which set apart the province of Upper Canada and gave rise (1794) to the embryo capital. When Gen. Simcoe and the advance guard of civilization appeared on the site of the city, all that there was of human interest to greet the new comers were two families of Mississauga Indians. By the close of the century, however, much was accomplished. Toronto was fortunate, in its beginnings, in receiving among its sturdy early settlers a considerable contingent of United Empire Loyalists. During the war of 1812 the town, at that time called York, was twice sacked and burned by U. S. troops, though on one occasion at serious loss to the invaders. Recovering from this disaster, and receiving considerable accessions to its population, the town advanced apace. In 1834 it rose to the dignity of an incorporated city, having meanwhile largely extended its limits and gained a population of 10,000. Presently Toronto passed into its high prerogative era and accompanying period of political discontent, the issue of which was the rebellion of 1837, and the hard-won measures of reform, culminating in self-government. With the union (in 1841) of the two old Canadas, and the confederation (in 1867) of all the British North American provinces, Toronto forged ahead, and, aided by the railways, extended her bounds, increased her wealth, and made large additions to her population. At confederation she became the capital of the newly named province of Ontario and the seat of the provincial Government.

*Population, etc.*—In 1871 the population was 56,092; in 1881 it had increased to 86,415; in 1891, with the incorporating of its outlying suburbs, the population rose to 181,220. A special census, taking early in 1895, places the population at 188,914. The estimated population at the census taken Apr. 1, 1901, was 225,000.

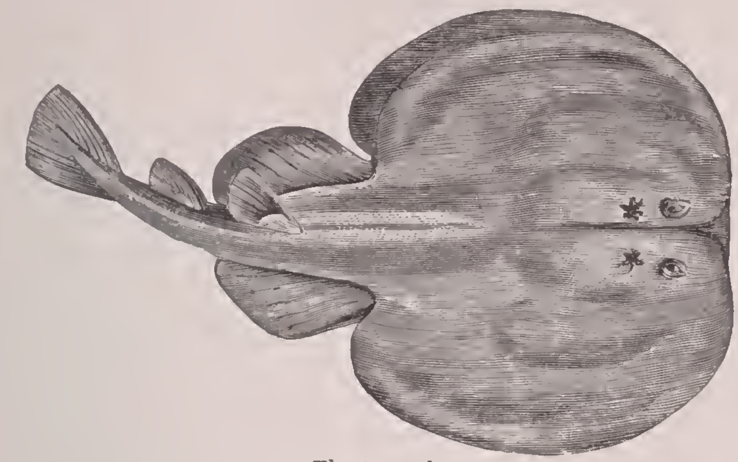
AUTHORITIES.—*Toronto of Old*, by Henry Scadding, D.D.; *Toronto Old and New: Historical, Descriptive, and Pictorial*, by G. Mercer Adams; *Illustrated Toronto; the Queen City of the West*, by the same; *Toronto, Past and Present*, by Henry Scadding, D. D., and J. C. Dent; *Annual Report* for 1894 of the Toronto board of trade; *Annual Reports* of the city treasurer and city engineer for 1893; *Annual Report* for 1893 of the Toronto public school board; and *Monetary Times, Trade Review and Insurance Chronicle* for 1894.

G. MERCER ADAM. Revised by F. A. ACLAND.

**Toronto**: village; Jefferson co., O.; on the Ohio river, and the Penn. Railroad; 9 miles N. of Steubenville, the county-seat (for location, see map of Ohio, ref. 4–J). It is principally engaged in manufacturing fire-brick, sewer-pipe, terra-cotta building materials, and pottery, and contains a private bank and a daily and a weekly newspaper. Pop. (1890) 2,536; (1900) 3,526. EDITOR OF "TRIBUNE."

**Torpedin'idæ** [Mod. Lat., named from *Torpe'do*, the typical genus, from Lat. *torpe'do*, *torpe'dinis*, torpedo, cramp-fish, liter., a numbness, deriv. of *torpe're*, be stiff, numb]: a family of skates (see RALÆ) noted for their electrical powers, which have caused them to be called cramp-fish, numb-fish, etc. About twenty species are known, but those most studied belong to the genus *Torpedo*, three of which occur in Europe and one (*T. occidentalis*) on the east coast of the

U. S. In these the body (including the pectoral fins) is a broad, rounded disk, the large fleshy tail resembling that of a shark. There are two dorsal fins on the tail, and the ven-



The torpedo.

tral fins are distinct from the disk. The mouth is of moderate size, the teeth pointed, and the skin smooth. The electrical organs, apparently formed by a metamorphosis of parts of the adductor and common constrictor muscles, occur on either side of the head, and receive their nerve-supply from the fifth (trigeminal) and tenth (vagus) nerves. Each organ consists of numerous hexagonal prisms, extending from the dorsal to the ventral surface of the body. The walls of these prisms consist of connective tissue in which run nerves and blood-vessels, while the prisms themselves are filled with gelatinous substance in which are "electrical plates" in which the nerves terminate, and which are apparently the modified motor end plates of the muscle. While the anatomy and physiology of these and other electrical organs have been extensively studied, the physics of the electrical generation is as yet unknown. The current produced will deflect a needle, decompose water, etc., and its production is under the control of the will. It is probably employed by the fish as a means of offense and defense. See F. Boll, *Archiv Anat. u. Phys.* (1873, 1876); Du Bois-Reymond, *Monatssch. Berlin. Akad.* (1881); Ewart, *Philos. Trans.* (1888, 1892); Gotch, *Philos. Trans.* (1887, 1888); different views are maintained by Fritsch, *Die elektrischen Fische* (Leipzig, 1887–90). J. S. Kingsley.

**Torpedo**: See Torpedinidæ.

**Torpedo Boats and Vessels**: those whose function in battle is the use of torpedoes as a principal weapon, or whose general employment is connected with the transportation of torpedo-supplies and with the maintenance of other torpedo boats and vessels in a state of efficiency.

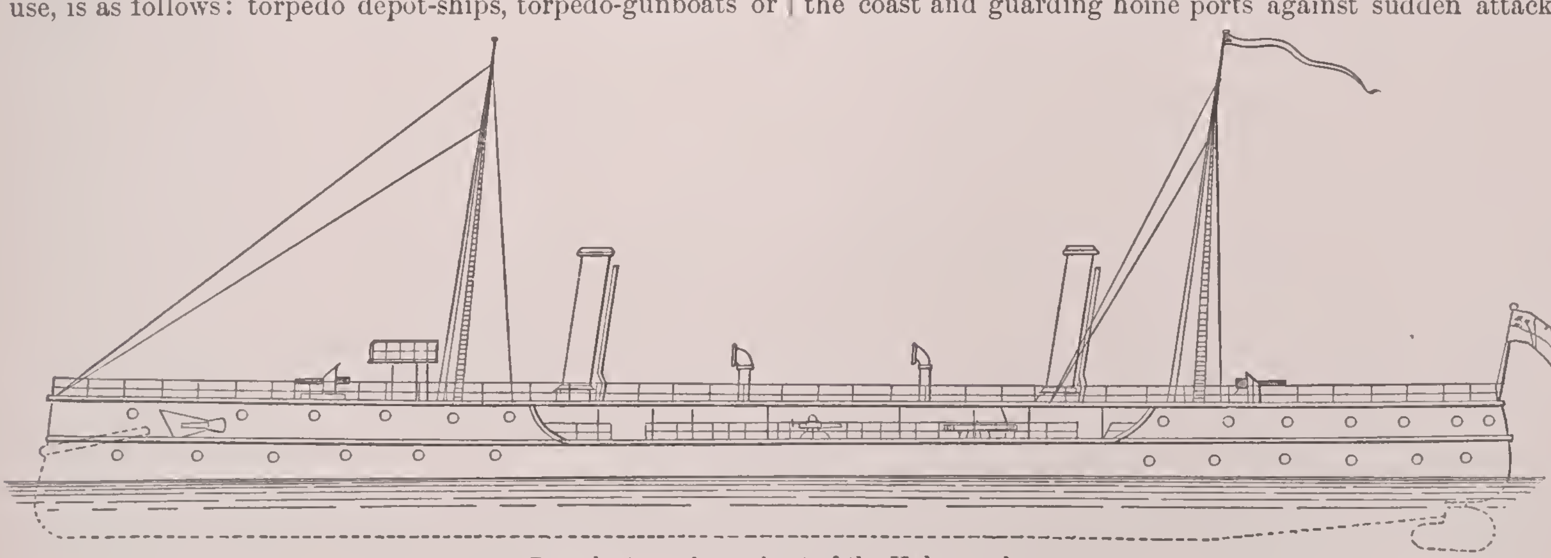
The classification of torpedo-vessels and torpedo-boats in the order of size, and employing such names as have survived among a somewhat perplexing variety at one time in use, is as follows: torpedo dépôt-ships, torpedo-gunboats or torpedo-vessels, seagoing torpedo-boats, and first, second, and third class torpedo-boats.

*Torpedo dépôt-ships*, otherwise known as torpedo-boat transports, torpedo supply and repair vessels, torpedo supply-ships and floating machine-shops, etc., are primarily designed to carry to any required distant point numbers of the smaller or third-class torpedo-boats, which are stowed in cradles on the upper deck in readiness for hoisting out at short notice and in quick time, powerful derricks and steam or hydraulic machinery being installed for this purpose. The torpedo dépôt-ship serves as a movable base from which these boats may operate, departing from an attack on an enemy anywhere within their radius of action, and returning after the attack has been concluded. Torpedo dépôt-ships are armed with a light-gun battery for defense and with automobile torpedoes for attack, and carry a supply of torpedoes and torpedo-stores, not only for themselves and for their own particular flotilla of boats, but sufficient to meet the demands of other boats of the squadron to which they may be attached. They are also equipped with forges and with the tools of a machine-shop, and are available for other repair-work than that of torpedo-boats alone, being of general utility in light repairs of the ships of the squadron and of their engines. They also carry submarine mines, with all the appliances for handling and planting them in any port to be defended, and the electrical appliances required for their operation.

The Vulcan in the British navy and the Foudre in the French furnish two good examples of the torpedo dépôt-ship.

The Vulcan has a displacement of 6,620 tons at a mean draught of 22 feet. Her length is 350 feet and breadth of beam 58 feet. A complete protective deck is fitted, having a thickness of from 2·5 inches to 5 inches over the machinery. The indicated horse-power on her trial was 10,250 maximum, and her speed $18\frac{1}{4}$ knots. Her radius of action is calculated at 3,000 miles for a speed of 18 knots, and 12,000 miles at 10 knots. The torpedo armament consists of automobile torpedoes, for whose ejection four launching-tubes are installed, two above and two under water. The gun armament comprises twenty rapid-fire guns. She carries on deck six torpedo-boats, two countermining launches, and a steam-pinnace. Two heavy cranes, 65 feet in height, worked by hydraulic machinery, are used for hoisting the boats in and out. She is well equipped with workshops and machinery for making repairs. The Foudre has a displacement of 5,970 tons at a mean draught of 20 ft. 2 in. Her length is 370 ft. 8 in., and breadth of beam 51 ft. 2 in.; protective deck, 1·7 to 3·4 inches thick; indicated horse-power, 11,400; speed, 19 knots. Armament, automobile torpedoes, for which five launching-tubes are installed, and sixteen rapid-fire guns, of which eight are 3·9-inch caliber, four are 9-pounders, and four are 3-pounders. She is designed to carry ten torpedo-boats.

*Torpedo-gunboats, or torpedo-vessels*, are a class which occupy what may be called the middle zone between the cruiser and torpedo craft. They are smaller in tonnage than cruisers of the third class and have a much lighter gun armament, and are, on the other hand, at the extreme of size and of weight of ordnance in the torpedo-boat category. They are of especial importance and value in being sufficiently large to keep the sea for a long period, patroling the coast and guarding home ports against sudden attacks by the torpedo-boats of the enemy that might be otherwise unopposed. They may also serve with efficiency as scouts and dispatch-vessels accompanying a cruising squadron. The Halcyon, of the British navy, is given as the latest improved individual of this type. The principal dimensions are as follows: Length, 250 feet; breadth of beam, 30 ft. 6 in.; displacement, 1,070 tons at a mean draught of 9



Dryad; torpedo-gunboat of the Halcyon class.

feet. Indicated horse-power, with natural draught, 2,500; with forced draught, 3,500. Mean speed on measured mile, with natural draught, 17·5 knots; with forced draught, 19 knots. The torpedo armament is of 18-inch Whiteheads, to be launched from five tubes, one tube fixed in the bow and four tubes mounted, two on each side on training-carriages. Two 4·7-inch rapid-fire guns constitute the gun armament, one on the forecastle and one abaft the mainmast. The steaming radius of action of the Halcyon class is 2,500 knots at 10 knots an hour.

To the Argentine Republic belongs an enlarged and improved vessel of the Halcyon type, the Patria, built by the Laird Brothers, of Birkenhead. The displacement is 1,183 tons. Five launching-tubes for torpedoes are installed, and she carries a rapid-fire gun armament of two 4·7-inch guns, four 8-pounders, two 3-pounders, and two machine-guns. Estimated maximum speed, 20 knots.

Closely allied to the torpedo-gunboat is the German torpedo division-ship, in which is also found the equipment of a torpedo supply and repair vessel. This type of vessel is built by Schichau. A summary of the especial characteristics required in these division-ships will serve to indicate their style of construction and the varied nature of the duties to be performed by them. As a class they are intended to serve the purpose of guiding a fleet or division of seagoing torpedo-boats; to have the same or even greater speed than ordinary boats; to be capable of safely riding out any gale; to be able to take on board a full inventory of stores and spare gear for a whole division; to be able to quarter a reserve force of men to replenish crews of boats reduced by casualties; to be fitted with complete workshop arrangements, smiths' forges, etc.; and to be provided with hospital accommodation for the sick and wounded. In common with other torpedo vessels and boats, they are to be armed with automobile torpedoes and rapid-fire guns to enable them to take an active part in an engagement; they are to be of sufficiently strong construction to enable them to ram a hostile torpedo-boat; to have as little draught as possible; to show little surface above the water, thus having small visibility and offering a small target to the enemy; to have large coal-carrying capacity and economical engines, to enable them to make long and fast voyages; and to be cheap in first cost and in maintenance. Division into as many water-tight compartments as practicable, and means for rapidly freeing themselves of water are not omitted.

Two of these having been built for the German Government, they gave such satisfaction that others were speedily ordered. They were 180 feet long and of 22 feet beam, with a displacement of about 250 tons. Each vessel, built throughout of the best steel, is divided into twelve water-tight compartments. The fixed torpedo-tubes, apparatus for launching, and the crew space are forward; abaft this is the workshop, fitted with all necessary tools and appliances; then come the boiler and engine rooms; aft are quarters for the commanding and other officers; next is the hospital; and next are the quarters of mates, etc. Store-rooms and coal-bunkers are judiciously distributed, the latter completely surrounding the boilers and engines. Launching-tubes and rapid-fire guns are distributed to best advantage on deck. The engines, working at 270 revolutions a minute, developed an indicated horse-power of 2,000. The speed on trial was 21 knots, the boat being fully equipped and carrying coal for 2,500 knots at the rate of 10 knots an hour. In a special storm trial for eight hours at full power against a very high sea and a gale of wind, a speed of 18 knots was maintained. A similar but larger boat of 300 tons displacement and 3,000 indicated horse-power, and of estimated speed of 21 knots an hour, was ordered by the Austrian Government.

In addition to services of guidance and care of the boats of its division, a torpedo division-ship will find useful employment in picking up the enemy at times when the torpedo-boats might be quite unable to find him; and also, by virtue of its weight and strength, in clearing passages through booms and in sweeping away nets from a protected vessel.

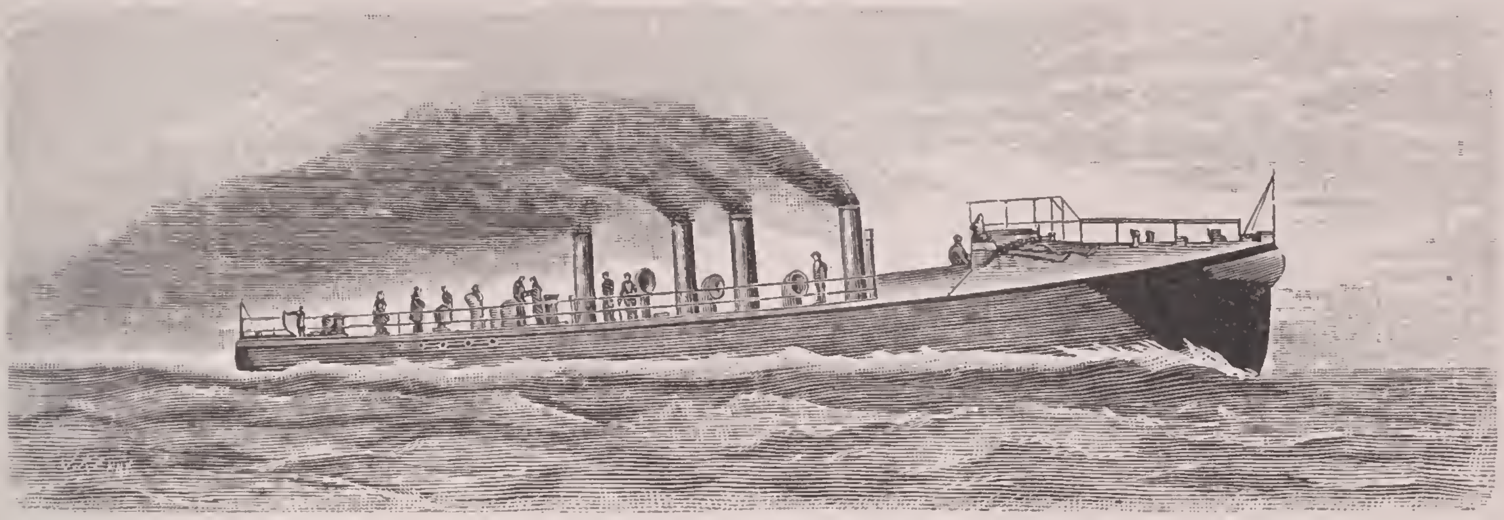
The latest size of this vessel in favor in Germany is of 220 tons displacement at a mean draught of 9·8 feet, 185·3 feet long, and 21·6 feet beam. In addition to the torpedo armament they carry a gun armament of six 37-millimeter Hotchkiss revolving cannon.

*Seagoing torpedo-boats*, often called torpedo-boat destroyers and torpedo-boat catchers, are the largest size of torpedo-boats designed to act independently and with a large radius of action, but without embodying any provision for the repair or maintenance of other torpedo-boats. In these, as in all other torpedo craft, the leading idea of construction has been to install the highest possible power in the smallest possible space compatible with seaworthiness, and to build with the lightest materials consistent with strength. Emulation has been great between maritime nations and among the builders of each nation to produce the boat of highest speed. Victory, resting from time to time with Thornycroft, or Yarrow, or White, of England, with Normand, of France, and with Herreshoff, of the U. S., now appertains to Thornycroft in the record of the torpedo-boat destroyer Boxer, which ran over the measured mile during her official trial at the amazing rate of 30·354 knots per hour, equal to 34·95 statute miles.

The accomplishment of such a result as this has been made possible only by the closest study of scientific principles, and their application in shaping the lines of the hull and in designing the machinery so that the maximum of power should prevail with the practical minimum of size and displacement. In no class of marine architecture has progress been more marked and persistent than in the development of torpedo-boats. Each improvement in naval construction and in marine steam-engineering has been incorporated whenever applicable. In these boats, of all classes, are found exemplified the best modern ideas. Twin screws of powerful lines are driven at a surprisingly high rate of speed by multiple-expansion engines, generally installed in pairs, fed with steam by a number of multitubular boilers whose heating surface is relatively large in comparison with the amount of water-space in the boilers. A large grate surface, with closed fire-rooms and forced draught, permits the generation of steam in sufficient quantity to run the boat in a very short period of time after starting the fires, and maintains the steam in quantity and in pressure for all demands made by the engines at their highest rate of speed. The fuel is selected with the greatest care that the best results may be obtained, hand-picked coal of the best quality being the fuel commonly employed at present. Liquid fuel, such as petroleum and other hydrocarbons, finds many advocates, but its successful use has not yet been established. Safety arrangements are in general use, not only in the form of water-tight compartments and great pumping-out power to insure against sinking in case of a damaging wound to the underwater body, but in and around the boilers and engines, to provide immunity from total crippling should any of these important adjuncts be injured. Each engine and each boiler is isolated from the rest, being placed each in a separate compartment, and the steam-piping so connected that they may act in unison or independently one of another. If one engine or any one of the boilers is crippled, it may be shut off from the rest without stopping the boat or withdrawing from action. Many boats have safety arrangements in connection with the boilers, such that in the event of the bursting of a boiler-tube, the furnace-doors are closed automatically, and the escaping steam finds its way out through the smokestack, being shut off from the fire-room, thus saving the firemen. In some boats, also, the furnace-doors are so constructed that in case of the flooding of any boiler compartment, the furnace-doors of that boiler may be closed water-tight and steam maintained in the boiler for a considerable period of time by the coal remaining in the furnaces. Protection to the inmates of the conning-towers is given by steel plating, and in the larger boats the machinery and boiler compartments are also steel plated, and they are additionally protected in all boats by the coal, which is stowed in bunkers surrounding the vital parts of the boat.

The Boxer belongs to what is known as the Havock type of torpedo-boat destroyers. The British naval estimates for 1894 provide for forty-two boats of this type, inaugurating a building programme which proposes sixty-four of these boats in all, on the basis of four for each battle-ship completed for the Channel and Mediterranean squadrons. The contracts for building these boats have been distributed among a large number of builders, and such as have been completed up to date have been marvels of success. The Havock, a Yarrow boat, the pioneer of the class, recorded a speed of 27·565 knots on her trial. The Hornet, also a Yarrow construction, made 28 knots over the measured mile. Following this, the Daring, a Thornycroft boat, made a mile at the rate of 29·268 knots an hour. Finally, the Boxer, also built by Thornycroft, attained the greatest speed known, of all vessels of whatever size, at the figure already given—30·354 knots.

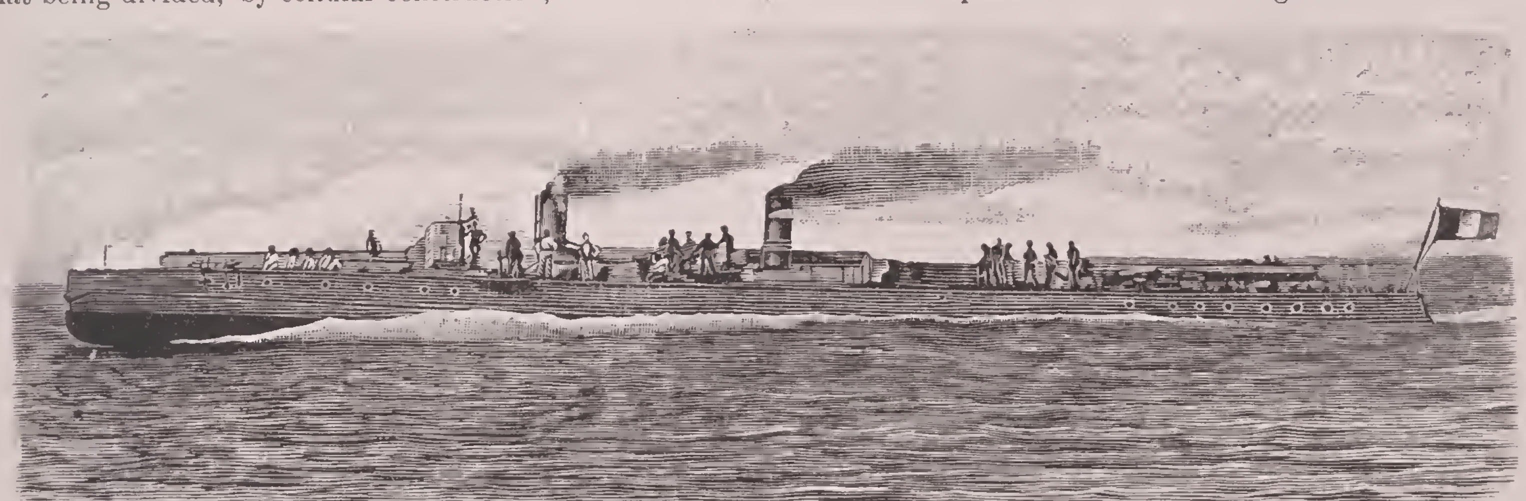
All boats of the Havock type follow very closely the general features of the original type, with the exception of certain minor changes in the design, and in a slight increase of size in the later boats. Each contractor has been allowed to install his own type of machinery and boilers. The dimensions of the Havock are as follows: Length on the load-water line, 180 feet; breadth of beam, 18 ft. 6 in.; displacement, 220 tons at a mean draught of 6 feet. The motive power consists of two triple-expansion engines, fed by two boilers of the locomotive type, with a grate surface of about 100 sq. feet, and a total heating surface of about 5,000 sq. feet. She has three-bladed twin propellers. Her radius of action is about 3,500 knots at a speed of 10 knots an hour. The torpedo armament consists of 18-inch Whitehead torpedoes, for the launching of which three tubes are fitted, one fixed in the bow and two on training-carriages, one on either side of the upper deck. Transportation of the torpedoes about the deck is facilitated by a transporting carriage which runs on a railway from the conning-tower forward to the launching-tubes aft. The gun armament consists of one 12-pounder Hotchkiss rapid-fire gun, mounted on top of the conning-tower, and two 6-pounder rapid-fire guns, abaft the turtle-back. A search-light is mounted on the upper deck. The complement for this type of torpedo-boat is forty-two men all told. Of the important changes in construction affecting the seaworthiness of the boat, the turtle-back may be noted as being carried much farther aft than in preceding torpedo-boats. In the Havock and others of the class the turtle-back extends to abaft the conning-tower, where it meets two high bulwarks and two low deck-houses, which give additional protection from water coming on board, to the deck abaft the conning-tower. Another novel feature is the construction of what is practically a double bottom in the forward part of the boat. This is effected by a water-tight flat at the level of the water-line, running from the eyes of the boat to the forward boiler-room bulkhead, the space under this flat being divided, by cellular construction, into lockers for ammunition, stores, etc. The boat has in all about twenty water-tight compartments, all connected to the bilge ejection. The Havock has two boilers of the locomotive type, with two smokestacks. The Hornet has eight water-tube boilers of the Yarrow type, with four smokestacks. The advantages of this large number of boilers are the avoidance of material diminution of the power developed in the event of the disabling of one boiler, and the facilitation of the removal of the boilers when necessary in making repairs. The Hornet's eight boilers weigh 43 tons, as against 54 tons, the weight of the Havock's two boilers. The boilers of the Daring and Boxer are the Thornycroft improved water-tube boilers. In the trial of the Daring the mean indicated horse-power developed was 4,573, with a maximum of 4,842, and the average number of revolutions of the propellers a minute, for a three hours' run over the measured mile, was 387. In her turning trials the boat's tactical diameter was found to be about 500 feet, and the time occupied in making a complete circle, at 210 revolutions, was 1m. 56s. A serious defect was found in the column of flame, which rose to a height of from 12 to 15 feet above the smokestacks when the boat was running at high speed, and which would render the boat visible at a great distance at night, and would offer an excellent target for the enemy.



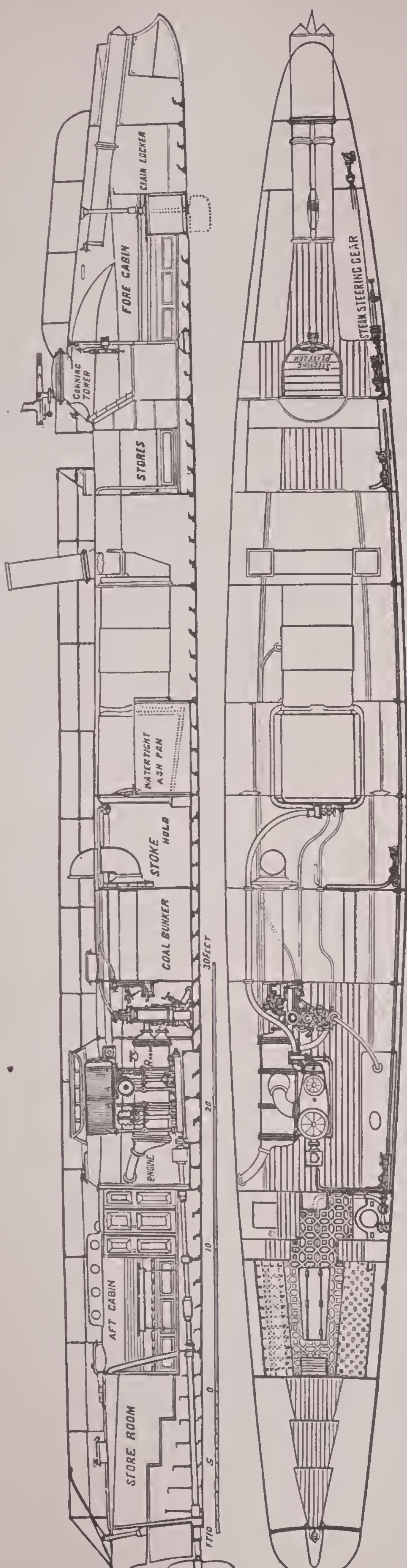
The Hornet; seagoing torpedo-boat.

A typical French boat of this general class, although much smaller, is the Chevalier, a Normand boat, of 125 tons displacement, with an average speed of 27·22 knots on a two-hours' trial. Her length is 154 feet; beam, 15·4 feet; and extreme draught, 6·2 feet. The armament consists of two 18-inch deck torpedo-tubes and two 1-pounder rapid-fire guns. Two Thornycroft boilers furnish steam for two triple-expansion engines, whose cylinders are respectively 15·8, 23·6, and 35·5 inches in diameter, with 15·8 inches stroke. Either one or both of the boilers can be used to feed steam to the engine.

*First and Second Class Boats.*—It is generally conceded, as the result of experience derived from many trials under all circumstances of weather and sea, that the minimum length necessary to an effective seagoing torpedo-boat is 150 feet. Boats under this length are properly classified, in the decreasing order of size, as first-class, second-class, and third-class torpedo-boats. The limiting lines of size and of tonnage in the three classes differ somewhat among different nations, but it may be generally stated that first-class boats are, as a rule, of from 100 to 80 tons displacement, second-class boats of 50 tons or less, and third-class boats of 15 tons and under. First and second class boats find their place in



Mousquetaire; French seagoing torpedo-boat.




Profile and plan of a first-class torpedo-boat.

the home-defense of ports. Stationed in numbers in different ports, or massed at threatened localities, by inland waterways, where such routes of communication exist, their presence would be a constant menace to an investing naval force, which, however powerful, would always be in danger of destruction whenever opportunity might offer for a sortie of the torpedo-boats. The following dimensions are those of one of the most recently constructed first-class boats: Length, 140 feet; breadth of beam, 15 ft. 6 in.; displacement, 110 tons at a mean draught of 5 ft. 4 in. She has engines capable of developing 2,000 indicated horse-power, and her maximum speed is 23·8 knots. Her torpedo armament is of 18-inch Whitehead torpedoes, for the launching of which three tubes are installed. The gun armament consists of three 3-pounder rapid-fire guns.

*Third-class boats* are designed to be carried on the upper decks of battle-ships, or of torpedo-boat transports, to be hoisted out when occasion for their employment arises. The third-class boats for the U. S. S. Maine and Texas, two for each ship, are excellent examples of the most advanced type of construction of this class of boats. The dimensions of the boats for the Maine are as follows: Length on water-line, 58 ft. 6 in.; breadth of beam, 9 ft. 1 in.; displacement, $14\frac{3}{4}$ tons. The boats are completely decked over, with the exception of two water-tight cockpits, one forward and one aft, and are divided into seven water-tight compartments. The boilers are water-tubular, with 12 sq. feet of grate surface and 440 sq. feet of heating surface. The engines are quadruple expansion, compounded, of the inverted, direct-acting form. A speed of 18 knots with 200 indicated horse-power is expected. The radius of action, at 10 knots an hour, is calculated as 500 knots. The torpedo armament is of 18-inch Whitehead torpedoes with one bow tube for launching, and the gun armament consists of one $1\frac{1}{2}$-inch rapid-fire gun. The complement is five men all told. The material of which the boat is constructed is steel. With the object in view of reducing the weight as much as possible, the Yarrow Shipbuilding Company has recently built, for the French torpedo-boat transport Foudre, an aluminium boat, 60 feet long and of 9 ft. 3 in. beam, and of a displacement of 10 tons; speed, $20\frac{1}{2}$ knots. The decrease in weight over similar boats built of steel is about 2 tons, and the gain in speed is about $3\frac{1}{2}$ knots.

*Submarine boats* are still practically in their infancy, although the idea is an old one. See the article SUBMARINE NAVIGATION.

The U. S. S. Vesuvius and the Destroyer, a boat sold by the Ericsson Coast-defense Company to the Government of Brazil during the war of the rebellion in that country in 1894, stand as unique examples of ingenious systems worked out to a practical accomplishment, but not yet generally adopted. The Vesuvius has a battery of three pneumatic guns designed to fire projectiles, known as aërial torpedoes, to an extreme range of one mile. These projectiles contain a large charge of high explosive which detonates, either on impact with the enemy, if a direct hit be made, or shortly after entering the water, with a torpedo effect, if the hull be missed. The Destroyer has for its leading feature an Ericsson submarine gun, fixed in the line of the keel and pointing directly ahead, from which a projectile containing a heavy charge of high explosive is discharged by gunpowder impulse. The projectile explodes on impact with the hull of the enemy below the water-line. The effective maximum range of this gun is 600 feet. See NAVY, SHIPS OF WAR, etc.

GEORGE F. W. HOLMAN.

**Torpedoes** [from Lat. *torpe'do*, torpedo-fish, to whose shocks its destructive explosions may be compared]: submarine devices containing explosives and designed to destroy hostile shipping. They are either contrivances propelled through the water so as to strike the enemy's ship or more or less stationary submerged mines, each so arranged as to be set off when a ship is over it. The germ of the idea is found in the Greek fire of the ancients, from which the torpedo has been naturally developed since the introduction of gunpowder into warfare.

*Historical Notes.*—The earliest "infernal machine" on record dates from the siege of Antwerp in 1585, where an Italian engineer, Zambelli, destroyed an important bridge laid by the enemy over the Scheldt, by setting adrift against it four scows, each carrying a masonry mine heavily charged with gunpowder. Ignition was to be effected either by a slow match, or by a gun-lock discharged by clockwork after the lapse of a certain time. One of these floating mines exploded against the bridge with tremendous effect, and thus stimulated investigation in a new field of warfare. Other similar attempts were made during the next two centuries by the French, British, and Russians, but, like the fiasco before Fort Fisher in the civil war in the U. S., they usually proved to be failures. The condition now regarded as essential in attacks directed against shipping, that the charge shall be submerged, was totally ignored. To an American engineer officer of the Revolution, Capt. David Bushnell, the credit is due not only of experimentally developing this principle, but also of devising a submarine boat, by which the first attempt to apply it to the destruction of an enemy was ever made. By his fertility of invention and persevering efforts to perfect the new weapon he justly won the right to be considered the originator of submarine mining as practiced at the present time. His first practical trial was made in 1776, use being made of his submarine boat, navigated by Sergeant Ezra Lee. The attack was directed against the Eagle, the flag-ship of Lord Howe, lying in New York harbor, and the vessel narrowly escaped destruction. In 1777 Bushnell caused the blowing up of a prize schooner, lying at anchor astern of the frigate Cerberus off New London, by means of a drifting torpedo which he had directed against the latter, and which was ignorantly taken on board the schooner. In the following winter he set adrift many torpedoes to annoy the British fleet in the Delaware, thus giving occasion to the so-called Battle of the Kegs, which was commemorated in a humorous song by Hopkinson, the author of *Hail Columbia.* Twenty years later Robert Fulton revived the general ideas of Bushnell, and attempted to introduce submarine warfare in the French navy. He made a submarine boat named the Nautilus, by which in Aug., 1801, he blew up a launch in the harbor of Brest—the first instance on record of a vessel destroyed by a submerged charge of gunpowder. Rejected by France, he next induced Great Britain to organize an abortive "catamaran" expedition against the French fleet lying at Boulogne. Although supported by Pitt, and successful in experimentally destroying the brig Dorothea by a drifting torpedo, his projects were finally rejected by the British Government as unsuited to the interests of a nation that enjoyed the sovereignty of the sea. Fulton returned disappointed to the U. S., where, after some successful experiments, he finally met a like repulse, largely through the active opposition of Commodore Rogers of the navy. He ultimately abandoned his efforts in submarine mining, as his attention became absorbed in steam-navigation. Although Fulton began his experiments by employing a submarine boat, experience led him to abandon this device. As finally rejected by the U. S. Government, his system included four classes of torpedoes: (1) Buoyant mines, anchored in the channel to be defended, and exploded by a mechanical device set in action by contact with the enemy's hull. (2) Line-torpedoes, designed to be set adrift and fouled by the cables of the hostile fleet at anchor. (3) Harpoon-torpedoes, to be discharged from a gun, and thus attached to a vessel and fired by clockwork. (4) Block ship torpedoes, to be carried on booms projecting from vessels of a peculiar type, and exploded by contact with the enemy. The modern system includes all these devices in a modified form, except the third—a fact which sufficiently shows how far Fulton was in advance of his age in appreciating the capabilities of submarine warfare. In the war of 1812 several abortive attempts were made by individuals to employ Fulton's system against British shipping in U. S. waters, but the Government took little interest in the operations, and no success was achieved, although considerable alarm was excited in the fleet of the enemy.

During the next thirty years torpedo warfare was neither forgotten nor neglected in Europe, as many writings abundantly prove, but it was left to Col. Samuel Colt, of Hartford, inventor of the revolving pistol which bears his name, to make the next great advance. It consisted in introducing, as the igniting agent, electricity, at that date considered rather as a toy of the philosopher's laboratory than as a practical force in engineering. Colt began his torpedo experiments in 1829 or 1830, and after years of labor elaborated a system of buoyant submarine mines, to be planted quincuncially in the threatened channel and operated by electricity. To convey the current he devised one of the very first submarine cables ever attempted, which in the winter of 1842–43 he successfully laid across East river, New York harbor. Gutta-percha was then unknown as an insulating material, and Colt employed a wrapping of cotton yarn soaked in asphaltum and beeswax, and, when used in exposed localities, inclosed in a leaden tube. When designed for torpedo purposes, each cable included two separate conductors, which,

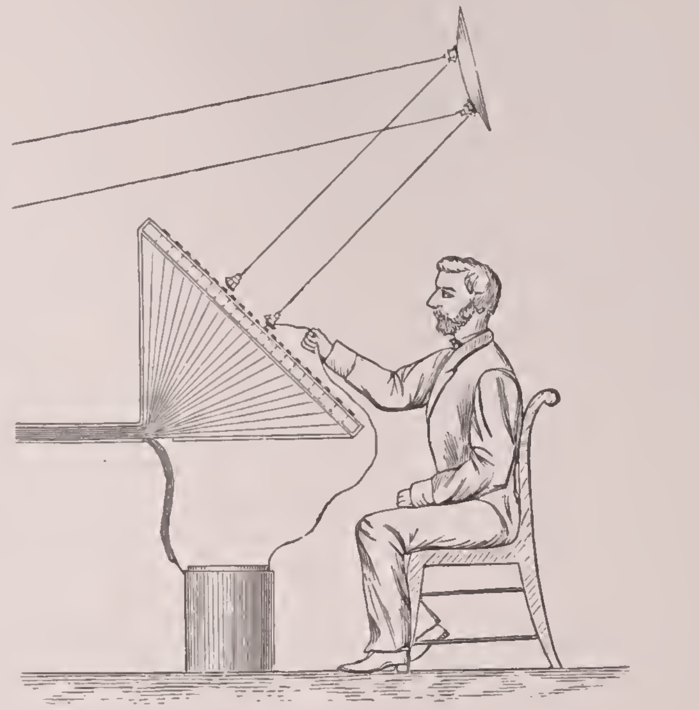


FIG. 1.

entering the mine, were united by a fine platinum wire imbedded in gunpowder. The operator, by sending at pleasure a strong current of voltaic electricity through this bridge, heated the platinum to redness and determined the explosion. For convenience of manipulation the shore-ends of the cables were all led to a casemate. The sketch shown in Fig. 1 was found among Colt's papers after his death, dated 1836; it represents one of his devices for igniting the mines at the proper instant, although it is of course applicable only to an elevated site. A secret believed to relate to a method of making the vessel telegraph her own position died with him. This sketch explains itself. One set of conductors from all the cables are united and permanently attached to a single pole of a powerful battery. The other conductors lead to a map of the channel, and each is secured at the point corresponding to the known position of its mine. The reflector is arranged to throw the image of the hostile ship upon the map, and as it passes over a wire terminal the operator with his other battery-wire closes the proper circuit and explodes the torpedo. Colt's experiments extended over a period of about fourteen years, the latter part of the time under the auspices and at the expense of the Government. He destroyed several vessels at anchor, and finally, on Apr. 13, 1843, accomplished the feat of blowing up a brig under full sail on the Potomac, operating his battery at Alexandria, 5 miles distant. This decisive trial was witnessed by many members of Congress and by the President, and its success at that date stamps Colt as a man of extraordinary ability. The time, however, was not yet ripe for the introduction of the new weapon, and, like those of his predecessors, Colt's plans were ultimately rejected by the Government.

The idea of submarine warfare, although dormant, was by no means dead, as various tentative devices prove; but it was not until the Schleswig-Holstein rebellion in 1848 that they appeared in actual warfare. Prof. Himly, of the Kiel University, then obstructed the entrance to the harbor of that city by barrel mines of his own invention, operated from the shore by electricity. No attack was attempted by the Danish fleet.

The Anglo-French war with Russia in 1855 furnished the next occasion for the application of submarine mines to harbor defense. Sebastopol, Cronstadt, and Sweaborg were protected in this manner by devices of Prof. Jacobi. Unfortunately for the success of his system, the charges were too small (25 lb.), and although explosions occurred under two or three British frigates, no serious damage was done. The fuze consisted of a small bottle of sulphuric acid imbedded in a mixture of potassium chlorate and sugar; the mechanical breaking of the bottle by contact with the vessel effected ignition. The great improvement of placing the igniting apparatus within the torpedo, independent of external levers, is due to Prof. Jacobi, who also made use of electrical mines to be fired by an operator on shore. Some abortive attempts at submarine mining were made by the

Chinese in the war with Great Britain in 1857–58, but they resulted in nothing. The Italian war of 1859 gave occasion for Col. von Ebner, of the Austrian Engineers, to employ in the defense of Venice a system of electrical mines more carefully elaborated than any which had preceded it, but no opportunity for practically testing its merits occurred.

It was reserved for American engineers to demonstrate upon a grand scale the important part which the modern torpedo can be made to play in maritime warfare. The civil war of 1861–65 offered conditions peculiarly favorable to its development. The Southern Confederacy was possessed of no fleet worthy of the name, while a long line of seacoast and many navigable rivers exposed its territory to easy assault by water. It could, therefore, well afford to sacrifice most of those routes of communication, provided they could be closed to the war-vessels of the Union. Every variety of torpedo became, therefore, admissible. After some preliminary trials, the service was formally legalized in Oct., 1862, and an efficient bureau was established at Richmond, which continually extended the scope of its operations until the end of the war. Seven U. S. ironclads, thirteen wooden war-vessels, and seven army-transports were destroyed by torpedoes, and eight more vessels were more or less injured. The Confederates lost four vessels by their own mines, and a fine ironclad, the Albemarle, by the counter-operations of the U. S. fleet. This wholesale destruction occurred chiefly during the last two years of the war; and if at its beginning the system had been as well organized as at its close, the influence which might have been exerted upon the naval operations of the Union forces can hardly be estimated. The details of the Confederate system were published to the world soon after the end of the war, and formed the basis for further investigation and development in many nations. The several devices may be grouped in five distinct classes—stationary torpedoes or submarine mines, automatic drifting torpedoes, infernal machines, offensive spar-torpedoes, and submarine boats.

*Stationary Torpedoes, often called Sea-mines.*—To form an obstruction in the channel which shall stop the enemy,

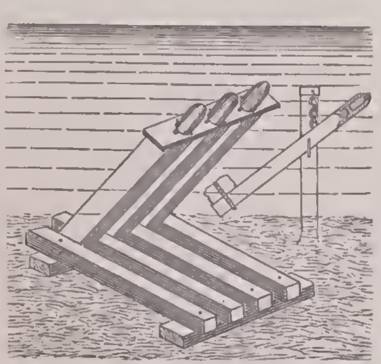


FIG. 2.—Frame and pile torpedoes.

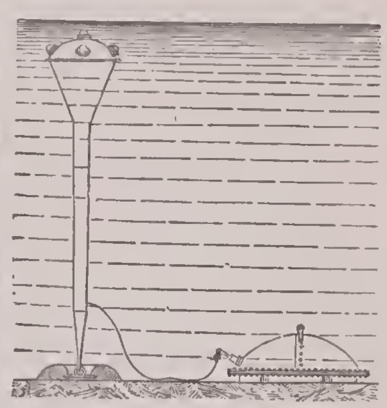


FIG. 3.—Swaying boom and turtle torpedoes.

either by his actual destruction or by his fear of it, is the object of this class. Several types were used. The frame-torpedo was one of the most simple. Each shell weighed about 400 lb., and contained 25 lb. of gunpowder. The fuze, consisting of a vial of sulphuric acid imbedded in potassium chlorate and sugar, was placed in the loading-hole, protected by a thin lead cap to be crushed by the vessel. The pile-torpedo, a similar pattern of mine, also shown on the figure, was found in the water-approaches to Savannah. The swaying-boom torpedo was a marked improvement upon this device, since, being free to move, it was not so easily discovered by dragging. To render it still more effective, it was often attached by a line to a "turtle" containing a fuze made upon the principle of an ordinary cannon-primer. The attempt to grapple and raise the boom-torpedo exploded this auxiliary, which was planted in front, so as to be well under the bottom of the enemy. The charge of the boom-torpedo was about 70 lb., and of the turtle 100 lb.; the whole device was called the devil-catcher. Another approved pattern was known as the Singer or Fretwell torpedo, invented by Singer and introduced by Fretwell. The principle of its action was similar to that of the "turtle," the charge (50 to 100 lb.) being fired by a percussion-cap acted upon by an external plunger released when the inverted saucer-cap was thrown off by the touch of the enemy. The weakening of the spring under continued tension, and the growth of seaweed and shellfish, were found to destroy efficiency after the torpedo had remained a few weeks in position. To obviate this difficulty—which is inherent to all mechanism acting externally—Gen. Rains, when in charge of the laboratory at Augusta, Ga., devised a fuse priming said to consist of fulminating mercury and fulminating silver, which was exceedingly sensitive, a slight blow being sufficient to cause detonation. Fuzes containing it, protected against

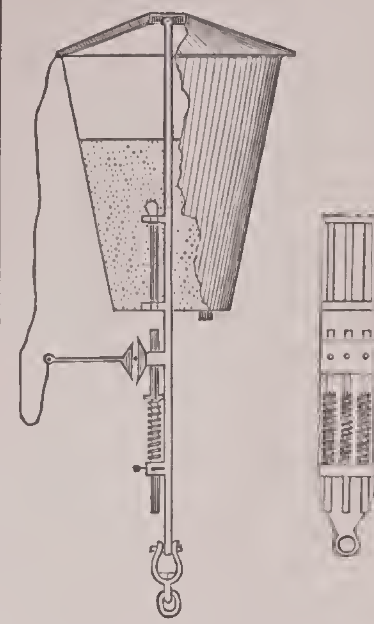


FIG. 4.—Singer's torpedo.

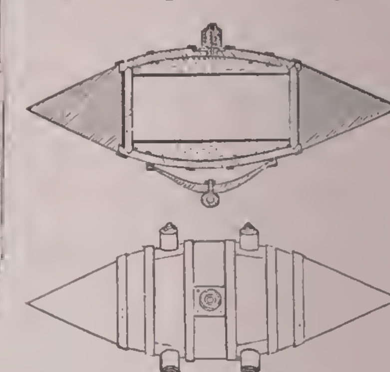


FIG. 5.—Barrel-torpedo.

moisture by a lead cap easily crushed by contact, were used in his barrel-torpedoes. These torpedoes contained from 70 to 120 lb. of gunpowder, conical ends of light wood being added to increase flotation and to strengthen the case. The Rains fuze served its purpose well, and was used in land-mines, in hand-grenades, and in several types of torpedoes. Lastly, electrical mines, to be fired by the act of an operator on shore, were employed; but the difficulty of procuring the requisite insulated cable restricted their use, and it is worthy of note that no attempt was made to make them automatic. The charges employed were usually enormous, amounting to 2,000 lb. of gunpowder. The Commodore Jones was destroyed on May 6, 1864, by a torpedo of this type. It was planted in a narrow part of the channel of James river, in about 35 feet of water, and was operated from a pit on the river-bank containing a small Bunsen battery. The Commodore Jones was allowed to advance safely over the mine, which was reserved for the flag-ship, but, the operator hearing the order given to return preparatory to a more thorough search for torpedoes, the vessel was blown up as she backed down stream. She appeared to be lifted bodily by the explosion, and was utterly destroyed, more than three-fourths of her crew being killed or wounded.

*Automatic Drifting Torpedoes.*—This class was especially designed for rivers where the current, setting in one direction, could be depended upon to sweep the apparatus down to the hostile fleet, and perchance to bring it into contact

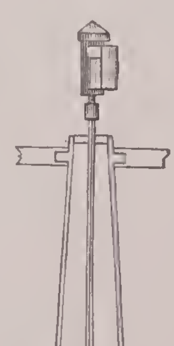


FIG. 6.—Drifting torpedo.

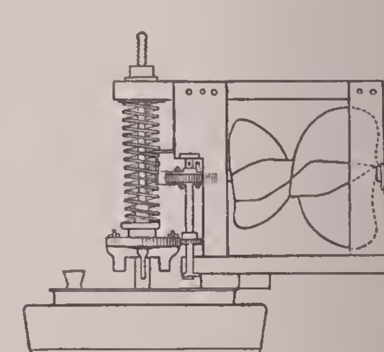


FIG. 7.—Current torpedo.

with some vessel. Night was often selected for the attempt, but the ease with which a ship at anchor may be protected by nettings rendered the several devices of little avail. The simple form shown in the figure was used in great numbers on the James river. A piece of slow-match was arranged to burn down the tube to the charge. These torpedoes were often caught by nets, but did no damage. A more complex arrangement is shown in Fig. 7. This torpedo was often set adrift, connected to a log by a knotted line, which, fouling the anchor-chain, would bring the former to rest under the bottom, when the current acting on the wheel would release the plunger and determine an explosion.

*Infernal Machines.*—This class of torpedoes is not generally considered to come within the limits of legitimate warfare as practiced at the present day, because it subjects non-combatants to great peril without any previous warning. It was designed to be smuggled on board the Union war-vessels or transports, and thus to effect their destruction. Two types were employed. The most simple was known as the coal-torpedo. It consisted of a metal case containing several pounds of gunpowder, cast and colored to resemble closely a lump of coal. When ignorantly thrown into the furnace it caused the explosion of the boiler. The Greyhound was destroyed in this manner on the James river, as were also several transports on the Western waters. The other type was known as the horological torpedo. It consisted of a case containing a large charge of gunpowder and a clockwork arrangement set to run for a certain time, at the expiration of which it released a plunger and fired the charge. A disastrous explosion was caused in the army powder-fleet at City Point in 1864 by an arrangement of this character which was placed on board one of the barges by a spy. At Mound City a similar explosion was effected.

*Offensive Spar-torpedoes.*—This form of the weapon afforded the best opportunity for the display of personal gallantry, and several officers won distinction in its use. An outrigger spar from 20 to 30 feet in length carried a torpedo designed to be brought in contact with the enemy's hull and exploded in a hand-to-hand conflict. The Confederates early supplied ram-torpedoes to their ironclad fleet, but a lighter pattern was chiefly used, operated from a special craft termed Davids, by reason of their small size and insignificant appearance as compared with their adversaries. The type used at Charleston was built of boiler iron and was about 35 feet long, shaped like a cigar, with a low combing to exclude the waves. Small engines driving screw-propellers gave a maximum speed of about 7 knots per hour. The torpedo was of copper, charged with about 50 lb. of fine gunpowder. Under cover of the night these boats approached the hostile fleet, trusting to suddenly dart alongside and discharge the torpedo with impunity in the confusion and alarm created by their sudden appearance. Another type of this class of boats consisted of an ordinary steam-launch equipped in a similar manner. Several of the Union war-vessels—the New Ironsides on Oct. 5, 1863, the Memphis on Mar. 6, 1864, the Minnesota on Apr. 8, 1864, and the Wabash on Apr. 18, 1864—narrowly escaped destruction, and the Confederate ironclad Albemarle was sunk at her moorings by this mode of attack. The latter feat was performed by Lieut. Cushing, U. S. navy, and for its exceptional gallantry it deserves a special description. The boat was an ordinary steam-launch equipped with a Wood and Lay torpedo and a brass howitzer. This torpedo was provided with an air-chamber, and at the proper moment was to be detached from its boom and allowed to rise under the enemy. A strong pull upon the lanyard then released the ball, which, falling on the percussion-cap, ignited the charge. Lieut. Cushing, with a crew of thirteen officers and men, advanced 8 miles up the Roanoke river, passing the Confederate pickets undiscovered. On approaching the Albemarle, moored to the wharf and protected by a pen of logs about 30 feet from her side, he suddenly darted upon her, and under a heavy fire exploded his torpedo against her bottom, thus sinking her. Most of his party were captured and some were drowned; Lieut. Cushing himself and one man escaped by swimming and threading the swamps to the Union lines.

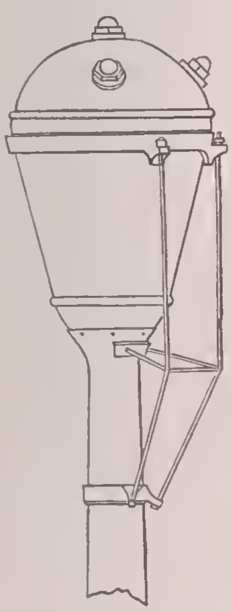


FIG. 8.—Spar-torpedo.

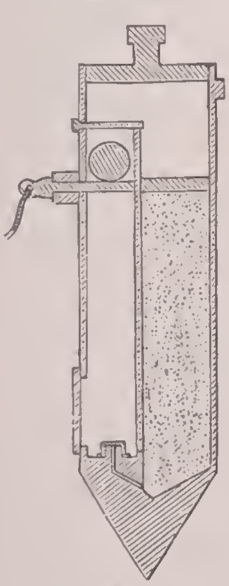


FIG. 9.—Wood and Lay torpedo.

The Schleswig-Holstein war of 1864, although short, afforded an opportunity for employing defensive mines, and one of the invading vessels was sunk through their agency. The Paraguayan war of 1864–68 furnished the next occasion for submarine warfare. Immediately after the Brazilian fleet entered the waters of that state a fine ironclad, the Rio de Janeiro, was sunk by two torpedoes against which she had struck. Subsequently a division of the fleet ran past the batteries of Curupaity, only to find itself entrapped between two lines of torpedoes, one in front and the other planted in rear, after the passage, to bar the retreat; the defective nature of these obstructions alone prevented a serious disaster. Later in the war the Tamandaré was crippled by a submarine mine. The Paraguayan torpedoes belonged to the anchored or drifting class, and the sulphuric-acid fuze was largely used. In the war between Austria and Italy in 1866 the harbors of Venice, Pola, and Lissa were obstructed by mines—the latter after the attack by the Italian fleet. No hostile trial of their efficiency was made. During the Franco-German war of 1870–71 no conspicuous use was made of torpedoes, but the German ports were protected by them, and the French contributed a new device to the list. It is known by the name of the "ball of Verdun," devised by Capt. Bussière, of the engineers, to destroy a military trestle-bridge thrown by the Germans over the Meuse a short distance below the fortress. It consisted of a large sheet-iron sphere over 3 feet in diameter, heavily charged with gunpowder and provided with a clockwork train, which after a certain time was to discharge a pistol and thus ignite the mine. It was but little heavier than water, and was carefully adjusted so as to make the center of figure and of gravity coincident. A body fulfilling these conditions will be rolled along the deepest part of the channel by the current, and will, of course, be far more difficult of detection than a floating object. The capitulation of the fortress prevented a trial of its efficiency, but many letters were introduced into Paris during the siege by similar balls caught by nets spread for the purpose. In the Russo-Turkish war of 1877–78 the Russians made decisive use of torpedoes. Through their agency the armored fleet on the Danube was held in check without the aid of a single Russian war-ship, and successful invasion was rendered possible. The channel was obstructed by mines at strategic points, and an attack with spar-torpedoes upon the fleet where it had taken refuge in the Matchin branch resulted in sinking the monitor Duba Saife and so completely demoralizing the Turks that no further attempt was made to defend the river. For this gallant exploit the names of Lieuts. Dubasoff and Chestakoff will remain associated with that of Cushing. The Russian ports on the Black Sea were defended against an overwhelming superiority in naval power, directed by Hobart Pasha, through the moral influence of their submarine defenses. A Turkish gunboat, the Suna, was sunk by a contact-mine at the Sulina mouth of the Danube. Eight attacks were made by the Russians, use being made of spar, Harvey, and Whitehead torpedoes. Two of them were successful. In one a steamer was sunk at Batoum on Jan. 25, 1878, by a Whitehead torpedo, the first triumph of the weapon on record. Two failures had preceded, one by the British cruiser Shah against the Peruvian Huascar on May 29, 1877, and the other by the Russians at Batoum on Dec. 20, 1877. In the war between Chili and Peru in 1880–81 both parties made use of torpedoes, but without noteworthy results, except perhaps to throw discredit on the Lay torpedo. During the Franco-Chinese hostilities in 1884–85 two naval vessels were sunk by the French with spar-torpedoes, proving that this weapon is not wholly superseded. During the Chilian revolution of 1891 several attempts were made with Whitehead torpedoes, one of which was successful in sinking the battle-ship Blanco Encalada and over 150 of the crew. During the war between Japan and China in 1894–95 submarine operations played only a subordinate part. At the battle of the Yalu, the Chinese fired four or five torpedoes ineffectively, while their adversaries appear to have made no attempt to use the weapon. At the attack on Wei-hai-wei, the Japanese torpedo flotilla entered the harbor on two successive nights, and succeeded in sinking three or four vessels, two of which were armored ships of war. No effective use of submarine mines is reported.

From the foregoing *résumé* it is apparent that torpedoes are no longer to be regarded as experimental devices, but that they have become recognized weapons of maritime warfare, admitting of very varied applications. They may be employed offensively in the combats between hostile vessels, or they may be used defensively to repel an apprehended attack upon a harbor or district by preventing the passage of the enemy's squadron through the channel of approach. Entirely different principles of construction and of manipulation mark these two classes of the weapon. The former requires the technical skill of a sailor to move the charge into position and explode it within destructive range. The latter differs in no essential respect from the mines so long employed in the defense of land fortifications. Accordingly, in Great Britain, the U. S., and some other countries possessing an extended seacoast, the service of torpedoes has been divided between the navy and the engineers of the army—the former operating offensively afloat, and the latter defensively from the shore. The U. S. naval war college is at Newport, R. I., where the needful investigations are conducted, and where classes of officers receive regular instruction in the use of the new weapons. The naval torpedo station also is at Newport, but at this instruction is given to seamen qualifying for the grade of seaman-gunner only. The army school is at Willets Point, New York harbor, where the subject is experimentally studied, and where the officers and the enlisted men of the engineers are exercised in all the duties of defensive submarine mining. While in general the line of demarkation between the two services is thus plainly marked, some of the weapons—such, for example, as fish-torpedoes steered by electricity—may be conveniently operated either from land or from shipboard, and they would be used in war either by army or navy as occasion might offer.

*Offensive Torpedoes.*—In offensive torpedo warfare many devices have been proposed from time to time, and subjected to systematic trial by naval officers. The Harvey torpedo belongs to this type. The charge is contained in a narrow copper vessel, encased in wood strapped with iron, and so ballasted as to ride vertically in the water. A towline of wire rope passes from the slings of the torpedo through a block on the yard of a fast steamer to a reel fitted with a brake on her deck. The enemy is passed at full speed, with the torpedo diverging at an angle of about 45° from the quarter, and the course is so directed as to bring the weapon in contact with his hull. Just before striking him the torpedo is made to dive by suddenly slacking the tow-line, and then to rise under his bottom by checking it with the brake. Explosion is effected through the agency of the projecting levers, which when struck either detonate a contact fuze or close an electric circuit, and thus cause the passage of a powerful current through a platinum fuze. These torpedoes are made of various sizes, one of the largest patterns being 4·5 feet long, 2 feet deep, and 6 inches wide, designed to contain 100 lb. of guncotton or dynamite. The requisite flotation is given by the cork buoys, *a a'*, as when at rest the torpedo sinks by its own weight. This weapon was devised by a skillful sailor, Capt. Harvey, of the Royal Navy, and he claims that it can be successfully used on the high seas even during a gale; but although formerly adopted by several European nations and highly commended, it failed in the Russo-Turkish war (1877–78) and has passed out of use.

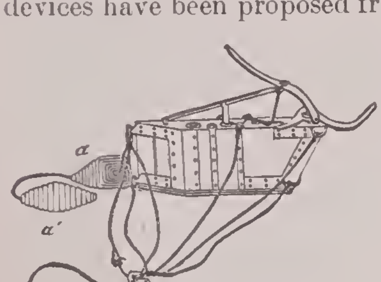


Fig. 10.—Harvey torpedo.

A more successful type of offensive torpedo is that known as the Whitehead. The idea developed by this weapon is due to an officer of the Austrian marine artillery, but the first practical trials were made in 1864 by Robert Whitehead, superintendent of iron-works at Fiume, acting upon the suggestions of Capt. Lupis, an officer of the Austrian navy. The torpedo has undergone great improvements between that date and the present time, and the right to use it has been purchased by the U. S. and by most European nations. The latest type consists of an iron and steel vessel in the shape of a spindle of revolution. It is driven by a propeller moved by compressed air. The 18-inch pattern adopted by Austria is claimed to have a speed of 32 or 33 knots for a run of 437 yards, and of 30 knots for one of 875 yards. The latest British pattern carries a charge of 250 lb. of guncotton of 12 per cent. moisture, with a 16-oz. detonator of dry guncotton. The torpedo can be projected from a launching-tube or started by hand, and is capable of regulating and preserving its depth and direction, within narrow limits, in still water; but cross-currents or seaweed may introduce large variations. It can be set to explode on contact or after a definite time, and either to sink or rise to the surface after finishing its course. The Schwartzkopff torpedo is essentially a Whitehead encased in phosphor-bronze instead of steel. The Howell torpedo, devised by a U. S. naval officer, and patented in 1871, has been slowly developed until it has become a formidable rival of the Whitehead, from which it differs chiefly in motive power. This is derived from the rapid revolution of a heavy fly-wheel transmitted to the propeller shafts by beveled gearing. A speed of 22 knots and, what is more important, an inherent directive force giving great precision of fire are claimed. The U. S. Naval Department has purchased several Howell torpedoes for service, as well as Whiteheads.

Submarine rockets, carrying explosive charges and started from submarine guns, have received and are receiving attention, both in the U. S. and in Europe. Such a weapon, if its course can be successfully controlled, will be especially dangerous in the combats of ironclad vessels at short range, since the blow, being delivered under the armor, can not fail to achieve decisive results.

The fish-torpedo steered and controlled by electricity was first patented by Lieut.-Col. Ballard, Royal Engineers, in Aug., 1870, and again by Lieut.-Col. Foster, U. S. Engineers, in 1872. It has been independently elaborated by Mr. Lay and H. J. Smith in the U. S., and by Col. von Schelīha in Russia. The claim to priority in the invention has been the subject of litigation; but the decision of the commissioner of patents (June 13, 1873) has awarded it to Mr. Lay, whose boat has also been brought most conspicuously before the public. This type of torpedo consists essentially of a boat of the Whitehead class, which carries and unreels a coil of insulated wire through which the electric current from a battery on shore or on shipboard can be passed at will to certain electro-magnets. By closing and breaking the circuit, and reversing the direction of the current, valves connected with the motive power are controlled, and thus the rudder may be put to starboard or port, and the engine may be started or stopped. In this manner the motion of the fish is under perfect control from the instant of starting. The motive power may consist of liquefied carbonic acid, or ammonia, or compressed air, or steam peculiarly applied. The boat may be made to move at the surface or below it. Her position is known to the operator from two small flags carried near the water-level, which at night are replaced by two lanterns shaded in front so as not to be seen by the enemy. Any of the modern explosives may be employed, and detonation results from the action of a mechanical fuse or of a circuit-closer and battery. The Lay torpedo proper has been superseded by later patterns; it was a surface boat driven by liquefied carbonic acid. Exposure to projectiles and freezing of the motive power during expansion were among its inherent defects. They have been obviated in its successors, the Wood-Haight and the Patrick, by submerging the torpedo under an unsinkable float and by heating the carbonic acid during the run with sulphuric acid and lime placed around the pipes. A mile has been traversed in an official trial at a speed of 19 miles per hour. A controllable torpedo was proposed by Capt. Ericsson, who supplied his motive power to the engine by a flexible tube drawn after the boat. This motive power was compressed air generated by an engine near the operator; and by regulating the supply the boat was steered without the aid of electricity. A movable torpedo invented by Mr. Sims has been developed at Willets Point since 1879. All parts vulnerable to machine-guns are submerged. It is moved and controlled by electricity conveyed by a cable from a dynamo on shore to an electric motor on board. The charge is 400 lb. of explosive gelatin. The boat, carrying 11,000 feet of cable, had attained in 1885 a speed of about 10 miles an hour in a run of 2 miles, the turning radius not exceeding 300 feet. This was accomplished with a difference of potential at the poles of the dynamo under 350 volts, and a current under 35 amperes. In 1886 Mr. Edison became associated with Mr. Sims in the invention. A new experimental boat was prepared carrying 6,000 feet of cable, and with improved electrical conditions (1,200 volts and 30 amperes). With this torpedo a speed of about 19 miles an hour for a short run has been obtained; but that these conditions do not overstrain the insulation resistance of any cable the boat can carry has not been proven. The full range of 11,000 feet is regarded as essential in a torpedo suited for defending the harbors of the U. S. The Brennan torpedo has been developed by the Royal Engineers at Chatham, and has been adopted by the British Government. The motive power is supplied by unreeling piano-wire from two drums on board to two drums on shore, the latter driven by a steam-engine of 100 horse-power. A speed of 20 miles an hour, a range of 1·5 miles, and limited lateral control are claimed. The depth of submergence is regulated by a modified Whitehead device, and the position is known from a single steel mast. The charge is 200 lb. The torpedo is operated from an elevated site with the wire in air. Among other experimental torpedoes of this class may be named the Victoria, the Berdan, and the Halpine. The proper field of this weapon appears to be the protection of mine-fields, through which it can pass without doing injury. To a counterminer their anticipated attack would be disheartening. The complexity inherent in their construction, and the consequent large percentage of failures in their attempted runs, have heretofore militated strongly against their adoption in actual service.

*Defensive Torpedoes.*—To understand the full importance of the submarine mine in defending the great seaports of the U. S. against hostile fleets, it is necessary to consider the changes in ships of war which immediately preceded its introduction. Before the invention of the screw-propeller, vessels in attacking forts were at the mercy of winds and currents; and long experience proved that one gun ashore was more effective than many afloat. Moreover, since stone walls were more resisting to shot and shell than bulwarks of oak, the rule introduced into land defense soon after the invention of gunpowder, that no masonry must be exposed to a direct fire of artillery, could be ignored in water-batteries, thus rendering it easy to mass the guns and provide a heavy fire against hostile shipping, even where the site was restricted. The screw-propeller, followed shortly after by armor-plating and big guns afloat, effected a radical change in the conditions of the problem. The fleet was now free to steam rapidly past the batteries under favorable conditions not before practicable. The class of guns required to assail the armor-plating with a reasonable chance of success was far more bulky and difficult to manœuver than the former armament of the forts; moreover, it was considered that earthen parapets and substantial traverses must take the place of the compact masonry casemates heretofore in use. The defense thus found itself at great disadvantage. The hostile ships of war, more under control, less vulnerable, and possessed of much higher speed, were to be encountered by guns more unwieldy, and, in most of the harbors, much fewer in number from the naturally contracted sites available for the earthen batteries. The attention of military engineers was thus urgently directed to the devising of some obstruction which, by holding the enemy under fire and depriving him of the comparative immunity resulting from a high rate of speed, should restore to the defense its lost superiority. The modern submarine mine has accomplished this vitally important object. Evidently, if through its influence the guns can be fired 100 times at a slowly moving ship, instead of once at a rapidly passing enemy, the effective power of the battery is multiplied more than 100 times. Independently, therefore, of its own destructive power, the defensive torpedo has become an essential auxiliary of the land gun. Indeed, they are inseparable in a judicious system of harbor defense, for, while the former is necessary to developing the full power of the latter, the latter is no less essential in protecting the former against the operations of the enemy; for it is an admitted principle that electrical submarine mines can not defend themselves without the aid of flanking guns to keep off boats, and of a fort secure against assault wherein to place the necessary batteries and operating apparatus. The trifling expense and superior power of this combination as compared with monitors for harbor defense has effectually disposed of the latter, which at one time were popularly believed to be the only dependence in the future for protecting the great seaboard cities of the U. S. against the dangers of a bombardment. They are now reduced to the grade of a useful auxiliary reserve force, which should not be neglected in a few of the large harbors. The navy is thus released from an irksome confinement to a defensive warfare in ports, and is free to strike effective blows where the enemy may be most vulnerable to attack, and where he will fear something more than a simple repulse as the result of an unfortunate naval action.

Some of the more important of the recent improvements in submarine mining are the following: The modern explosives (see EXPLOSIVES) have largely superseded gunpowder, because greater power with less bulk may thus be secured. The latter is an important matter, since upon the size of the torpedo depends the depressing effect of the current, and hence the amount of buoyancy necessary to keep the case always high enough to be touched by the enemy in passing. This buoyancy of course regulates the weight of the anchors and the size of the mooring connections, and, in fact, the principal dimensions of the system. The increase in intensity of explosive action is also important, for efforts are being made to give increased strength to the hulls of war-vessels by employing iron in the form known as the double-cellular bottom, thus reducing the destructive range of the torpedo, and exacting the employment of more powerful charges. In England experiments upon the Oberon, a vessel of this type, have shown that the horizontal destructive range of guncotton in charges even as large as 500 lb. is restricted to a few feet. This charge was fired on the bottom in 48 feet of water at horizontal distances from the ship of 100, 80, 60, 50, and 30 feet, and finally vertically under her side. Although she was much shaken and injured by some of these shots, only the last burst through the double bottom and sunk the vessel. At the engineer school of defensive submarine mining at Willets Point, N. Y., a long series of trials has been conducted to determine the effective range of different charges of various explosives sunk at different depths below the surface; and by the careful measurements of several hundred explosions the matter has been successfully brought within the scope of mathematical analysis. The formulas and results have been made public, and they confirm the fact of restricted destructive range.

Electricity is now chiefly used as the igniting agent in submarine warfare, because this enables the obstructed channels to be safely traversed by friendly vessels. The mines are usually arranged to be fired at will, or automatically by the touch of the vessel. By the use of proper fuzes (see FUZE) ignition may be effected with certainty. To cause the explosion to occur automatically by the touch of the vessel, a device called a circuit-closer or circuit-breaker, according to the circuit chosen, is employed. Many ingenious devices have been proposed. Even for contact-mines unconnected with the shore, and hence under no control, electricity is now available for ignition; and its use largely reduces the danger of handling and planting the mines. A small battery is placed in the torpedo or in a hollow anchor under it, and its circuit is closed by the enemy.

In the matter of torpedo cases, experience has shown that metal, usually steel, must be employed where the mines are to remain submerged for long periods. Wood in such cases can not be trusted to exclude water, although lager-beer kegs supply a good temporary expedient. It is an essential condition that the form shall be symmetrical, in order to reduce the tendency to rotary motion to a minimum. Wire rope is found to supply the best moorings. The electric current is conveyed by armored cable, not unlike that employed for the Atlantic telegraphs. To avoid a multiplicity of cables, as well as to reduce cost, several different cores are often united in a bundle and included in a common armor.

While the details of the system of submarine mines in use in the U. S., as elaborated by the writer at Willets Point, are not made public, its general features were exhibited at the Centennial Exhibition at Philadelphia in 1876, and are as follows: Two types of electrical mine are in use, the ground and the buoyant. The former is employed in comparatively shallow water, and consists of a case resting upon the bottom and containing a large charge of dynamite. Floating near it, but so far below the water-surface as to be concealed from view, is a buoy carrying a circuit-closer to regulate the current through a fuze imbedded in the former. The buoyant mine is designed for use in deep water, and consists of an anchor holding in position a torpedo floating just below the surface; the latter contains the charge of dynamite, the fuze, and the circuit-closer. If desired, the latter may be carried by a separate buoy so placed that when touched by outriggers or other torpedo-catchers, the mine will be directly under the vessel. The channel to be defended is thickly studded by lines of these mines, so arranged with respect to each other that no vessel can pass without coming in contact with one or more of them. Single-conductor electric cables running from each mine combine in multiple cables, and are extended through a subterranean gallery to a secure bombproof casemate within the fort, where is placed the apparatus by which, at the will of the operator, the mines may be fired by judgment, or be rendered either inert or automatically explosive when struck by a vessel. The system is arranged to permit easy electrical tests, by which any injury at once becomes known, as well as its nature and locus. Wires also extend from the casemate to flanking guns, so that if a boat succeeds by night in cutting a cable or in disturbing a mine, by so doing it draws upon itself a heavy automatic discharge of canister, grape, or shrapnel, according to its distance from the fort. Electric lights are arranged to sweep the lines of mines, and thus give additional security against hostile operations conducted under cover of the darkness. The casemate is connected by telegraph with a lookout, so that the whole system is under the perfect control of an officer who can see what is required, and instantly give the needful orders. For instance, a vessel might be chased by an enemy's cruiser. She could pass with absolute safety the mines, which for her pursuer would at once become deadly engines of destruction.

Detailed maps and plans for the torpedo defense of all the most important channels in the U. S. have been carefully prepared by the board of engineers for fortifications, and are on file in the engineer department at Washington. The casemates and galleries for the introduction of the cables have been actually constructed at several forts. Large stores of torpedo material are being accumulated at Willets Point, where engineer troops receive the training needful to prepare them, in case of sudden war with a maritime power, to plant and operate the defensive mines along the extended seaboard of the U. S. HENRY L. ABBOT.

**Torqua'tus**, TITUS MANLIUS: a member of the celebrated patrician family, the Manlian gens, of ancient Rome; received his surname TORQUATUS in 361 B. C. for slaying a gigantic warrior among the Gauls in single combat on the Anio, and ornamenting himself with the neck-chain (*torques*) of the fallen foe. He was several times consul and dictator, and finished the wars with the Latin League. During one of his campaigns he forbade all single combats. His son, nevertheless, fought with a Latin warrior and slew him, but when he returned to the camp and laid the spoils at the feet of his father, he ordered him to be punished with death: hence the expression, *Manliana imperia*, common in Latin literature.—Another member of the same family, LUCIUS MANLIUS TORQUATUS, was a conspicuous member of the Pompeian party in the civil war. He was prætor when the war broke out in 49 B. C., fought under Pompey at Dyrrachium, went to Africa after the battle of Pharsalia, and was taken prisoner and killed at Hippo Regius in 46 B. C. He was a friend of Cicero, and is introduced by him in his dialogue *De Finibus* as the advocate of the Epicurean philosophy. Revised by C. H. HASKINS.

**Tor'quay**: town; in Devonshire, England; on Tor Bay, an inlet of the English Channel, 23 miles S. of Exeter (see map of England, ref. 15–E). It contains St. John's church, a fine example of modern Gothic architecture, a town-hall, a museum, and a theater. On account of its equable climate, freedom from fogs, and beautiful scenery, it is much frequented as a health resort and watering-place. It has a good harbor, which is used as a yachting station. Pop. (1891) 25,534.

**Torque** [from Lat. *tor'ques*, a twisted neck-chain, deriv. of *torque're*, twist]: a twisted and bent rod, often of gold, worn as a personal ornament upon the neck by the ancient Celts and other rude races of the Old World.

**Torquema'da** (Lat. *Turrecrema'ta*), JUAN, de: cardinal; b. at Valladolid, Spain, in 1388; entered the Dominican order of friars in Valladolid 1403; was present at the Council of Constance 1417; afterward pursued the study of theology at the University of Paris, where he graduated 1424; became an instructor there; was successively prior of the Dominican convents at Valladolid and Toledo; was called to Rome by Pope Eugenius IV., by whom he was made master of the sacred palace 1431; was papal theologian at the Council of Basel, where he contributed to the condemnation of the doctrines of Wycliffe and Huss, and advocated the doctrine of the Immaculate Conception; participated in the same capacity in the Council of Florence 1439, where he drew up the project of union between the Greek and Latin Churches, for which he received from the pope the title of defender of the faith and the rank of cardinal; attended the Council of Bourges 1440; became Bishop of Palestrina 1455, and of Sabina 1464. D. in Rome, Sept. 26, 1468. He was the author of *Meditationes* (1467); *Expositio brevis et utilis super toto Psalterio* (1470), which were among the earliest productions of the press at Rome; *Quæstiones Spiritualis Convivii Delicias præferentes super Evangeliis* (1477); *Commentarii in Decretum Gratiani* (Lyons, 6 vols., 1519); of a treatise on the Church and the authority of the pope, on the body of Christ against the Bohemians, on penance, on the Council of Florence, on the Immaculate Conception, and other works. Revised by J. J. KEANE.

**Torquemada**, JUAN, de: historian; b. at Valladolid, Spain, about 1545. When a young man he went to Mexico, where he entered the Franciscan order; he became an adept in the Nahuatl language, was professor in the Tlaltelolco College, and from 1614 to 1617 was provincial. Torquemada is best known for his voluminous *Monarquía Indiana* (3 vols. folio, Seville, 1615; 2d ed., Madrid, 1723), which gives a vast amount of information on the Mexican Indians, their religion, laws, customs, traditions, etc. Much of this is valuable; but it is badly arranged, and is loaded down with irrelevant matter. He died in Mexico about 1625. H. H. S.

**Torquemada**, TOMAS, de: inquisitor-general; b. at Valladolid, Spain, about 1420; became a Dominican monk and prior of the monastery of Santa Cruz at Segovia; was appointed by Ferdinand and Isabella first inquisitor-general of Spain 1483; was confirmed in that post by Pope Innocent VIII. in 1487; labored with great vigor and success in organizing the Inquisition throughout Spain, especially at Seville, Cordova, Jaen, and Ciudad Real; drew up the code of procedure subsequently followed, and was influential in causing the expulsion of Jews and Moors from Spain. The number of persons burned during his administration has been greatly exaggerated by Llorente and others. Oscar Peschel and Gams have calculated that not more than 2,000 persons suffered that death in Spain from 1481 to 1524, and not all of those for religious motives. See Gams, *Kirchengeschichte Spaniens*, vol. iii., part ii., p. 72. Torquemada was as much a servant of the state as of the Spanish Church in his conduct as grand inquisitor, since the Spanish Inquisition was largely a civil and political institution. In his later years his authority was curtailed by the appointment of four colleagues by orders of Pope Alexander VI. D. at Avila, Sept. 16, 1498. Revised by J. J. KEANE.

**Tor're del Gre'co** [Ital., Tower of the Greek, the Greek's Tower]: town of Italy, province of Naples; on the eastern coast of the Bay of Naples, at the foot of Vesuvius, whose eruptions have destroyed it several times (see map of Italy, ref. 7–F). It was always rebuilt, however, and it is very celebrated for its wine and fruits; tunny, anchovy, sardine, and coral fishing are carried on with energy by the inhabitants. Pop. 21,580.

**Torre dell' Annunzia'ta** [Ital., Tower of the Annunciation]: town of Italy, province of Naples; at the foot of Vesuvius, 12½ miles S. E. of Naples (see map of Italy, ref. 7–F). It is chiefly noted for its thermal springs and its manufactures of arms. Pop. 20,000.

**Torrel'li**, ACHILLE: dramatist; b. in Naples, Italy, May 5, 1844; began early to write for the stage; was a volunteer in the Italian army in 1866; became director of the theater of San Carlo in Naples in 1878. His first piece, the comedy *Chi muore, giace*, was written when he was sixteen. It was followed by numerous more or less successful plays—*Il buon vecchio tempo*; *Cuore e corona*; *Prima di nascere* (1862); *Il precettore del re* (1863); *La missione della donna* (1864); *La verità* (1865); *Gli onesti* (1867); *I mariti* (1867); *La fragilità* (1868); *La moglie* (1870); *Nonna scelerata* (1870); *Il colore del tempo* (1875); *Triste realtà*; *Scrollina* (1880); and others. He has also published a collection of lyrical poems, which he styled *Schegge*. J. D. M. FORD.

**Tor'rens**, ROBERT: economist; b. in Ireland in 1780; became major-general in India; was for some years a member of Parliament, where he was a vigorous supporter of the Reform Bill, and acquired note as a political economist. His theories had great influence on the statesmen of his time. His views on the corn-laws were finally adopted by Sir Robert Peel and his supporters. D. May 27, 1864. Among his numerous treatises were an *Essay on Money and Paper Currency* (1812); *Essay on the External Corn-trade* (1815); *Essay on the Production of Wealth* (1821); *The Budget, a*

*Series of Letters on Financial, Commercial, and Colonial Policy* (1841–43); *Tracts on Finance and Trade* (1852), and several single *Letters* on similar subjects addressed to prominent statesmen. F. M. COLBY.

**Torrens**, WILLIAM TORRENS MCCULLAGH: statesman and author; b. at Greenfield, County Dublin, Ireland, in Oct., 1813; son of James McCullagh; graduated at Trinity College, Dublin, 1834; sat in Parliament for Dundalk as an advanced Liberal 1848–52; was elected from Yarmouth Mar., 1857, but was unseated on petition; was returned for Finsbury in July, 1865, and sat for that borough in four consecutive parliaments; was prominent during the American civil war as an advocate of the Union cause; aided Disraeli in 1867 to carry his Household Suffrage Bill, to which he procured the addition of the lodger franchise; introduced in 1868 the Artisans' Dwellings Bill, which was carried after protracted debates; obtained in 1869 an important reform in the management of pauper children by the poor-law guardians in London, and secured in 1870 the adoption of the Extradition Act, and in the same year proposed the creation of the London school board. He assumed in 1863 his mother's name, Torrens. D. in London, Apr. 26, 1894. He was the author of *The Use and Study of History* (Dublin, 1841); *The Industrial History of Free Nations* (2 vols., 1846); *Memoirs of Richard Lalor Sheil, with Anecdotes of Contemporaries* (2 vols., 1855); *Life and Times of Sir James Graham, Bart.* (2 vols., 1863); *The Lancashire Lesson* (1864); and *Our Empire in Asia: how we came by it* (1872).

**Torrens System**: See the Appendix.

**Tor'res Strait**: the channel which separates New Guinea or Papua from Australia. It is 80 miles broad, but covered with islands and full of shoals and reefs, which make its navigation difficult. It was discovered by Torres in 1606.

**Torres Ve'dras**: a town in the province of Estremadura, Portugal; 26 miles N. of Lisbon (see map of Spain and Portugal, ref. 17–A). It is best known from the lines of defense constructed here by Wellington in 1810. These consisted, when completed, of 152 distinct works, arranged in three lines, and extended from the Tagus to the sea. They were provided with an armament of 534 pieces of ordnance, and their garrisons were calculated at 34,125 men. The allied army fell back and entered their line Oct., 1810, holding the invading forces at bay till Mar., 1811, when the latter retired discomfited.

**Torrey**, JOHN, M. D., LL. D.: botanist; b. in New York, Aug. 15, 1796; graduated in medicine in College of Physicians and Surgeons, New York, 1818; was Professor of Chemistry, Geology, and Mineralogy in the Military Academy, West Point, 1824–27, of Chemistry and Botany in the College of Physicians and Surgeons 1827–55, and of Chemistry and Natural History in the College of New Jersey 1830–54; was U. S. assayer in New York 1853–73; was one of the founders of the New York Lyceum of Natural History, of which he was for many years president, and at the request of which he prepared, as early as 1817, while still a medical student, a *Catalogue of Plants growing spontaneously within Thirty Miles of the City of New York* (Albany, 1819); published vol. i. of a *Flora of the Northern and Middle States* (New York, 1824), and a *Compendium* of the same (1826); was appointed botanist of the geological survey of New York 1836; published a monograph on the *Cyperaceæ of North America* (1836); began in 1838, in connection with Dr. Asa Gray, the publication in numbers of a *Flora of North America*, which had reached the close of the great natural order *Compositæ* when in 1843 the vast accumulation of materials compelled its suspension; published the *Flora of the State of New York* (2 vols., 1843–44), forming vols. vi. and vii. of the *Natural History* of that State; edited Dr. L. D. de Schweinitz's *Monograph of the North American Species of the Genus Carex* (New York, 1825), and Dr. John Lindley's *Introduction to the Natural System of Botany* (New York, 1831), to which he added an *Appendix*; from 1822 to 1858 he edited most of the numerous reports of U. S. surveying and exploring expeditions; was an original member of the National Academy of Sciences and a founder of the Torrey Botanical Club; was a frequent contributor to periodicals and the proceedings of learned societies; was many years a trustee of Columbia College, to which he presented his valuable herbarium and botanical library. D. in New York, Mar. 10, 1873.

**Torrey**, JOSEPH, D. D.: educator; b. at Rowley, Mass., Feb. 2, 1797; graduated at Dartmouth College in 1816, and at Andover 1819; was pastor of a Congregational church at Royalton, Vt., 1819–27; Professor of Greek and Latin in the University of Vermont, Burlington, 1827–42; Professor of Intellectual and Moral Philosophy 1842–67; and president of the university 1863–65; author of a posthumous volume of lectures, *A Theory of Art* (1875); editor of the *Remains* (1843) of President James Marsh, and of the *Select Sermons* (1861) of President Worthington Smith, to both of which he prefixed *Memoirs*; and translator of Neander's *General History of the Christian Religion and Church* (Boston, 5 vols., 1854), accompanied by elaborate and scholarly notes. D. at Burlington, Nov. 26, 1867. Revised by S. M. JACKSON.

**Torrey'a** [Mod. Lat., named in honor of Dr. John Torrey, a botanist]: a genus of trees of the order *Coniferæ*, allied to the yews (family *Taxaceæ*). *T. californica* is a fine ornamental species; *T. taxifolia* of Florida has a durable, strong-

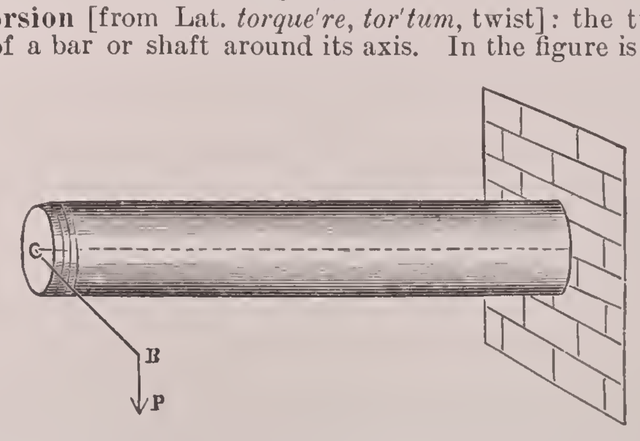
*Torreya taxifolia*: Leaves half the natural size; staminate and pistillate aments enlarged; fruit and a section reduced.

scented, heavy, and close-grained wood and horizontal, whorled branches. It sometimes attains a height of 50 feet. Eastern Asia has several species. *T. myristica* has a useful timber. The seeds of *T. nucifera* afford an oil used in cooking food. When burned the leaves and wood of the torreyas give off a powerful and disagreeable smell. Revised by CHARLES E. BESSEY.

**Torricelli**, tor-rēe-chel'lēe, EVANGELISTA: physicist; b. at Faenza, Italy, Oct. 15, 1608; studied mathematics and physics in Rome under Castelli, and in Florence under Galileo, whom he succeeded in 1642 as professor at the Academy. D. in Florence, Oct. 25, 1647. In 1644 he published his *Opera Geometrica*. His most remarkable discovery is that of the barometer, sometimes called the Torricellian tube.

**Torrington**: town; Litchfield co., Conn.; on the Naugatuck river, and the N. Y., N. H. and Hart. Railroad; 20 miles N. of Waterbury (for location, see map of Connecticut, ref. 8–E). It has 8 churches, 20 public schools, high school, public library, Y. M. C. A. building, a private and a savings bank, a daily and a weekly newspaper, extensive brass-works, and manufactories of hardware, sewing-machine needles, bicycles, and woolen goods. It was incorporated in 1740 and made a borough in 1887, and is celebrated as the birthplace of John Brown, the abolitionist, and of Samuel Mills, the pioneer of American missions. Pop. (1880) 3,327; (1890) 6,048; (1900) 12,453, borough 8,360.

**Torsion** [from Lat. *torque're, tor'tum*, twist]: the twisting of a bar or shaft around its axis. In the figure is seen




a horizontal bar with one end rigidly fixed in a wall and the other subject to a vertical force, $P$, acting with a lever arm,

$BC$. The product $P \times BC$ is the twisting moment whose tendency is to cause all horizontal lines on the surface of the bar to assume a spiral form. This moment is resisted by the sum of the moments of the internal shearing stresses which exist in any cross-section. If the bar be circular and of a diameter $d$, and if $S$ be the shearing unit-stress at the circumference, then

$$P \times BC = \frac{\pi d^3 S}{16},$$

which is the fundamental formula for the discussion of round solid shafts.

The most common investigation is that of the transmission of power by shafts. If $H$ be the number of horse-powers transmitted and $n$ the number of revolutions per minute, the unit-stress, $S$, for a round solid shaft is $321000 \frac{H}{n\,d^3}$, and the diameter required, $d$, is $68{\cdot}5 \sqrt[3]{\frac{H}{nS}}$, in which, for proper security, $S$ may be taken at about 2,500 lb. per square inch for cast iron, 5,000 for wrought iron, and 7,500 for ordinary steel.

Hollow forged steel shafts are coming into use for ocean steamers, their strength being greater than solid shafts of the same sectional area. If $D$ be the exterior and $d$ be the interior diameter, these may be investigated by the formula

$$S = 321000 \frac{DH}{n(D^4 - d^4)}.$$

For example, if $D = 17$ inches and $d = 11$ inches, and 16,000 horse-powers be transmitted at fifty revolutions a minute the value of $S$ will be found to be about 25,000 lb. per square inch, which is too high a value for ordinary steel, but which would be a safe unit-stress for nickel-steel.

Mansfield Merriman.

**Torsion Balance**: an apparatus for measuring delicate electrical or other attractions and repulsions. The attraction or repulsion is measured by the resistance offered to it by the torsion of a metal wire or a filament of spun glass, quartz, or other fiber. By this means Coulomb discovered the laws of electrical attraction and magnetic force, and Cavendish deduced a value of the density of the earth. See Earth (*Density and Mass*).

**Torsk**, or **Dorse** [*torsk* = Dan.: Icel. *þorskr*, codfish: Germ. *dorsch*]: a name applied to the cusk (*Brosmius brosme*), a food-fish of Northern Europe and the eastern coast of the U. S., and also to the Baltic cod (*Gadus callarias*), another food-fish of Northern Europe. They belong to the cod-family, and are eaten fresh, or more generally are salted and dried. The Pacific coast of the U. S. has another torsk, *Brosmophycis marginatus*. F. A. L.

**Tor′stensson**, Lennart: soldier; b. at Torstena, West Gothland, Sweden, Aug. 17, 1603; was educated as a page at the court of Gustavus Adolphus, whom he accompanied in 1630 to Germany; distinguished himself greatly as commander of the artillery in the battle on the Lech in 1632; was taken prisoner before Nuremberg Sept. 3, 1632, and kept for six months in a damp, subterranean dungeon in Ingolstadt by Maximilian of Bavaria; was appointed commander-in-chief of the Swedish army in Germany in 1641, but was compelled by the gout to resign his command in 1646; returned to Sweden; was made Count of Ortala by Queen Christina and governor-general of the province of West Gothland. D. at Stockholm, Apr. 7, 1651. See De Peyster's *Torstenson*, New York, 1886.

**Tort** [from Fr. *tort*, wrong < Late Lat. *tortum*, liter., neut. of *tor′tus*, twisted, crooked, perf. partic. of *torque′re*, twist]: in English law, such an unlawful invasion by one person of another's rights which are created by law as was remediable by a common-law action. A husband or a wife wrongs the other by marital unfaithfulness; a parent wrongs his minor child by unreasonable chastisement; but in neither case is a tort committed. Neither wrong could be remedied by a civil action at common law. The injured spouse might obtain a divorce; the parent might be prosecuted criminally. It is apparent, therefore, that procedure has played a part in fixing the limits of this branch of the law. Again, one who sells and delivers property to another upon the latter's promise to pay a fixed sum therefor at a fixed date has a right to the stipulated payment. The purchaser's refusal to pay, however, is not a tort, but a breach of contract; the right which is invaded was created by the agreement of the parties, and not by the law. One who unlawfully invades another's right to personal security, by Assault and Battery (*q. v.*), or by defamation (see Libel and Slander), or by a Nuisance (*q. v.*) to health, or his right to personal liberty by false imprisonment, or his right to private property, commits a tort. The rights which are interfered with in all these cases do not originate in any agreement to which the wrongdoer is a party, but are created by the law. His liability for the damage caused by his wrongdoing does not rest upon his consent, as in the case of a breach of contract. Nor, in English law, does it rest upon the moral quality of the act. The actor may be free from actual blame and yet be a tort-feasor. See Trespass.

In certain cases, the wrongdoer may be sued on contract or in tort, at the option of the injured party. This is true wherever the contract creates a relation out of which springs a legal duty independent of the contract obligation, as in the case of lawyer and client, of consignor and factor, of shipper and common carrier. The carrier who fails to deliver goods received by him may be sued either on the contract of shipment or in tort for breach of the common-law duty to carry safely and deliver. Acts or omissions of this class are sometimes called *quasi* torts. *Taylor* vs. *Manchester, etc., Ry.*, 11 *Times* Law Reports 27, A. D. 1894.

*Scotch law* employs the terms delicts and quasi delicts instead of torts and quasi torts. Those terms were defined by Lord Watson, in a recent case that went up to the House of Lords from Scotland, as follows: "Delicts proper embrace all breaches of the law which expose their perpetrator to criminal punishment. The term quasi delict is generally applied to any violation of the common or statute law which does not infer criminal consequences, and does not consist in the breach of any contract, express or implied. Cases may and do often occur in which it is exceedingly difficult to draw the line between delicts and quasi delicts. The latter class, as it has been developed in the course of the present century, covers a great variety of acts and omissions, ranging from deliberate breaches of the law, closely bordering upon crime, to breaches comparatively venial and involving no moral delinquency." (*Palmer* vs. *Wick Steam Shipping Co.*, 1894, Appeal Cases 318.) It is clear from this extract that delicts and quasi delicts are not synonymous with torts and quasi torts.

For a full discussion of the nature and classification of torts, the reader is referred to Holmes, *The Common Law*, Lectures 3 and 4; Markby, *Elements of Law*, chap. xvi.; Pollock, *Torts*, bk. i., ch. i.; Ringwood, *Outlines of the Law of Torts*, chap. i.; Wigmore, *Analysis of Tort Relations*, 8 *Harvard Law Review* 200, 377.

Francis M. Burdick.

European Law.—Among the private or civil actions of tort (*ex delicto*) given by the Roman law were actions for the recovery of penalty, actions for the recovery of penalty and damages (*actiones mixtæ*), and actions for the recovery of damages simply. Modern European law generally treats the prosecution of penalty as a matter of criminal law, and confines the action of tort to the recovery of damages. Many of the Roman actions of tort have therefore become criminal actions, and even where the prosecution is instituted only at the demand of the person injured the penalty goes to the state. See Libel and Slander (*History of Libel and Slander*).

It was the general rule of the Roman law that no one was liable for damages *ex delicto* unless wrongful intent (*dolus*) could be shown or inferred. Mere negligence (*culpa*) created no liability unless a duty of diligence had been assumed, and then damages were recovered on the contract, or *quasi ex contractu*, not on tort. In the case of damage to property, however, the *lex Aquilia* departed from the rule and imposed liability for damage occasioned by carelessness. Modern European legislations have generally extended the principle of the *lex Aquilia*, and impose liability for all injuries to the person or to property occasioned by negligence. (See *Code Napoléon*, § 1382, *et seq.*; Austrian Code, § 1295, *et seq.*; German Draft Code, § 704.) The recovery of damages is excluded when the injured person consented to the injury; when the person who inflicted the injury acted in self-defense, or under orders which he was legally bound to obey; also when he was doing what he had a right to do, and (according to some legislations) when he erroneously supposed that he was acting within his rights, provided the mistake was an excusable one. (The German Draft Code declares that a mistake of law may be excusable.) Insanity of course excludes liability; drunkenness does not. Infancy (which lasts until the completed seventh year) excludes liability; after that it is a question of the intelligence of the wrongdoer. For damage done by children and lunatics, their parents or guardians are responsible if by due surveillance they could have prevented the injury. For the torts of employees within the general scope of their employment the employer, at French law, is held to the same responsibility as a parent; it is incumbent on him to prove that he could not have prevented the injury. The German codes make the employer liable only when he has chosen unfit persons or has failed to exercise due superintendence. Analogous responsibilities are regularly imposed upon the owner for damage done by animals or things (defective buildings, machinery, etc.).

At Roman law, as at the English common law, the heirs of a person willfully or negligently killed had no claim for damages. The modern codes generally recognize such a claim, and treat the amount of damages as a question of fact. In place of a lump sum to be paid to persons who were dependent upon the deceased for their support, modern German legislation provides for an annuity, limited to the number of years during which support could legally have been claimed from the deceased, and to his expectancy of life at the time the fatal injury was received.

All actions for the recovery of actual damages descend to the heirs of the injured person and run against the heirs of the tort-feasor. The period of limitation is usually a short one; but when the tort-feasor is enriched by his tort, the quasi-contractual claim for the recovery of the unjust enrichment does not expire with the limitation of the action of tort.
MUNROE SMITH.

**Tortoise** [M. Eng. *tortuce*; cf. O. Fr. *tortis*, crooked, and *tortue*, tortoise < Vulg. Lat. *tortu'ca*, deriv. of *tor'tus*, twisted, crooked. So called from its crooked feet]: a name sometimes applied to any species of turtle, but more correctly restricted to those belonging to the family *Testudinidæ*, a group whose members are distinguished by their club feet, strictly terrestrial habits, and, as a rule, high, arched carapaces. There are something like fifty species of tortoises, inhabiting the warmer portions of the globe, the most remarkable being the large black species found on the Galapagos islands and Aldabra. Although of uniform color these vary in form and proportions, and belong to very distinct species of the genus *Testudo*. At least five species occur on the Galapagos, each confined to a particular island. The shell of some specimens measures over 4 feet in length, the animal weighing as much as 800 lb. They feed entirely on vegetables, are good eating, and yield an excellent oil. Tortoises of this kind formerly abounded in Mauritius and Reunion, but "they have been eaten off the face of the earth," and the same fate threatens the tortoise elsewhere. The GOPHER (*q. v.*) of the Southern and Southwestern U. S. is a true tortoise, but, as the name is more commonly applied to the pouched rat, care must be taken to specify that the gopher in question is a tortoise. There are three species, *Gopherus polyphemus*, *G. agassizii*, and *G. berlandieri*, the first named being the common Florida species.
F. A. LUCAS.

**Tortoise-plant**: another name for ELEPHANT'S FOOT (*q.v.*).

**Tortoise-shell**: the overlapping scales which cover the carapace of *Eretmochelys imbricata*, a large turtle found in the tropical Atlantic and Indian Oceans, and *E. squamata*, a similar species found in the Pacific. They are popularly known as hawk's-bill turtles. Tortoise-shell is remarkable for its plastic quality, which enables the artificer to give it almost any desired shape while under the influence of heat. Pieces of the shell may even be welded together, and the filings and chips are moulded and shaped as desired when heated to the proper temperature. Tortoise-shell is chiefly used for making combs, toilet articles, etc., and inlaying boxes. It is successfully imitated by artificial compounds, such as celluloid, of much less cost. It is customary in some regions to apply heat to the back of the living tortoise, and then remove the plates, but the crop of shell which replaces the first is thin and of inferior quality.
Revised by F. A. LUCAS.

**Torto'na** (Lat. *Dertona*): town; province of Alessandria, Italy; about 12 miles E. of the city of Alessandria, on a hill nearly 900 feet above the sea (see map of Italy, ref. 3–C). It was once strongly fortified, but its last defenses were destroyed in 1799 by Napoleon, after the battle of Marengo. The cathedral, dating from 1575, contains some valuable pictures. The principal industries are silk-reeling and tanning, and there is a local trade in grain and wine. Pop. about 7,150.

**Torto'sa**: an old, well-built, fortified and busy town in the province of Tarragona, Spain; on the Ebro; 40 miles by rail S. W. of Tarragona; in a fertile and well-cultivated district (see map of Spain, ref. 15–I). Its cathedral, occupying the site of a mosque built in 914, contains much carved work and marbles that are worthy of examination. Other public buildings, including the episcopal palace and town-hall, are commonplace. Tortosa has manufactures of paper, leather, soap, and pottery. Its fisheries constitute the most important industry. Pop. (1887) 25,192.

**Tortric'idæ**: a family of insects. See LEAF-ROLLERS.

**Tortricidæ** [Mod. Lat., named from *Tortrix* (*Tortric-*), the typical genus, liter., twister, from Lat. *torque're*, *tor'tum*, twist]: a family of serpents of the sub-order *Tortricina*. They are worm-like in appearance; have no constriction separating the head and trunk; the head is shielded above; the maxillary bones have alveolar ridges and teeth; the pupils of the eyes are round; the body is covered with smooth scales; the tail is short and conic, and there are rudiments of posterior extremities. The family has few species, and is mostly confined, and thus restricted, to South America, Southern Asia, and Australia. The typical species, *Tortrix scytale*, is sometimes known as the coral snake, but is not to be confounded with the *Elapidæ*, which are also frequently designated by the same name; it is a South American species. The Oriental species belong to the genus *Cylindrophis*, and are said to be viviparous. See Günther, *Ann. and Mag. Nat. Hist.*, vol. i., p. 428, 1868.
Revised by F. A. LUCAS.

**Tortu'ga** (Fr. *Tortue*): an island of the West Indies, N. of the northeastern extremity of Haiti, to which it belongs. Area, about 80 sq. miles. It is separated from the main island by the Tortuga or Tortue Channel, 5 miles wide; the surface is broken, but not very high. It was long the most noted resort and settlement of the buccaneers, where they established a rough form of government; eventually the French adventurers accepted a royal governor from their country; passing the channel they conquered and occupied the western part of Santo Domingo, now the republic of Haiti.
H. H. S.

**Tortugas**, Florida: See DRY TORTUGAS.

**Torture** [= Fr. < Lat. *tortu'ra*, a twisting, a wrenching, racking, writhing, deriv. of *torque're*, *tor'tum*, twist]: the infliction of severe pain; specifically, the infliction of severe pain for the purpose of punishing or inflicting revenge, or for the purpose of extracting or forcing evidence or confessions in criminal or ecclesiastical trials. Torture for one purpose or another has been practiced during all ages and among all or nearly all peoples. Among savage races it is most commonly used either as a means of ORDEAL (*q. v.*) or as a means of inflicting revenge or punishment upon captured enemies. As a means of forcing religious conformity, the infliction of torture was carried to an almost incredible extent of cruelty in the later Middle Ages and down to the eighteenth century, especially in Southern Europe, where the INQUISITION (*q. v.*) was unchecked in its use.

*Judicial torture*, as it is called when administered by or under the direction of the courts of law during the trial of causes, has been chiefly directed to the purpose of compelling an accused person during his trial either to confess his crime, clear up contradictions in his previous testimony, disclose his accomplices, reveal other crimes of which he may have been guilty but has not been accused of, or to purge him of the disability of INFAMY (*q. v.*). Judicial torture is rarely used during that stage of a people's existence when ordeals are used, but has very commonly succeeded to the use of ordeals, judicial torture being essentially a product of civilization rather than barbarism.

Although torture is now no longer a part of the jurisprudence of any modern Christian nation, yet until about the end of the eighteenth century, it formed a recognized part of the jurisprudence of European nations, excepting Great Britain and Sweden, and the rules for its application were developed into a regular system as a part of the principles of jurisprudence.

Among the ancients it appears not to have been practiced among the Hindus, the Hebrews, or the Egyptians. Among the Greeks, however, the use of torture was thoroughly understood and permanently established; as a general rule no freeman could be tortured, but only slaves and those who were not members of the body politic of the state. There were various exceptions, as in the case of flagrant political offenses, and among the Rhodians the torture of free citizens was not forbidden.

The people acting as the supreme power, or a despot, could of course decree the torture of any one irrespective of privilege. The evidence of slaves, however, was inadmissible, except when given under torture, and either party to a controversy could demand the torture of his opponent's slaves. The principal modes of torture among the Greeks were the wheel, the rack, the sharp comb, the vault, into which the witness was thrust bent double, the burning tiles, the heavy hogskin whip, and the injection of vinegar into the nostrils.

In the Roman law, upon which the subsequent European systems which recognized torture as a part of their jurisprudence were based, the general principles governing the administration of torture were the same in the earlier days as those of Greece. In later times under the emperors, although nominally still restricted in use to slaves, except in certain specified cases, torture was in fact not infrequently applied to freemen contrary to law; and its use could be authorized in any case by order of the emperor, which power was freely used. There appears to have been no limit set upon the application of torture, but the extent to which it might be carried seems to have been in the discretion of the tribunal; and in Rome, as in Greece, its use was not restricted to criminal cases in respect of slaves, but they might be tortured in any case except for the purpose of testifying against their master. The modes of torture generally authorized by the Roman law were the rack, the scourge, fire in its various applications, and hooks for tearing the flesh.

The barbaric races of Europe with whom the Romans came into contact adopted more or less of the Roman practice of judicial torture; and the Visigoths established a system of torture which continued uninterrupted in Spain from the period of their settlement down to modern times, and their legislation on the subject has been to a great extent a model for other European nations. Generally, however, the use of torture was slow in replacing the barbaric systems of ordeal and sacramental compurgation, and it was not till the latter half of the thirteenth century that the first traces of legalized torture appeared in France, and in Germany it was not used until the fifteenth century, its introduction being powerfully aided by the then increasing rigor and systematization of the Inquisition.

The influence of the Church during the Middle Ages upon the use of torture was to aid in its prevalence, and to add ingenuity in devising new cruelties to be inflicted upon the tortured, although in the earlier centuries St. Augustine, Gregory I., and Nicholas I. had denounced it, and its use had been forbidden. The Church, so far as it could, adopted the Roman law, and torture was inflicted mostly as a means of forcing religious conformity or extorting a confession of heresy. Originally the infliction of torture seems to have been left by the ecclesiastical tribunals to the ordinary civil tribunals, but later they exercised it themselves under a perfected system of rules which culminated in the INQUISITION (*q. v.*), and served as a basis and excuse for the wide extension of the use of torture in civil cases, and furnished innumerable varieties of new forms of torture of unspeakable cruelty. As a result of the interference of the Church the clergy were generally restricted from torture at the hands of the civil courts, the clergy in Catholic countries being specially favored, and the immunity obtained being practically about the same as that accorded to the nobility. In any case, however, the torture inflicted on the clergy by the civil tribunals was of a milder character than that inflicted upon laymen, and much more decisive proof was required before submitting them to torment. If clerical executioners could be had they had the privilege of demanding that they should be tortured only by them. Torture as administered even by the Church, however, was more cruel than the fair construction of the rules of the Church regulating the subject. Owing to the secrecy of its infliction, the helplessness of the accused to prosecute or punish illegal tortures inflicted, and the specious casuistry countenanced in the evasion of the rules, the extent to which torture was carried in any instance, and the cruelties inflicted, rested practically in the discretion of the judges or executioners. The rules themselves generally spoke of it as dangerous and uncertain, and depending largely for its results upon the question of physical strength. The rule that a confession made under torture could not be used against an accused, except it was afterward confirmed by voluntary confession, was in effect nullified by repetition of the torture upon a subsequent retraction of the confession until the tortured person finally yielded and gave the desired voluntary confession.

From the thirteenth century on the use of torture increased until it finally became established as a permanent part of the judicial machinery of European nations, excepting in England and Sweden. Although torture was never a part of the common law of England as a means of obtaining evidence, there is proof that it was practiced for that purpose under Henry VIII. and his children, and also during the reigns of James I. and Charles I., not only in political cases, but in the case of common crimes. Either with or without royal authority torture was in fact frequently inflicted, especially in the case of alleged witches, and why it did not become a recognized part of the jurisprudence there as well as elsewhere in Europe it is difficult to say. Sir James Fitzjames Stephen says: "Probably the extremely summary character of our early methods of trial, and the excessive severity of the punishment inflicted, had more to do with the matter than the generalities of Magna Charta or any special humanity of feeling."

In the British colonies the use of torture was never legally recognized, and only a few sporadic instances of its use occurred, such as the infliction of PEINE FORTE ET DURE (*q. v.*) upon Giles Cory, in Salem, Mass., in 1692.

Although the system of torture was recognized as a legal means for obtaining evidence for so many centuries, there was never any time when its cruelty was not generally recognized and its use justified as a measure deplorable but necessary for the protection of society; and, from the first until its abolishment, there were those among the foremost thinkers who not only denounced its cruelty, but exposed its uselessness and the utter unreliability of the testimony obtained by its use. Its extreme use and the horrors of its practice during the fourteenth to the eighteenth centuries finally led to a revulsion of feeling, and judicial torture was at length abandoned during the latter half of the eighteenth century, although in some countries it continued to be legally recognized and occasionally practiced, until the early part of the nineteenth century. It was swept away in Saxony in 1783, and about the same time in Switzerland and Austria; in Russia it was partly abolished in 1762, and finally in 1801; in Würtemberg it was abolished in 1806, in Bavaria in 1807, in France in 1789 (being temporarily restored in 1814), in Hanover in 1819, and in Baden in 1831. See Henry C. Lea's *Superstition and Force* (Philadelphia, 1870); Stephen's *History of the Criminal Law of England*; Jardine's *Reading on the Use of Torture in the Criminal Law of England, previously to the Commonwealth.*

F. STURGES ALLEN.

**Toru Dutt**: See DUTT, TORU.

**Torula Cerevisiæ**: the name first given to the yeast-plant. See FERMENTATION (*The Yeast-plant*).

**Tory** [from Ir. *toiridhe*, pursuer, searcher, plunderer]: a name applied to the Roman Catholic outlaws who lived in the bogs of Ireland during the reign of Charles II.; afterward extended (1679) to all those, whether English, Scotch, or Irish, who were opposed to the bill excluding the Duke of York from the succession. It was thus sought to imply Roman Catholic sympathies on the part of those who favored the duke's succession. Finally, the name came to designate the anti-Whig party in British politics; but as a formal designation it has been replaced by Conservative since 1830. In the war of the Revolution in the U. S. the loyalists were called Tories.

**Tosa-riu**: the name of a Japanese school of painting, which traces its origin to Fujiwara no Tsunetaka, a native of Tosa, who flourished about the year 1200 A. D. It is a branch of the native or Yamato school, and is the least of all affected by Chinese influences and the fullest of naïve conventions. It is historical in spirit, dealing with famous events in mythology and history, and picturing historic scenes, and was especially cultivated at Kioto. J. M. D.

**Tosti**, FRANCESCO PAOLO: song-composer; b. at Ortona, Italy, Apr. 9, 1846; studied, practiced, and taught music in Italy until 1875, when he first visited London; made annual visits until 1880, since which time he has remained there permanently. He has written very many popular songs in Italian, French, and English, his most popular one being *For Ever and for Ever.* D. E. H.

**Total Abstinence**: See ABSTINENCE, TOTAL.

**Totemism**: a system of beliefs, worship, and social obligations, found in savage communities in nearly every part of the world. The word *totem*, by some authorities spelled *ote*, possessive *otem*, by others *toodaim*, or *dodaim*, is from the Ojibway dialect, in which it signifies a family or tribe. As now used in ethnology it means a species or class of animals or plants, or, rarely, of inanimate objects, which is regarded by a horde, clan, or individual, with superstitious respect. A totem must be distinguished from a fetish, which is always an individual object. The savage believes that he is descended from his totem, and that it helps and protects him in all the affairs of life. As a rule, he will not injure, kill, or eat the totemic animal or plant. Even when the totem is a highly dangerous species, as one of the venomous snakes, or the scorpion, it is regarded without fear, and in this case men suspected of being untrue clansmen may be subjected to a practical test. If they survive the deadly bite of the totemic serpent their fidelity is established.

*The Clan Totem.*—Wherever totemism prevails it is associated with kinship and with tribal subdivisions. Clans are named from their respective totems and identified by rude images or symbols. The North American Indians E. of the Rocky Mountains commonly carved or painted totemic signs on their huts, or embroidered them on tents and blankets. (See *Totemism* under INDIANS OF NORTH AMERICA.) The Alaskan tribes carve them elaborately on the totem posts that guard their houses. In Australia and the Pacific islands tattooing and scarring are methods commonly employed. Not infrequently the totem is painted on the skin and then burned in. Most of the mutilations and adornments characteristic of savagery, such as the breaking of teeth and the wearing of feathers, horns, claws, and beaks, have intimate association with totemism. Sometimes the totem is a part only of the natural object, as among the Omahas, where the buffalo is subdivided into head, shoulder, side, tail, each being the totem of a sub-clan. These split totems, so called, indicate the subdivision of what was once a single clan.

*As a Religion.*—Dire penalties are supposed to follow any disrespect toward the totem. Some clans even avoid looking at their totem. The Elk clan of the Omahas believe that if any clansman were to touch the male elk he would break out in boils and white spots. The Red Maize sub-clan believe that if they were to eat the red maize they would have running sores around the mouth. The Samoans generally thought that death would follow any injury to the totem. So in Australia sickness and death were supposed to be the penalties for eating the totem. Everywhere the totem is worshiped and propitiated, and in many parts of the world, notably in Samoa, the dead totem is mourned for and buried like a dead clansman. Throughout North America, South America, and Africa totemism had become, before the invasion of the whites, an elaborate ceremonial religion, having its festivals, dances, processions, fasts, and mysteries, its medicine-men and priests, and its secret societies, carefully guarding the sacred tradition.

*Social Aspect of Totemism.*—Totemism is inseparably bound up with the social organization of savage communities. Marking the limitations of right and obligation, it is an essential factor in primitive law. Men and women owning the same totem must defend one another and redress one another's wrongs. Absolute prohibition of marriage between man and woman of the same totem is the rule. McLennan believed that the explanation of exogamy must be sought in totemism, but it is probable that totemism serves merely as a means of extending an exogamy previously initiated. (See SOCIOLOGY.) Yet we are not warranted in assuming that clan totems were the earliest totemic forms. Clansmen generally have their individual as well as their clan totems. The American Indian boy usually took as his guardian totem or "medicine," to protect him through life, the first animal of which he dreamed during the long and solitary fast observed on attaining maturity. But on the Isthmus of Tehuantepec when a child was expected the relatives drew on the floor figures of animals, one after another, and the one that remained when the infant was born became its totem. A somewhat similar custom prevailed in Samoa. It is probable that the development of clan totems out of individual totems was the first step in the evolution of the clan itself. See SOCIOLOGY.

Nothing is certainly known of the origin of totemism, and none of the theories that have been advanced has proved satisfactory. Herbert Spencer argues that plant and animal worship grew out of ghost-worship through a confusion of names. Tylor attaches chief importance to the habit of personifying all objects, which is characteristic of the child and of the primitive man. (See ANIMISM.) McLennan has suggested that imitations of animal forms and habits, and consequent nicknamings of neighboring hordes by each other, may afford an explanation. Perhaps in some combination of imitation with those dreams in which the savage imagines himself transformed into an animal is to be found the key to his belief that he and his totem are of one kin.

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**Tot'ila**: king of the Ostrogoths; chosen in 541 after the defeat and capture of Vitiges at Ravenna by Belisarius. He besieged and conquered Rome in 546, and extended and consolidated the Ostrogothic empire in Italy after the recall of Belisarius in 549, but was defeated and mortally wounded in the battle at Tagina by Narses in 552.

**Totipalmatæ**: See STEGANOPODES.

**Totis**, or **Dotis** (Hun. *Tata*): market-town; in the county of Komorn, Hungary; near the Danube; station of the Buda-pest-Bruck Railway (see map of Austria-Hungary, ref. 6-G). It consists of the town proper, of the upper town, and Tóváros; is situated on a great lake; has a fine castle belonging to the Esterházy family, a Piarist college with a classical gymnasium, and other schools, sulphur springs, rich marble-quarries, numerous mills, spirit-factories, a large sugar-factory, and a leather-factory. There are remains of an old castle inhabited by King Mathias Corvinus. Considerable forests, vineyards, and pastures are in the vicinity, which is rich in Roman antiquities, coins, urns, etc. The town was founded about 994. Pop. 10,290. HERMANN SCHOENFELD.

**Totonicapam'**: a town of Guatemala, 60 miles W. N. W. of Guatemala city; on the plateau near the foot of a high mountain (see map of Central America, ref. 3-D). It was a Quiché pueblo before the conquest, and here the tribe gathered to resist the march of Alvarado. Most of the inhabitants are Indians, and some of the better class claim descent from Quiché chiefs. Pop. 20,000. It is the capital of the department of Totonicapam, which has an area of 552 sq. miles and a population (1889) of 158,419. H. H. S.

**Totten**, JOSEPH GILBERT: military engineer; b. at New Haven, Conn., Aug. 23, 1788; graduated at the U. S. Military Academy July, 1805, and commissioned second lieutenant in the Corps of Engineers; aided his uncle, Jared Mansfield, in the survey of Ohio and the Western territories, resigning from the army 1806; returned to the army, and Feb. 23, 1808, was reappointed a second lieutenant of engineers, and was engaged on the construction of Castle Williams and Fort Clinton, New York harbor, 1808-12. At the beginning of the war with Great Britain, Totten (captain in his corps, July 31, 1812) was assigned to duty as chief engineer of the army under Gen. Van Rensselaer in the campaign of 1812, on the Niagara frontier. He was subsequently chief engineer of the army under the command of Gen. Dearborn, in the campaign of 1813, and of the army under Gens. Izard and Macomb in the campaign of 1814 on Lake Champlain; was breveted major June, 1813, and lieutenant-colonel Sept. 11, 1814; at the close of the war returned to duties in connection with the national coast defenses, and served chiefly at Newport, R. I., where he had charge of the construction of Fort Adams, and continued until Dec., 1838; advanced to the grade of lieutenant-colonel in 1828; appointed colonel of the Corps of Engineers and chief engineer Dec. 7, 1838, and took up his residence in Washington. Col. Totten assumed in 1847 the immediate control of the engineering operations of the army destined to invade Mexico, directing in this capacity the siege of Vera Cruz. For his services he was breveted a brigadier-general Mar. 29, 1847, then left the active army and resumed his station at Washington, but was appointed one of the commissioners for arranging the terms of capitulation. On Mar. 3, 1863, he was promoted brigadier-general and chief of engineers, and on Apr. 21, 1864, breveted major-general for long, faithful, and eminent services. During the whole time of his chief-engineership he labored indefatigably to bring the ports and harbors along the whole seaboard into a defensible condition. In addition to the manifold duties of his office, involving the inspection and supervision of the Military Academy, Gen. Totten was an active member of the lighthouse board from its organization in 1851; a regent of the Smithsonian Institution from its establishment in 1846; a corporator of the National Academy of Sciences, created in 1863, and one of the harbor commissioners for the cities of New York and Boston. In 1815 Totten modeled an embrasure for casemated batteries which remained unchanged until 1858, but the casemate continued a subject of study and experiment during most of his life, establishing his right to be considered the inventor of the American casemate, and led to the construction of the embrasure subsequently introduced into the U. S. seacoast forts, and known as the Totten embrasure. He published *Essays on Hydraulic and other Cements* (New York, 1842). D. in Washington, D. C., Apr. 22, 1864.

**Tottenville**: village; Westfield town, Richmond co., N. Y.; on Staten Island Sound, Raritan Bay, Prince's Bay, and the Staten Island Rap. Trans. Railroad; 20 miles S. W. of New York city (for location, see map of New York, ref. 8–A). It contains 4 churches, a graded public school, 2 weekly newspapers, manufactory of dental goods, a printing, electrotyping, and bookbinding establishment, saw and planing mill, ultramarine-factory, fire-brick and retort works, and several shipyards. Many New York business men live here. The village contains the Billopp mansion, built many years prior to the Revolutionary war, and in which Lord Howe had a conference with John Adams, Benjamin Franklin, and Edward Rutledge, a committee of Congress, concerning the possibility of a return of the colonies to British allegiance. Pop. (1894) 2,563. It is now a part of the Borough of Richmond, New York city.

**Toucan**: See RHAMPHASTIDÆ.

**Toucey**, ISAAC, LL. D.: jurist; b. at Newtown, Conn., Nov. 5, 1796; received a private classical education; was admitted to the bar 1818; representative in Congress 1835–39; States attorney for Hartford co., Conn., 1842–44; Governor 1846–47; U. S. Attorney-General 1848–49; U. S. Senator 1852–57; and Secretary of the Navy under President Buchanan 1857–61. D. at Hartford, July 30, 1869.

**Touch** [deriv. of the verb *touch*, from O. Fr. *tochier*, *toquer* (> Fr. *toucher*), from Teuton. **tukkon*, move suddenly > Germ. *zucken*, twitch, shrug, quiver, start]: the sense by which contact or pressure upon the surface of the body is perceived. Bell and Magendie established the distinction of motor and sensory nerves issuing from the anterior and posterior roots, on either side respectively of the spinal cord. Through these, from every part of the body, the sensory nerves, having received impressions at their bud-like, tactile ends, return impressions to the spinal axis and to the brain; the nerves of the head communicating directly. This power is developed to a variable degree upon different surfaces, the tactile sensibility of some, as the finger-tips and tongue, being very acute, other parts being relatively obtuse. The acuteness of touch is due in part to the number and distribution of nerve-fibers, in part to habitual education of the part. The part which has the most finely educated touch, the tips of the fingers, may be far less susceptible to pain, to heat and cold, or to tickling. The tactile sensibility of parts is measured by means of needle-points in arms movable upon a graduated bar—the instrument termed the "æsthesiometer." The shortest distance on the surface at which distinct perceptions of the two points are felt gives the diameter of the so-called "Weber's circles" of sensibility. From the experiments of Valentin the following will suffice to illustrate. The unit of measure is a line, one-twelfth of an inch:

| | |
|---|---|
| Tip of tongue | 0·483 of a line. |
| Palm of forefinger | 0·603 " |
| " " little finger | 0·733 " |
| Surface of lip | 1·500 " |
| " " eyelid | 3·833 " |
| Skin of cheek | 4·541 " |
| Forehead | 6·000 " |
| Back of hand | 6·966 " |
| Lower part of thigh | 10·208 " |
| Leg | 13·708 " |
| Middle of forearm | 17·083 " |
| " " back | 24·208 " |

The finger, tongue, toes, and other surfaces may be highly educated. Each artisan in his special line acquires wonderful tactile recognition of the kind and quality of fabrics, minute sizes, shapes, and relative smoothness of surfaces. The blind learn to read the raised alphabet, recognize persons by feeling their features, and manufacture various articles, many of delicate structure. In the sensitive tactile part at the finger-tip the touch-corpuscles, or nerve termini, are situated near the surface, constituting sensitive papillæ; as many as 108 have been found in one-fiftieth of a square inch. See HISTOLOGY and SENSATION.

Revised by J. MARK BALDWIN.

**Touch-paper**: a loose bibulous paper which is soaked in solution of saltpeter and then dried. It was used in lighting fires with flint and steel, and is sometimes burned in a room to relieve the paroxysm of asthma.

**Touchstone**: See JASPER.

**Touchwood**, or **Spunk**: (1) the dried fungus *Polyporus igniarius*, used in getting fire with flint and steel; also employed as a port-fire. (See AMADOU.) (2) Also the decayed and crumbling wood of the ash or willow which has undergone dry rot. It is used for the same purposes as the foregoing; and it is remarkable that close examination shows that such wood is always the seat of a growth of fungi much like that referred to above. All the varieties of spunk are much improved by wetting with solution of potassium nitrate or chloride and then drying. Spunk, although a native product of the U. S., is also imported from Europe. It is also called *punk*.

**Tougaloo' University**: an institution of learning at Tougaloo, Madison co., Miss., established by the American Missionary Association in 1869 and chartered by the State in 1871. It trains colored youth of both sexes, and has as its object the development of Christian character and of such intellectual and manual skill as shall enable young colored people to become efficient leaders in the uplifting of the Negro race. In the heart of a section called "the Black Belt," because of the density of the Negro population, it is admirably located to reach those for whom it is intended. It has ample grounds—a plantation of 500 acres—and plain and substantial buildings. From the first it has combined handwork with headwork. It has now college preparatory, normal, theological, grammar, agricultural, manual-training, nurse-training, and musical departments, with a model primary school as a practice school for the normal students. A strictly pedagogical course of two years is part of the normal work. The John F. Slater fund trustees have given Tougaloo $3,000 yearly for its normal and manual work. Until the adoption of the new State constitution in 1890 the normal department was in part supported by the State. The enrollment for 1894–95 was 379, with 23 instructors and officers. The school has no endowment, but is supported by the American Missionary Association.

FRANK G. WOODWORTH.

**Toul'min**, HARRY: jurist; son of Rev. Joshua Toulmin; b. at Taunton, England, in 1767; was several years a Dissenting minister at Chorobert, Lancashire; settled at Norfolk, Va., 1793; was president of Transylvania College 1794–96; secretary of State of Kentucky 1796–1804; was appointed judge of U. S. district court of Mississippi 1804; passed his later years in Alabama; assisted in framing the constitution of that State, and served in its Legislature. He was the author of *A Description of Kentucky* (1792); *Collection of the Acts of Kentucky* (Frankfort, 1802); *Magistrate's Assistant*, *A Digest of the Territorial Laws of Alabama* (Cahawba, 1823); and other publications, and aided James Blair in the preparation of his *Review of the Criminal Law of Kentucky* (1804). D. in Washington co., Ala., Nov. 11, 1823. Revised by F. STURGES ALLEN.

**Toulmin**, JOSHUA, D. D.: clergyman and author; b. in London, England, May 11, 1740; educated at St. Paul's school and at the Dissenting academy of Dr. S. M. Savage; was for some time minister of a Dissenting congregation at Colyton, Devonshire; became in 1765 pastor of a Baptist church at Taunton, where he also conducted the business of a bookseller; subsequently adopted Unitarian views; became prominent in their advocacy, and was pastor of Dr. Priestley's church at Birmingham from 1804 to his death there July 23, 1815; author, among other works, of *Memoirs of Faustus Socinus* (1777) and *Dissertations on the Internal Evidences of Christianity* (1785); was editor of D. Neal's *History of the Puritans* (Bath, 5 vols., 1793–97), with notes

and a memoir of the author, and subsequently published as a supplement *An Historical View of the State of the Protestant Dissenters in England under King William* (1814). A volume of his *Posthumous Discourses* was published in 1818.
Revised by J. W. CHADWICK.

**Toulon**, too'lōn': town; department of Var, France; 42 miles E. S. E. of Marseilles (see map of France, ref. 9–H). It is at the head of a narrow but deep inlet of the Mediterranean, from which it rises like an amphitheater on an acclivity, leaning against a row of lofty hills which encircle the bay. Next to Brest, Toulon is the principal naval station of France, and a fortress of immense strength. It is surrounded by a double-bastioned wall, and all the commanding heights in the neighborhood bristle with forts and redoubts. The harbor is double; one part, given up to commerce, is lined with convenient quays; the other, arranged for naval purposes, is surrounded with ship-building docks, cannon-foundries, ropewalks, magazines, arsenals, schools, hospitals, barracks, and naval establishments of every description; and this part of the harbor is separated from the roadstead by hollow but bombproof moles lined with batteries. Toulon carries on a considerable trade with Algeria. Pop. (1896) 95,276.
Revised by M. W. HARRINGTON.

**Toulouse**, too'looz': city of France; capital of the department of Haute-Garonne; in a fertile plain on the Garonne and the Canal du Midi; 160 miles S. E. of Bordeaux (see map of France, ref. 9–E). The streets in the older portions are narrow, crooked, and badly paved, the houses built of brick and without any characteristic style, though the broad quays and boulevards that have taken the place of the old walls are handsome thoroughfares. Of the cathedral, dedicated to St. Stephen, the nave dates from the twelfth and thirteenth centuries, the front façade from the fifteenth. The Church of St. Sernin is one of the most beautiful Ro-

Church of St. Sernin.

manesque structures in France, begun in the eleventh century, completed in the fifteenth, and with a tower 250 feet high. There are many buildings of unusual interest and the promenades are attractive. Toulouse is the residence of an archbishop, and has seminaries, monasteries, etc., a court for the departments of Haute-Garonne, Tarn, Tarn-et-Garonne, and Ariège, a commercial court, faculties of theology, medicine, and law, many special and general schools, a noted museum, a public library of over 60,000 volumes, and numerous benevolent institutions. It also has military schools, arsenals, powder-factories, etc. The manufacturing industry is important, especially in cloth, woolen and cotton fabrics, machinery and agricultural implements, candles, oil, soap, oilcloth, paper, tobacco, etc. The commerce is very active, especially in grain, wine, marbles from the Pyrenees, wood, etc. Four large fairs for cloth, woolens, and cattle are held annually. Pop. (1896) 149,963. Toulouse was the name of an ancient French family which ruled independently over the city and the country along the Garonne. In 852 the possession was made a dukedom, and for some time it was united to the countship of Auvergne and the dukedom of Aquitaine. In 1208 Pope Innocent III. waged war against Toulouse, conquered the country, and gave it to Simon of Montfort. His successor, pressed hard by the legitimate heirs of Toulouse, transferred his rights to Louis VIII. of France, and a war ensued between this king and Duke Raymond VII. The country was finally incorporated with France by Philip III. On Apr. 10, 1814, the French under Soult were defeated by Wellington in a battle before Toulouse.
Revised by M. W. HARRINGTON.

**Tou'raco, Turacou**, or **Turakoo** [from the native name]: any one of the plantain-eaters (*Musophagidæ*) of the genus *Turacus*, a group of large birds peculiar to the warmer parts of Africa, and characterized by their red and green plumage and conspicuous erect occipital crest. The wings are rounded; tail rather long. The touracos go in small flocks, dwell in the woods, and feed on fruit. The red pigment of the feathers (known as turacin) is soluble in water, and the birds are temporarily paler after bathing. F. A. L.

**Touraine**, too'rān': an ancient province of France, in the central part of the country, on both sides of the Loire, with Tours for its capital, consisting of the present department of Indre-et-Loire and part of Vienne. It was inhabited by the Turones when Cæsar arrived in Gallia, and was annexed to the French crown in 1204. On the revocation of the Edict of Nantes it suffered very much, as most of its inhabitants were Protestants.

**Tourcoing**, toor'kwăn': town of France, department of Nord; 10 miles by rail N. E. of Lille (see map of France, ref. 2–F). It is a large manufacturing place, where great quantities of wool, cotton, and flax are spun and woven into various kinds of fabrics; its breweries, distilleries, and sugar-refineries are also important. Pop. (1896) 73,353.

**Tourgee**, toor-zhā', ALBION WINEGAR: author; b. at Williamsfield, O., May 2, 1838; educated at the University of Rochester, New York; served in the U. S. army in the civil war, and was twice wounded; after the war, settled in the practice of the law at Greensboro, N. C., and at the Southern loyalist convention in Philadelphia, Pa., in 1866, prepared the report on the condition of the Southern States. He was judge of North Carolina superior court in 1868–74. With Messrs. Barringer and Rodman he prepared *A Code of Civil Procedure for North Carolina* (1868); author of *A Fool's Errand* (1879); *Bricks without Straw* (1880); *Hot Ploughshares* (1883); *An Appeal to Cæsar* (1884); *Black Ice* (1888); *Letters to a King* (1888); *With Gauge and Swallow* (1889); *Pactolus Prime* (1890); *Murvale Eastman* (1892); and *An Outing with the Queen of Hearts* (1894). In 1882–85 he edited *Our Continent*, a weekly paper published in Philadelphia.
Revised by H. A. BEERS.

**Tourjee**, EBEN: musician and teacher; b. at Warwick, R. I., June 1, 1834; at a very early age displayed great talent for music; at the age of thirteen was organist of a local church; when seventeen went to Providence, opened a music-store, and began teaching; in 1859 went to East Greenwich, R. I., and founded the Musical Institute; in 1863 went to Europe for further study; returned in 1867, and removed the Musical Institute to Boston and renamed it the New England Conservatory of Music; in 1869 received the degree of Doctor of Music from Wesleyan University, Middletown, Conn.; in 1872, with P. S. Gilmore, organized the World's Peace Jubilee. He held many places during his life and edited a number of musical works. D. in Boston, Apr. 12, 1891. D. E. HERVEY.

**Tourmaline** [Cingalese *turamali*; the first gems of it being brought from Ceylon]: a mineral found in granitic and metamorphic rocks, and occasionally furnishing fine gems. It is a complex silicate of aluminium, with about 10 per cent. of boric oxide and smaller amounts of other oxides, its varying composites giving rise to different varieties. It occurs in brittle, prismatic crystals, usually three-, six-, or nine-sided, which have a hardness of 7·5. Its color is usually black, but when found in limestones it is often rich brown. Tourmalines of blue, green, pink, and red colors occur, frequently with two or three colors in the same crystal. These colored crystals, when transparent, make beautiful gems and have received distinct names. The black is called *schorl*, the white *achroite*, the red *rubellite*, and the blue *indicolite* or, when clear, *Brazilian sapphire*; and different shades of green, *Brazilian emerald* and *Brazilian chrysolite*; and the yellow, *Ceylon peridot*. Fine red and green tourmalines occur at South Paris and other Maine localities, in the San Jacinto Mountains, California, in Minas Geraes, Brazil, and the island of Elba; pink and red in Madagascar and Southern California; brown and red in Carinthia and Ceylon. The mineral is remarkable also for its optical properties, and is used for experiments in polarized light. The colored tourmalines of Maine are treated of in published works by Dr. A. C. Hamlin, whose collection of them, as well as those of others, has become the property of Harvard University. See also GEM and PRECIOUS STONES.

GEORGE F. KUNZ.

**Tournament**, or **Tourney** [*tournament* is M. Eng. *turnement* < O. Fr. *torneiement*, deriv. of *torneier*, turn round and round, tilt, tourney; *tourney* is from O. Fr. *tornei*, deriv. of *torneier*]: a friendly contest at arms among the warriors of noble birth in the Middle Ages. The term is general, and denotes the gathering of the nobles and knights, the challenging and settling the terms, and the armed struggles themselves, the whole sometimes lasting for many days. All the lodgings in the town would be taken up by visitors, each intending combatant, and perhaps each man of knightly rank, hung out his pennon or banner from his windows, the lists were laid out and fenced in and fitted with seats for ladies and others, and the combats were arranged with care and fought under exact supervision. This was the condition of the tournaments of the fourteenth and fifteenth centuries; before that these gatherings were less ceremonious, and indeed were less frequent, and were often forbidden, not only by the Church, but by kings, as by Philip the Fair of France and Henry III. of England. This would seem to point to much greater danger to life and limb from the earlier tournaments, and it is certain that the arms of war were more used in these than afterward. In fact, the distinction must have been hard to make at first between the judicial duel (see ORDEAL) and the friendly contest between two (see JOUST); and in like manner a tournament must have resembled a pitched battle at a fixed place and time, fought to establish a noble's right to an estate or to a title, or merely out of bravado. When, however, the tournaments had become matters of regulation, the arms used were exactly specified and were generally blunt and pointless swords, maces, or clubs of wood, and for the tilting-match, lances with heads divided into three or four blunt points. The defensive armor was enormously heavy, because the rider was not to dismount, but only to run so many courses with the lance and to strike so many blows with the sword or mace. In this way the tournaments became more and more occasions for unbounded display of wealth and splendor, and less and less serious and dangerous as contests of armed men. The death of Henry II. of France, by an accident in the tilt, in 1559, is generally thought to have put an end to tournaments in France; but throughout Europe the changing conditions of warfare and the more critical temper of the revival of learning (see RENAISSANCE) were making them impossible. The name lingered on in England as applied to *riding at the ring*—that is, the trying to carry off a ring on the point of the lance, and the *quintain*—that is, the game of charging a figure which revolved when the shield was struck, and flung a bag of sand at the rider, who had to be active to escape it.

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RUSSELL STURGIS.

**Tournay'**: an old but very handsome and interesting town of Belgium, province of Hainaut; 35 miles W. S. W. of Brussels (see map of Holland and Belgium, ref. 11–B). It is on the Scheldt, which here is crossed by several elegant bridges and lined with quays which are planted with trees and afford beautiful promenades. Tournay contains many fine edifices, among which the cathedral in the Romanesque style is the most remarkable, and important manufactures of carpets, porcelain, hosiery, lace, and liqueurs. Pop. (1891) 34,442. Revised by M. W. HARRINGTON.

**Tournefort**, toorn'fōr', JOSEPH PITTON, de: botanist; b. at Aix, France, June 5, 1656; studied botany and traveled extensively in Southern Europe; was made professor at the Jardin des Plantes in Paris in 1683; went to the Levant with the support of Louis XIV. 1700–02; was appointed Professor of Medicine at the Collège de France. His *Éléments de Botanique* (3 vols., 1694) he translated in 1700 into Latin, *Institutiones Rei Herbariæ*, and this translation was republished with additions by Jussieu in 1719, and translated into English (London, 1719–30). He also wrote *Histoire des Plantes qui naissent aux Environs de Paris, avec leur Usage dans la Médecine* (1698), enlarged by Jussieu in 1725, and translated into English by Martyn (London, 1732), and *Voyage du Levant* (2 vols., 1717; translated into English, 1741). D. in Paris, Nov. 28, 1708.

Revised by CHARLES E. BESSEY.

**Tourneur**, toor-nėr', CYRIL: an Elizabethan dramatist, the dates of whose birth and death are uncertain; author of two powerful but extravagant plays, *The Revenger's Tragedy* (1607) and *The Atheist's Tragedy* (1611), and of a peculiar poem entitled *The Transformed Metamorphosis* (1600). His works were edited by Churton Collins in 1878 (2 vols., London).

**Tour'niquet** [=Fr., deriv. of *tourner*, turn]: an instrument for checking the flow of blood from wounds or during surgical operation by means of pressure applied to the principal artery supplying the blood. A rude but often very useful tourniquet may be made by tying a handkerchief around the wounded limb between the heart and the wound, passing a stick through the handkerchief, and then twisting it till the flow of blood is checked. In the more effective forms a pad is strongly pressed against the main artery by means of a screw. Revised by W. PEPPER.

**Tou'ro**, JUDAH: philanthropist; b. at Newport, R. I., June 16, 1775; son of Rev. Isaac Touro, a rabbi of the synagogue at Newport; engaged in mercantile business; settled in New Orleans as a merchant in 1802, and acquired a large fortune; served as a volunteer at the battle of New Orleans 1815, where he was severely wounded; gave liberally of his fortune during his lifetime, and at his death, which occurred in New Orleans, Jan. 18, 1854, bequeathed most of his property to the public charitable institutions of that city. Among them was the Touro Almshouse, occupied during the civil war as barracks for colored troops, by whom it was burned.

**Tours**, toor: capital of the department of Indre-et-Loire, France; 147 miles by rail S. W. of Paris (see map of France, ref. 5–E). It is on a small strip of land between the Cher and the Loire, which here is crossed by one of the most magnificent bridges in Europe, built in 1765–77 by Bayeux, and lined with handsome quays and finely planted promenades. It has a magnificent Gothic cathedral, several other remarkable edifices, and good educational institutions. Silk manufactures were established here by Henry IV., and during Richelieu's time more than 40,000 persons were employed in this branch of industry; but the revocation of the Edict of Nantes drove the workmen into exile, and gave the city a blow from which it never recovered, though its manufactures of silk-stuffs, ribbons, serges, pottery, and confectionery are still extensive. The town has given its name to the famous battle between Charles Martel and the Saracens in 732. The latter were decisively defeated, and Western Europe was saved from subjection to the Mohammedans. During the war with Germany Tours was the seat of the national Government from Sept. 11 to Dec. 10, 1870. It was occupied by the Germans on Jan. 19, 1871. Pop. (1896) 63,267. Revised by M. W. HARRINGTON.

**Tours**, BERTHOLD: composer; b. in Rotterdam, Holland, Dec. 17, 1838; received his first instruction from his father; afterward studied at Leipzig and Brussels, and thence accompanied Prince Galitzin to Russia. He removed to London in 1861, where he resided until his death (Mar. 11, 1897), composing, teaching, and playing in orchestras and bands. He composed much church music, services, and anthems, which are immensely popular, and also many very popular songs, much good organ music, a number of pieces for piano and also for the violin, and made piano arrangements of many vocal and orchestral scores. D. E. HERVEY.

**Tourville**, toor'veel', ANNE HILARION DE COTENTIN, Count de: admiral; b. at Tourville, department of La Manche, France, Nov. 24, 1642; was educated for the navy, and made a captain in 1667; distinguished himself in the battle of Agosta 1676; commanded the vanguard in the battle of Palermo 1677; made several successful expeditions against the pirates of Northern Africa 1682–88; was created a vice-admiral in 1689; defeated a Dutch-English fleet off the Isle of Wight in July, 1690, and pursued the English to the mouth of the Thames; attacked a Dutch-English fleet superior to his own off La Hogue May 29, 1692, and was beaten after twelve hours' fight; was made a marshal in 1693, and defeated and destroyed a Dutch-English fleet off Cape St. Vincent on May 26, 1693. On the outbreak of the Spanish war of succession he was made commander-in-chief of the united naval force of France and Spain in the Mediterranean, but died in Paris May 28, 1701. See Delarbre, *Tourville et la Marine de son Temps* (1889). F. M. COLBY.

**Toussaint Louverture**, too'sañ'loo'vār'tür' (or **L'Ouverture**), DOMINIQUE FRANÇOIS; revolutionist; b. near Cap Français, Haiti, in 1743. He was a Negro and originally a slave on a plantation belonging to the Jesuits; they gave him the rudiments of education, and passing into the hands of a creole planter he was made overseer. He did not take part in the insurrections until 1791, when he protected the flight of his master before joining Jean François. With the latter he went over to the Spanish Dominicans in 1793, but in 1794 he deserted to the French republicans, carrying with him a large force of blacks. This step gave the republicans overwhelming power, and as Toussaint was now the acknowledged leader of the Negroes and could turn the scale as he pleased, he became the most influential man in the island. He was made commander-in-chief and deputy governor, and the French commissioner, though nominally the highest officer, was left with only a semblance of power. Mainly through Toussaint's generalship the British, who had aided the royalists, were forced to evacuate the island in 1798. Their commander, Gen. Maitland, surrendered the posts directly to Toussaint, refusing to recognize the French commissioner. Soon after an insurrection, secretly incited by Toussaint, drove the commissioner from the island; the mulatto Gen. Rigaud, to whom he delegated his powers, was defeated by Toussaint in 1799, leaving the latter undisputed master of the western or French part of the island. He used his power with great moderation, protected the whites, and proclaimed a general amnesty. As the only available means of restoring agricultural prosperity he forced the Negroes to work on the plantations, securing to them, however, a part of the profits. The eastern part of the island having been ceded to France, he occupied it in 1801. Finally, in July, 1801, he promulgated a constitution which made him president for life. Under his rule the island was unquestionably prosperous, and he had won not only the respect but the enthusiastic devotion of the Negroes. An admirer of Bonaparte, he modeled his actions and conversation after him, and claimed to have seized the supreme power in the same manner. One of his numerous letters to the First Consul was superscribed, "The First of the Blacks to the First of the Whites." Bonaparte paid no attention to these letters, and when Toussaint threw off all semblance of subjection to France he organized an expedition under LECLERC (*q. v.*) to reduce the island to obedience. During the early part of 1802 Toussaint made a desperate resistance, finally capitulating in April. He was pardoned, but two months afterward was arrested for alleged conspiracy and sent a prisoner to France. He died in captivity at the castle of Joux, near Pontarlier, Apr. 27, 1803. HERBERT H. SMITH.

**Tow**: See FLAX.

**Towan'da**: borough; capital of Bradford co., Pa.; on the Susquehanna river, and the Barclay and the Lehigh Val. railways; 82 miles N. W. of Wilkesbarre (for location, see map of Pennsylvania, ref. 2-G). It is in an agricultural and dairying region; has electric and gas lights and water-supply from springs 16 miles distant; and contains the Susquehanna Collegiate Institute (Presbyterian, chartered 1850), 2 national banks with combined capital of $275,000, a daily, a semi-weekly, and 4 weekly newspapers, an extensive toy-factory, several foundries, planing-mills, and piano, carriage, and furniture factories. Pop. (1880) 3,814; (1890) 4,169; (1900) 4,663. MANAGER OF "REVIEW."

**Tower**: a building or member of a building, simple and compact in its form, cylindrical or prismatic; generally, though not always, higher than wide. The towers of an ancient fortress (see CASTLE and FORTIFICATION) are to be considered partly as flanking works, projecting from the curtain walls in such a way as to allow of a cross-fire of arrows and the like, and partly as higher structures commanding the top of the curtain walls. In Greek and Roman city walls, and in mediæval castles and towns previous to the thirteenth century, the towers are nearly always higher than the walls and serve both the purposes cited above. In the later fortresses of the Middle Ages they are often of the same height as the walls. The evolution of defense against the old means of attack had led to a complete freedom for the garrison of movement from point to point of defensive works, and the towers were often mere bastions, parts of the wall and of the same height with it, as notably in the famous BASTILE (*q. v.*) of Paris. Height alone is, however, of great utility in defense against attacks by sapping and by escalade, and accordingly the donjon of a castle was generally a very lofty and partly isolated tower. In the Italian cities lofty square towers were erected for defense; hundreds of them existed in a single town; but of these very few remain, the greatest number being at San Gimigniano, in Tuscany, though several others exist at Bologna (see LEANING TOWERS), at Arezzo, and elsewhere. The small strong buildings of border barons in the Pyrenees, in Germany, and on the English-Scottish frontier, are commonly in the form of towers; some few of these remain in a partly ruined condition. In parts of the Caucasian mountain country and in Afghanistan whole villages exist of which each important house has a tower of defense into which the family may retreat in case of a violent attack. Church towers, on the other hand, being intended primarily for belfries, are made high so as to lift the mouths of the bells well above the church-roof and all surrounding buildings. From this original utilitarian form they passed into one of the chief means of decorative architecture in the Middle Ages, and of this great height was a necessary feature in most cases, although in some English parish churches the tower is hardly higher than its own breadth across the buttresses. Throughout the north of Europe the church tower was generally closely united with the mass of the church, and in some cathedrals as many as six, in one case eight, towers formed part of the original design. In Italy the tower was always a belfry or *campanile*, and was almost wholly detached from the church building.

Small towers forming part of larger masses of building are generally called turrets or *tourelles*, from the French word of the same meaning. These are often carried on corbeling and in projection from the main wall; they frequently contain winding stairs and often serve as watch-towers; oriel windows also are sometimes built in the semblance of such *tourelles*. The *round towers of Ireland* are slender, nearly cylindrical, but built generally with a slight taper, roughly built of stone, and always very near to a church. Only about a dozen remain nearly complete, but there are more than a hundred of which ruins exist. Their purpose has never been satisfactorily explained, though many works have been devoted to them. See ROUND TOWERS. RUSSELL STURGIS.

**Tower**, ZEALOUS BATES: soldier and military engineer; b. at Cohasset, Mass., Jan. 12, 1819; graduated at the U. S. Military Academy at the head of his class, and was appointed second lieutenant in the Corps of Engineers July 1, 1841. After a brief service as assistant with the board of engineers he was recalled to West Point Aug., 1842, serving as assistant professor until Apr., 1843, and as principal assistant professor of engineering Apr.-Aug., 1843, when, returning to duty with his corps, he served as assistant engineer in the construction of the defenses of Hampton Roads, Va. He served with distinction in the war with Mexico, especially at Cerro Gordo, Contreras, and Chapultepec, and in the assault and capture of the city of Mexico. During 1848-61 he was engaged in the construction of fortifications at Portland, Me., and Portsmouth, N. H.; of the defenses of San Francisco, Cal., and as member of the board of engineers for the Pacific coast. He was promoted major of engineers Aug. 6, 1861, and assigned as chief engineer to defend Fort Pickens; breveted lieutenant-colonel for gallant services; and commissioned brigadier-general of volunteers from Nov. 23, 1861, the date of its bombardment. Assigned to command of a brigade in the Army of Virginia in 1862, he was engaged in the battle of Cedar Mountain Aug. 9, and subsequent operations during Pope's campaign in Northern Virginia, and was severely wounded at the second battle of Bull Run. For gallantry at Cedar Mountain he was breveted colonel, and the brevet of brigadier-general was conferred on him for Groveton. From July 8 to Sept. 8, 1864, he was superintendent of the U. S. Military Academy. In Sept., 1864, he was appointed chief engineer of the defenses of Nashville; was engaged in the battle of Nashville Dec. 15-16, 1864; and from Oct., 1864, was inspector-general of the fortifications of the military division of the Mississippi; chief engineer of the military division of the Tennessee July, 1865–Jan., 1866; breveted major-general Mar. 13, 1865. Returning to duty in Jan., 1866, with his corps in which he had attained the rank of lieutenant-colonel Nov., 1865, he was a member of various engineer and special boards, and during 1866–67 had charge of the construction of the defenses of Portsmouth, N. H.; in May, 1867, was appointed a member of the board of engineers for permanent fortifications and river and harbor obstructions; became colonel of engineers Jan., 1874; and retired Jan. 10, 1883. D. Mar. 21, 1900.

**Tower City**: city; Schuylkill co., Pa.; on the Williams Valley Railroad; 11 miles W. S. W. of Tremont, and 24 miles W. of Pottsville, the county-seat (for location, see map of Pennsylvania, ref. 5–H). It is in an agricultural and coal-mining region, and has a building and loan association and a weekly newspaper. Pop. (1890) 2,053; (1900) 2,167.

**Tower of London**: the ancient citadel of the city of London, standing, as the Louvre does in Paris, on the banks of the river, immediately below and outside of the city, which it once defended. Its government has been intrusted since the days of the Conqueror to a high officer called the constable, which office has been held by the Duke of Wellington, Field-marshals Sir John Burgoyne, Sir George Pollock, and Sir William Gomm. The oldest portion is the isolated donjon or keep called the White Tower, built by William the Conqueror, and contains an interesting chapel of the same period. This is now surrounded by a rampart and moat, with inner wall (the Inner Bail), flanked by half-circle towers, each of which has a distinctive name, as the Bell Tower, the Beauchamp Tower, Wakefield Tower (where are kept the regalia), Bloody Tower, Bowyer Tower. There is also within the inclosure the Horse-armory, a museum of ancient armor; St. Peter's church, where are interred the remains of Anne Boleyn, Katherine Howard, Dukes of Somerset ("The Protector") and Northumberland, Lady Jane Grey and her husband, and many other celebrated victims of the headsman. Closely adjacent to the Tower is Tower Hill, the famous place of execution for persons delivered from the Tower to the sheriffs of London for execution. Here suffered (among others) Bishop Fisher, Sir Thomas More, Lord Guilford Dudley, Earl of Strafford, Archbishop Laud, Algernon Sydney, and (1747) Lord Lovat, the last person beheaded in England. Queen Anne Boleyn and Lady Jane Grey were beheaded on scaffolds within the Tower, the site of which is shown, as also the block on which the former suffered. Within the Bloody Tower took place the murders of the princes, sons of Edward IV., and, elsewhere within the precincts, of Henry VI., of the Duke of Clarence, of Sir Thomas Overbury, and of the Earl of Essex.


The Tower of London.

**Towers of Silence**: the structures on which the modern PARSEES (*q. v.*), in accordance with the tenets of their faith, dispose of the dead by allowing them to be devoured by vultures. This disposition of the corpse is a very ancient one in Iran, and it is inculcated in the AVESTA (*q. v.*) as enjoined by Zoroaster. Allusions to the customs are found also in Herodotus (i., 140), who describes it as Magian, and elsewhere in the classics. According to the Zoroastrian religion the elements, fire, earth, and water, were sacred, and not to be defiled; the dead body, as full of corruption and pollution, could not therefore be burned, buried, nor thrown into the water, but was exposed on mountain heights, upon structures called *dakhmas*, as a prey to the dogs and birds. The modern Parsee *dakhma*, or tower of silence, is a structure from 60 to 90 feet in diameter, and from 20 to 30 feet in height, somewhat resembling a gasometer. The interior raised floor upon which the dead bodies are placed is divided, like the spokes of a wheel, into three concentric rows of troughs (*pavis* they are called), the outer for men, the middle for women, the inner for children. The center or hub is a great pit (*bhandar*), some 30 feet in diameter, into which the denuded bones, parched and dried in the Oriental sun, are later deposited, and there crumble into dust. All flow and exudation of putrid matter is carefully conducted through disinfecting channels, so that the earth is preserved from defilement, and the sanitary laws are preserved. No one is allowed to witness the descent of the "heaven-sent" birds; the body, it is said, is quite stripped of flesh in an hour or two. Remains of ancient Zoroastrian *dakhmas* are to be seen in Persia, for example, at Teheran, and the principal towers of silence in use to-day by the Parsee community of India are found on Malabar Hill, Bombay. See Dosaithai Framji Karaka, *History of the Parsis*, i., 199–210 (London, 1884); Modi, *A Tower of Silence* (Bombay, 1885).

A. V. WILLIAMS JACKSON.

**Towianski**, tō-vēē-aan'skēē, ANDREAS: impostor; b. at Antoszwiniec, Lithuania, Jan. 1, 1799; studied at Wilna, and made himself conspicuous early in life by his mystical enthusiasm and pretensions of receiving divine revelations; practiced law at Wilna 1818–26. After wandering around in Europe, he went to Paris about 1841, and obtained complete control of Mickiewicz, the great Polish poet, especially by the marvelous manner in which he cured his insane wife. He actually formed a sect which accepted him as a Messiah, but was expelled in 1842. He then tried to get a foothold in Brussels, in Switzerland, in Rome, but in vain. From Rome he was expelled as an impostor, and, returning to Switzerland, he gave up his *rôle* of a prophet, settled in Zurich, and died there May 13, 1878. See Semenke, *Towianski et sa doctrine* (Paris, 1859). Mickiewicz wrote in his favor *L'église officielle et le Messianisme* (2 vols., Paris, 1842–43).

Revised by S. M. JACKSON.

**Towle**, tōl, GEORGE MAKEPEACE: journalist and author; b. in Washington, D. C., Aug. 27, 1841; graduated at Yale College 1861, at Harvard Law School 1863; practiced law in Boston 1863–66; U. S. consul at Nantes, France, 1866–68, and at Bradford, England, 1868–70; managing editor of the Boston *Commercial Bulletin* 1870–71; State senator of Massachusetts in 1890–91; author of *Glimpses of History* (1865); *Henry the Fifth, King of England* (New York, 1866); *American Society* (2 vols., London, 1870); *Beaconsfield* (1878); *Certain Men of Mark* (1880); *England and Russia in Asia* (1885); *England in Egypt* (1886); *Young People's History of England* (1886); *The Nation in a Nutshell* (1887); *Young People's History of Ireland* (1887); and *The Liter-*

*ature of the English Language*, of which he had finished two of its three volumes at the time of his death. He also contributed to English and American periodicals. D. at Brookline, Mass., Aug. 8, 1893. Revised by H. A. BEERS.

**Town** [O. Eng. *tūn*, inclosure, fence, village, town : O. H. Germ. *zūn*, inclosure (> Mod. Germ. *zaun*, hedge, fence) : Icel. *tūn*, inclosure, house ; cf. Celtic *dunum* in names like *Lugdūnum*, Lyons]: a word of varying signification, both in popular speech and in legal usage. In its broadest sense, it includes not only every sort of municipality, without regard to size, origin, or form of government, but also populous districts which are destitute of self-governing powers. It has this generic signification in some statutes. The House of Lords has declared that a town exists, within the meaning of that word in a railway statute, "where there is such an amount of continuous occupancy of ground by houses that persons may be said to be living as it were in the same town or place continuously." (*London Ry.* vs. *Blackmore*, L. R. 4 H. L. 611.) See also the Towns Improvement Clauses Act, 1847 (10 and 11 Vict., c. 34). As a generic legal term, however, it ordinarily includes only municipalities; that is, political subdivisions less than counties established for local government. It is employed in this sense in § 23 of Magna Charta ("neither a town nor any person shall be distrained," etc.) as well as in modern statutes. (*Banta* vs. *Richards*, 42 N. J. L. 497.) The common-law definition of the word, in this sense, is "a place with a constable or a church." Baron Parke in *Elliott* vs. *South Dev. Ry.*, 17 L. J. Exch. 262.

As a specific term it is used (1) to designate a municipality, which is not a city nor a borough nor a village, without regard to its size or form of government. It is so employed in § 13 of Magna Charta—"all other cities and boroughs, and towns, and ports." It has this meaning in Pennsylvania, Maryland, Virginia, and some other States, as well as in the Federal statutes relating to town sites on the public lands. (U. S. R. S., §§ 2380, *et seq.*) (2) In some of the States municipalities are divided into cities, towns, and villages; those having 2,000 inhabitants or more, for example, are declared to be cities; those having less than 2,000 and not less than 500 are towns; those having less than 500 are villages. (See Miss. Code of 1892, § 2911.) Even in such States, however, the term is sometimes used in statutes in its generic sense, and includes unincorporated settlements. (*Murphy* vs. *State*, 66 Miss. 46.) So variable is the import of this word that its signification in any particular enactment must depend largely upon the occasion and purpose of the law. (*Broome* vs. *Tel. Co.*, 49 N. J. L. 497.) (3) Again, the term designates a territorial subdivision, which is the unit of local administration. In this sense it is employed by Blackstone, who asserts that it is synonymous with tithing or vill. (1 *Commentaries*, 114.) It bears this meaning in New England, in New York, and in several of the Western States. At first, the New England town consisted of clusters of inhabitants dwelling near each other, but as soon as the territorial boundaries of these village communities were fixed the term was applied to the territory or district. The term township was used interchangeably with town. For example, the General Court of Plymouth ordered, in 1637, that "Ducksburrow shall be a township, and unite together for their better security, and to have the privilege of a town, only their bounds and limits shall be set and appointed by the next court."

TOWNSHIP.—In New Jersey, Pennsylvania, and some other commonwealths, as well as in Canada, the word township is used exclusively to designate this primary division of the State. In the Federal statutes relating to public lands, however, and in the nomenclature of the new western States, the township is a territorial subdivision, made by the intersection of meridians and parallels 6 miles apart, and containing an area of 36 sq. miles, but is not a political subdivision. It has no functions of local government.

The origin of towns, their political powers and duties, and their relations to counties and to States, can not be treated adequately in an article of this kind. For information on these topics, the reader is referred to *Commonwealth* vs. *City of Roxbury*, 9 Gray (Mass.) 451, and note by the editor, now Mr. Justice Gray; *Hill* vs. *Boston*, 122 Mass. 344; *Webster* vs. *Town of Horwinton*, 32 Conn. 131; *Johns Hopkins Studies in History and Political Science*, series i. to viii. inclusive; Howard, *Introduction to the Local Constitutional History of the United States* (1889); De Wolf, *The Town Meeting* (1890); Adams, *Study of Church and Town Government* (1892); *Genesis of the Massachusetts Town*, 2 *Proc.* Mass. Hist. Soc., vii., 172–264; *The Anglo-Saxon Township*, by Ashley, *Quarterly Journal of Economics*, viii., 345; Chalmers, *Local Government* (London, 1883); Bryce, *American Commonwealth*, ch. xlviii.; Stubbs, *Constitutional History*, vol. i., ch. v.; Stubbs, *Select Charters*, part i. FRANCIS M. BURDICK.

**Townley**, CHARLES: archæologist; b. at Townley Hall, Lancashire, England, Oct. 1, 1737, of a Roman Catholic family; received his education on the Continent under the tutorship of the celebrated John Turberville Needham; resided at Rome 1765–72, engaged in the study of antiquities, and enjoying in that pursuit the advice and experience of Winckelmann and other celebrated archæologists; devoted his large fortune to the formation of a magnificent collection of ancient art, which he subsequently largely increased through his agents and by the purchase of the Nollekens collection, and arranged his museum in two houses which he purchased in Park street, Westminster, where he died Jan. 3, 1805. The Townley Marbles were purchased by the nation for £20,000, and in 1814 his bronzes, coins, and gems were also acquired for £8,200. They now form part of the Græco-Roman collection in the British Museum, of which institution Mr. Townley had been a trustee. He was the author of *Antiquities discovered at Ribchester* (London, 1800).

**Townley**, JAMES: clergyman; b. in Manchester, England, May 11, 1774, of parents belonging to a Wesleyan congregation; became a local preacher at the age of nineteen, and was a regular minister from 1796 to 1832. He became secretary-general of the Wesleyan Missionary Society in 1827, and presided over the conference at Sheffield in 1829 and over the Irish conference in 1830. He was well versed in all biblical matters, and wrote, among other works, the excellent *Illustrations of Biblical Literature, exhibiting the History and Fate of the Sacred Writings, from the Earliest Period to the Present Century*, including biographical notices of translators and other eminent biblical scholars (3 vols., London, 1821; 2 vols., New York, 1842). D. at Ramsgate, Dec. 12, 1823.

**Townsend**: town (incorporated in 1732); Middlesex co., Mass.; on the Squannacook river, and the Fitchburg Railroad; 22 miles W. of Lowell, and 44 miles W. N. W. of Boston (for location of county, see map of Massachusetts, ref. 2–H). It contains the villages of Townsend, West Townsend, and Townsend Harbor; has a high school, 12 public schools, public library, a national bank with capital of $100,000, and an assessed valuation of over $1,000,000; and is principally engaged in cooperage and the manufacture of furniture. Pop. (1880) 1,967; (1890) 1,750; (1900) 1,804.

**Townsend**, GEORGE ALFRED: journalist; b. at Georgetown, Del., Jan. 30, 1841; graduated at the Philadelphia High School 1859; became news editor of the Philadelphia *Inquirer*, and subsequently city editor of the *Press*. He was correspondent for the New York *Herald* and *World* during the civil war, and was in Europe 1866–67 reporting the Austro-Prussian war and the Paris Exposition for American newspapers. He was for several years from 1868 on the staff of the Chicago *Tribune* as editorial writer and correspondent; and has been a successful lecturer and a general contributor to periodicals under the pen-name of *Gath*. He has published several volumes, including *Campaigns of a Non-combatant* (1865); *Poems* (1870); *Washington, Outside and Inside* (1871); *Tales of the Chesapeake* (1880); *The Entailed Hat* (1884); *Katy of Catoctin* (1886); and *Mrs. Reynolds and Hamilton* (1890). H. A. BEERS.

**Townsend**, LUTHER TRACY, D. D.: clergyman and author; b. at Bangor, Me., Sept. 23, 1836; graduated at Dartmouth College in 1859; studied theology at Andover, where he graduated in 1862; adjutant in the army in 1863–64; from 1873 to 1893 Professor of Practical Theology in Boston University, and since 1893 pastor of Mt. Vernon Place Methodist Episcopal church, Baltimore. Among his works are *The Arena and the Throne* (1874); *The Chinese Problem* (1876); *Supernatural Factor in Religious Revivals* (1877); *Art of Speech* (1880–81); *Mosaic Record and Modern Science* (1881); *Bible Theology and Modern Thought* (1883); *Real and Pretended Christianity* (1884); *The Bible and other Ancient Literature in the Nineteenth Century* (1889); *Bible Miracles and Modern Thought* (1891); *Outlines of Theology* (1893).

**Townsend**, THOMAS S.: See the Appendix.

**Townsend**, WILLIAM K.: See the Appendix.

**Townshend**, CHARLES, second Viscount Townshend: statesman; b. at Rainham, England, Mar. 10, 1674; succeeded to the peerage on the death of his father Horatio, the first viscount, Dec., 1687; was summoned to the privy council in 1707; was joint plenipotentiary with Marlborough (1709) at the conferences of Gertruydenburg for negotiating a peace with France, and ambassador to the States-General of Holland 1709–10; signed the Barrier treaty at The Hague Oct. 29, 1709; resigned his embassy and returned to England on the fall of the Whig ministry 1712; was censured by the House of Commons for having signed the Barrier treaty, and declared by vote of the same House an enemy to the queen and kingdom; entered into correspondence with the Elector of Hanover, who on his accession to the throne of England made him Secretary of State and Prime Minister Sept. 14, 1714; resigned that post, and was appointed Lord-Lieutenant of Ireland 1717, but never took possession of that office; became president of the council June, 1720, and was again Secretary of State from Feb. 10, 1721, to May 15, 1730, when he retired on account of differences with his brother-in-law and colleague, Sir Robert Walpole. D. at Rainham, Norfolk, June 21, 1738.

**Townshend**, Charles: statesman; grandson of the second viscount; b. in England, Aug. 29, 1725; entered the House of Commons 1747, where he acquired prominence by an eloquent speech on the Marriage Bill 1753. In 1754 he became a lord of the admiralty, but was dismissed for an attack on the ministry in the following year. A supporter of Pitt, he was appointed treasurer of the chamber in Dec., 1756, and in the following spring became a member of the privy council, but in 1760 ranged himself on the side of Bute, and was rewarded with the post of Secretary of War (1761–62). He was for a time in opposition to the Grenville ministry, but toward its close accepted the office of paymaster of the forces (1765), and supported Grenville's Stamp Act of that year. He was appointed Chancellor of the Exchequer and Lord of the Treasury by Pitt Aug. 2, 1766; and was virtually Prime Minister during the retirement of Pitt. His last act was to introduce the celebrated resolutions for taxing the American colonies in 1767. D. in Oxfordshire, Sept. 4, 1767. For the instability of his political opinions he was commonly known as the "Weathercock," but he had an immense parliamentary reputation for oratory and wit. His character has been largely discussed by Macaulay (who said "he was a man of splendid talents, of lax principles, and of boundless vanity and presumption") and by historians of the American war, especially Bancroft, and has been made the subject of a special biography, *Charles Townshend, Wit and Statesman* (1866), by Percy Fitzgerald. F. M. Colby.

**Townshend**, Chauncy Hare: author; b. in England in 1798; educated at Eton; graduated at Cambridge 1821; took orders in the Church of England, but from ill health never engaged in active professional life. He devoted himself to poetry, literature, and art; formed valuable collections of pictures and other objects of art; gave much time to the investigation of mesmerism, in which he was a firm believer, and spent much of his life at his villa of Monloisir at Lausanne, Switzerland. D. in London, Feb. 25, 1868. By his will he bequeathed most of his art collections to the South Kensington Museum, and left a sum of money and the care of his MSS. to Charles Dickens, requesting him to publish such extracts as would illustrate his religious views. Dickens accordingly issued in Dec., 1869, *The Religious Opinions of the Rev. Chauncy Townshend, published, as directed by his Will, by his Literary Executor.* Mr. Townshend was the author of works on mesmerism and several volumes of poems. Revised by H. A. Beers.

**Township**: See Town.

**Townsville**: town of Queensland, Australia; 700 miles N. W. of Brisbane, on Cleveland Bay; lat. 19° 16′ S., lon. 147° E.; E. terminus of railway to Hughenden (see map of Australia, ref. 3–I). It is a rapidly growing town, the outlet of a rich agricultural district, but has a poor harbor, which, however, is being improved. It is at the mouth of Ross creek, and climbs Melton Hill, an elevation of about 1,000 feet just behind. It has numerous churches and schools, a hospital, an orphan asylum, a large concert-hall; has special provisions for immigrants in great numbers, and an excellent water-system. Among the industries are a soap-factory, a foundry, and two distilleries. The railway to the W. is rapidly developing the inland basins of the Herbert and Diamantina rivers. Pop. (1891) 8,564: with the suburbs, 15,015. Mark W. Harrington.

**Toxæmia**: another name for septicæmia or blood-poisoning. See Blood-poisoning.

**Toxicol′ogy** [Gr. τοξικόν, poison (for τοξικὸν φάρμακον, poison for smearing arrows, deriv. of τόξον, bow) + λόγος, discourse, reason]: the science of poisons. It treats of the nature and properties of poisons, their effects upon the animal system, their detection, and the legal questions connected with poisoning. A poison is any substance which, either introduced into or arising in the body, is capable of exercising chemical or vital effects deleterious to health or life. What we speak of as *vital* effects are probably based upon chemical actions, but of such nature that present means of examination will not reveal them. Much depends upon the quantity of the substance acting upon the body; small doses may be tolerated, large quantities poisonous.

*The action* may be local or general. Among poisons affecting particular parts of the body are such as are corrosive. The symptoms may terminate with the local disturbances, or secondary general symptoms, such as fever, depression, or collapse, may result from the effects of the local disorder rather than from a generalized action of the poison. When the action of poisons is general there is always a dissemination through the blood, which may act simply as a carrier or may itself be altered by the poison.

*Entrance into the System.*—Poisons may gain access to the system by subcutaneous inoculation, through open wounds, through the mucous membrane of the stomach, of the rectum, or of the vagina, and sometimes through the unbroken skin; and the order in which these avenues are named is that of the rapidity of absorption in each. Volatile poisons may enter the system with the inspired air, and rarer modes of poisoning, such as from the urethral surface, from the eyes, nose, etc., have occasionally been noted.

*Circumstances affecting the Action of Poisons.*—Every poison must be in liquid or gaseous state to act. Solution may be effected in the stomach, but at times the stomach and intestines free themselves before the solid poison is dissolved. Sometimes elimination is so rapid and absorption so slow that poisoning does not ensue, and thus a substance may be intensely toxic when injected beneath the skin, though harmless in the stomach. The question of absorption depends much upon the character of the poison. Some, particularly certain salts of the heavy metals, exercise so much local change by chemical reaction with the solid tissues that they are absorbed in very small amounts.

After absorption, the effect of poisons depends largely upon the animal species acted upon and upon the individual. It is well known that certain individuals gain by repeated usage a high degree of immunity from the action of certain poisons, such as alcohol, opium, or the like. This immunity may sometimes be inborn; and, on the other hand, there may be marked idiosyncrasy in the opposite direction, so that the individual is affected profoundly or in a peculiar manner by even minute doses of the poison. The remarkable tolerance of entire races for certain poisons is illustrated by the comparatively trivial effects of opium in India. The evidence of the investigation (1893–95) of the British Government shows that the enormous consumption of opium by the natives of India does not lead to anything approaching the evil effects that would result from a like consumption by European races. Alcohol is comparatively trivial in its effects on Europeans as compared with certain savage races among whom it has been introduced.

The fate of poisons introduced into the system varies greatly. Some are absorbed in an unaltered state, circulate in the blood, and are excreted without any change in the urine, sweat, or other excretions. In many cases, however, chemical changes occur, by oxidation, reduction, or various forms of combination. In many cases substances violently poisonous may thus undergo changes which deprive them of toxic properties, as in the case of alcohol, which is soon broken up by oxidation. The place in which the greatest destruction occurs is probably the liver, and in the same organ very frequently a storage of the poison occurs for a time, so that only minute quantities reach the blood at a time, and serious results are prevented.

*Symptoms of Poisoning.*—These depend upon the nature of the poison, its mode of introduction, and the concentration of the solution or mixture taken. There are in general two groups of cases: (1) those in which intense tissue changes are present, and in which the resulting symptoms are irritative or dependent on absorption of abnormal products of tissue destruction; and (2) those in which the anatomical changes discovered are trivial as compared with the violence of the symptoms, which mainly spring from the nervous system.

I. Of the first group there are first those in which the poison acts upon some external surface—that is, some surface which may be reached without the entrance of the poison into the blood. (*a*) The most common form is that in which corrosives act upon the skin, causing redness, vesiculation, or various degrees of necrosis. (*b*) A most important group of cases is that in which some irritant, most commonly mineral, poison sets up gastro-enteritis (inflammation of the lining of stomach and bowel). The symptoms in such cases are primarily irritative—nausea, vomiting, pain, and purging—the dejecta being mucous, serous, and often bloody. Later, as a result of the copious evacuations, or of reflex nervous influences, depression and collapse ensue. (*c*) Gaseous irritants, or more rarely liquids, gain access to the respiratory tract, and set up intense inflammatory changes with violent cough, expectoration, and difficulty in breathing. Sometimes they occasion dropsical swelling of the mucous membranes of the larynx—œdema of the larynx—and thus lead to the most intense obstruction to breathing, ending in suffocation.

Of the same large group of poisons acting by tissue change there is a second class in which the poison gains access to the blood, and occasions alterations in that important fluid, or circulating in it leads to pathological changes in various organs. (*a*) The blood-poisons act in two ways: some enter into combination with the hæmoglobin of the blood, destroying its functional activity, and cause dyspnœa, cyanosis, stupor, and unconsciousness; others occasion more profound alterations of the blood, and when rapidly acting lead to cyanosis, jaundice, hæmoglobinuria, and rapid destruction, while the more slowly acting ones produce a gradually increasing anæmia. (*b*) The class in which the solid tissues are attacked by poisons carried in the blood is variable in the symptomatology, according as one organ or another is involved. In all the pathological changes in the organs are much the same, cloudy-swelling, fatty degeneration, and necrosis (given in the order of severity) being the alterations produced. When the liver is affected, enlargement of the organ and jaundice are noted, as in phosphorus-poisoning; when the kidney is attacked, albuminuria, bloody urine, or hæmoglobinuria, and other pathological characters of the urine are seen, as in turpentine or cantharides poisoning; when the heart muscle is involved, failing circulation, collapse, and sudden death may ensue, as in some cases of phosphorus-poisoning or chloroformization.

II. Finally there is the second large group of poisons in which marked tissue changes are not found at the portal of entrance or within the body, but in which profound nervous symptoms are observed. The symptoms vary infinitely with the part of the nervous system affected, with the peculiar activity of the poison (physiological action), and with the individual susceptibility of the person affected. Excitement, cramps or convulsions, delirium, rapid pulse, and increased rapidity of the breathing may mark one group of cases, while another presents depression, sleep, stupor, or coma, with depression of the general organic functions; but all grades of severity and shades of demarkation exist to distinguish the individual poisons.

*Diagnosis of Poisoning.*—This must be made by taking the sum of the evidence of all kinds. A thorough discussion of this intricate subject in all its medico-legal relations is obviously impossible within the limits of this essay, but the following are the essential points to be borne in mind: In the first place, the diagnosis of poisoning can not be made with infallible certainty from the symptoms alone, for there are no symptoms absolutely distinctive of any single poison. Neither does the mere fact, taken by itself, of the presence of a poisonous substance in the stomach, the excreta, or even the tissues of the dead body, necessarily prove that the illness or death was occasioned by the poison. On the other hand, neither does the absence of characteristic symptoms or lesions, or failure to detect the presence of poison, prove that the case is *not* one of poisoning. Presumptive evidence of poisoning is afforded by the following circumstances: (1) Sudden onset of the symptoms in a previously healthy individual, especially shortly after taking food, drink, or medicine. Still stronger is the presumption where several persons, so partaking, are similarly and simultaneously attacked. (2) Correspondence of the symptoms with those known to be produced by some poison. (3) Finding of a poison in the stomach, excreta, or tissues of the dead body. Proof of the presence of a poison may be obtained by chemical tests, physiological experiments upon animals with the suspected matters, etc. But as regards chemical testing, which is very properly regarded as the means of getting most certain proof, it is important to know that in a body dead from poisoning chemistry may for many reasons utterly fail to detect any traces of the poison. This, because for some poisons no definite test has yet been found, and with others because the poison may have wholly disappeared by reason of volatility, or by being vomited, excreted, or decomposed during life, before the analysis is begun, to such an extent as to be no longer within the power of chemical means to detect. Hence in judicial cases it is not always necessary to demonstrate, quantitatively, a fatal dose within the person of the poisoned individual. (4) Outside corroborative circumstances. Examples are the finding of charred clothing and corrosion of the lips in a case of suspected sulphuric acid poisoning; proof of possession of the suspected poison by the administrator; finding of motive for the poisoning; proof of administration by direct or circumstantial evidence. From the more or less perfect chain afforded thus by the evidence from the symptoms, the results of analysis, and corroborative circumstances, the diagnosis of poisoning is made with greater or less certainty.

*Treatment of Poisoning.*—The aim here is to prevent absorption or local injury by combined attempts at bodily removal of the poison and chemical neutralization of its poisonous property, and then to combat the effects by general medical means. With inoculated poisons, as in bites from venomous reptiles or rabid animals, the part should be instantly washed, and then thoroughly sucked either by the mouth or a cupping-glass. At the same time, where practicable, a ligature should be tied tightly around the limb near the wound and between it and the heart. Then in dangerous cases the wound should be thoroughly cauterized with a red-hot iron, or powerful caustics. In the use of these care must be taken not to injure any large artery or important organ. Where the poison is swallowed, the stomach should be evacuated with the least possible delay, and, if there be one, the antidote to the poison should be immediately given. For emptying the stomach the means are emetics and the stomach-pump. This should be done even though the drug itself had already caused some vomiting and had been in the stomach for some time, for the vomiting is only rarely complete enough to insure removal of all of the poison swallowed, and absorption may be so slow that some of the substance may still remain in the stomach after a long interval. Of emetics, the best is the chloride of apomorphia, because it is prompt, thorough, unirritating, and, most important of all, because it will act if only put under the skin. One-fifteenth of a grain in solution in a little water should be injected under the skin by the hypodermic syringe, or double the quantity given by the mouth. Other useful ones are the following: *Cupric sulphate* (blue vitriol), in the dose of 2 or 3 grains, repeated if necessary; *zinc sulphate* (white vitriol), dose from 15 to 20 grains; common *ground mustard*, a dessert-spoonful diffused through a tumblerful of water; powdered *alum*, a teaspoonful, taken dry, mixed with sugar, in molasses, or in water. *Ipecac* is a safe and unirritating emetic, but is rather slow. Dose, 20 or 30 grains of the powder, or from 1 to 2 tablespoonfuls of the sirup or wine. These doses are for an adult, and must be duly reduced for children. In all cases where an emetic is given, its action should be assisted by free drinking of nauseous potions, as warm water, warm salt water, or warm chamomile tea. The stomach-pump is invaluable where emetics fail to thoroughly empty the stomach, but in corrosive poisoning the stomach-pump should not be used for fear of perforating the corroded or softened walls of the stomach. When employed, water is to be repeatedly pumped into the stomach and then out again. In irritant poisoning, after evacuation of the stomach, copious draughts of bland and viscid fluids should be taken to sheathe the walls of the alimentary canal from the action of the poison. Such are mucilages, oils, flaxseed tea, milk, white of egg, barley-water, etc. As regards antidotes, the special substances to be used will be mentioned in connection with each poison. In general, antidotes act by chemically transforming the poison, while still in the stomach, into a comparatively innocuous compound. Thus for acids *alkalies* are to be given, and, *vice versâ*, for alkalies, *acids*, whereby a salt is formed devoid of the caustic effect of either of its components. For the irritant metallic salts, *albumen*, as white of egg, is given to form the comparatively insoluble, and therefore inert, albuminate of the metal. In poisoning by vegetable alkaloids the antidote is *tannin* (tannic acid), or a vegetable infusion containing the same, such as strong green tea, infusion of galls, of cinchona, of blackberry-root, logwood, rhatany, etc. Here a rather insoluble tannate of the alkaloid is formed. But yet the efficacy of antidotes is generally small; they can not reach such of the poison as has been already absorbed, and with irritant poisons they generally come too late. Effects of the poison necessarily vary greatly. In all cases, besides such local treatment as may be necessary, the special tendency to death should be recognized and intelligently combated by appropriate means.

*Detection of poisons* in medico-legal questions requires the most careful application of all chemical tests as well as of physiological experiments. The materials removed must be sealed or locked by the examiner to prevent any possible suspicion of tampering. All known tests must be tried, and in metallic poisoning the metal should be obtained from the tissues if possible. All vessels employed and the reagents must be absolutely clean and free of contamination.

### Systematic Toxicology.

*Systematic toxicology* is concerned with the classification and study of individual poisons. The best classification is that based upon the symptoms, and we may distinguish the (*a*) irritant or corrosive poisons, which act locally; (*b*) parenchyma poisons, which cause little local trouble at the portal of entrance, but decided inflammatory and degenerative changes in the organs of the body, principally the glands; (*c*) the blood-poisons, whose symptoms result from chemical or morphological changes in the blood; and (*d*) nerve-poisons, which produce marked symptoms, but little or no discoverable anatomical change.

I. *Corrosive Poisons.*—These produce a local death or necrosis of tissue, and reactive inflammation beneath and around. The extent and depth of the process depend upon the individual poison and its concentration. The most common poisons of this group are the acids and alkalies. They may act on the surface of the body, causing most painful destruction of the skin and deeper tissues, or internally with production of intense gastro-enteritis and collapse. The treatment consists in the neutralization of the poison and in the application of bland liquids to protect the inflamed surface. In the case of acids weak alkalies, such as magnesia, chalk, soap, dilute ammonia solutions, lime from the plastering of the wall, and the like may be used; in the case of alkaline poisoning, dilute vinegar or acetic acid, or lemon juice is generally at hand. After the poison has been neutralized, mucilaginous drinks, milk, the white of eggs beaten up with milk or water, and the like are given; and remedies administered to quiet irritation. The results of external application of corrosives are treated like burns, by soothing and protective applications. Among the individual poisons of this group *sulphuric acid* (oil of vitriol) is probably the commonest, and most serious. It is frequently thrown in the face with criminal intent, or accidentally applied or swallowed. Linear scars of a yellowish-brown color on the face, radiating from the mouth if the poison is swallowed, are the characteristic indication. The clothing is charred where the acid has come in contact with it. When the poison reaches the digestive tract the most intense gastro-enteritis is set up. *Nitric acid* is less intense. It produces yellowish areas of corrosion and internally violent gastro-enteritis. *Oxalic acid* and the soluble oxalates (salt of lemon and others) cause marked irritation of the mucous membrane, and also nervous symptoms from action on the brain. The ordinary alkalies are not antidotal, as the oxalates are soluble. Lime forms an insoluble oxalate, and is therefore the most useful antidote. *Hydrochloric acid* and *hydrofluoric acid* act similarly to the others of this group, as does also *carbolic acid*; but the latter occasions specific nervous symptoms as well. Of the alkaline poisons *caustic potash* and *soda* are common forms, because of their use as lye. Concentrated *ammonia* is another common form. The symptoms are of the same irritative nature as in the case of acids. *Chlorine, bromine, nitric oxide*, and other substances in vapor form act as violent irritant poisons of the respiratory tract.

II. *Parenchyma Poisons.*—There are innumerable examples of this group, but only a few of the more common can be referred to here. In concentrated form most of them cause irritation of the stomach and intestines, but the more specific action is due to their solution and absorption by the blood, and the subsequent action on the organs. The symptoms in the several cases are so varied as to require separate description.

*Arsenic* is a very common poison of the accidental and homicidal kind. Arsenic is used as a coloring-matter or for other commercial purposes in the forms of Scheele's green, Schweinfurth green, Brunswick green, Paris green, orpiment (yellow arsenic), and realgar (red arsenic). Green, yellow, and red wall-papers, carpets, and other house-furnishings may be colored with these, and the dust very often occasions slow arsenic-poisoning. Fowler's solution (containing arsenite of potassium) is very poisonous. It is often prescribed by physicians in concentrated form, and over-doses may be used by careless persons. See Arsenious Oxide.

*Acute arsenical poisoning* is generally manifested in the form of violent gastro-enteritis with pain in the abdomen, vomiting, purging of a watery character, cramps in the legs, and finally collapse with the attendant symptoms of this condition. The symptoms in such cases soon resemble those of Asiatic cholera, and the diagnosis may be extremely difficult. In other cases the abdominal symptoms are almost absent, and collapse alone or delirium and coma with convulsions may lead to rapid death. In either form the course of the case is rapid and generally fatal. The fatal dose of arsenic may be placed at from 0·1 to 0·15 gramme.

Arsenic may act as an external poison when brought into contact with the skin or mucous surfaces in concentrated form or as solid arsenious acid. In this case the lesions of a violent caustic are present, but absorption of the poison does not take place to any large extent.

The treatment of acute arsenical poisoning consists in the administration of emetics, in careful washing out of the stomach, and subsequently the administration of an antidote. The best is a freshly prepared hydroxide of iron made by adding magnesia to a solution of sulphate of iron.

Chronic arsenical poisoning is exceedingly common, more so, perhaps, than is generally supposed. In these cases the source of poison is most frequently wall-paper, colored lamp-shades, clothing, tapestries, etc., and the poison enters through the stomach or respiratory tract. Chronic catarrh of the stomach, persistent cough, sneezing, throat troubles, and conjunctivitis may be present. In more serious or protracted poisoning, paralyses, general deterioration of health, or pigmentation of the skin are noted.

*Phosphorus-poisoning* is due in all cases to the common yellow phosphorus, the red being wholly insoluble and inactive. The common sources from which this poison is derived are phosphorus matches, rat-poisons, and the phosphorated oil of the chemists. In chronic cases, mainly workmen in match-factories are affected. The symptoms of acute phosphorus-poisoning are usually those of a severe gastro-enteritis, with eructation of gases having a phosphorescent odor, and a luminous character when seen in the dark, and of vomiting of materials presenting similar characters. Enlargement of the liver, a jaundiced hue of the skin, and the appearance of leucine and tyrosin in the urine are among the more distinctive symptoms. Later, loss of consciousness, collapse, coma, and convulsions may be present. Amounts over 0·15 gramme are usually fatal.

The treatment of acute phosphorus-poisoning consists in the removal from the stomach of every trace of the poison, and the administration of ozonized oil of turpentine, of solutions of ozone in water, or of permanganate of potash. In chronic phosphorus-poisoning, catarrhal conditions of the respiratory and digestive tract are noted, but more characteristic is a form of necrosis of the lower jaw-bone, which is not uncommon among workmen in match-manufactories.

*Lead* is perhaps the most common of all mineral poisons. Acute cases are mainly due to ingestion of acetate of lead, the carbonate, oxide, or chromate; and manifests itself as an intense gastro-enteritis, with white vomiting and dejections of a black color. In more subacute cases, where small quantities of poison are repeatedly inhaled or swallowed, lead colic is apt to occur. In this condition there is intense constipation, with twisting pains in the abdomen, a certain amount of cachexia, and a blue line on the gums at the junction of the teeth.

Acute lead-poisoning may occur in persons exposed to the odors of fresh paint, and is very often met with in painters and others engaged in occupations in which lead is used. In these, however, the subacute form (lead colic) is more common than the truly acute.

In still more chronic cases, cramps of the limbs, paralysis (particularly of the forearms), and marked cerebral disturbances may be developed. Disturbances of sight, chronic Bright's disease, and gout are results of protracted lead-poisoning. Cases of very chronic and insidious lead-poisoning may occur from obscure causes, such as the drinking of water conducted in lead pipes, the use of cosmetics containing lead, and eating canned food contaminated by the lead of the solder. Water containing saline materials is not apt to be contaminated by the lead pipe, because of the precipitation of an insoluble incrustation in the pipe. Pure spring water, however, is more dangerous. In acute cases the treatment consists in emptying the stomach, and the administration of a soluble sulphate, which precipitates an insoluble sulphate of lead. Epsom salt answers this purpose, and acts as a purge as well. In more chronic cases the same purge may be employed, and iodide of potash is useful to eliminate the lead from the system.

*Mercury-poisoning* is similar to lead-poisoning in its varieties and symptoms. Very acute poisoning, with violent gastro-enteritis, results from the ingestion of the corrosive sublimate. Non-corrosive or irritating preparations may produce no local disturbance, but occasion soreness of the mouth, sponginess of the gums, and free flow of saliva with swelling of the salivary glands (mercurial salivation). In very chronic cases, particularly where small particles of vapor or dust containing mercurial compounds are inhaled, nervous symptoms are common, such as tremor, headache, and cerebral disturbances. The fatal dose of corrosive sublimate is not definitely determined; 0·5 gramme has proved fatal, and 1 gramme has been recovered from.

Treatment in acute poisoning (as by the bichloride) demands the administration of egg-albumen, milk, or other albuminous materials. In chronic cases, iodide of potash is given to eliminate the mercury, and if ptyalism is present, atropine and opium are useful.

In addition to these there are a number of other less important forms of mineral poisoning, such as those by antimony, copper, zinc, iron, silver, and chromium. Among the vegetables belonging to this group ergot takes the principal rank, for the symptoms of which see Ergotism; but it may be said at this place that there are two forms: that in which acute poisoning occurs, and in which gastro-intestinal symptoms, with sleepiness, delirium, and coma, play a part, and chronic poisoning, which is apt to affect large communities of people, particularly during periods of famine, and which may occasion a form of gangrene or irregular nervous disturbances.

III. *Blood-poisons.*—The number of these is very great, but none of them is of such great importance as to merit extended discussion. Carbonic oxide gas, bisulphide of carbon, sulphuretted hydrogen are among these. Somewhat more important are the various cyanogen compounds, such as prussic acid, cyanide of potash, oil of bitter almond, and ferrocyanide of potash. These may lead to rapid death in the course of a very few minutes, with loss of consciousness, intensely disturbed respiration, and great weakness of the pulse. When the poison is taken in less quantity, preliminary dizziness, nausea, ringing in the ears, and other mild symptoms may precede more serious disturbances. Chlorate of potash, nitrobenzol, aniline, and nitroglycerin are analogous in action. Among the vegetables the poison mushroom *Amanita phalloides* and certain others less well-known act similarly upon the blood.

IV. *Nerve-poisons.*—Finally, there is the great group of poisons which act through the nervous system, and which for the most part cause no definite and recognizable changes of structure. Many sub-classifications have been attempted, but the actions of the individual poisons are so varied in some directions and so similar in others that it is best to attempt no subdivisions.

*Opium* and its principal alkaloid, *morphine*, are perhaps the most common of all poisons used for suicidal and homicidal purposes. The better qualities of opium contain from 12 to 20 per cent. of morphine as well as other alkaloids. Some of the preparations of opium are specially apt to be taken by accident or design, such as the tincture (laudanum), the extract, and the solution of morphine. Paregoric contains so little opium that it is dangerous only for children. The fatal doses can not easily be estimated, as idiosyncrasy plays a more prominent part in the action of this drug than of any other. Children bear it very badly. From 0·2 to 0·4 gramme of morphine and from 2·0 to 4·0 grammes of opium may be taken as surely fatal doses. Habit will develop tolerance for these or even greater quantities in some persons.

*Acute opium-poisoning* is marked by a preliminary stage of mild or considerable cerebral excitement, in which, as a rule, pleasant emotional stimulation predominates. Later, drowsiness, sleep, and complete unconsciousness follow in order. In the first stage the pulse is excited, and the skin dry and warm; in the second the pulse is weak and irregular, the skin grows cold and moist, and with growing stupor the muscular power and reflexes are completely lost. The pupil is more and more contracted, until just before death, when paralytic dilatation may occur. The respirations become slower and slower, until the individual breathes but once a minute, or even less frequently. The skin becomes livid, and the patient dies gradually and quietly of failure of the respiratory power. In some persons the primary stage of stimulation may alone occur, and wild delirium or convulsions may be the only symptoms.

*Treatment.*—The stomach must be promptly emptied, and repeatedly washed with water. Tannic acid may be given as an antidote, but permanganate of potassium has been found decidedly useful. Cerebral stimulants should be given to combat stupor, such as coffee, atropine, or strychnine. The patient must be kept awake by cold douching or other means, and electrical stimulation of the respiratory muscles or artificial respiration should be practiced. Forced artificial respiration will save many cases apparently dead.

*Chronic Opium-poisoning.*—Opium eating and smoking are scourges of the East, but the consumption of opium or morphine is a common habit in Western countries as well. In the East the results are comparatively trivial. Among Europeans and Americans there is gradual deterioration of health, more and more craving for the drug, and intellectual deterioration. Eventually death ensues from exhaustion and disturbance of the gastro-intestinal tract.

The treatment can only be carried on with satisfaction in institutions where abstinence can be enforced. Regulation of the general health and tonics must be used as adjuvants in the treatment.

*Chloral.*—This substance is in frequent use as a hypnotic, and has often been taken as a poison. The symptoms in acute cases are those of deep sleep, without a previous stage of excitement such as opium produces. The patient may pass into deep coma, and sudden heart failure is not rare. The treatment consists in the rapid removal from the stomach, and in the administration of strychnine, atropine, and other stimulants. Chronic chloral-poisoning leads to symptoms not unlike those of chronic alcoholism in some persons; more characteristic, however, are certain eruptions in the skin, weakness of the heart, with rapidity of its action, and emaciation of the individual.

*Chloroform* and *ether* are the well-known anæsthetics. In overdoses these act as narcotic poisons, and sometimes chronic poisoning is acquired as a habit. The symptoms in the case of etherization or chloroformization may be divided into two stages, like those of opium-poisoning. In the first the patient is excited, the heart is accelerated, the respiration is rapid, and the face flushed. In the second consciousness becomes more and more disturbed, until the patient is wholly insensible, the muscles are relaxed, and the reflexes are wanting. If pushed too far absolute paralysis of the vital functions may occur, and the patient dies of failure of respiration or of the heart's action. If these substances are taken into the stomach they act as local excitants and irritants. Certain persons acquire the habit of inhaling or of drinking ether and chloroform, but such are comparatively rare.

*Alcohol* is perhaps the commonest of all poisons, and may manifest itself as an acute or chronic intoxicant. The details are given under the headings Intoxication and Inebriety (*qq. v.*).

*Atropine*, the alkaloid of belladonna, in overdose produces delirium, flushing of the skin, dryness of the mouth, dilatation of the pupil, and sometimes convulsions. Wide differences exist in different persons with regard to the tolerance for this drug. The smallest dose which has proved lethal is 0·095 gramme in a child of three years, and 0·195 gramme in an adult. The treatment consists in the removal of the poison from the stomach, the administration of tannic acid as an antidote, and of morphine to combat the symptoms.

*Cocaine* is derived from the *Erythroxylon coca*. The symptoms produced by overdoses are rapidity of the heart, cold sweat, nausea, and vomiting, followed by vertigo, unconsciousness, and delirium. The pupils are dilated. Death occurs in collapse. The fatal dose may be placed at 1 gramme.

Morphine may be used as an antidote in the earlier stages, while stimulants will be required in the later stages. Chronic cocaine-poisoning presents many of the symptoms seen in chronic opium-poisoning, and the treatment is the same.

*Strychnine* is the alkaloid of the *Strychnos nux-vomica*. In toxic doses it produces intense excitement of the spinal cord and general nervous system, leading to cramps and convulsive seizures resembling those of tetanus. The slightest irritation, as by a breath of wind, may throw the patient into a violent convulsion, in which the body is bent backward, resting upon the heels and head. The patient as a rule remains conscious until shortly before death, when cyanosis may be present from tetanic arrest of respiration, and coma may be developed. The fatal dose for adults is from 0·03 to 0·1 gramme. The treatment consists in rapid evacuation of the stomach and the administration of chloral and opium.

There are many other vegetable substances which act upon the nervous system in similar manner, and some of these, like aconitine, nicotine, and curari, are intensely toxic. The more important, however, have been named.

*Animal Poisons.*—There are a number of animal poisons, such as the venom of serpents, tarantulas, etc., which are properly considered in this place. The action of these is rather complex. There is, in the first place, decided local irritation at the point of the sting or bite, leading to swelling, redness, and œdema, and, in severe cases, it may be to gangrene. Then the poison after its access to the blood may occasion serious destruction of that fluid, with the production of such symptoms as jaundice, cyanosis, hæmaglobinuria (the blood coloring-matter appearing in the urine), and finally hæmorrhage into the tissues or from the free surfaces; and, finally, there are general symptoms, due on the one hand to the blood-poisoning and on the other hand to direct action upon the nerve-centers. Among these general symptoms are dyspnœa, vertigo, extreme prostration, loss of power of the muscles, slowing of the pulse, with weakening of the heart's action, and finally collapse. Death may occur rapidly, or after a period of prolonged prostration. The treatment of such poisoning consists, in the first place, in the application of a tight band on that side of the point of injury toward the body, so as to shut off rapid absorption; in the second place, the destruction, by the knife or cauterizing agents, of the area of inoculation; and, in the third place, of the administration of remedies, such as ammonia, alcohol, or strychnine, to support the system. The poisons in question are albuminous substances, which may be extracted from the liquid secretion of the poison glands by glycerin and other agents, and even dried and preserved.

*Putrefactive Poisons.*—Many instances have been recorded in technical literature, as well as in the public prints, of poisoning of families or communities of persons by food which has undergone some change of a putrefactive character. The foods most apt to give rise to such poisoning are meat, sausage, and cheese. The poisons in these cases are spoken of as ptomaïnes, and numerous forms have been described. The actions of these are as dissimilar one from another as are those of the various vegetable alkaloids, and there is a strong resemblance in action of some of these ptomaïnes to certain of the vegetable alkaloids. Not only this, but there is a close relation in chemical reaction of some of them, so that it becomes a matter of the greatest medico-legal interest to determine the minute differences between these animal poisons and the vegetable alkaloids. See Vaughan and Novy, *Ptomaïnes and Leucomaïnes*.

William Pepper.

**Toxiglos'sa** [Mod. Lat.; Gr. τοξικόν, pertaining to an arrow, hence poison + γλῶσσα, tongue]: a group of molluscs, including the cone-shells, the augur-shells (*Terebridæ*), etc., in which there is frequently a poison apparatus in connection with the lingual ribbon.

**Toxodon'tia** [Mod. Lat., plur. of *To'xodon*; Gr. τόξον, bow + ὀδούς, ὀδόντος, tooth]: a sub-order of extinct mammals whose remains have been found in South America. They were most nearly related to the perissodactyle ungulates, but differed in several characters, and especially the teeth, showing affinities with the *Proboscidea* and *Rodentia*. The molars of the upper jaw were broad, and extended severally into an externo-anterior angle; those of the lower jaw were narrow, and continuous in a uniform row; the incisors were diversiform in shape as well as the mode of insertion and number; the feet are mostly unknown; the hind feet, however, had the astragalus at its anterior face inclined obliquely inward, and articulating in front only with the navicular, and the calcaneum had an extensive upward-extended surface for the articulation of the fibula, and a large lateral process articulating in front with the astragalus. Two families—the *Toxodontidæ* and *Typotheriidæ*—represent the sub-order. Revised by F. A. Lucas.

**Toxodont'idæ**: a family of placental mammals of the order *Toxodontia*, which formerly flourished in South America, and which were especially distinguished by their teeth, which consisted of large incisors, very small canines, and strongly curved molars, all with persistent roots. Only one genus, *Toxodon*, is known. It was composed of large-sized mammals which lived in South America during the later Tertiary epoch. The remains first obtained of *Toxodon platensis* were found by Darwin during his sojourn in the Banda Oriental, near the Sarandis, a tributary of the Rio Negro, about 120 miles N. W. of Montevideo, and were known to the natives as giants' bones. Revised by E. A. Birge.

**Toxot'idæ** [Mod. Lat., named from *To'xotes*, the typical genus, from Gr. τοξότης, bowman, archer, deriv. of τόξον, bow]: a family of fishes of the order *Teleocephali* and sub-order *Acanthopteri*, remarkable for the power of "shooting" water at insects, etc., to insure their capture. The family is represented by but two known species—*Toxotes jaculator* (see Archer-fish for illustration) and *Toxotes microlepis*—in the East Indian and Polynesian seas. These (or at least the former) catch insects and other small animals which rest on aquatic plants or those growing on the banks near their quarters, by protruding their mouth into a tubular form and shooting drops of water, and it is said they can hit insects thus at a distance of 3 feet and more. This habit is a source of amusement to the natives, and the fishes are kept to give evidence of their skill and industry. They attain a length of about 6 or 7 inches.

Revised by E. A. Birge.

**Toy**, Crawford Howell, D. D., LL. D.: educator; b. at Norfolk, Va., Mar. 23, 1836; graduated at the University of Virginia 1856; attended the University of Berlin 1866–68; was Professor of Hebrew in Southern Baptist Theological Seminary 1869–79; since 1880 Professor of Hebrew and other Oriental languages and Dexter lecturer on biblical literature in Harvard University; translated and edited the volume on Samuel in Lange's *Commentary on the Bible*; edited Prof. Murray's *Origin of the Psalms* (1880). He is author of *The Religion of Israel* (Boston, 1882; 3d ed. 1884); *Quotations in the New Testament* (New York, 1884); and *Judaism and Christianity, a Sketch of the Progress of Thought from Old Testament to New Testament* (Boston, 1890).

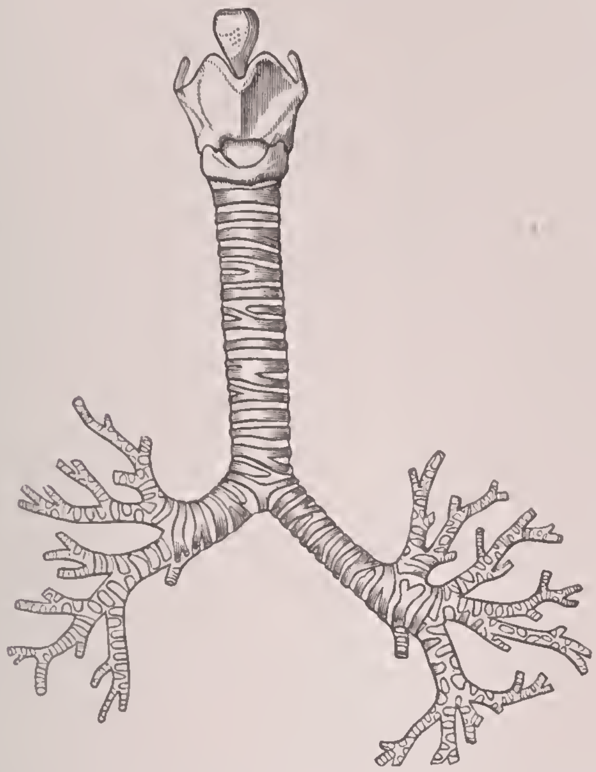
Revised by S. M. Jackson.

**Toynbee**, Arnold: philanthropist; son of Joseph Toynbee, a well-known aural surgeon; b. in London, Aug. 23, 1852; spent two years at a military college, but left and entered Oxford, and after taking his degree proceeded to London. Having a keen sympathy with the laboring classes, he took up his residence in Whitechapel, and devoted himself to improving the condition of the poor, addressing audiences of workingmen, and taking part in religious work. His health was undermined by his incessant labors, and the strain incidental to the delivery of two lectures against Henry George's *Progress and Poverty* was the immediate cause of his death in 1883. From the inspiration of his example arose Toynbee Hall, founded in 1884, as the outcome of a scheme, framed by members of Oxford and Cambridge Universities, to provide education and the means of recreation for the people of the poorer districts of London, and to consider and support plans calculated to promote their welfare. It is a center of social life and organized effort to elevate the masses by educational work, loan exhibitions of pictures, etc. There is a regular force of fifteen residents, besides a body of associates, men and women, who come at intervals to take charge of classes and clubs. In connection with Toynbee Hall are Wadham House and Balliol House, where students and workers reside. Similar institutions, called college settlements, have been founded in the U. S. See University Settlements. R. A. Roberts.

**Trac'adie** [Micmac *Tracadiesh*, or Heron island]: town of Gloucester County, New Brunswick; near the mouth of Tracadie river, and on the Gulf of St. Lawrence; 20 miles S. of Shippigan (for location, see map of New Brunswick and Quebec, ref. 3–I). It has good fisheries of herring, salmon, and cod. Here are about twenty lepers, formerly more numerous, and the disease is said to have been introduced from

Mitylene in 1758. Traeadic contains a Trappist monastery and a convent of Sisters of Charity. Pop. about 1,200, mostly Acadian. M. W. H.

**Tra'chea** [Mod. Lat., from Lat. *tra'chia* = Gr. τραχεῖα, liter., the rough one (scil. ἀρτηρία, artery, windpipe)]: the tube which in all air-breathing vertebrates carries the air from the oral cavity to the lungs. It begins on the floor of the throat and extends backward until it divides into two parts



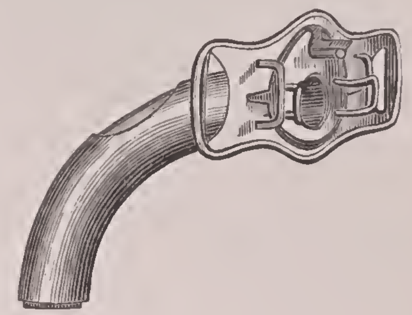
Human trachea dividing below into the bronchi. At its upper end the laryngeal cartilages.

(*bronchi*) connected with the right and left lungs. In its wall are numerous incomplete rings of cartilage; these being to prevent collapse and at the same time, by reason of their incompleteness, to allow the œsophagus to compress them during the swallowing of food. The term trachea has also been applied to the air-tubes which penetrate the body in insects and spiders. These have also a ringed appearance, due to a corrugation of the lining membrane, and not, as was formerly thought, to the presence of a spiral filament. See ENTOMOLOGY. J. S. KINGSLEY.

**Trachea'ta** [Mod. Lat., from TRACHEA (*q. v.*)]: a group of ARTHROPODA (*q. v.*) recognized by many authors, embracing those forms which respire by air-tubes which penetrate the body. Under this head are included the insects ARACHNIDA and MYRIAPODA (*qq. v.*). The later discoveries go to show that this division is unnatural, and that there are at least two distinct kinds of tracheæ in the group.

**Tracheids**: See HISTOLOGY, VEGETABLE.

**Tracheot'omy** [Mod. Lat. *trache'a* = Gr. τραχεῖα + τέμνειν, cut]: opening of the trachea by incision or puncture for the free ingress and egress of air when respiration is labored or suffocation is imminent from laryngeal obstruction. Older writers treat the subject under the title bronchotomy. The operation is chiefly demanded when the larynx is obstructed by the membrane of croup or diphtheria, is the seat of acute œdema or dropsy, is closed by the impaction of foreign bodies, or is contracted by previous inflammation or ulceration. It may also be performed to permit the escape of foreign bodies accidentally passing the larynx and entering the trachea and bronchial tubes. When goiter of great size compresses the upper part of the trachea, tracheotomy affords relief. Older writers advocate opening the trachea before employing artificial respiration in cases of asphyxia by noxious vapors or drowning, but this is seldom done. The air-passage may be opened at either of three points. Laryngotomy, the operation highest up and involving least danger, is preferable when membranous or other obstruction does not exist below the larynx; it consists in opening through the crico-thyroid membrane. Incision a little lower, cutting the cricoid cartilage and one ring of the trachea, is termed laryngo-tracheotomy, while incision of one or more rings of the trachea below the thyroid gland is strictly tracheotomy. The operations are most easily performed on thin, long-necked children; infants with short necks and corpulent persons present difficulty. The incision is always longitudinal, and in the median line over the elected point of opening, the cutting being cautious and progressive; at every step vessels should be pushed to one side rather than cut, as bleeding delays the operation, and the entrance of blood into the air-passage endangers life by causing asphyxia by clot, or at a later period by exciting broncho-pneumonia. When the trachea is fully exposed, it is firmly held with a sharp hook or tenaculum and incised, and a tracheotomy tube or canula, provided with a fenestrated, hollow pilot-trocar as a guide, is inserted, the guide being removed as soon as the tube is in place. The canula is usually of silver or rubber, curved so as to descend in the air-passage. An inner tube is provided, slightly longer than the outer one. Mucus or membrane obstructing the end may be removed by withdrawing and cleansing the inner tube. The tube is retained in the wound by means of a tape around the neck, and should be worn until all danger from the original disease is past and the larynx is again free. Tracheotomy is performed more frequently than formerly, and with increasing success. It should not be left till too late; should be carefully performed at a point below all obstruction; the tube should be of large size, adequate to admit air freely; an attendant should be constantly at hand to keep the tube open; the patient should breathe a pure but warm and moist atmosphere, and should be supported by abundant but easily assimilated food and by tonics.



Tracheotomy tube.

Revised by JOHN ASHHURST, Jr.

**Trachin'idæ** [Mod. Lat., named from *Trachi'nus*, the typical genus, from Gr. τραχύς, rough, rugged]: a family of marine teleost fishes containing the forms known in England as weevers and kindred types. The body is elongated, narrowed from shoulders to tail, and compressed; the scales very small; lateral line high up and continuous; the head terminates in a conical snout; eyes lateral, but separated by a narrow interval, and far forward; the operculum has a strong acute spine arising from its upper surface and pointing backward; villiform teeth are developed in bands on the jaws and palate; the branchial apertures are continuous below; branchiostegal rays in six pairs; the dorsal is represented by two fins, the first short and sustained by a few diverging spines, the second elongated and with branched rays; the anal is very long, and composed of articulated rays; the caudal distinct; the pectorals large, and composed of branched rays; the ventrals are approximated to each other and jugular, and have each a spine and five rays; pyloric appendages are developed in small number (about six); the vertebral column has the normal number of abdominal, but an increased number of caudal vertebræ (A. 10–11 + C. 25–31). The family is composed of a few species, chiefly found in the European seas (where are three) and along the western African coast, but one occurs along the coast of Chili. By most authors these species have been combined in one genus (*Trachinus*), but they have been distributed among three by Bleeker. They are considerably feared by fishermen and others on account of the formidable opercular spines, with which they can inflict severe wounds. These spines are generally cut off when the fishes are caught, and thus they are exposed for sale. The species are of inconsiderable economic importance. For illustration, see GREAT WEEVER. Revised by F. A. LUCAS.

**Trachoma**: See GRANULAR LIDS.

**Trachypter'idæ** [Mod. Lat., named from *Trachyp'terus*, the typical genus; Gr. τραχύς, rough + πτερόν, fin]: a family of teleost fishes of the order *Teleocephali* and sub-order *Acanthopteri*. The body is very long and exceedingly compressed, and gradually diminishes in height from head to tail; the skin is naked; the lateral line is low and continuous; the head is oblong and compressed; the eyes lateral, and in anterior half of head; the opercular bones unarmed, scaleless, and with radiating striæ; the mouth has a small cleft; the teeth are feeble; branchial apertures confluent below; branchiostegal rays in six pairs; dorsal fin very long, extending the whole length of the back, divided into a very short elevated anterior portion and a remaining continuous fin, all the rays of both of which are flexible spines; anal wanting; caudal undeveloped, or composed of an enlarged upward-directed upper and a rudimentary lower portion; pectorals small; ventrals thoracic or absent; there are five gills, and also well-developed pseudobranchiæ, "situated in a pouch formed by a fold of the mucous membrane (*Trachypterus*);" pyloric appendages are developed in large number; the skeleton has comparatively little consistency; the vertebræ are very numerous. This family is composed of large-sized, extremely compressed, and thin fishes, which are inhabitants of the deep or open seas, and rarely stranded on shore or otherwise caught. They are probably widely distributed; specimens have been observed from time to time in many parts of the European seas, as well as in the Bermudian archipelago, the Australasian seas, the East Indian seas, and on the west coast of North and South America. The large species have doubtless in part given rise to the belief in a sea-serpent, and been mistaken for such, as they well might from a distance on account of their size, some species of *Regalecus* attaining the length of 20 feet. Nearly twenty species of the family are known. Revised by F. A. Lucas.

**Trachysto'mata** [Mod. Lat.; Gr. τραχύς, rough + στόμα, mouth]: a group of amphibians by some considered as a sub-order of *Gradientia* or *Urodela*, and by others (e. g. Cope) as an independent order. It has been constituted for the reception of the family *Sirenidæ*, and is characterized by the absence of the basioccipital, supratemporal, supraoccipital, and vomer; there are no maxillary or palatine arches. The frontals and premaxillaries are distinct, as are also the propodial bones and caudal vertebræ. There are but two species in the group, *Siren lacertina* and *Pseudobranchus striatus*, both from the southern parts of the U. S. F. A. Lucas.

**Trach'yte** [from Gr. τραχύς, rough, rugged]: aphanitic or glassy rock, usually porphyritic, having chemical composition similar to that of syenite. Constituent minerals are potash-feldspar (sanidine), some lime-soda-feldspar, and one or more ferromagnesian minerals—biotite, hornblende, augite—besides others in small amount. Abundant alkalies lead to the crystallization of sodalite and nephelite, when the rock grades into Phonolite (*q. v.*). When quartz is present in small amount the rock is quartz-trachyte; with increasing quartz it passes into Rhyolite (*q. v.*) and pantellerite. Trachytes may be rough and porous, or compact and dense, or glassy, dense vesicular, or pumiceous. Non-porphyritic trachytic glass, or trachytic obsidian, is distinguishable from rhyolitic obsidian, the more common kind, only by its chemical composition. Trachytes are usually light-colored rocks, but may be any shade of gray to black. Many rocks formerly called trachyte are andesite, being rich in calcium and in lime-soda-feldspar. The name *trachyte* was introduced by Haüy in 1822 for light-colored, porous, and rough lavas of the Auvergne with glassy feldspars. Afterward it was applied to any rough lava with prominent glassy feldspars. Modern petrographic usage restricts it to the definition given above. Trachytes are much rarer rocks in the U. S. than andesites. They occur in Montana, Wyoming, South Dakota, and Colorado, and are better known in Italy, France, and Germany. J. P. Iddings.

**Tracta'rianism**: the Anglican doctrinal and religious system promulgated in the Oxford *Tracts for the Times*; the principles of the movement known as the *Oxford Movement* and afterward as the *Catholic* or *Anglo-Catholic Revival*. In the first quarter of the nineteenth century the distinctive principles of the Church of England were maintained with little zeal, and public worship and church edifices evidenced laxity and neglect. The old High Church party still existed, but inactive and in the background. Evangelicalism dominated, but had spent much of its force. Constant attacks were made on the doctrines and liturgy of the Church, neological teachings were imported from Germany, and unfavorable political changes seemed imminent. The first marked sign of a reaction was the appearance of John Keble's *Christian Year* and its phenomenal popularity. Keble was a strong Tory and High Churchman and a brilliant scholar, but very modest and retiring. Richard Hurrell Froude, Keble's pupil, and of a more aggressive disposition, brought under Keble's influence John Henry Newman, till then known as an Evangelical. In 1833 the changes connected with the Reform Bill threatened the Church. The Government had suppressed ten bishoprics in Ireland, and disestablishment and alterations of the Prayer-book were feared. In view of the agitation against the Church, Keble preached July 14 a university sermon, which was published under the title *National Apostasy*, and was regarded by Newman as the start of the movement. In the same month a meeting to begin an agitation in defense of the Church was held at the parsonage of Hugh James Rose, editor of *The British Magazine*. Addresses presented to the Archbishop of Canterbury in 1834, one signed by 7,000 clergy and the other by 230,000 heads of families, counteracted the movement toward disestablishment. The publication of the *Tracts for the Times*, prepared by different authors and far-reaching in their influence, began Sept. 9, 1833. The first sixty-six tracts were short papers, some original, but mostly extracts from eminent Anglican writers, especially of the seventeenth century, and from Ante-Nicene fathers. The opening paper struck the key-note. To restore the vigor and authority of the Church it was necessary to reaffirm her divine institution and historical continuity, and so the doctrine first emphasized was that of the apostolic succession. In the course of 1834–35 Dr. Edward Bouverie Pusey, a man of influential position, massive learning, and quiet solidity of character, joined in the preparation of the tracts, which now became carefully digested theological essays or catenæ of authorities, and of considerable length. The teaching of the tracts seemed novel and strange to many. The Anglican understanding of the Catholic Church as one historical body with an organism perpetuated by the apostolic succession, and with a doctrinal system inherited from the past and defined by councils accepted both in the East and West, of which body the Anglican Church was a living part with her own authoritative usages and formularies, was a conception strange alike to Roman Catholics, who considered the historical Church as conterminous with the papal obedience, and to dissenting Protestants and the general public, practically ignorant both of Church history and of the actual existence of the great Greek Church, ancient, orthodox, and non-Roman. The points especially insisted on by the Tractarians in addition to apostolic succession (the grace of the sacraments, and therefore belief in baptismal regeneration, the real presence in the holy Eucharist, and the power of the keys in absolution) were therefore regarded by many as Romish. Tractarian strictness in fasting and favor shown to clerical celibacy were viewed in the same light. During the publication of the tracts Newman was the most prominent figure in the movement. His wonderful powers as a preacher and writer and his immense personal influence over the Oxford undergraduates made him especially influential and prominent. As the movement progressed differences began to appear among its adherents. Some laid aside former feelings against Rome and began to respect and even admire her. Some began to have misgivings as to the Catholicity of the Anglican Church. William G. Ward occasioned many complaints by anti-Anglican and pro-Roman articles in *The British Critic* and by his book, *Ideal of a Christian Church* (1844). After several occurrences which had intensified feeling against the Tractarians, *Tract No. XC.*, the last of the series, appeared in 1841. It dealt with the Thirty-nine Articles from the Tractarian point of view. The Articles had, at the time of the Reformation, been accepted by Anglicans unfavorable to Protestantism as well as by the others, but were afterward considered distinctively Protestant and even Calvinistic. When Newman, therefore, undertook in this tract to show that they were capable of being understood in a Catholic sense, his treatment was taxed as dishonest and tending to Romanism. The tract was condemned by the hebdomadal board of the university, which refused to wait for his defense. After this and other troubles Newman in 1845 entered the Church of Rome. In this step he was followed by others, a number seceding soon after him and others at various dates. These defections were held by those unfavorable to the movement to demonstrate its Romish character. On the other hand, the statement has been made that "one large parish church would hold them all" (i. e. all the converts from Anglicanism to Romanism since Newman). Other leaders of the movement, including the two greatest, Keble and Pusey, remained steadfast Anglicans. Both approved of *Tract No. XC.*, and its positions have since been widely accepted by Anglicans.

The movement, at the time apparently much injured, survived its losses and became vigorous again. As Pusey was now its most prominent figure it was for a number of years termed Puseyism. One very valuable outcome of the movement, begun as far back as 1836, was the series of translations entitled *Library of the Fathers of the Holy Catholic Church anterior to the Division of the East and West.*

In its new stage, since 1845, the Anglo-Catholic revival has assumed a more and more practical character in the institution of guilds, religious sisterhoods and brotherhoods, and parochial missions, improvement of church music, introduction or revival of hymns and popular devotions, restoration and building of churches. Since 1848–50 there has been also a revival of ritual, grounding itself especially on the ornaments rubric of the present English Prayer-book as re-enacted in 1662, directing the retention and use of the ornaments of the second year of Edward VI. Those most prominent in this revival were called Ritualists, and met not only with popular opposition, but with litigation and special legislation, subjecting them to lay judges. A number of priests were even imprisoned for their ritual, and societies were formed to prosecute and to defend them. In a case in 1888–90 (appeal 1892), a bishop (Dr. King, of Lincoln) was tried before the Archbishop of Canterbury, a case important as reviving such exercise of authority. But the general result, whatever the action of these courts, has been the extension of the ritual impugned.

All the principal phases of the Tractarian and Anglo-Catholic movement have reproduced themselves in the Episcopal Church of the U. S.

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LEIGHTON HOSKINS.

**Tract Societies** [*tract* is from Lat. *tracta'tus*, a touching, handling, treating, treatise, deriv. of *tracta're*, handle, treat]: societies for the publication and circulation of religious literature, other than the Scriptures, which are distributed by organizations called BIBLE SOCIETIES (*q. v.*).

The word tract, though commonly applied to small, unbound pamphlets, includes also, by derivation and early usage, any treatise or bound volume for general circulation, of whatever size. Long before the invention of printing, the importance of multiplying copies of the best religious writings was recognized, for the sake of both preserving and diffusing them, and the early Reformers made great use of them, the timely invention of printing opening the way for a rapid growth of this method of doing good.

*European Societies.*—In the eighteenth century the friends of religion began to associate themselves for greater efficiency in this work, three societies having been organized before 1701 by members of the Church of England—one "for the propagation of the gospel in New England and America," another "for foreign parts," and the third for "promoting Christian knowledge." In 1750 was formed the first tract society in which different denominations united—the Society for Promoting Religious Knowledge among the Poor. In 1793 the Religious Tract and Book Society of Scotland was formed. In May, 1799, the Religious Tract Society was organized in London, and has since become the largest and most efficient tract society in the world. The first year its entire receipts were £2,340; now (1895) its annual income is about £175,000, and its grants £29,000. It has issued a total of over 18,000 different publications, large and small. Its publications at home and abroad are in 212 languages, and amount to a total of 3,000,000,000 copies. Besides this great and undenominational society, each religious denomination in Great Britain has a publication board of its own; and the opponents of religion have adopted the same means of disseminating their views. There are also tract societies in which Christians of all denominations unite, at Paris, Lausanne, Toulouse, Brussels, Geneva, and some other points on the continent of Europe; also at various foreign missionary centers.

*Societies in the U. S.*—In the U. S., where common school education and a free press have formed an eminently reading community, tracts and volumes on religion appeared early and in great numbers, and societies for printing and circulating them were at length formed—the Methodist Book Concern in 1789; the Massachusetts Society for Promoting Christian Knowledge, at Boston, in 1803; and other societies in Boston, New Haven, Middlebury, Vt., New York, Albany, Philadelphia, Baltimore, and Hartford. Prominent among these was the New York Religious Tract Society, organized in 1812, and afterward continued in the American Tract Society, New York; and the New England Tract Society, organized in 1814, which in 1823 changed its name to the American Tract Society, and in 1825 became a branch of the national society of the same name, then instituted. In the present American Tract Society Christians of all denominations in the U. S., and most of the local tract associations then existing, united to publish and circulate whatever would best "diffuse a knowledge of our Lord Jesus Christ as the Redeemer of sinners, and promote the interests of vital godliness and sound morality"—with only this restriction, that it should be "calculated to receive the approbation of all evangelical Christians." Such men, of twenty different denominations, have always been found among its officers, its laborers, and its warm friends and supporters. For the first two years only brief tracts were published, for adults and for children. The issue of volumes, however, was intended from the first, and in the third year volumes began to appear. In the fourth year monthly tract distribution began to be practiced by many churches and church unions. In the eighth year was begun an attempt to supply every family in the Southern and Western States with one or more volumes. The next step was the organization of a system of colportage, in 1841, to carry the Gospel to the doors of neglected, scattered thousands—at least one-third of the entire population of the U. S.—who would never seek it and whom churches did not reach. Each colporteur was to visit every family in his district, induce them to purchase or accept Christian books or tracts, and by his teachings and prayers do as far as possible the work of a Christian pastor. At one time over 600 men were so employed during the whole or a portion of the year.

Another notable point in the progress of the society is found in the establishment of its periodicals. The first three were *The American Messenger*, the *Amerikanischer Botschafter*, and *The Child's Paper*. To these have since been added the *Deutscher Volksfreund* (or *German People's Friend*), an eight-page illustrated weekly; *The Morning Light*, a small illustrated paper for beginners; *Apples of Gold*, a weekly for the youngest readers; and *Light and Life*, a series of monthly tracts. The aggregate circulation of these papers is about 2,500,000 yearly. The distribution of tracts in foreign languages forms a large and very important branch of the society's work. Its home presses print in more than thirty foreign tongues for the millions of immigrants that swarm into the U. S., and for many foreign missions.

Among results may be mentioned the printing of over 8,000 distinct publications, of which over 1,900 are volumes and the others tracts, handbills, wall-rolls, etc. Among the publications for home use are 1,560 in seventeen foreign languages—German, French, Spanish, Italian, Portuguese, Swedish, Welsh, Dutch, Danish, Bohemian, Polish, Armenian, Hebrew, German-Hebrew, Lithuanian, Finnish, and Hungarian—for immigrants, for many of whom scarcely any other Christian literature is provided. Of the periodicals 231,000,000 copies have been issued. Of the other home publications, over 31,000,000 volumes have been printed and over 3,150,000,000 pages of tracts, literature which has had an immense influence. Annual grants to the destitute are made to the amount of over $30,000 worth of the society's home publications, forming a total of $2,180,000. Besides large amounts thus transmitted by shipping to foreign nations, a total of over $720,000 in money has been granted to aid the missionaries in heathen lands to print books which the society approves for their work; and thus 4,600 publications, including 800 volumes, have been printed by its help abroad, in 151 languages.

Since the organization of the system of colportage the society has circulated 15,000,000 volumes, and its agents have made over 14,000,000 family visits. The total amount received in donations and legacies, and expended in the charities of the society, is over $6,000,000; and the sales amount to above $13,000,000.

Besides these undenominational societies, each of the leading denominations in the U. S. has its own board of publication.

WILLIAM W. RAND.

**Tracy**: city; Lyon co., Minn.; on the Chi. and N. W. Railway; 165 miles S. W. of St. Paul (for location, see map of Minnesota, ref. 10-B). It is in a noted wheat and corn belt, and contains 7 churches, a public school with twelve departments, electric lights, water-works, a State bank with capital of $35,000, a private bank, and 2 weekly newspapers. Pop. (1880) 322; (1890) 1,400; (1900) 1,911.

EDITOR OF "REPUBLICAN."

**Tracy**, trăă'see', ANTOINE LOUIS CLAUDE DESTUTT, Count de (commonly called Destutt de Tracy): philosopher; b. near Moulins, France, July 20, 1754; was educated for the army; was a member of the States-General in 1789; joined the revolutionary party; served in the army under Lafayette; was, nevertheless, arrested, but was released after the fall of Robespierre; was made a senator under the empire, but voted for the deposition of Napoleon; opposed the reactionary measures of the restoration. D. at Auteuil, Mar. 9, 1836. He was a commander of the Legion of Honor, and a member of the French Academy. He published *Grammaire générale* (1803); *Logique* (1805; often reprinted); *Traité de la volonté et de ses effets* (1815); *Éléments d'idéologie* (4 vols., 1817-18), containing a full representation of his philosophical system; *Essai sur le génie et les ouvrages de Montesquieu* (1828). As a philosopher he was a follower of Condillac and a representative of the sensualistic school, whose principles he, in common with the other members of the society of ideologists at Auteuil, pushed to their last consequences.

**Tracy**, tră'si, BENJAMIN FRANKLIN: lawyer and statesman; b. at Owego, N. Y., Apr. 5, 1830; educated in the common schools and Owego Academy; admitted to the bar 1851; district attorney for Tioga County 1853-56; member of the State Assembly 1861; appointed by the Governor in the spring of 1862 to recruit for the Union army; personally recruited the 109th and 137th Regiments; accepted the coloneley of the former; participated in the battles of the Wilderness and Spottsylvania; on account of ill health was obliged to go North to recuperate; on recovery became colonel of the 127th Colored Troops, and commanded the military post at Elmira; obtained the rank of brevet brigadier-general; resumed practice of law at the close of the war in New York city; U. S. district attorney for eastern district of New York 1866-73; associate justice New York State court of appeals 1881-83; appointed by President Harrison Secretary of the Navy, Mar. 5, 1889. On the expiration of his term he resumed the practice of law in New York.

**Tracy**, ROGER SHERMAN: See the Appendix.

**Tracy City**: village; Grundy co., Tenn.; on the Nash., Chat. and St. L. Railway; 20 miles S. by N. of Cowan (for location, see map of Tennessee, ref. 7-G). It is on the summit of the Cumberland Mountains, in a coal-mining and coking region, and has railway car and repair shops, foundry, steam sawmill, and a weekly newspaper. Pop. (1890) 1,936; not returned separately in 1900.

**Trade-mark**: a mark by which one's trade or wares are known in business. The rules of law governing this subject have been developed during the nineteenth century. Lord Chancellor Hardwicke declared in 1842 that while every trader had his distinctive mark or stamp, he knew of no precedent for enjoining one trader from using another's mark, and he thought such a precedent would be mischievous. Such a precedent was established, however, by Lord Eldon in 1803 (*Hogg* v. *Kirby*, 8 Ves. 215), and was followed by a very rapid growth of this branch of the law.

STATUTES AND TREATIES.—Trade-marks have become the subject of modern legislation and international conventions. In Great Britain the principal statutes are the Merchandise Marks Acts of 1887 and of 1891 (50 and 51 Vict., c. 28, and 54 and 55 Vict., c. 15). The earliest legislation by the U. S. Congress on this subject was enacted in 1870 as a part of an act to revise the statutes relating to patents and copyrights. Its constitutionality was soon attacked and the Supreme Court decided against its validity, holding that a trade-mark is neither an invention, a discovery, nor a writing, and hence was not within Art. I., § 8, cl. 8, of the U. S. Constitution; also that the statute in question was not a regulation of commerce with foreign nations, or among the several States, or with the Indian tribes (see Art. I., § 8, cl. 3), but was a regulation applicable to all trade. (*U. S.* v. *Steffens*, 100 U. S. 82.) The court declared that the property in trade-marks, like the great body of the rights of person and of property, rests on the laws of the States. At present there is an abundance of State legislation on this subject. Later acts of Congress are limited to trade-marks used in commerce with foreign nations or with Indian tribes, and are therefore constitutional. (See Act of Mar. 3, 1881, 21 U. S. Statutes at Large, ch. 128.) Section first of the last-named act provides that owners of trade-marks used in commerce with foreign nations, or with Indian tribes, provided such owners shall be domiciled in the U. S., or located in any foreign country, or tribes which by treaty, convention, or law, afford similar privileges to citizens, may obtain registration of such trade-marks by recording in the Patent Office the prescribed statement and by paying $25 to the U. S. treasury. The reciprocal privileges referred to above have been secured by special treaties, one of the latest of which is the treaty with Denmark of June 15, 1892, or by the International Convention for the Protection of Industrial Rights, adopted at Paris Mar. 20, 1883, to which the U. S. became a party July 3, 1887, and which was reproclaimed June 22, 1892. 27 U. S. Statutes at Large, Treaties, p. 119.

*Its Nature and Purpose.*—These were set forth with clearness and precision by Justice Strong in a leading case in the U. S. Supreme Court. The office of a trade-mark is to point out distinctively the origin or ownership of the article to which it is affixed. This may in many cases be done by a name, a mark, or device, well known, but not previously applied to the same article. But though it is not necessary that the word adopted as a trade-mark should be a new creation, never before known or used, there are some limits to the right of selection. This will be manifest when it is considered that, in all cases where rights to the exclusive use of a trade-mark are invaded, it is invariably held that the essence of the wrong consists in the sale of the goods of one manufacturer or vendor as those of another, and that it is only when this false representation is made, or the necessary tendency of defendant's acts is to deceive the public, that the party who appeals to a court of equity can have relief. Hence the trade-mark must either by itself or by association point distinctively to the origin or ownership of the article to which it is applied. The first appropriator of a name or device which points to his ownership, or which, by being associated with articles of trade, has acquired an understood reference to the originator or manufacturer of the articles, is injured whenever another adopts the same name or device for similar articles, because such adoption is in effect representing falsely that the productions of the latter are those of the former. Thus the custom and advantages to which the enterprise and skill of the first appropriator had given him a just right are abstracted for another's use, and this is done by deceiving the public, by inducing the public to purchase the goods and manufactures of one person supposing them to be those of another. The trade-mark must therefore be distinctive in its original signification pointing to the origin of the article, or it must have become such by association. There are two rules which are not to be overlooked: No one can claim protection for the exclusive use of a trade-mark which would practically give him a monopoly in the sale of any goods other than those produced or made by himself. If he could, the public would be injured rather than protected, for competition would be destroyed. Nor can a generic name, or a name merely descriptive of an article of trade, of its qualities, ingredients, or characteristics be employed as a trade-mark, and the exclusive use of it be entitled to legal protection. *Canal Co.* v. *Clark*, 13 Wallace 311.

It will be observed that the foregoing decision bases the protection of trade-marks on the power of the courts to prevent fraud. Such is deemed to be the correct view in the U. S. (*Chadwick* v. *Covell*, 151 Mass. 190.) The later English cases, however, place emphasis on the property element in a trade-mark, and no longer conceive of the wrong to be redressed "as a species of fraud, but as being to an incorporeal franchise what trespass is to the possession or right to possession of the corporeal subjects of property." Pollock, *Torts*, p. 264.

The right to use a trade-mark is not confined to a manufacturer or producer of goods. One who exercises skill and fidelity in the selection of goods, or who bleaches goods, or is a shipper, a commission merchant, a seller or a carrier, may acquire the right to a trade-mark which serves to distinguish his vendible commodities from those of others—to authenticate them as the signature authenticates a letter.

*When Acquired.*—It is sometimes said that a trade-mark must have been used for a considerable period before its adopter will be protected. The better view appears to be, however, that as soon as the mark is adopted and used as a trade-mark in connection with vendible articles, the right to protection is complete. *Cope* v. *Evans*, L. R. 18 Eq. 143; *Shaver* v. *Shaver*, 54 Ia. 208.

*Examples.*—As stated above, a name or device which is generic or descriptive of the article, its qualities, ingredients, or characteristics can not be monopolized as a trade-mark. Accordingly, the courts have refused to protect the use of such terms as Cherry Pectoral, Toffe Tulu, Rye and Rock, Straight Cut, Cresylic Ointment, Iron Bitters, Ferro-phosphorated Elixir of Calisaya Bark; while they have protected Cottolene, Bromo-caffeine, Lacto-peptine, Sirup of Figs, and others. The decision in such cases often turns on a question of fact. Is the term, claimed as a trade-mark, either originally descriptive of the article, or had it, before its adoption as a trade-mark, become incorporated into the language so as to be descriptive of the article? If either of these questions is answered in the affirmative, the term can not be protected as a trade-mark. (*Chemical Co.* v. *Meyer*, 139 U. S. 540; *Kearly* v. *Brooklyn Chemical Works*, 142 N. Y. 467.) On the other hand, if the term is employed in an arbitrary or fanciful manner, the person first adopting and using it in connection with his wares will be protected. The word "Ideal," therefore, applied to fountains has been held a valid trade-mark, so La Favorita applied to flour, so Falstaff and Phil. Sheridan applied to cigars, and Roger Williams applied to cotton cloth.

Devices, symbols, or pictures may be used as trade-marks. For example, a star, an elk's head, a picture of a boy doubled up with cramps, a peculiar grouping of letters, an arbitrary combination of numerals such as 3214, may be used to individualize the goods made or dealt in by a particular person, and become a valid trade-mark. Letters or numerals, however, can not be monopolized to indicate quality.

Ordinarily a geographical name can not be turned into a trade-mark. If it is used in an arbitrary or fanciful sense, it may be protected, as in the case of Vienna bread, or Columbia Hotel; and in Britain, certainly, it will be upheld if it has acquired a secondary signification in connection with a particular manufacture, as in the case of Glenfield starch. (*Wotherspoon* v. *Currie*, Law Reports, 5 House of Lords 508.) The name of a mine or of a mineral spring may become a valid trade-mark for its product, where the one asking for protection is the exclusive owner of the spring or mine. "Carlsbad salts," "Clysmic water," "Hunyadi Janos," "Apollinaris" and "Congress water" are examples.

*How Lost and Transferred.*—The owner of a trade-mark may lose his right to it by abandoning it, that is, intentionally discontinuing its use. It is incumbent on one alleging abandonment to show by clear and unmistakable evidence that the right has been relinquished. If the owner is guilty of laches in proceeding against persons infringing his trade-mark, he may lose his right to an account for part profits, but does not lose his right to an injunction. *McLean* v. *Fleming*, 96 U. S. 245.

A trade-mark is a subject of commerce and may therefore be sold and transferred, unless such disposition of it works a fraud upon the public. If it is personal, that is, if it owes its value to the personal skill of a particular individual, it can not be transferred, as it is inseparable from that which gives it its value. Oftentimes a trade-mark is an incident of a particular business. In such cases a sale or devolution of the business carries with it the trade-mark without any express mention of it. Upon the dissolution of a partnership each partner has the right to use a firm trade-mark unless he has vested the others with an exclusive right to this firm asset. (*Merry* v. *Hoopes*, 111 N. Y. 415.) The treatises upon this subject are numerous. Among the best are Barclay, *Law of France relating to Trade-marks*; Sebastian, *Law of Trade-marks* (London, 1890); and Browne, *Law of Trade-marks* (Boston, 1885). FRANCIS M. BURDICK.

**Trad'escant**, JOHN: traveler and naturalist; b. in Holland about 1570; traveled through various countries of Europe, Asia Minor, and North Africa, making a collection of objects of natural history; was in 1608 settled in Kent, England; subsequently established a botanic garden at South Lambeth, where he added largely to his collection of curiosities; was the means of acclimatizing several useful plants in England; was employed by several of the nobility to lay out their gardens, and in 1629 was appointed gardener to Charles I. D. at Lambeth in 1638.—His son JOHN, b. at Meopham, Kent, in 1608, added largely to the collection by his travels, in the course of which he visited Virginia, and published in 1656 a descriptive catalogue under the title *Museum Tradescantium, or a Collection of Rarities preserved at South Lambeth, near London.* D. Apr. 22, 1662. The museum was given by the younger Tradescant to the antiquary Elias Ashmole, and became the nucleus of the celebrated Ashmolean Museum, presented to the University of Oxford 1682. Revised by C. E. BESSEY.



**Trade Schools**: See SCHOOLS.

**Trades-unions**: societies of workingmen organized chiefly to assist members in contest with employers to secure rights and privileges. They are a natural evolution of the ancient guild into more definite, better organized, and larger societies than the guilds were.

*Origin of Trades-unions.*—They made their appearance about the middle of the eighteenth century, by which time mere temporary combinations of workmen to resist employers' exactions and to raise wages crystallized into permanent local societies which were virtually trades-unions. They were at first confined each to its own trade. Each town then separated its union from every other, and isolated societies were the only unions. These were at first supported by voluntary contributions, but as each union hardened into permanency and began to have regular needs, a specified tax was laid upon members and a treasury was established. Later the features of benefit societies were added to attract new members, but the union still retained its primal object as a fighting organization to resist injuries and to secure privileges, the usual objects of every organization in history from the church and the state down to the family and partnership. Trades-unions differ in no way from other combinations of men for self-protection and self-aggrandizement.

In their benefit society features unions agreed to give help to members out of work, for sickness, or other legitimate cause, to pay burial expenses for members and their wives, and sometimes to give superannuation allowances, insurances against accident, and the like. By such provisions unions secured more members and larger funds. But these objects were not the chief purpose of the unions. That was and continues to be the adjustment of relations between men and masters in a way favorable to the men, and the points for which the men are combined were in general always the same, namely, higher wages, shorter hours, provisions against physical dangers connected with work, and equalization of work among different bodies of workmen so as to prevent over-supply in one and scarcity of work in another.

*English Trades-unions.*—It was in England that trades-unions took their rise. The reason of this rise in England rather than elsewhere was because there the wages system consequent on the development of the factory first came into general use. Then for the first time laborers were grouped in large bodies, and this grouping tended naturally to associations for mutual help and protection. The old industrial body had been slack, personal, intermittent, and had called into existence temporary coalitions of workmen for specific purposes which dissolved themselves as soon as those purposes were accomplished. But with the advent of the factory system, with its regular wage payments and promotion of stable habits, workmen began to improve their condition. With the increase of production their average wealth increased, and this turned their occasional coalitions into permanent institutions. English law for centuries bore hard upon all labor combinations and punished them as conspiracies. The common law from time immemorial and many express statutes down to 1825 made them criminal. Workmen were forbidden even to discuss wages rates, hours of labor, contracts between employers and employed, or to try to induce their fellows to join them in efforts to increase wages. In fact they were absolutely forbidden to work out their own interests in any reasonable way down to 1825. Between 1776 and 1814, however, the inventions of Hargreaves, Arkwright, and Watt brought about a vast increase of production, which was succeeded as always by increase of wages. Workmen were gathered into cities and began to consult together. The result was an accession of force which, though against the law, made it possible for them to combine and discuss. Parliament at last began to listen and statutes were passed recognizing the legality of combinations of workingmen. In 1815 the ten-hour movement started, which won its victory in 1847. In 1867 special factory laws protecting children and women were passed; in 1875 laws to improve laborers' houses and preventing payment in commodities were made, and to-day labor finds itself intrenched, protected, and favored on all sides, with political parties bidding against each other for its support and vote.

*Labor Representation in Parliament.*—In 1874 the first labor member of Parliament, Thomas Burt, was elected in England. He was president of the Northumberland Miners' Association. In 1885 the labor interests elected ten members; in 1886 thirteen members. In 1892 seventeen were returned, among whom was Sir Charles Dilke. Up to 1886 these members were all representatives of unions of skilled laborers. They stood rather for defensive than aggressive measures. In the elections of 1895 the labor party received a severe blow in the defeat of most of its candidates.

*Trades-unionism since 1886.*—Since 1886 the development of trades-unions in Great Britain has been most important. A great step was taken in the organization of unskilled labor, which dates from the London dock strike of 1889. Joseph Arch had organized rural laborers between 1870 and 1875. Benjamin Tillett and Thomas Mann organized the dock workmen, and by a strike succeeded in raising their wages to sixpence an hour. This has been followed by the so-called new unionism, a movement to organize unskilled labor everywhere in the United Kingdom. This unionism is aggressive, and elected four members to the House of Commons in Aug., 1892. It goes for the eight-hour day, for "one man, one vote," payment of members of Parliament and election expenses by Government, simplification of procedure in law courts, better factory acts, and other valuable measures. The British unions extend to every department of industry, and are now the fourth estate of the realm. In 1883 Great Britain had 195 unions of 253,088 members, and funds amounting to £431,495 sterling. In 1886 the membership had increased to 800,000, and in 1893 was 1,507,026, or 3·98 per cent. of the entire population.

*Continental Nations.*—In Germany trades-unions of a type differing from the British began to appear in 1868, laws against combinations of workmen having been repealed in 1866. General unions were first formed, and afterward local unions under the direction of the general unions. They originated with the professional classes, and in 1869 had 267 societies in 145 towns with 30,000 members, diminished to 20,000 in 1872, but have since increased. They tend much to theories, unlike British unions, which are for business only. They easily become socialistic, get into politics, and begin to decay because they gain so little of practical benefit to their members. In 1875 France had seventy unions forbidden to meddle with politics. Switzerland and Belgium have many unions in a flourishing condition. Italy has had them since 1865, but they are still subject to some legal disabilities. Poorer countries have none, and all continental trades-unions are more interested in views than in gains of wages or shorter hours as a rule, and are therefore ineffective. Fifteen national organizations, with over 52,000 members, were represented at the International Typographical Congress held at Berne, Switzerland, in 1892. It was resolved to create an international strike and traveling benefit fund, and to agitate for uniform wages and less hours. The next international congress was appointed for 1897.

*Trades-unions in the United States.*—Colonial history shows no labor-unions among its scattered populations. Unions rise in cities, and not till 1840 did the U. S. possess a city of a population of 500,000. Local labor-unions arose, however, from 1800 to 1825. Notably the New York Society of Journeymen Shipwrights, organized Apr. 3, 1803; the House-carpenters of the City of New York, in 1806; the New York Typographical Society, 1818—with Thurlow Weed for a member. In Boston the Columbian Society of Shipwrights and Calkers of Boston and Charlestown was given a charter in 1823 "to have and use a common seal, to make its own by-laws, manage and apply its funds, promote invention and improvements in its arts, assist mechanics with loans of money, and relieve unfortunate mechanics and their families."

Local labor-unions multiplied between 1815 and the beginning of the civil war (1861). These local unions also began to extend to men of the same trades in other cities as the railway developed increased ease of intercourse, and finally the idea of a general national union began to be mooted, though with indifferent success. In these movements the best men among the most skillful laborers took the lead. Boston, New York, and Philadelphia were most prominent in the struggles of labor during those years. In 1820 George Henry Evans and his brother Frederick arrived in New York from England, and soon began to influence laborers with their ideas of land reform, holding that men should have only the use of land, and rent should be abolished. They published *The Workingmen's Advocate* between 1825 and 1829, probably the first labor paper published in the U. S. The General Trades-union, established in New York in 1833, was the first central labor-union in the U. S. Its objects were "to guard against encroachments by aristocracy, to preserve natural and political rights, to elevate moral and intellectual conditions, and to establish the honor and safety of industrial vocations." The right of laborers to combine for protection was asserted, and the position that general trades-unions would diminish the number of strikes and lockouts was maintained. One rule was that "no trade or art should strike for higher wages without the sanction of the convention."

In 1831 Stephen Simpson published in Philadelphia *The Workingmen's Manual*, with the motto "Governments were instituted for the happiness of the many and not the benefit of the few," and to show that "labor is the source of wealth and industry the arbiter of its distribution." The writer had no notion of the economic laws which determine distribution, giving to each his own with small regard to civil laws or society resolutions. Seth Luther published *An Address to Workingmen* in 1832 of greater value, in which he recounted the miseries of workmen of that day. They worked from twelve to fifteen hours per day, beginning often at half-past four. Children eleven years of age and women were treated with incredible brutality, beaten, and maimed, and mangled. Wages were low, from 65 to 71 cents per day. The press was hostile, and employers everywhere denounced trades-unions and combined to suppress them; $20,000 was raised among Boston merchants for that purpose, so ignorant were they of their usefulness.

A workingman's convention in 1830 nominated Ezekiel Williams for Governor and gave him 3,000 votes. Their party was later called Locofocos and joined the Democrats, who favored them more than did the Whigs. Their work and principles show an advanced stage of social thought, though mixed with many uneconomic ideas, such as the abolition of "wages slavery," the inalienability of homes, abolition of laws to collect debts, and the natural right of man to the soil. Other notions, as the abolition of imprisonment for debt, equal rights of women, abolition of slavery, general bankrupt laws, were more reasonable, and some of them have taken their places on the statute-book.

The New England Association of Tanners, Mechanics, and other Workingmen was formed in 1831, and met in Boston Sept. 6, 1832. The labor movement began to enlist much sympathy now among literary people—William Ellery Channing, Robert Rantoul, Horace Mann, and the like—who laid stress on education. Their sympathy was grateful, their help very small, since what was needed was not words but more things and greater production. Poverty could only be abolished by wealth, and poverty was the disease to be cured.

*Dates of Organizations.*—In 1850 the Typographical Union appeared, and in 1852 used first the prefix National, then International. At first New York, New Jersey, Pennsylvania, Maryland, and Kentucky were represented in it; now it extends through all the States and some Territories. At first opposed by employers, it is now welcomed and supported by most and endured by all. Labor organizations were formed by the hatters in 1854, iron workers in 1858, machinists in 1859, and others organized later till twenty-six trades had national unions in 1860, and many have been added since. International unions were formed by cigar-makers (1864), engineers (1864), masons (1865). Unions were also formed by conductors (1868), wool-hatters (1869), furniture-workers (1873), locomotive firemen (1869), horseshoers (1875), granite-cutters (1877), coal-miners (1885), bakers (1886), carpenters, plasterers, tailors, glass-workers, boiler-makers, bookkeepers, bottle-blowers, plumbers, piano-makers, switchmen, spinners, stereotypers, lithographers, and finally messenger-boys. At length women also caught the spirit, and organized their various callings, till now the unions are everywhere.

In 1872 eight-hour leagues began to be formed, and they are now very extensive. Already many trades have secured the nine-hour and some the eight-hour work-day. In the U. S. trades-unions, though numerous, were local and confined to their own special trades until Mar. 3, 1859, when the National Union of Machinists and Blacksmiths was called together in order to make a more extended organization. It met in Philadelphia and took into consideration a long list of workmen's "wrongs," such as "the payment of wages in orders," the taking on of too many apprentices, and the peremptory dismissal of workmen. It recognized, however, the real identity of interests between employers and employed.

The success of this meeting led one of the moulders, W. H. Silvis, to call another for permanent organization. The same Mr. Silvis also called to order the first national union of all trades-unions on Feb. 22, 1861. During the civil war the National Labor-union fell into abeyance, but was revived in 1867, though with little enthusiasm at first. It pushed forward the homestead law, however, and in June, 1868, it succeeded in getting the eight-hour labor-day adopted by Congress as the standard time of Government employees. It adopted a platform, reciting a long list of grievances entailed upon labor by the existing scheme of society, and so deployed into politics, with the usual result of such departures from the proper field. The National Labor-union fell into neglect during the years from 1870 to 1873, and threatened to disappear. A general convention was called at Cleveland, O., on July 15, 1873, to prevent this, under the new name of an Industrial Brotherhood, which passed the usual denunciatory resolutions, and called a second meeting on Apr. 14, 1874, at Rochester, N. Y. But, entering the domain of politics with a very radical programme, this organization perished as the previous one had, and was dead in 1875 from mere "neglect and indifference." Trades-unions properly so called still flourished, but the National Union, to effect by law that amelioration of the laborers' condition which could be accomplished only by an increase of production, fell to pieces for want of a sufficiently practicable purpose.

*Knights of Labor.*—On Dec. 9, 1869, the Garment Cutters' Union of Philadelphia dissolved itself, and divided its money among its members. On the 28th of the same month some of the ex-members of that body met and formed the first association of the Knights of Labor. To save its members from the temptations of the saloon this body resolved to combine reasonable pleasure with business, and had refreshments served at its meetings. The trades-unions had become social, and like most social institutions began to succeed, since a social trend is always better than a political one. The order was made secret, and care was taken to avoid the admission of unfit persons as members. In July, 1870, this organization was opened to others beside garment cutters, and soon began to assume wide relations. It was simply an evolution of the ordinary trades-unions to an extraordinary extension, and carried with it, therefore, that relation to practical business affairs which the more ambitious national brotherhoods had lost in politics. Its secrecy and the consequent limitation of its members gave it an unusual interest to workmen. One of its expressed objects was to harmonize labor and capital. It discountenanced strikes, idleness, and frivolity, and was to labor for the prime object of securing to every man the fruits of his toil. It arose out of the irrational readiness of the trades-unionists to strike all round for the grievance of one man without considering the injuries which the strike might work to all. The unions thought only of the workman; the Knights of Labor began to consider the community. It really marked a step in advance over all previous organizations in the field of thought, inasmuch as it displayed a consciousness of social duties belonging to the mechanic apart from any mere quarrel with his employer, duties which might lead him to waive his own wrongs in deference to the greater evils to be suffered by society in case he insisted upon his contention.

This organization also sought to occupy a higher intellectual plane than any before it. It set to work to compile facts about the classes belonging to it, to learn their work, wages, and mode of living, to keep a record of the number of its employed and non-employed, to encourage men to know the laws of the land, and to learn to read and write at least their own names. The second branch of the Knights of Labor was organized on July 18, 1872, and by Jan., 1876, it had over 100 societies from all kinds of trades, extending as far W. as Wyoming. In 1877 it took part in the great strike on the Baltimore and Ohio Railroad and the Pennsylvania Railroad to resist a 10 per cent. reduction of wages, which resulted in losses of $5,000,000. Four hundred and fifty-six assemblies were in existence in 1877, and in June, 1878, a national body of Knights of Labor was organized. It adopted the platform of the deceased Industrial Brotherhood at Reading, Pa. Laborers still remained under the common misconception that "the development of aggregated wealth" threatened to increase the poverty of the masses and their degradation, which is much like saying that plenty of rain is the cause of drought, or a big crop in a tobacco-field tends to sterilize a corn-field. In 1881 the knights discarded the rule of secrecy.

Many of their ideas are good, as that "Politics are always too late, coming only after the evil is done—that they must be superseded by education." They would have spoken better if they had said "Education is too slow; we must devote ourselves to production and increasing our own wealth —the rest will come." The establishment of labor bureaus in different States occupied the knights' attention with such success as to create such bureaus in twenty-eight States, and finally the U. S. bureau of labor was established in 1884, a really signal step in advance for the civilization of the U. S. In 1888 the Department of Labor was further created at Washington, and at last there was begun a reasonable governmental attention to the main interest for which government exists at all, and that is the increase of the means of living among the people. The eight-hour problem is now the main consideration of trades-unions. The alien-labor law, long seriously contended for, is already in force.

*The American Federation of Labor.*—This organization originated in Nov., 1887. In 1891 it claimed to have 4,453 local unions under its control, included in seventy-four general unions, under Samuel Gompers, president. Its general objects are the same with other unions, namely, short hours, higher wages, protection of laborers in factories and on active duty, prevention of unprepared and useless strikes, prevention of the labor of children under fourteen years of age, passage of laws to improve the laborers' condition, equalization of men's and women's wages for the same work, and the like. Between it and the Knights of Labor there is more or less antagonism, arising from their attempting to cover much the same ground as universal organizations. The knights desire a centralized system, while the Federation of Labor wishes to leave the different trades-unions in a position like that of the separate commonwealths in the U. S., each with its own government. In most matters the two organizations aim at similar results, but with different machineries. Neither of them has as yet attempted the organization of unskilled labor in the U. S., where the difficulties would be enormous owing to differences of nationalities in the laboring classes and the constant influx of laborers from all countries. Many of these importations, unfortunately, are far below the level of organization as yet.

*Benefits of Trades-unions.*—George Howells enumerates the benefits of trades-unions to workmen as follows: (1) Discipline arising from subjection to rules and laws. (2) Unity, which gives strength. (3) Social restraint, inducing sobriety. (4) Thrift, arising from frequent discussions of ways and means. (5) Emulation among members, who ridicule drones and botchers. (6) Educational effects springing out of discussions of important subjects and political issues. Mr. Howells, however, fails here to include the benefits for which the unions chiefly exist, namely, to raise wages and shorten working hours. STARR HOYT NICHOLS.

**Trade Winds**: See WINDS.

**Tradu'cianism** [from Lat. *tra'dux*, *tra'ducis*, a vine-layer trained for propagation, deriv. of *tradu'cere*, lead across, lead along, train, propagate]: the theory that the human soul is derived from the souls of the parents, as the body is from their bodies. Tertullian, Athanasius, Gregory Nazianzen, and the Lutheran theologians are Traducians, generally holding that the parents are the divinely appointed means of a divine act of creation. Augustine leans toward this view, although careful not to commit himself to it. During the Middle Ages, however, creationism, or the theory that each soul is a separate creation and joined to the body just after its conception, was the orthodox view, and is the prevalent view in the Roman and Protestant Churches. Revised by S. M. JACKSON.

**Trafalgar**: See CAPE TRAFALGAR.

**Trag'acanth** [from Lat. *tragacan'thum*, deriv. of *tragacan'tha* = Gr. τραγάκανθα, a shrub producing tragacanth; τράγος, goat + ἄκανθα, thorn]: a gummy exudation from several shrubs of the genus *Astragalus* found in Asia Minor and neighboring lands. The dried gum is slightly translucent, resembling horn in appearance. It is hard, but difficult to pulverize; has no smell, and but very little taste. It does not dissolve in water, but absorbs it, swelling up and forming an adhesive paste. Upon adding an additional quantity of water to this paste, a uniform mixture is formed, from which, however, the greater part of the gum is gradually deposited. It is insoluble in alcohol. Tragacanth appears to consist of two distinct constituents, of which only one is soluble in water. This is very similar to gum arabic, but differs from it in a few chemical properties. The insoluble portion, which is perhaps identical with *bassarine* ($C_6H_{10}O_6$), and is termed *tragacanthine*, is colored blue by iodine, but the coloration is probably owing to the presence of a small proportion of starch. The analysis of tragacanth gives gum, 53·3; tragacanthine and insoluble starch, 33·1; water, 11·1; the ash forming 2·5 per cent. Gum tragacanth is used in calico-printing, and also to some extent medicinally.

Revised by IRA REMSEN.

**Trag′edy** [from O. Fr. *tragedie* < Lat. *tragœ'dia* = Gr. τραγῳδία, deriv. of τραγῳδός, tragic poet or singer, liter., goat-singer; τράγος, goat + ἀείδειν, ᾅδειν, sing, the tragedy originating in a rustic festival]: that variety of the drama which represents the fatal solution of a tragic situation or the final catastrophe in the lives of characters doomed for some cause to misfortune or evil. This definition, however, like all definitions of the forms of art, must be regarded as empirical and incomplete. The most famous and in many ways the most interesting definition of tragedy is that given by Aristotle in his *Poetics* (ch. vi., Butcher's trans.): "Tragedy is an imitation of an action that is serious, complete, and of a certain magnitude; in language embellished with each kind of artistic ornament, the several kinds being found in separate parts of the play; in the form of action, not a narrative; through pity and fear effecting the proper purgation of these passions." Here, as throughout the *Poetics*, Aristotle uses "imitation" not of mere realistic picturing of fact, but of creative reproduction of fact, similar to the original production of it in nature. The process of purgation is undoubtedly a medical analogy, and implies an effect of tragedy on the spectator similar to the effect of medicines according to homœopathic theory.

Historically, tragedy is purely an invention of the Greek genius, and the name is actually given to no dramatic work that either is not Greek or was not composed directly or indirectly under the influence of Greek models. The drama, of course, is found among many peoples that have felt little or not at all the intellectual influence of Greece, e. g. India (compare the dramas of KALIDASA, *q. v.*), China, and Japan. But no dramatic work of these peoples, however violent its incidents, is generally accepted as a tragedy. In the Occident, also, in modern times, tragedies have been composed only where some knowledge of the Greek drama or its Latin imitation was generally diffused.

The origin of tragedy is to be found in the Greek lyric dithyramb in honor of the god Dionysus. This is first mentioned by Archilochus, though it must have existed long before him, particularly in Thrace, where Dionysus was particularly celebrated. Originally probably monodic (that is, sung by a single voice), this lyric form was late in the seventh century B. C. employed by Arion of Lesbos for the choral celebrations of Dionysus introduced by him at Corinth. Arion, furthermore, constituted his choruses of satyrs (τράγοι, τραγικὸς χορός), after a fashion already familiar in the Peloponnesus. In this form the choral dithyramb came to Athens during the reign of Pisistratus in the sixth century, and was made a feature of the new festival of Dionysus—the Great Dionysia—celebrated in the spring toward the end of March. In 534 B. C. the poet Thespis made an important innovation by appearing as a reciter of verses, in colloquy with this chorus of satyrs. It now became possible to relate an action, the chorus by its songs showing the emotion produced by it. The action, however, could not as yet be represented. Nevertheless immense possibilities were already opened to the new literary form. Early in the fifth century we find Phrynichus employing it to bring before an Athenian audience the capture of Miletus by the Persians and the battle of Salamis. The glory of finally constituting tragedy belongs, however, to Æschylus, who, by introducing two reciters or actors, made possible a real reproduction of the events described. This innovation made feasible the representation of all kinds of tragic themes; but Æschylus wisely turned for his material in the main to the great store of heroic legends of the Greeks, many of which had already been employed in the epos. Athenian audiences, therefore, were delighted by the visible portrayal of heroic personages familiar to them, personages involved, too, in those very actions with which they were associated by long tradition. As a consequence, the vogue of tragedy in the fifth century B. C. became very great, and a multitude of poets entered the annual competitions for popular favor. Of these, the most famous are Sophocles, who gave still greater variety to the representation by the use of a third actor; and Euripides, whose innovations in style and in the choral parts of the drama were felt by conservative contemporaries, like Aristophanes, to have robbed tragedy of what was highest and noblest in it.

The rise of Attic comedy, as well as the decay of tragedy itself, prevented the production of tragedies in Greece from being important after the fifth century B. C. The dramas of the three great poets remained, however, objects of admiration and of eager literary study. Thus it naturally happened that when the Romans, in the end of the third century B. C., turned to Greek literature for models for their own, they adopted tragedy among the first literary forms. Both by direct translations and by imitations the Roman playwrights sought to familiarize their fellow countrymen with what they believed to be the noblest achievement of the dramatic art. Livius Andronicus, Nævius, Ennius, Pacuvius, and Accius, all rendered noteworthy services to this end during the third and second centuries B. C. And yet with all their efforts these writers do not seem to have been able to make tragedy really popular at Rome, or so to establish the form and style of it that their successors should have safe models to follow. To judge by the fragments and other indications, the tragedies of the first century B. C. had lost most of their inner meaning and become empty rhetoric or trivial vulgarity. In the first century of the Roman empire, however, there was a kind of purely literary revival of the writing of tragedies, though public audiences seem by this time quite to have ceased to be interested in them. In cultivated circles, however, the *Thyestes* of L. Varius, the *Medea* of Ovid, and the nine tragedies of L. Annæus Seneca, the younger, which last alone survive entire, as well as others by less eminent writers, enjoyed a considerable reputation. This was really the last effort of Roman tragedy. Toward the end of the same century, to be sure, Curiatius Maternus essayed the form, but with no durable success, and after the first century the writing of tragedies practically ceased in the Roman world. The gladiatorial shows were the only tragic spectacles enjoyed by Roman audiences, and in the theaters only comedy in its various forms was given.

We come now to a long gap in the history of tragedy. In the last centuries of the Roman empire there was a steady decline in the condition of the theater, and after the Germanic invasions of the fifth and sixth centuries actors became one of the most scandalously degenerate classes of society. Nothing could exceed the contempt and reprobation with which the Church spoke of the *histriones*, *mimi*, *scurræ*, *thymelici*, etc., during the whole mediæval period. The very names comedy and tragedy ceased to have a determinate meaning attached to them. The former was applied to any poem with a painful beginning and a happy ending; the latter to poems in which the case was reversed. Isidore of Seville puts Horace, Persius, and Juvenal among the *comici*, while others classed the epics of Lucan and Statius among tragedies. Dante was still under the influence of these confusions, and called his great poem *Commedia*, because its style, not being Latin, was not properly that of tragedy; and because, beginning with hell and ending with paradise, the work conformed to the supposed principles of comedy.

As the mediæval period drew to a close, a new form of the drama rapidly developed itself, at first quite without the influence of ancient tragedy or comedy. This was the *mystery-play*, which was followed later by the *miracle-play* and the *morality*. All these forms arose from the necessities and observances of the Church; and through them the world became familiarized with a pathetic drama ungoverned by the laws that had obtained among the classical playwrights from Æschylus down. In it unity of time and place were unknown, the subordination of character to action was unthought of, and the limitation of the number of the actors was impossible. Vivid pictorial effects and psychologic analysis were the chief means of success. From these traditions of the mediæval drama it has been impossible for modern dramatists, however much imbued with the classical spirit, to break away.

The revival of tragedy proper connects itself with the larger revival of the study of antiquity, which is called the Renaissance. During the whole mediæval period, to be sure, there had been considerable familiarity with the comedies of Terence, and the Saxon nun Hrotsuitha (tenth century) had attempted to imitate them. We find also occasional traces of a knowledge of the tragedies of Seneca, and these were destined to have an important part in the revival of tragedy. Indeed, this revival may be said to date from the *Commentaries* on Seneca's tragedies composed by the learned English Dominican Nicholas Treveth (about 1260–1330), at the request of Cardinal Niccolò Albertini da Prato, Bishop of Ostia and Velletri (d. 1321), one of the most influential men at the papal court at Avignon. Treveth's *Commentaries*, both from his own reputation and from that of his patron, were speedily known all over Europe, and greatly increased the interest in Seneca. In Italy particularly, where so many causes were at work to turn men back to classical antiquity, and where during the fourteenth century the powerful influence of Petrarch and Boccaccio definitely established the ideal of humanism, the step was speedily taken from admiration to imitation. Early in this century a learned circle in Padua, of which the judge Lovato was the leading spirit, gave itself to the study of Seneca, and from one of the group—the statesman, historian, and poet, Albertino Mussato—proceeded what may fairly be called the first tragedy of the modern world. The title of this is *Eccerinis*, and it is the dramatized history in Latin of the famous tyrant Ezzelino da Romano, composed in order to inspirit the Paduans in their struggle against Can Grande della Scala. In form, however, the piece follows Seneca as nearly as Mussato knew how. The meters are various and imitate Seneca's, and even the chorus is present. It was largely for this play that in 1315 Mussato received from the Paduans the poet's laurel crown. The example of Mussato was not left unfollowed in Italy, though the choice of a subject from Italian history remained peculiar. Early in the fifteenth century we find Antonio Loschi (1365–1441), of Vicenza, Gregorio Corraro (1410–64), and the Florentine Leonardo Dati winning great applause by their Latin plays after the style of Seneca. From the first we have the *Achilleis*; from the second, *Progne* (about 1428); from the third, *Hiempsal* (about 1441). On the whole, however, the humanists found comedy more congenial than tragedy, and their Latin imitations of Terence and Plautus were both more numerous and more interesting than their tragedies.

Through the efforts of these men the understanding of tragedy in the ancient sense had been restored to the world. And yet their works were works of the closet, or at best designed for mere recitation. Not one of them was ever actually played on a public stage. Here the popular religious drama still held undisputed sway. Furthermore, they were in Latin, and not till tragedies had been written in a modern tongue could modern tragedy be said to have been born. As is well known, the secular drama in the vulgar tongue began in Italy with comedy, or a near approach to it. The *Orfeo* of Poliziano, though it contains pathetic situations, is idyllic rather than tragic in its general character. It was not till 1524 that a regular tragedy in Italian, meant for actual production, was written. This was the piece *La Sofonisba* of Giangiorgio Trissino, which has the glory of being the first tragedy in a modern language.

Tragedy passed to the remaining countries of Europe with the other Renaissance influences that proceeded from Italy. By the end of the fifteenth century the Italians had so completely revived both Latin and Greek that a large body of the ancient drama had become accessible. Not only Seneca, but also Æschylus, Sophocles, Euripides, and Aristophanes were now known. Aristotle's remarks on the drama in the *Poetics* had been studied in the light of the very plays on which he based them. And yet it is interesting to see how long the example of Seneca remained preponderant. In France, about 1540, Buchanan had Latin plays of the Seneca type, *Jephthah* and *John the Baptist*, played at the Collège de Guienne at Bordeaux. And, though the *Electra* of Sophocles and the *Hecuba* of Euripides were translated into French by Lazare de Baïf about the same time, the first original French tragedy, the *Cléopâtre* of Jodelle, acted in 1552, shows much more reading of Seneca on the author's part than of the Greeks. In England the importance of Seneca for the development of tragedy is no less marked, and the first English tragedy, *Gorboduc*, by Sackville and Norton, acted in 1562, shows practically no influence of the Greek dramatists. All is Seneca.

In this manner tragedy was reintroduced and established in the modern world. And yet it must be noted that the greatest modern tragedies are the result of a fusion of the antique type with dramatic traditions of mediæval origin. In France alone did classicism so triumph as to make playwrights attempt accurately to conform to what they supposed to be the rules of the ancient drama. During the seventeenth and eighteenth centuries the unities that Aristotle was believed to have found in Greek tragedy were held to be the law of perfection. Yet even in Corneille and Racine the skilled observer can detect abundant traces of the mystery-play and the morality. In England and Spain, on the other hand, the unities were never really accepted; the limited scope, the subordinated personalities, the dramatic machinery of ancient tragedy were freely disregarded. In Shakspeare and the other Elizabethans, in Calderón, Lope de Vega, and the dramatists of the Siglo de Oro, we have the ample material of the mediæval drama frankly fused with the classical tradition. Hence the superiority of the work of these poets.

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A. R. MARSH.

**Trag'opan** [Mod. Lat., from Lat. *tra'gopan* = Gr. τραγόπαν, a fabulous Ethiopian bird]: any bird of the genus *Ceriornis*, family *Phasianidæ*. *Ceriornis* is nearly related to the genus *Gallus*. The males, however, instead of a comb, have a crest of soft feathers and a pair of soft horn-like appendages, protractile and retractile at will, above the eyes, as well as wattles in front on the throat; the tail is large, depressed, and rounded at its posterior margin; the tarsi are armed, in the male, with short conic spurs. The species are mostly confined to the pine forests of the Himalaya Mountains and neighboring chains of Asia. They are generally solitary in their habits, dwell in the inmost recesses of their native forests, and are difficult of approach. They average about the size of the domestic poultry, or perhaps are a little larger. They feed upon grain, insects, worms, etc., and indeed resemble in this and many other respects the common gallinaceous birds. Revised by F. A. LUCAS.

**Tragu'lidæ** [Mod. Lat., named from *Tra'gulus*, the typical genus, dimin. of Gr. τράγος, goat]: a family of placental mammals of the order *Ungulata* and sub-order *Artiodactyla*, containing the smallest living representatives of the order. In external appearance they suggest a small deer, but are peculiar in the arching of the back behind and the projection of the buttocks backward; the neck is rather short; the head slender and with a pointed snout; the ears moderate; no horns are developed in either sex; the tail is moderately short; the legs are slender; the feet provided with lateral hooflets; the teeth are in the normal ruminant number (M. $\frac{3}{3}$, P. M. $\frac{3}{3}$, C. $\frac{1}{1}$, I. $\frac{0}{3} \times 2$), and form the chief distinctive feature, consisting of the interruption of the incisorial series at the symphysis and the enlargement and expansion of the middle incisors toward their crowns, and the development of the canines of the upper jaw as tusks in the males; the stomach is tripartite, the psalterium being incompletely developed; the placenta is diffuse; the outer metatarsals are developed. The family is now peculiar to Asia and Africa. It is specially interesting as exhibiting an intermediate condition in the development of the stomach and some other parts between the typical ruminant ungulates and the omnivorous or hog-like forms.

Revised by F. A. LUCAS.

**Trailing Arbutus**: See EPIGÆA.

**Traill**, CATHERINE PARR (*Strickland*): author; sister of AGNES STRICKLAND (*q. v.*) and Mrs. Susanna Moodie; b. in

Kent, England, Jan. 9, 1802; educated at her home; removed to Canada in 1833 with Lieut. Thomas Traill, whom she had married the preceding year. She settled at Douro, Ontario, and subsequently resided in Peterborough, but for many years has made her home at Lakefield, Ontario. She began to write when fifteen years of age, and has devoted much of her time to literary work ever since. Among her works are *The Backwoods of Canada* (London, 1835); *Canadian Crusoes* (New York, 1852); *Ramblings in the Canadian Forests* (1854); *Afar in the Forest* (London, 1869); *Studies of Plant Life* (Ottawa, 1884); *Pearls and Pebbles* (1895). N. M.

**Traill**, ROBERT, D. D.: b. at Lisburn, Ireland, July 15, 1793; graduated at Trinity College, Dublin, about 1817; took orders in the Church of England 1820; became parish minister of Schull, County Cork, 1830, and fell a victim to his incessant labors to relieve his parishioners during the great Irish famine, dying of an epidemic fever in 1847. He is the author of a superior English translation of Josephus's *Jewish War* (London, 1846–47, with Isaac Taylor's notes and Tipping's illustrations of Palestinian scenery; later ed. rep. Boston, 1868). Revised by S. M. JACKSON.

**Traill**, THOMAS STEWART, M. D.: b. at Kirkwall, Orkney islands, in 1782; graduated at the University of Edinburgh 1801; became a physician, and was Professor of Medical Jurisprudence in that university from 1832 to his death July 30, 1862. He was editor of the eighth edition of the *Encyclopædia Britannica* (22 vols., 1853–61), for which he wrote more than 400 articles; wrote for scientific periodicals, and was author of *Lectures on Medical Jurisprudence* (2d ed. 1840; Philadelphia, 1841) and other works.

**Train**, GEORGE FRANCIS: author; b. in Boston, Mass., Mar. 24, 1830; entered upon mercantile business there, and subsequently in Australia; in 1860 went to England, and attempted to introduce street-railways into Liverpool and London, but was met by legal opposition. Subsequently he traveled extensively, wrote considerably, spoke much in public, and developed singular idiosyncrasies. For many years he declined to speak to anyone, using pencil and paper as his only medium for conversation. One of his peculiarities is a special fondness for children, with whom he surrounds himself in his daily visits to Madison Square, New York, which city has long been his place of residence. Among his publications are *An American Merchant in Europe, Asia, and Australia*, and *Young America Abroad* (New York, 1857); *Spread-eagleism*, consisting of some of his public speeches (1859; London, 1860); *Young America on Slavery* (1860); *Union Speeches delivered in England* (4 vols., Philadelphia and London, 1862); *Downfall of England* (1865); *Irish Independency* (1865); *Championship of Woman* (Leavenworth, Kan., 1868).

**Trajan** (*Marcus Ulpius Trajanus*): Roman emperor A. D. 98–117; b. at Italica, near Seville, Spain, Sept. 18, A. D. 52, of Roman descent; was educated in the camp of his father, and distinguished himself so much in the Parthian and German wars that, although not of Italian birth, he was adopted by Nerva in 97, and in January of the following year succeeded him on the throne. Trajan's reign is considered, next to that of Augustus, the most brilliant period of the history of imperial Rome. By two campaigns (101–102 and 104–106) Dacia, the region between the Theiss and the Pruth, comprising the present Transylvania, Moldavia, and Wallachia, was conquered and made a Roman province. Of less permanent importance were the conquests in Armenia and Mesopotamia, made in the wars with the Parthians. Although most eminent as a general, Trajan was a vigorous and capable ruler, and the probity of his administration gave rise to the phrase with which a new emperor was first saluted—*Augusto felicior, melior Trajano* (more fortunate than Augustus, better than Trajan). Cities were founded, colonies settled, fortresses and harbors constructed, and numerous roads, canals, bridges, etc., were built throughout the empire. In Rome the Forum Trajani was constructed, containing the famous column in its center. Large sums were employed in the education of freeborn Roman children. Libraries, among which was the celebrated Ulpia Bibliotheca, were founded, and the Latin literature experienced its afterbloom in Tacitus, the younger Pliny, and Juvenal. Pliny's correspondence with Trajan when governor of Bithynia gives a valuable picture of the provincial government, and throws light on the condition and treatment of the Christians, whose relation to the empire was at this time becoming a question of considerable importance. Trajan died at Selinus, in Cilicia, in Aug., 117. Revised by CHARLES H. HASKINS.

**Trajan's Wall**: a fortification in the Dobrujda, Roumania, nearly 50 miles long, extending from Tchernavoda on the Danube to Kustendji on the Black Sea. It is a double and in some places a triple earthwork on the south side of a natural fosse, consisting of a narrow marshy valley. It is even now a strong line of defense. It was constructed in 377 by Trajan, a general of Valens, to prevent the Visigoths, who had crossed the Danube, from advancing farther southward. E. A. G.

**Trajectory**: See GUNNERY.

**Tralee′**: town; in County Kerry, Ireland; on the Lee, 1 mile from its mouth; 207 miles by rail S. W. of Dublin (see map of Ireland, ref. 12–B). It is well built, and has some trade in agricultural produce. It has ceased to be of importance as a port since ships began to discharge at Fenit, 5 miles distant. Tralee returned a member to Parliament until 1885. Pop. (1891) 9,318.

**Tramps**: See VAGRANTS AND VAGRANCY.

**Tramways**: See RAILWAYS and STREET-RAILWAYS.

**Trance** [from O. Fr. *transe*, extreme fear, swoon, trance, deriv. of *transir*, pass over, fall into a swoon < Lat. *transi′re*; *trans*, across + *i′re*, go]: a state of abeyance of most of the vital functions, resembling in some cases a profound sleep, in others closely simulating actual death. Some cases of so-called trance are clearly cataleptic, and all are associated with abnormal nervous conditions or perverted nerve-functions. Trance sometimes follows extreme religious excitement. In some cases of real or pretended trance the patient can speak, and even address public audiences, the condition being assumed at will. But in the more profound trance all sensibility and power of motion is lost, and in some no sign of breathing or of heart-beat is apparent. This condition has been known to last for months or even years. See CATALEPSY and HYPNOTISM.

Revised by J. M. BALDWIN.

**Trani**, traa′nee: town; in the province of Bari delle Puglie, Southern Italy; on the Adriatic; about 27 miles N. W. of the town of Bari (see map of Italy, ref. 6–G). A few traces of an old castellated wall, with towers and bastions, remain. The port is well sheltered except on the N. W., and during the flourishing period of Italian mediæval commerce with the East, Trani was a very important center of maritime trade. The cathedral, Byzantine in its architecture, was begun in the twelfth century and consecrated in the thirteenth; the tower is one of the boldest in Italy. The law school established here by Charles V. had a wide reputation. In 1799 the city was sacked and burned by the French. It is a place of considerable industry and commerce, the exports being chiefly oil, wine, and fruits, especially almonds from the vicinity. A fine calcareous building-stone, known as *pietra viva*, and found near Trani, is exported. Pop. 25,000. Revised by M. W. HARRINGTON.

**Tranquebar′** [Tamil *Tarangambadi*, or city of the waves]: town of Tanjore, Madras, British India; on the Coromandel coast, in the delta of the Cavery; in lat. 11° 2′ N.; on a small bay which forms a good harbor (see map of S. India, ref. 6–F). It is surrounded by walls, defended by forts, and well built. Pop., with an indigenous suburb, 6,200. The town, with adjacent district, very productive of rice, cocoanuts, and fruits, was originally a Danish possession, but in 1845 was sold to Great Britain. It has declined in importance, partly because of this change and partly because of the advantage given to the rival port, Negapatam, through the construction of the South Indian Railway to it. Tranquebar is a healthful place, has a mild and agreeable climate, and was long a favorite watering-place.

Revised by M. W. HARRINGTON.

**Tranquillus Suetonius**: See SUETONIUS TRANQUILLUS.

**Transbaika′lia** [i. e. across the Baikal; Rus. *Sabaikal*]: province of Eastern Siberia, bordering on Mongolia, and S. and E. of Lake Baikal; between the parallels 49° 8′ and 56° 31′ N., and the meridians 101° 28′ and 121° 30′ E. Area, 236,868 sq. miles, or nearly that of Texas. The eastern part is mountainous; the western is a high plateau with many lakes and marshes. The waters belong to the basins of Lake Baikal, the Lena, and the Amur. The climate is continental, rigorous, and dry. This is the central part of the Nertshinsk mineral region, and is rich in gold, silver, copper, tin, lead, coal, asphalt, and salt. It was rich in forests, but these are rapidly disappearing. Agriculture does not prosper, but stock-raising is profitable. The collection of pelts is a regular pursuit, and the skins obtained include those of the fox, bear, ermine, and sable. The last two are especially fine, but these animals are fast being exterminated. Pop. (1897) 669,721, mostly Russians, but about 150,000 are Buriats, Tunguses, and Chinese. M. W. H.

**Transcaspian District**: province of Russia in Asia; part of the government of Turkestan; E. of the Caspian Sea, S. of Uralsk, W. of Khiva and Bokhara, and N. of Afghanistan and Persia. Area, 214,237 sq. miles, or a third larger than the Caspian Sea. The country is largely steppe and desert. It is traversed by the Transcaspian Railway, and has many caravan routes. The district was formed in 1881, and Merv was added to it in 1884. Pop, (1897) 382,327, of whom 210,000 are Turkomans, 44,000 Kirghiz, 7,000 Russians (not including the troops), the remainder Persians, Afghans, Bokhars, Armenians, and Jews. M. W. H.

**Transcauca'sia** [Lat. *trans*, across, beyond + *Caucasus*]: the name given generally to that part of Asiatic Russia which lies S. of the Caucasian Mountains; between the Black Sea and the Caspian. It includes the provinces of Baku, Daghestan, Elizabethpol, Erivan, Kars, Kutais, Tiflis, and Zakataly, making altogether an area of 91,346 sq. miles, with a population of 5,011,555 in 1890. M. W. H.

**Transcenden'talism**: a term used to describe the doctrine of the New England school of philosophy, initiated by Ralph Waldo Emerson and A. Bronson Alcott, which, however, owed its origin to the study of Plato and the Neo-Platonists rather than of Kant, although the latter, through Coleridge, exercised some influence. Kant called transcendental all those cognitions or elements of cognitions which are not derived *a posteriori* by experience, but underlie all experience as its necessary *a priori* conditions, and which consequently transcend the whole sphere of experience. Transcendental are all those primary, original, and *a priori* principles of knowledge which, as necessary and universal truths, underlie all contingent and particular truths derived from experience; and in this sense of the word transcendental is the opposite of empirical.

Revised by W. T. Harris.

**Transformer**: in electricity, an instrument for converting an alternating current from a higher to a lower potential, or *vice versa*. A step-down transformer converts a small current at a high potential to a large current at a low potential; a step-up transformer converts a large current of low potential to a small current at high potential. The energy obtained from a transformer is equal to that put in, less the losses due to heating. Step-down transformers are commonly used in the ordinary systems of alternating-current distribution for the supply of incandescent lamps at constant potential. The alternating-current transformer is a modification of the old-fashioned induction coil (see Induction Coil), and consists essentially of a primary and a secondary coil of wire embracing the same magnetic circuit.

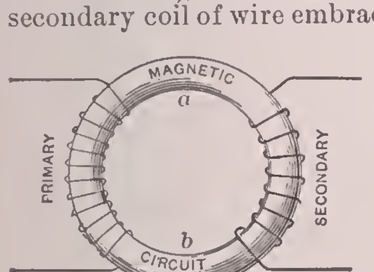



Fig. 1.—Typical representation of a transformer.

The simplest form of such a transformer is shown in Fig. 1. The primary coil, commonly spoken of merely as the "primary," consists usually of many turns of fine wire. This is connected to a supply of alternating current commonly at 1,000 or 2,000 volts. The current which flows in the primary is small, being opposed by the counter-electromotive force of self-induction, which is large on account of the fact that the primary turns are many and embrace an iron coil. The secondary usually consists of fewer turns of larger wire, capable of carrying a larger current than the primary, which is, however, at a correspondingly lower potential. The primary current sets up lines of magnetic force which thread the secondary circuit and induce an electromotive force in the secondary, inasmuch as the magnetization keeps changing with the primary current and the lines of force are reversed with each alternation. It is then the function of the magnetic circuit to convey through the secondary coils the lines of force set up by the primary current. The magnetic circuit is usually a completely closed one made of soft, well-laminated iron. This is not always so, however, and a transformer may be constructed with only a partial magnetic circuit, as typically shown in the upper diagram of Fig. 2. Such is technically known as an "open-magnetic-circuit" transformer in contradistinction to the "closed-magnetic-circuit," as shown in Fig. 1. The open-magnetic-circuit transformer possesses the advantage of smaller losses at no load, due to diminished hysteresis (see

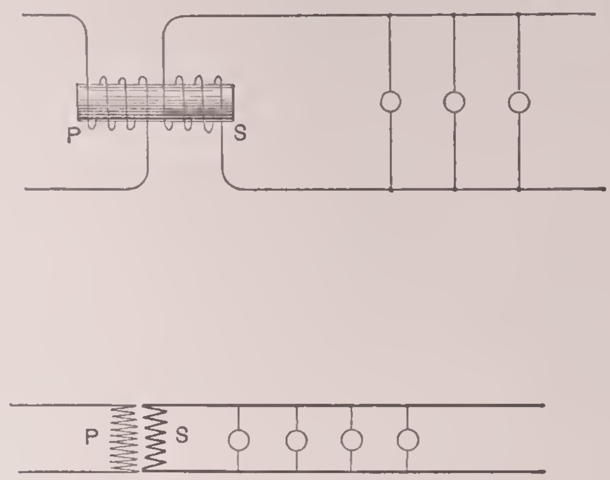



Fig. 2.

Magnetism of Iron); and although little used in the U. S., it is commonly used in Great Britain, notably in the case of the "hedgehog" transformer of Mr. Swinburne. Step-down transformers are used to supply incandescent lamps arranged in parallel, as typically shown in Fig. 2. Although Fig. 1 shows the general arrangement of the parts of a transformer, it must not be supposed that the form there shown is the design of the practical transformer in commercial use.

*Lines of Force due to the Secondary Current.* — We have thus far considered the lines of force passing through the magnetic circuit, due to the primary current; now the secondary current will likewise tend to set up lines of force which will be opposite in direction to those set up by the primary. (See *The Direction of the Induced Current* under Electricity.) These lines will accordingly meet and oppose each other,

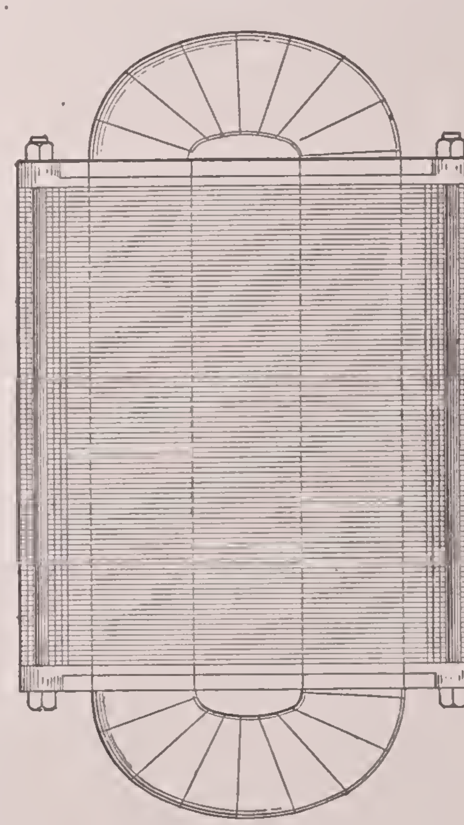


Fig. 3.—Transformer.

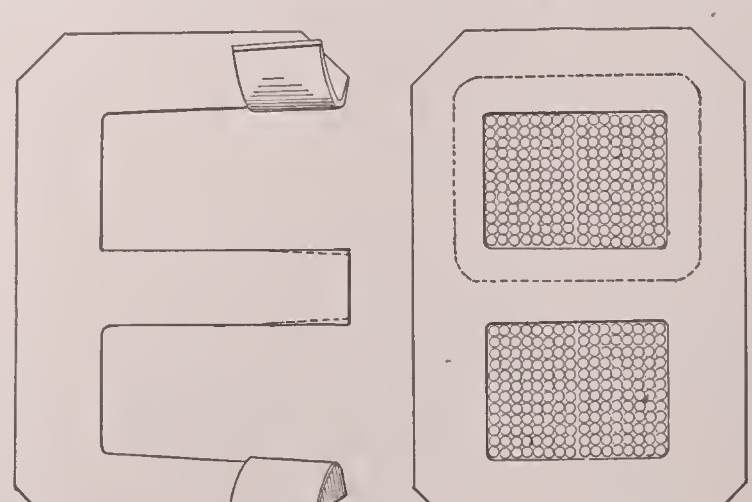


Fig. 4.—Transformer plates and arrangement of coils.

and in a transformer as Fig. 1 there will be a tendency for them to leak across between $a$ and $b$. This magnetic leakage, as it is called, diminishes the effect in the secondary circuit, and likewise interferes with the regulation for constant potential which is necessary for the supply of the incandescent lamps. A commercial form, avoiding to a large extent magnetic leakage and possessing mechanical advantages, is shown in Fig. 3. The primary and secondary coils are compactly arranged and the magnetic circuit built up of plates of soft iron bolted securely together. The shape of the transformer plate is shown in Fig. 4; the dotted line indicates the magnetic circuit—that is, the path of the lines of force. The lamination prevents loss due to Foucault currents induced in the iron.

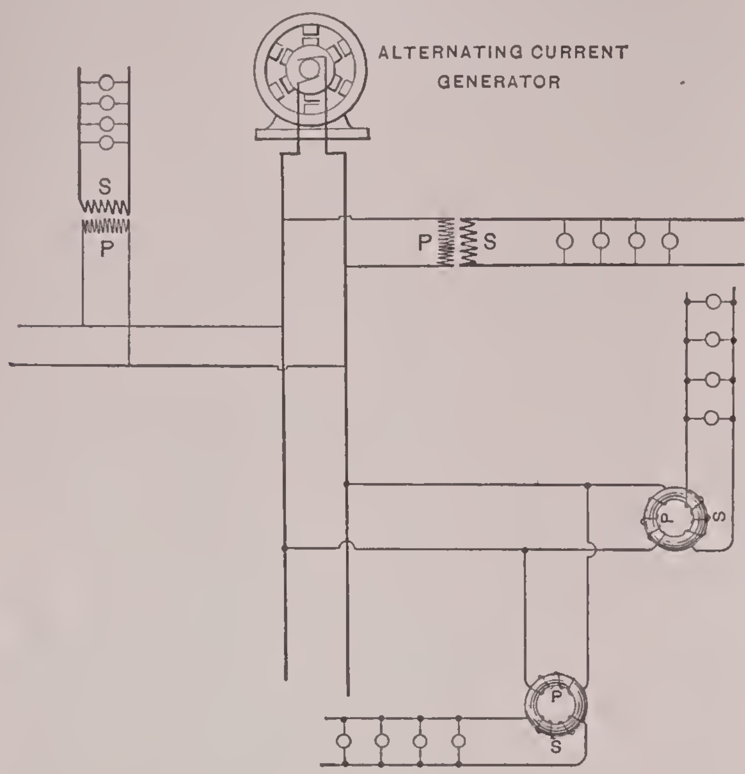



Fig. 5.

The common form of transformer distribution for lighting purposes is shown in Fig. 5. The primary mains are supplied with a potential of, say, 1,000 volts by a constant potential alternating-current generator placed in some central station. Each house to be lighted has installed in it an individual transformer which supplies incandescent lamps at 50 or 100 volts. This potential should be constant at all loads; in reality it decreases slightly with the load on account of the magnetic leakages, already referred to, and the fall in potential due to the resistance of the conductors. The primary mains are usually supplied both day and night. The lamps in the secondary may be turned on and off individually or altogether. This is the common system of supply, but a system of sub-stations is sometimes used. Here each house no longer has its own transformer, but one large transformer is used for each district or group of houses, thus entailing less first cost for transformers and a higher efficiency; for, as the output of the transformer is increased the size and cost do not increase in proportion; and, furthermore, greater efficiency is thus obtained. Although this fact is noticeably true for small transformers, it is, however, not so marked with larger ones, say those of 30 or 40 kilowatts capacity. The energy which is lost in a transformer appears as heat which must be radiated from the surface, and with large transformers the effect of rise of temperature, due to the smaller surface in proportion to the output, must be considered. In a closely settled district where a complicated network is necessary, a system of distribution, as shown in Fig. 6, may be used, in which a complete system of secondary wires is supplied from the secondaries of a number of transformers placed at suitable points.

Alternating-current measurements are necessarily complicated, inasmuch as we have to deal with quantities rapidly varying from instant to instant. In experimental investigations these instantaneous values are commonly ascertained, and are of particular importance in certain lines of research. The value of a quantity varying periodically is sometimes expressed in terms of the maximum value which the quantity attains in each period. These maximum values become more significant when the quantity varies harmonically or nearly so, as is ordinarily the case with alternating currents. For a current differing widely from a sine or harmonic function, the maximum value indicates little as to the magnitude of the current in the usual sense of the term. When a current is of periodically varying value, it is most commonly the case that we wish to know, not the value of the current from instant to instant nor its value when at a maximum, but the value of an equivalent unvarying current, by which we mean a current equivalent in heating and dynamic effects. This value of the alternating current is called its *virtual* value. It is the one commercially used in connection with transformers, being given by most measuring instruments. The virtual value of a quantity is equal to the square root of the mean square of the instantaneous value; and, for an harmonically varying quantity, that is, proportional to a sine or cosine of the variable,

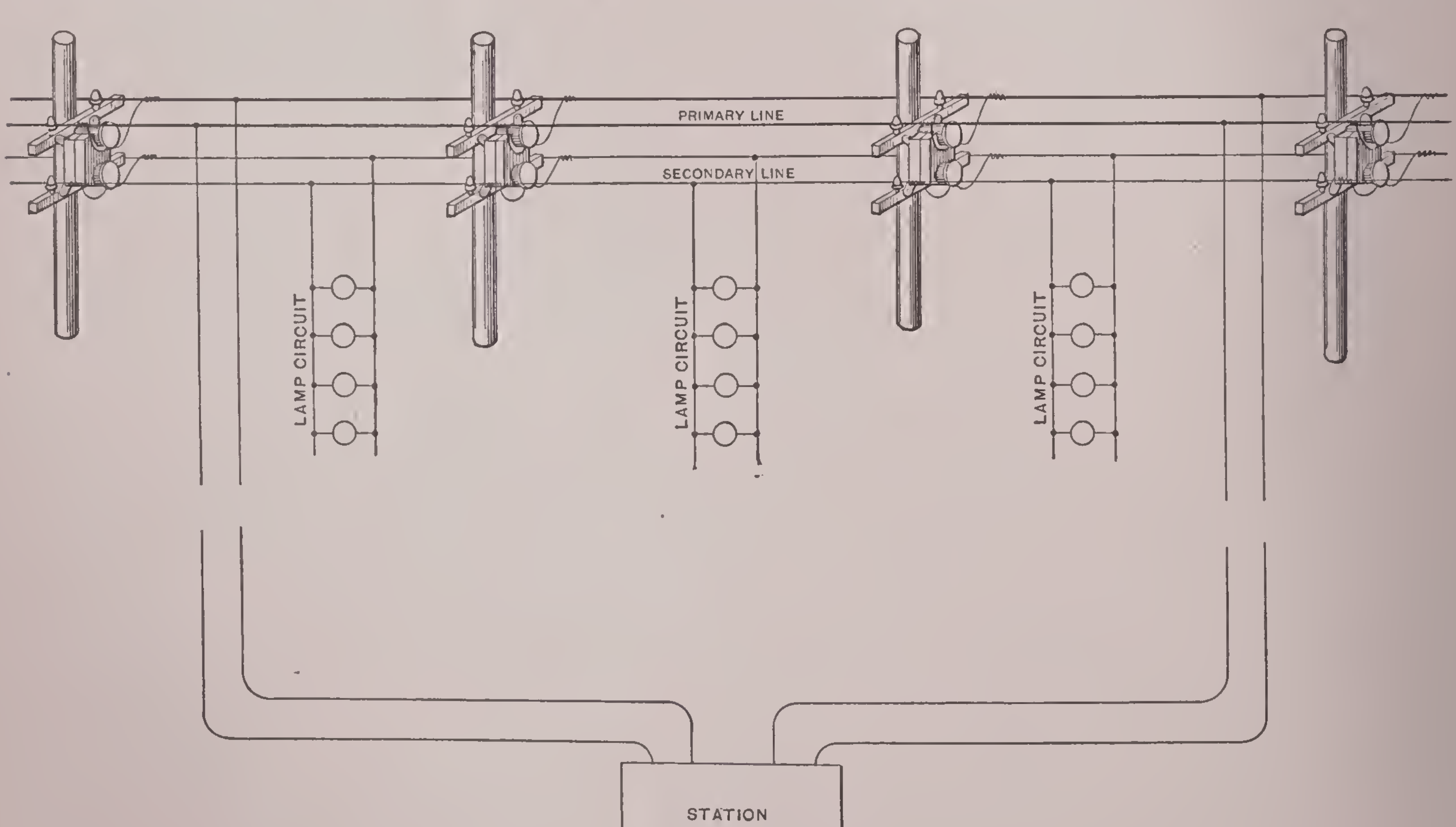



Fig. 6.

is equal to the maximum value divided by $\sqrt{2}$; or the virtual value is equal to 0·707 times the maximum.

The calculation of the efficiency of the transformer consists either in the measurement of the power supplied to the primary and the power obtained from the secondary, or in a determination of the several losses. The efficiency is the ratio of the secondary output to the power supplied to the primary—that is, efficiency $= W_2 \div W_1$.

The losses in a transformer are as follows: The iron losses, due to hysteresis and Foucault currents; the loss in the primary, due to the heating of the primary conductor; and the loss in the secondary, due to the heating in the secondary conductor. The loss due to the heating of a conductor equals the product of the resistance and the square of the current; hence the copper losses in the primary and secondary circuits are $R_1I_1^2$ and $R_2I_2^2$, respectively. The secondary power, $W_2$, utilized in operating incandescent lamps, is equal to the product of the secondary current and the difference of potential at the secondary terminals, inasmuch as the load is non-inductive and the current is in phase with the electromotive force—that is, $W_2 = E_2I_2$. The power put into a transformer is equal to the power taken out and made use of in the secondary load plus the several losses, thus:

$$W_1 = W_2 + \text{iron losses} + R_1I_1^2 + R_2I_2^2.$$

The primary power is also equal to the product of current, electromotive force, and the power factor; thus $W_1 = E_1I_1 \times$ power factor. The power factor is equal to the cosine of the angle by which the current lags behind the electromotive force.

*The action of a transformer* may best be investigated by a determination of the values, from instant to instant, of the currents and electromotive forces. For these determinations the method of instantaneous contact is used, employing a contact-maker (see Fig. 7) which closes a circuit once in each revolution of the armature of the generator, and thus enables measurements to be made at any desired phase of the alternation. (Methods of measurement are described in vol. ii. of Nichols's *Laboratory Manual of Physics and Applied Mechanics.*) The connections for a transformer test by this method are shown in Fig. 8. Curves thus obtained are shown in Fig. 9, which indicates in a complete manner the action of a transformer. (The curves here given were taken from a hedgehog transformer.) The primary current lags considerably behind the primary electromotive force. The secondary electromotive force is almost exactly opposite in phase to that of the primary. The efficiency may be obtained by computing the primary and secondary power from the instantaneous values of current and electromotive force. The results of a test upon a transformer possessing exceptionally high efficiency and good regulation are shown in Fig. 10.

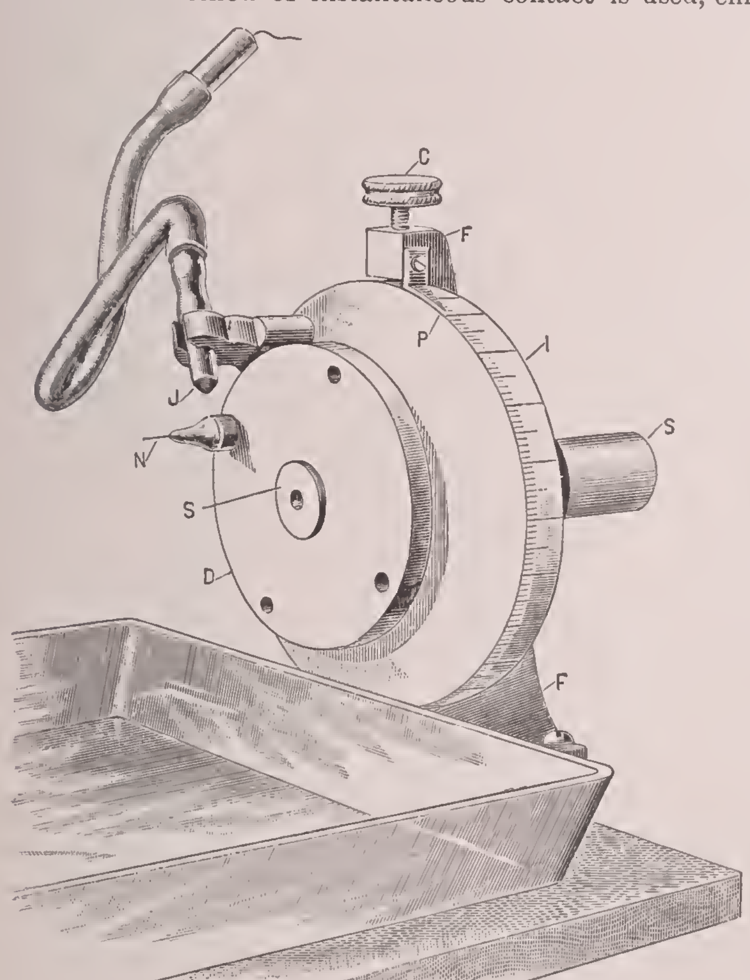


FIG. 7.—Bedell-Ryan revolving contact-maker.

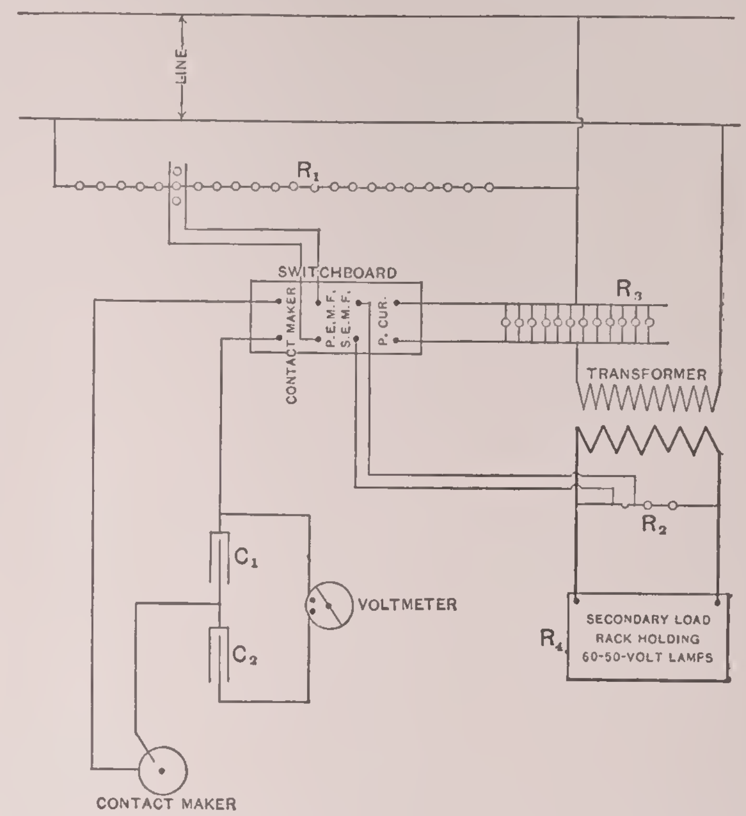


FIG. 8.—Connections for transformer test by method of instantaneous contact.

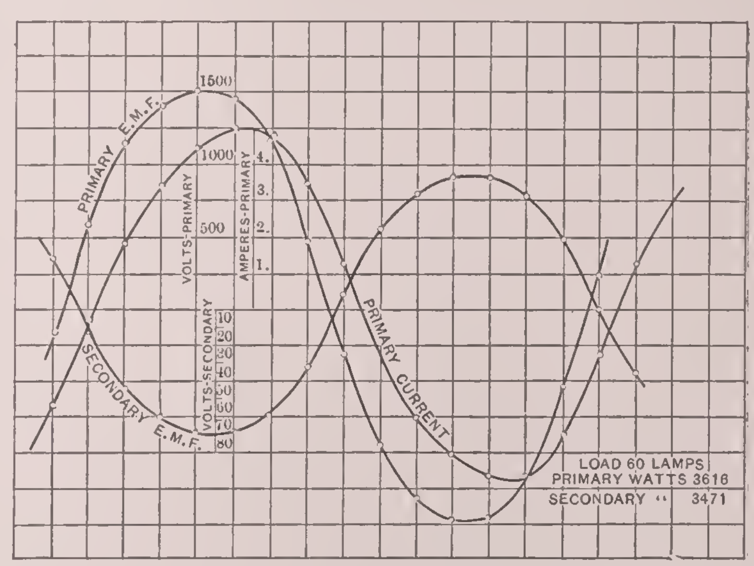


FIG. 9.—Transformer curves by method of instantaneous contact.

The theory of the transformer may be analytically developed from the two equations for primary and secondary electromotive forces:

$$E_1 = R_1I_1 + L_1\frac{dI_1}{dt} + M\frac{dI_2}{dt};$$

$$O = R_2I_2 + L_2\frac{dI_2}{dt} + M\frac{dI_1}{dt}.$$

These express the relation that the electromotive force in a circuit is equal to the electromotive force to overcome resistance, the counter electromotive force of self-induction and the back electromotive force of mutual induction. The coefficients of mutual induction, $M$, and primary and secondary self-induction, $L_1$ and $L_2$, are:

$$M = \frac{4\pi S_1S_2A\mu}{l};$$

$$L_1 = \frac{4\pi S_1^2A\mu}{l};$$

$$L_1 = \frac{4\pi S_2^2A\mu}{l}.$$

Here $S_1$, $S_2$ denote primary and secondary turns; $A$, $l$, and $\mu$ denote area, length, and permeability of the magnetic circuit. The ratio of transformation is equal to the ratio of the number of primary and secondary turns. It is by this

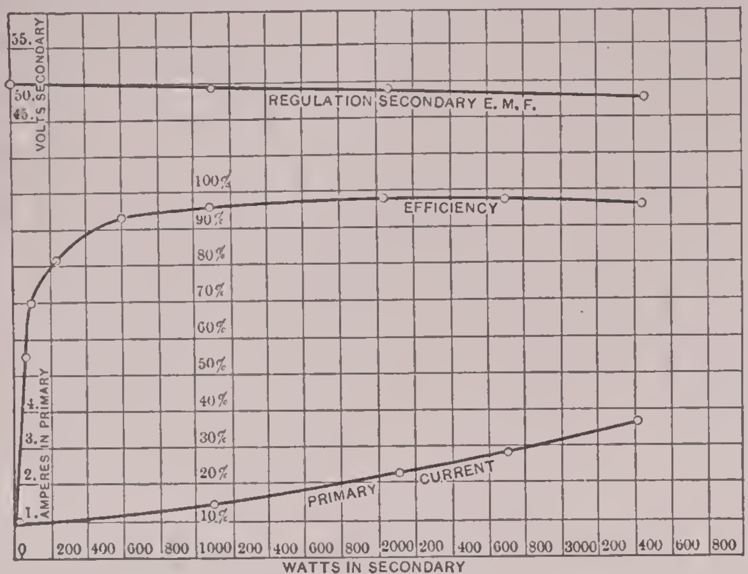



FIG. 10.—Efficiency and regulation curves.

ratio that the potential is transformed up or down—that is, the primary and secondary electromotive forces have the same ratio as the number of turns. Space will not here permit the development of analytical theory. The results of analysis may, however, be well shown by a diagram in which relative magnitudes and phase relations are shown graphically.

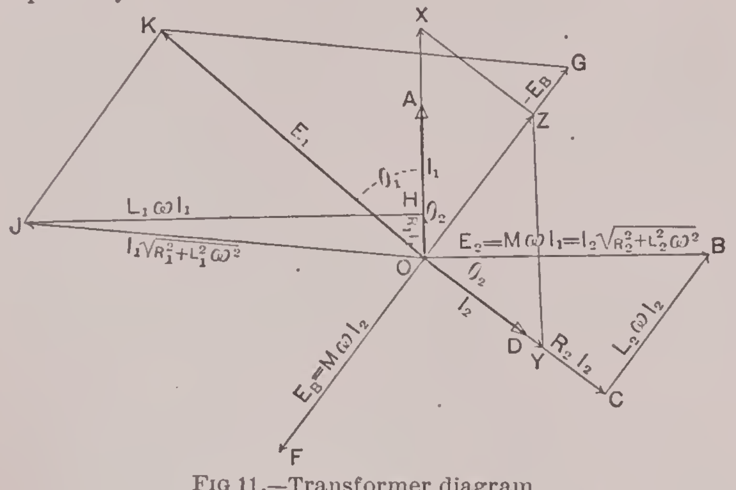



FIG 11.—Transformer diagram.

Such a transformer diagram is shown in Fig. 11 (Bedell and Crehore). Each line is drawn to represent the magnitude of some quantity. The diagram is supposed to revolve with uniform velocity in a counter-clockwise direction. The value of a quantity at any instant is found by projecting upon any fixed line of reference the line which represents it. The primary current is represented by $\overline{OA}$. Ninety degrees behind this is $\overline{OB}$, the electromotive force induced by the primary current in the secondary circuit, equal to $M\omega I_1$ (where $\omega = 2\pi n$, $n$ being the frequency or number of complete alternations per second). The secondary current $\overline{OD}$ lags by the angle $\theta_2$ due to the secondary self-induction. The electromotive forces in the secondary are $\overline{OB}$ induced by the primary current $\overline{CB}$ due to self-induction, and $\overline{OC}$ the resultant pressure at the terminals. The secondary current induces the back electromotive force, $\overline{OF}$, ninety degrees behind it in the primary. The primary electromotive force, $\overline{OK}$, is equal to the geometrical sum of three parts: $\overline{OG}$ to overcome the back electromotive force, $\overline{OF}$; $\overline{OH}$ to overcome resistance; and $\overline{HJ}$ to overcome the self-induction of the primary itself. Evidently the secondary current is about opposite in phase to the primary electromotive force. The magnitudes of the various quantities are indicated by the lines representing them. The angular positions of the lines represent the phase relations of the corresponding quantities. A transformer diagram of this sort can be constructed for a particular transformer under given conditions, and the complete action of the transformer is thus shown by purely graphical methods. FREDERICK BEDELL.

**Transfusion of Blood** [*transfusion* is from Lat. *transfu'sio*, deriv. of *transfun'dere*, *transfu'sum*, pour over; *trans*, across, over + *fun'dere*, pour]: a surgical operation in which blood from a strong and healthy person, or from one of the lower animals, is injected into the veins of a feeble or anæmic patient. It is especially employed after severe puerperal hæmorrhage, great care being taken to exclude bubbles of air or clots, either of which is likely to prove fatal. The blood, either defibrinated or not, is usually introduced by means of a suitable syringe. This operation, though long known and at present recognized as a legitimate one, is not as yet very common; but it may be considered as established that in well-selected cases, and when performed with proper skill, transfusion is an extremely useful and successful operation. The transfusion of warm saline solutions is almost if not equally useful and does not have the dangers of blood transfusion. Subcutaneous injection of saline solutions and rectal injections of water are scarcely less efficacious and prompt in action than transfusion in cases of hæmorrhage. Revised by W. PEPPER.

**Transit** [from Lat. *tran'situs*, a crossing, going over, deriv. of *transi're*, *tran'situm*, cross; *trans*, across, over + *ire*, go]: the passage of a planet over the disk of the sun, or, in a broader sense, the passage of any celestial body over an arbitrary point of reference.

*The transit instrument* is an astronomical instrument used to determine the time of a star's passage over a fixed great circle of the heavens, usually the meridian or the prime vertical. In the latter case the instrument is called a prime vertical transit. Roemer seems to have first used a transit instrument for the determination of right ascensions in 1675, and fourteen years after that he used it in the meridian for the determination of local time. A very excellent form of the most modern construction is shown in Fig. 1,

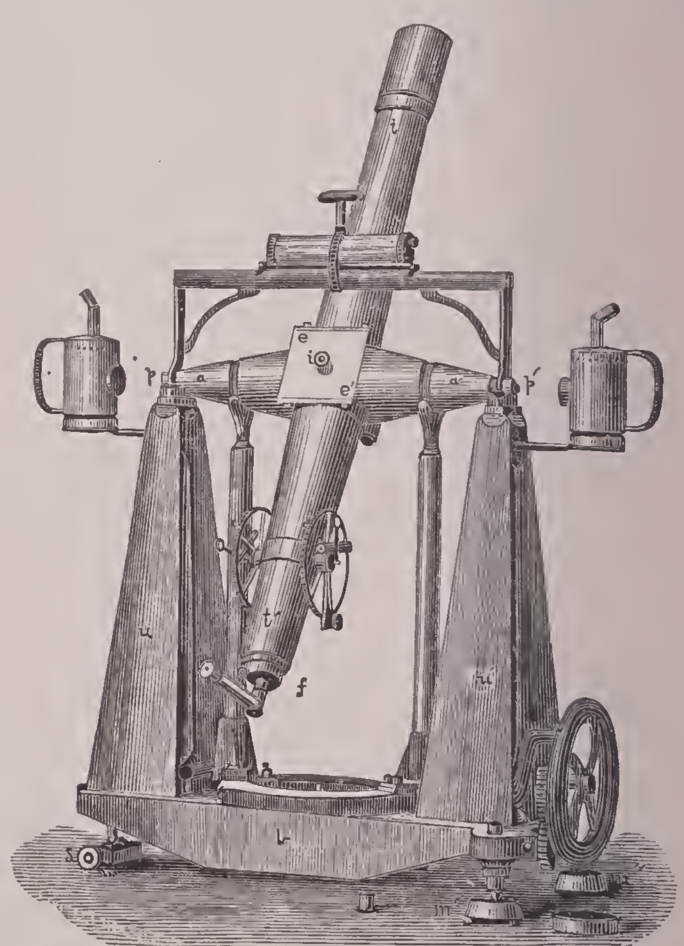


FIG. 1.

where $t\,t'$ represents a telescope of 3 inches aperture and 40 inches focus, which rotates around a horizontal axis $a\,a'$, and is composed of the frusta of two similar cones firmly secured to the hollow brass cube, $e\,e'$, at their larger bases. The axis, $a\,a'$, is also composed of the frusta of two similar cones terminating in two faces of the cube $e\,e'$ at right angles to the other two faces. This axis terminates in two pivots, $p\,p'$, $1\frac{1}{4}$ inches in diameter, made of cast steel, which rest upon V-shaped bearings firmly supported by the cast-iron piers, $u\,u'$, which are firmly bolted to a base plate at $b$, which in turn rests upon three points, $m\,m'\,m''$, of which the point, $m$, is capable of a slight lateral motion by means of the screw, $s$. The telescope is made conical in order to give it the greatest rigidity of form; it is of brass, and may be elevated to any desired angle by turning it on its axis.

The light from a lamp enters through an aperture in one end of the axis $p'$ and strikes a diagonal reflector, the tint of the reflected light of which is controlled by the milled head, $i$, operating colored glasses, and the reflector is so inclined as to reflect the light downward into the field of view; this is necessary to render visible a reticule of fine lines composed of spider's web, placed in the focus of the object-glass at $f$. At night these lines are quite invisible without artificial illumination. The simplest form of this reticule of lines is shown in Fig. 2, where $s$ is a star entering the field between two horizontal lines. The vertical line $c$ is supposed to coincide with the plane in which the instrument rotates: $a$ $b$ $d$ $e$ are four additional lines symmetrically placed, and the time at which the star $s$ is bisected by each of them, as at $s'$, is noted. The mean of these observed times is more nearly correct than the time obtained from the transit across a single wire, $c$, would be. Five or seven wires are usually employed when the times are noted by eye and ear; this number is increased when the times are noted with a chronograph.

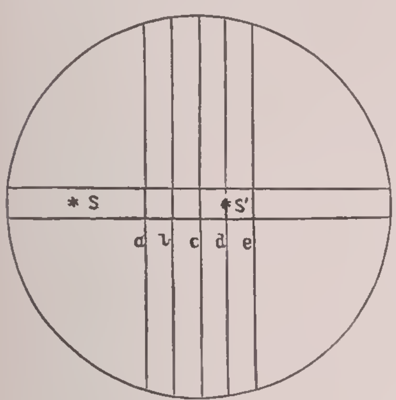


FIG. 2.

To determine the local time, the instrument is set up in the meridian and accurately leveled. The error of the timepiece is found by noting the difference between the observed and true times of transit of stars across the meridian. It is assumed that the horizontal axis is approximately level, and that the reticule has been so adjusted as to make the telescope axis pass through the middle wire, and that the system of wires is perpendicular to the horizon.

*Transit Circle.*—The mural circle was formerly a companion to the transit instrument in a fixed observatory; but by attaching a large circle to the horizontal axis of the transit instrument the results formerly obtained by two instruments and two observers are now more accurately obtained by this single instrument, called the transit or meridian circle; the declination of a star being obtained from the circle reading, while its right ascension is obtained at the same time by observing its transit.

Fig. 3 shows the transit circle of the Harvard College

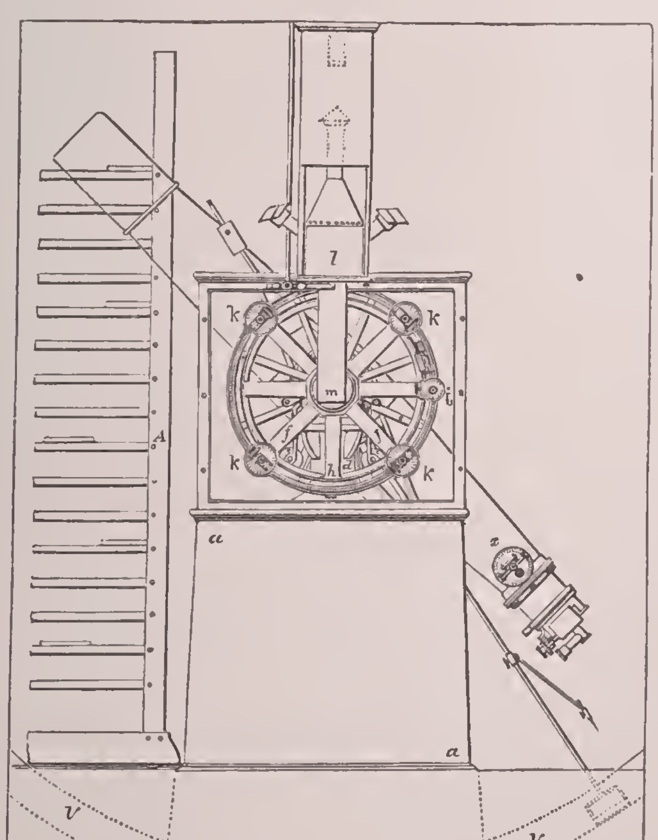


FIG. 3.

Observatory, built in 1870 by Troughton and Simms. The telescope has an aperture of 8¼ inches and a focal length of 9 ft. 4 in. The telescope pivots rest on iron castings imbedded in the solid marble block $a$ $a$. Two circles 3 feet in diameter, graduated on silver to five minutes of arc, are attached to the axis, and move with the telescope. Four microscopes, $k$ $k$ $k$ $k$, provided with micrometers, read to tenths of a second of arc the distance of the last five-minute division on the circle beyond which the telescope has been moved to bring a star into the position $s$ of Fig. 4 from the center of the microscopes. The microscopes are secured to a circular frame, which in turn is attached to the iron casting which supports the bearings for the pivots. A similar arrangement exists with regard to the circle on the other side of the telescope from the one shown in the drawing. Counterpoises at $e$ $e$, working upon the levers, $f$ $f$, diminish the amount of the friction of the pivots against their bearings. Glass cases cover both the circles. For the purpose of easily finding an object, the small finding-circles at $x$ were provided, but in practice it is found more convenient to use a long arm attached to the axis, which describes the arc indicated in the lower part of the figure $v$. A lantern at $l$ throws its light by a system of reflectors upon the circle. The framework at $A$ is used for putting the striding-level in position. The instrument differs from the usual form of transit circles in supporting the circles above the piers, in its system of counterpoises, and in the placing of the circles so near to the floor that they may be read without the inconvenience of using steps. These improvements are due to the late Prof. Joseph Winlock, as also the using of collimators having apertures of the same diameter as the observing telescope.

Fig. 4 represents the reticule of this instrument. It consists of a system of twenty-five vertical lines, fifteen of which are double and arranged as shown in the figure. A

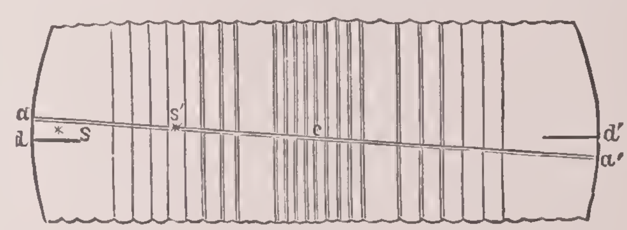


FIG. 4.

diagonal double line, $a$ $a'$, makes an angle of 85° with the vertical system. Fractional parts of a horizontal line, $d$ $d'$, extend far enough into the field to enable the observer to bring the star $s$ between the lines $a$ $a'$ and $d$ $d'$ when the star enters the field. Since $a$ $a'$ would intersect $d$ $d'$ at the center $c$, the star $s$ transits the line $a$ $a'$ at some point $s'$ between $a$ and $c$, and by noting the time when the star is at $s'$, it becomes a matter of simple trigonometry to compute the vertical distance of $s'$ from the line $d$ $d'$, and consequently from the assumed center of the field. The reading of the large graduated circle gives us the observed zenith distance of this central line $d$ $d'$ in space, and we are thus enabled, without any micrometrical measurements, to obtain the exact observed attitude by adding to the reading of the circle the computed vertical distance $a$ $s'$ with its proper sign. For a full discussion of the transit instrument, see W. Chauvenet, *Manual of Spherical and Practical Astronomy*; *United States Coast Survey Reports* (1866, appendix No. 9; 1868, appendix No. 10), by Prof. C. A. Schott. For discussions of transit circle, see W. Chauvenet (as above); *Washington Astronomical Observations for 1865.*

Revised by S. NEWCOMB.

**Transits of Venus and Mercury:** The term "transit" means the apparent passage of a planet as a dark object across the disk of the sun. This can take place only with the two planets Mercury and Venus, whose orbits lie within that of the earth. Transits of Mercury occur at intervals of a few years; never more than thirteen, nor less than three. They have no special astronomical significance, but owing to their interest they are industriously observed when they do occur. The times of occurrence for some time to come are given in the article MERCURY. Transits of Venus are among the rarest phenomena of astronomy, as only two occur in a period of more than a century. They were formerly believed to afford the most accurate method of determining the solar parallax. (See SOLAR PARALLAX.) For this reason the whole astronomical world devoted great attention to the observation of those which occurred in 1761, 1769, 1874, and 1882, and the leading nations sent expeditions to distant points of the earth's surface to make the necessary observations. On the whole, however, they have been a comparative failure, so far as the determination of the sun's parallax is concerned. The last transit occurred in 1882; no other will be seen until the year 2004. Further information respecting them is contained in the article VENUS.

Revised by S. NEWCOMB.

**Translation, Motion of**: See MOTION.

**Transleithania**, trăns-lī-tā'ni-ăā: the common name for that part of the Austrian-Hungarian monarchy which lies to the E. of the river Leitha, an affluent of the Danube. It comprises Hungary proper, Transylvania, Croatia, and Slavonia, or the Hungarian crown-lands. It has never become generally used, and corresponds closely to the present kingdom of Hungary as distinguished from Austria proper.

**Transmigra'tion** [from Lat. *transmigra'tio*, deriv. of *transmigra're*, transmigrate; *trans*, over, across + *migra're*, remove, migrate]: the doctrine of the repeated existence of the soul in different forms of matter, its form in each successive existence being determined by its merits and demerits in the preceding ones. Buddha, replacing the idea of soul with the wholly different idea of KARMA (*q. v.*), denied the entire theory of transmigration. It has, however, extensive sway among the ignorant masses of his followers, in spite of his negative teaching. The most striking fact in connection with this doctrine is its wide prevalence. The ancient civilization of Egypt seems largely to have grown out of this faith. The swarming millions of India also, through the chief periods of their history, have, under its spell, suffered their lives, wrought their great works of government, architecture, philosophy, and poetry, meditated, aspired, and exhaled their souls. Ruder forms of it are reported among innumerable barbaric tribes. It played an important part in the speculations of the early Fathers of the Christian Church, and has often cropped out in the works of later theologians. Men of the profoundest metaphysical genius, like Scotus Erigena and Leibnitz, have affirmed it, and sought to give it a logical or scientific basis. And even amidst the predominance of skeptical and materialistic influences in Europe and America at the present time, there are many individuals with independent minds who earnestly believe the dogma, for to a large class of minds the doctrine has transcendant attraction as well as plausibility.

*An Oriental Doctrine.*—Another striking fact connected with this subject is that it seems to be an ineradicable growth of the Oriental world, but appears in the Western world rather as an exotic form of thought. The pantheistic tendency which possessed and overwhelmed the Brahmanic mind, shaping and tingeing all its views, opened the whole range of sentient existences to an indiscriminate sympathy, and made the idea of transmigration natural, and more pleasing than repugnant. Furthermore, the Brahmanic sages are a distinct class of men whose lives are absorbed in introspective reveries calculated to stimulate the imagination and arouse to keen consciousness all the latent possibilities of human experience, thus furnishing the most favorable conditions for such a belief as that of transmigration. Accordingly, the doctrine has held the mind, sentiment, and civilization of the East through every period of its history as with an irrevocable spell. On the contrary, in the Western world, the characteristic tendencies are all different. Pantheistic theories are rarely held, and the dreams and emotions which those theories are fitted to feed are foreign. An impassable barrier is imagined separating humanity from every other form of being. Speculative reason, imagination, and affection are chiefly employed in scientific studies and social pursuits, or personal schemes external rather than internal. This absorption in material affairs engenders in the spirit an arid atmosphere of doubt and denial, in which no efflorescence of poetic and mystic faiths can flourish. Thus while outward utilities abound, hard negations spread abroad, and living, personal apprehension of God, providence, and the immortality of the soul dies out either in open infidelity or in a mere verbal acceptance of the established creed of society.

*Its Grounds.*—The grounds on which this belief rests are chiefly the following: (1) The strong resemblances, both physical and psychical, connecting human beings with the whole family of lower creatures. They have all the senses in common with us, together with the rudiments of intelligence and will. They all seem created after one plan, as if their varieties were the modulations of a single type. We recognize kindred forms of experience and modes of expression in ourselves and in them. Now the man seems a travesty of the hog, the parrot, the ape, the hawk, or the shark; now they seem travesties of him. As we gaze at the ruminating ox, couched on the grass, notice the slow rhythm of his jaw and the dreaminess of his soft eyes, it is not difficult to fancy him some ancient Brahman transmigrated to this form, and patiently awaiting his release. Nor is it incongruous with our reason or moral feeling to suppose that the cruel monsters of humanity may in a succeeding birth find the fit penalty for their degradation and crime in the horrid life of a crocodile or a boa-constrictor. (2) The conception of a series of connected lives furnishes a plausible explanation for many mysteries in our present experience. Reference is made to all that class of phenomena covered by the Platonic doctrine of Reminiscence. Faces previously unseen, and localities unvisited, awaken in us a feeling of familiarity with them. Thoughts and emotions not hitherto entertained come to us as if we had welcomed and dismissed them a thousand times. Many an experience, apparently novel and untried, makes us start as though the chambers of the soul had often before echoed to its shadowy footsteps. The supposition of forgotten lives preceding the present, portions of which reverberate and gleam through the veils of thought and sense, seems to throw light on this department of experience. (3) Much more weighty, however, than the foregoing considerations is the philosophical argument drawn from the nature of the soul. Consciousness being in its very essence *the feeling of itself*, the conscious soul can never feel itself annihilated, even in thought. It only loses the knowledge of its being when it lapses into unconsciousness, as in sleep or trance. The soul may indeed *think* its own annihilation, but can not realize the thought in *feeling*, since the fainter emotional reflex upon the idea of its destruction is instantly contradicted and overborne by the more massive and vivid sense of its persistent being in immediate consciousness. This incessant self-assertion of consciousness at once suggests the idea of its being independent of the changing body in which it is shrined. Then the conception naturally follows that the soul, as it has once appeared in human form, may reappear indefinitely in any of the higher or lower forms which compose the hierarchy of the universe. The eternity of the soul, past and future, once accepted by the mind, leads directly to the construction of the whole scheme of the metempsychosis—an everlasting succession of births and deaths, disembodiments and re-embodiments, with their laws of personality and fortunes of time and space weaving the boundless web of destiny and playing the endless drama of providence. (4) But the strongest support of the theory of transmigration is the happy solution it seems to give to the problem of the distressing inequality and injustice which appear so predominant in the experience of the world. To the superficial observer of human life, the whole scene of struggle, sin and sorrow, nobleness and joy, triumph and defeat, is a tangled maze of inconsistencies, a painful combination of discords. But if we believe that every soul, from that of the lowest insect to that of the highest archangel, composes an affiliated member of the infinite family of God, and is eternal in its conscious essence, perishable only as to its evanescent disguises of incarnation; that every act of every creature is followed by its legitimate reactions; that these actions and reactions constitute a law of retribution absolutely perfect; that these souls, with all their doings and sufferings, are interconnected with one another and with the whole, all whose relationships copenetrate and co-operate, with mutual influences whose reports are infallible, and with lines of sequence that never break—then the bewildering maze become a vindicated plan, the horrible discord a divine harmony. But the theory of the transmigration of souls remains, to the average modern mind of the Western world, a mere fancy, although it has a deep metaphysical basis, a strong poetic charm, and a high ethical and religious quality. See METEMPSYCHOSIS, PESSIMISM, and BRAHMANISM.

See Alger's *History of Doctrine of a Future Life*, part 5, ch. ii., for full treatment of the subject of metempsychosis; also Leibnitz, *Monadologie*; Hardy's *Manual of Buddhism*, ch. v.; Edward D. Walker, *Reincarnation: a Study of Forgotten Truth* (New York). WILLIAM R. ALGER.

**Trans-Mississippi Exposition**: See the Appendix.

**Transpiration**: the process of exhaling a gas or liquid, as watery vapor from the surface of leaves. The transpiration of gases and liquids is motion through capillary tubes under pressure. See GAS and PHYSIOLOGY, VEGETABLE.

**Transportation** [from Lat. *transporta'tio*, deriv. of *transporta're*, carry across, transport; *trans*, across, beyond + *porta're*, carry]: the act of conveying persons or goods and the like from one place to another. In connection with this subject we have to consider the history of the physical means employed—roadways and waterways, natural or artificial, sail and steam, wagon-road or railway—and the social and economic problems which arise out of the services rendered, including the question of the relation of the various transportation agencies to the government.

*Transportation by Water.*—For a long time in the world's history most of the transportation was by water. There was little internal commerce. Each village or manor lived chiefly within itself, and supplied its own rude wants. Most of the trade was in foreign products. The merchant vessels of the Phœnicians and other commercial nations many centuries before the Christian era, though rude in comparison with modern appliances, represented the highest mechanical and engineering art of the age, and the work done by these ships, both in discovery and in transportation, was of a remarkable character. On land there were no means of transportation to compare with them in efficiency. The earliest roads worthy of the name were built for purposes of war rather than of trade. As conquest preceded commerce, so the question of moving armies was in early days more important than the question of moving goods or travelers.

*By Roads.*—The first important system of roads was developed by Rome. In their first beginnings the Roman roads were military in their purpose and character. They were intended as means of holding the provinces in subjection, rather than as means of exchanging goods with them. But as the power of Rome became more securely established the warlike purpose partly gave place to the peaceful one, and during the days of the empire there was a system of roads through Europe better than existed for many centuries afterward. In fact, down to the present day, in certain parts of Europe the best roads are the remains of the old Roman system.

With the downfall of the empire and the establishment of the feudal system there was again a period of commercial isolation. Trade by sea began to revive as early as the eleventh century, but it was not until the fourteenth century that the efforts of merchants in the towns were sufficient to give security and importance to inland traffic, nor was it until the establishment of the French national power in the seventeenth century that any power was strong enough to resume the work of the Roman empire in road-building. It was Colbert, the great financial minister of Louis XIV., who conceived the idea of the French national system of roads and waterways, which his successors have continued to develop. There is a system of national highways, chiefly radiating from Paris, under the direct control of the department of roads and bridges. These are now supplemented by a system of departmental roads, bearing the same relation to each department or district that the national roads bear to France as a whole, while between them there are the local or communal roads, which are laid out and constructed in the same haphazard way as those in the U. S. The long lines of river in comparatively level country have enabled the French engineers to devise, at comparatively slight expense, an internal system of navigable water routes in connection with the roads, so that France is, on the whole, less dependent on her railways than is any other civilized country.

In England there was no such system of national or departmental roads. Down to the beginning of the eighteenth century the English road system was in the hands of local authorities, and, as is always the case under such conditions, it was imperfectly cared for. The establishment of national highways in England was due to private rather than to Government enterprise. Turnpikes—so called from the bar or pike which can be turned to bar the road at points for the collection of toll—were first established at the beginning of the eighteenth century. They were usually built by trusts; that is, by bodies of semi-public officials who were authorized to borrow money for the purpose of constructing the road, and charge tolls, which should not only pay interest on the money thus borrowed, but ultimately, if possible, extinguish the principal. The English canals were built by private companies. The first important one was constructed in 1760. The next forty years was a period of great activity in canal-building, the Duke of Bridgewater being the most active promoter of these enterprises.

The U. S. was much later in developing a road and canal system than England or France. This was due rather to the poverty of the country than to any lack of interest in the subject. The early roads were in the hands of local authorities—townships in New England, or counties elsewhere. In 1790 the first turnpike in the U. S. was built. The system developed first in Pennsylvania, but appears to have been carried further in New York. Some States gave subsidies to turnpikes, but on the whole they were built by private companies as a purely commercial enterprise. The one great public road of the U. S. was the national pike, or Cumberland Road, running from Washington by way of Wheeling, Columbus, and Vandalia, to the Mississippi river. It was built in sections, from 1808 to 1837. It was intended by its promoters as part of a large national system. Among the most prominent exponents of this idea were Gallatin in 1808, and Calhoun in 1818. Gallatin, as Secretary of the Treasury, urged the necessity of a comprehensive road system on economic grounds. Calhoun, as Secretary of War, argued in favor of the same proposal on military grounds also. Ultimately, however, the plan of national aid to roads was taken up—not by Democratic leaders like Gallatin and Calhoun, but by the Whig party. This party approved of internal highways on principle, as tending to bind the different parts of the country closer together, and to extend the influence of the central government. With the overwhelming victory of the Democratic party under the leadership of President Jackson the project of a national road system failed completely.

*By Canals.*—Canal-building in the U. S. was, for the most part, not in the hands either of private companies or of the national Government, but of the several States. By far the most important work of this kind was the Erie Canal, first projected in 1792, but actually built during the years 1817 to 1825. It proved so successful that it was enlarged in 1836, and for half a century, at least, was the most important internal transportation route in the U. S. The next best canal system was that of the State of Pennsylvania, which was useful and profitable until the development of railways, but afterward fell into comparative disuse. Some of the coal canals were also very successful, but the other canal routes were, as a rule, ill judged, if not ruinous. An important exception must of course be made in favor of those comparatively short ship-canals which virtually formed part either of the lake route or of the Mississippi system.

*By Railways and Steamships.*—The use of steam as a motive power revolutionized all transportion—inland and foreign alike. There were several reasons for this, of which the most obvious is not the most important. The obvious effect of the use of steam was quicker transportation. Its still more important effect was that its application to other forms of business created a greater amount of goods to transport.

When each village or each plantation lived within itself expensive roads were impossible, because the amount of traffic was too small to pay interest on a costly rail or water route, no matter how efficient it might be. But with the development of the factory system there came a chance for handling more traffic. The factories made goods on a large scale at very much lower prices than were admissible before. The difference between the old price and the new could be paid to any transportation agency which would lay down the goods in a market otherwise inaccessible. There thus grew up a demand for a means of placing factory products in distant towns and villages, and these in return were given the opportunity to send farm products to feed the larger towns in which the factories had collected. The amount of such traffic between town and country was now limited only by the question of price. Railways and steamships were developed as a means of doing an enormous business at low rates.

The two inventions were almost simultaneous, that of the steamship being slightly the earlier. The practical usefulness of this invention dates from the early years of the nineteenth century. As early as 1820 or 1830 it was extensively employed on inland waters and in the coasting trade. It was not until 1838 that a systematic effort was made to use it permanently on ocean routes. The first efforts of the British steamship lines, aided and backed by the Government, were connected with political and military considerations quite as much as with purely commercial ones. But by the year 1850 the commercial success of the new method was assured, and then there began the hard fight for supremacy between steam and sail. The owners of the sailing-vessels made determined efforts to hold their own by increase in size, by greater care both in construction and management, and, above all, by a study of the prevailing winds, due primarily to Lieut. Maury, which enabled sailing-vessels to reach their destination faster by somewhat circuitous routes than by the old direct ones. But, in spite of these, each new invention gave steam a new advantage. The substitution of iron for wood as a material in ship-building helped the steamer more than the sailing-vessel. The substitution of the screw for the side-wheel was an important step in economy of propulsion, especially in head winds and rough water. The introduction of compound engines, and afterward of the triple or quadruple expansion, marked a further step in the same direction. Even the increase in size of the vessels gave steamers a new advantage. It increased the consumption of fuel somewhat, but it increased the carrying capacity far more. With each year the percentage of the world's steam tonnage becomes larger, and its sailing tonnage relatively, if not absolutely, smaller. Since 1880, besides these general improvements in construction and economy, there has been a further tendency to systematize ocean traffic by the division of labor among different classes of boats. Formerly each boat was built for general purposes, and took all the traffic that it could get. To-day there are ocean passenger-steamers, built for high speed and on fine lines, and endeavoring to make their passages in the shortest possible time; freight-steamers, running on regular lines, but built with a view to economy in coal rather than economy in time, and attracting freight by their regularity and convenience rather than by their speed or their appointments; and, finally, ocean tramps, or still cheaper steamers, running like sailing-vessels, wherever they can get a cargo. In this competition the sailing-vessel has the advantage of cheapness in motive power, but the steamer can be so much more rapidly utilized that it often more than makes up for this disadvantage.

For history of railway development and of the various devices connected with it, see RAILWAYS. This article is concerned rather with the social and economic effects—with the relation between the progress of invention on the one hand, and the growth of business on the other. Of the kind of use which would be made of the railway none of the early inventors had any idea. When the first charters were granted in Great Britain or Germany it was assumed that the company would own the road, and that private individuals would furnish the vehicles if not the motive power. Railway charges under this view were to be like tolls on a canal or turnpike. Nor has the legislation of the present day everywhere outgrown this view. Equally erroneous was the old view of the kind of service which railways would probably render. It was supposed that they would carry passengers rather than freight. It was predicted in 1830 or 1840 that passengers would very soon be carried at 100 miles an hour. On the other hand it was not supposed that railways could carry freight so cheaply as they now do, least of all that they could do it in competition with water routes. Some early charters actually tried to prohibit such carriage of freight. In 1856 there was an agitation in New York State to prohibit the New York Central Railroad from carrying freight in competition with the Erie Canal. But each decade was marked by a lowering of rates and an increase in freight traffic which usually made the reduced charges profitable. This reduction, which was comparatively slow until 1870, was much more rapid after the introduction of steel rails in place of iron. It was not the direct saving in expense which produced economy. It was rather the capacity of doing more work. The use of steel rails instead of iron made it possible to carry larger train-loads. With the increase in train-loads, as with the increase in size of steamships, the direct expense of running a train was slightly increased, but the amount which such a train could carry increased enormously. In the year 1870 a freight-car weighed 10 tons and carried 10 tons. In the year 1890 a standard freight-car weighed from 12 to 13 tons and could carry 25 tons. Two-thirds of the total weight of the train is profitable under the new conditions instead of one-half. A similar change took place in the size of locomotives. The new locomotives cost perhaps one-fourth more than the old to run, but they do from two to three times the work. In order to utilize this increased capacity, both of the cars and of the traffic, a system of rates was made to develop traffic. It was seen that in certain lines of business little or no movement could be obtained at high rates, while a great deal of business could be had if the rates were made lower. This was the case with cheap articles like coal, stone, lumber, or even food products, especially if these articles were carried for long distances. Thus classification was introduced by which some goods paid more than others for the same weight, while the mileage system, which would make rates proportionate to the distance, was largely, if not wholly, abandoned. The effect of this change has been a reduction of rates at almost every point, combined with vastly increased efficiency of the railway system. It has also contributed to the further development of improvements in construction and economy. In the U. S., instead of cheap railways built to carry a small amount of traffic at two or three cents a ton per mile, there are being substituted more expensive roads carrying much larger traffic at one cent, half a cent, or, in certain exceptional cases, a quarter of a cent a ton per mile. Each increase of traffic makes it possible to introduce improvements in construction. Each improvement in construction renders it profitable to do an increased business at lower rates, and each lowering of rates enables the shippers to increase the volume of traffic furnished.

Yet all this reduction increases rather than diminishes the possibility of extortion on the part of the railway managers (see INTERSTATE COMMERCE), and renders the question of the organization of transportation service and its relation to the Government even more important.

*Service rendered by Transportation Agencies.*—This may be divided into two main heads: first, the transmission of intelligence; second, the transportation of persons and property. The former work has been kept in large measure in the hands of the government. There are obvious reasons for this. As a mere matter of military strength the government must have under its own control the means of transmitting intelligence as quickly as private individuals, if not more quickly. The establishment of political power of any kind has been usually followed by an assumption of the postal service. It was so with the Hanseatic League of free towns in the Middle Ages. It was so with the renewed national life of France in the seventeenth century, just described. In England for a time the postal service was left to some extent in private hands, but the results of this were not satisfactory either to the Government or to the public. It was made a Government monopoly by the legislation of 1649 and 1651, although it continued to be farmed out to some extent until the next century. The usefulness of the British post-office dates from the year 1784, the establishment of low postal rates from 1840. (See POSTAL SERVICE.) The U. S. postal service was a Government monopoly from the outset, and now there is scarcely a civilized country of which the same thing can not be said. The disadvantages in economy due to government administration are more than counterbalanced by the general public considerations already alluded to. The only questions at issue between the advocates and opponents of government activity are connected with the parcels post or express business and the telegraph. In Great Britain the telegraph was controlled by private companies until 1870, and the British parcels business is handled by the railways and private companies, and by the Government since 1883. But on the continent of Europe both of these matters are managed by the Government. In the U. S. the parcels business is done by private companies. The Government is willing to do a certain amount of such business, but under the conditions of Government efficiency it seems impossible for it to handle the great bulk of such traffic in competition with private companies. The rates would probably be higher, the responsibility would certainly be less. The only method of organizing a Government parcels post on a large scale would probably be to prohibit the express companies from doing business of that kind, and for such a measure the public is by no means ready. Neither the higher rates, the lessened responsibility, nor the extension of official patronage would be a desirable result. While the Government, in virtue of long-standing custom, can prevent private persons from carrying letters, it would find it impossible to prevent them from carrying parcels.

The question of the telegraph presents much greater room for doubt. In the first place there is great public dissatisfaction with existing conditions. The telegraph business of the U. S. is almost entirely in the hands of one company, and, rightly or wrongly, it is believed that the rates charged by this company are unnecessarily high. They are on an average higher than those of most countries of Europe, and in connection with this the amount of general use of the telegraph in the U. S. is less than in two or three other countries where the government manages the telegraph lines. Add to this that the Government telegraph in Great Britain has given great satisfaction, and there are strong reasons for the popular demand for the change. On the other hand, it is urged by the opponents of a government telegraph that the rates in the U. S. are not really higher than those of Europe, if we take distance into account, and that, though distance itself is not an important direct factor in telegraph rates, the sparseness of population which is connected with this fact of long distance is overwhelmingly important. They can also show that, in spite of the abuses charged against the Western Union Company, the capitalization of the telegraph lines of the U. S. per mile of line, per mile of wire, or per office is not high as compared with that of Great Britain; that the expenditures of the British Government on telegraph lines have been extravagant, and that the economy of operation of the British Government has been questionable; in short, that most of the economic objections against various forms of state activity may be urged in this case also.

*Railway Ownership.*—This question involves wider interests, and has given rise to more conflicting arguments, than that of the post-office or even the telegraph.

In the early stages of railway development governments were more concerned to encourage railways than to control them. Each nation saw how important it was to have railways. Few, even among the most far-sighted statesmen, perceived that the power connected with railway ownership might one day become dangerous to large public interests. All were anxious to have railways, and were ready to give such help as was necessary to that end. Sometimes the state built the roads, sometimes it gave money to private companies. Partial state ownership or an extensive subsidy system was the general rule. Great Britain was the only exception. There was so much capital in Great Britain seeking investment that no such encouragement was needed. In Ireland, where capital was scarcer and more timid, the British Government did not scruple to grant subsidies. In the U. S. the national Government from 1850 to 1857 gave large grants of land, and after a few years' interruption renewed the same policy on a still larger scale in 1862, also giving to two large railway systems, the Union and Central Pacific, a cash subsidy of $25,000 per mile. (See SUBSIDIES.) Equally extravagant cash payments were made by States and municipalities in the years preceding the crisis of 1873. There are no adequate data on the subject for the U. S. as a whole, but the records of so conservative a State as Massachusetts show that public assistance to the amount of something like $30,000,000 was given to the railways of that State, usually to the ones that did not pay, and sometimes to those that were not built, at least for many years after the payment of the subsidy. Much of the most burdensome part of the local debt of the U. S. is due to grants of this kind, whether in the form of subscriptions to capital stock or to bonds in aid of new roads. France went further than the U. S. The Government systematically defrayed about half of the original cost of the French railways. It laid out the road, did the grading, the tunneling, the bridge construction, and everything to the level of the line itself, leaving to the companies only the expense of track, buildings, and equipment. In addition to this the French Government granted to a few large companies a monopoly in their several districts, and this monopoly has proved so strong that no subsequent efforts have been able to break it.

In other countries of Europe the state actually built and operated the railroads to a greater or less extent. In Belgium this policy was pursued at the outset. The state built the best lines, leaving the private companies to occupy less advantageous fields of traffic. Somewhat later the states of South Germany pursued a policy like that of Belgium. Prussia at first did just tho converse. It allowed the best lines to be built by private companies, with more or less aid and encouragement from the state; it then built and operated on its own account, as a military or political necessity, those lines which private enterprise was unwilling to undertake. Austria vacillated between the German and the French policy, building some roads on Government account which it afterward sold to private companies below their true value. In Scandinavia and in Hungary the roads were generally owned and operated by the Government. In Russia, in Italy, in Switzerland, and in Spain private enterprise was the rule down to 1870. In one sense all the roads of continental Europe are government property because they will, by the terms of their charters, revert to the state about the middle of the twentieth century. Such is the theory, but it is not of much importance in practice.

After the year 1870 there was a strong movement among the nations in favor of increase of government control, if not actual ownership. This was due to several causes. In the first place the wars of 1859, 1866, and 1870 had awakened in Europe a feeling of national life and a desire to have a strong government, with widely extended activity. In the second place, certain abuses of railway power had developed themselves which led people to think that the government might do better. Every day also it became clearer that in the management of railway enterprises monopoly was the rule and combination the exception, and it was thought that the management of any such powerful monopoly should be in the hands of the government itself. In those countries like the U. S., where there were practically no government lines, the agitation in favor of national ownership was fruitless. There was some talk on the subject in connection with the Granger movement, but the only practical results of that movement lay in the direction of legislative control instead of actual ownership. (See INTERSTATE COMMERCE.) But in those countries where there was already a state railway system in existence the government, besides building new roads of its own, bought many of the old roads from private companies. This movement was first felt in Belgium, where the Government, in the years from 1870 to 1885, purchased most of the private lines and made close traffic arrangements with the roads, so that it now owns, in round numbers, three-quarters of the railways in the kingdom, and has considerable control over the policy of the remainder. The same movement was felt in Germany a little later. It seems to have been Bismarck's desire that the German empire, as such, should own and manage its railways. But this project, though urged more or less seriously from 1871 to 1877, met with opposition from the states of Southern Germany, which already controlled their railway systems and were jealous of encroachments by the imperial power. Defeated in his plan of organizing a German state railway system, Bismarck was forced to content himself with the extension of the Prussian state railways, and in this project he succeeded. In 1878 out of 11,000 miles of railway in Prussia, 6,000 were owned and managed by private companies, 2,000 owned by private companies but managed by the state, and only 3,000 miles owned by the state itself. In the years 1879 to 1884 the Government gradually acquired nearly all the railway lines previously managed by private companies. On May 1, 1894, out of 27,589 km., or 17,105 miles, of railway in Prussia only a few hundred miles were in private hands. There was little or no compulsion connected with the purchases. The prices paid were so high as to make it worth while for the stockholders to sell, the stockholders of the Berlin-Hamburg line obtaining Government securities which gave them a guaranteed income of over 16 per cent. on the par value of their shares. Austria followed the example of Prussia, but less completely, because the Austrian Government was not financially strong enough to conduct its operations on so rapid a scale. During this period Italy also moved in the direction of state railway management. Even in France there was a movement, under the leadership of Gambetta, to establish a strong national system of roads, partly as a means of military training for Government officials, partly as a check to the irresponsible activity of private lines. In those countries which had had few railways until 1870, most of the lines were owned or at least managed by the state from the very outset. Such has been the case in the extreme east of Europe, in many parts of South America, and, above all, in Australia. It has been to a considerable extent true of British India also.

About the year 1881 a counter-reaction against state ownership began to make itself felt in some quarters. This was noticeably the case in France, where, by a convention of 1883–84, the state system was confined to a relatively unimportant district in the southwest. The Government went so far as to abandon the idea of a line of its own to Paris, and in so doing it gave up all prospect of becoming a controlling power in the railway system of the republic. Still more important were the developments in Italy. In 1876 the triumph of state railway management there had seemed as fully assured as in Germany, and much more so than in Austria. But the financial burdens of the change were great, and the results of state management not wholly satisfactory. It was considered better to lease the Government roads to private companies for the time being, and to appoint a commission to consider what should be the permanent arrangement. This commission sat from 1878 to 1881, and its conclusions, based as they are on practical experience, form perhaps the strongest argument against government management of railways. The conclusions of the commission were: 1. That the state can not be expected to make lower rates than private companies. The theory that government railways can foster industrial development does not work in practice. The state is much more likely to tax industry than to foster it, and when anything of the sort is attempted, the state is more arbitrary than a private company and less subject to any outside control. 2. State management is, on the whole, more costly than private management. 3. The political dangers connected with state management are very great. So far from finding that the power of railway rings is checked by putting the roads into public hands, the commission believes that the power of such rings is increased. Politics corrupt the railways, and the railways corrupt politics. Rates are made to influence elections rather than to meet the necessities of traffic or of sound finance. On the basis of these conclusions the commission urged the Italian Government to give the railways into the hands of private companies for operation.

On the other hand, it should be said that the feeling in favor of state ownership in Germany and Austria shows no signs of abating; that Switzerland is gradually being drawn into a policy of nationalization of its railway lines; and that neither British India nor Australia shows any tendency in the direction of private ownership. In the U. S. the platforms of the Farmers' Alliance and the People's Party declare in favor of Government railway ownership, though it may be questioned how far those who have framed the platforms would be ready to meet the financial burdens involved in any such change.

It is extremely difficult to compare, with any degree of fairness, the results of the two systems of railway ownership, state and private. Such figures as can be given serve more than anything else to show the difficulties of the subject, and to indicate that the question is one whose solution depends largely upon national character.

The countries which have, on the whole, developed their railway systems most rapidly are Great Britain and the U. S. Care must be taken to avoid laying too much stress on this fact, which is quite as likely to be due to the exceptional wealth of these two countries as to any difference in system. If we compare Germany and France we find that Germany, with state-owned roads, has larger mileage and traffic than France, with subsidized roads. But the French roads are, as already stated, in the hands of a strong guaranteed monopoly. In general, it seems to be the rule that railway development is fastest under free competition, next fastest under government monopoly, and slowest under private monopoly. In the facilities furnished, the results of competition, though imperfect, show a still more marked superiority. The miles run by trains in the U. S. in the year 1891 amounted to over 830,000,000, or 13 miles for every inhabitant. In Great Britain the figures for the same period show an average of about 8 miles, in Germany barely 4 miles, and in France a little less than in Germany. In other words, the amount of railway service offered is vastly greater under competing private lines than under a monopoly, even though it be in the hands of the government. Equally marked is the difference in speed. Much the fastest trains are run in Great Britain and the U. S., a great many of them in the former country, a few of equal merit in the latter. Until recently France came next, though at a long interval, with Germany a bad fourth. Since the accession of William II. there have been efforts at increased speed, but the one fast train between Berlin and Hamburg, of which so much is said, does not surpass in speed the best English or American trains, and there is nothing else in Germany which even approaches them. With regard to rates, the matter is much more even. The average charges for freight and passengers on the railway systems of leading countries in 1887 were as follows:

| COUNTRY. | Per passenger per mile, cents. | Per ton per mile, cents. |
|---|---|---|
| United States | 2·16 | 0·94 |
| Great Britain | About 2 | Less than 2 |
| France | 1·39 | 1·77 |
| Prussia | 1·22 | 1·43 |
| Austria | 1·54 | 1·85 |
| Russia | 0·80 | 1·00 |
| India | 0·54 | 1·36 |

The question of high or low rates, as will be seen from this table, depends not so much upon the form of ownership as upon the character of the traffic. In a dense population and with small train service, like that of India, passenger rates will be relatively low. With a comparatively small population and high demand for train service, passenger rates will be relatively high. The U. S. pays more per passenger mile than any other country in the list, because a saving of time is of more importance to a large part of the people than a saving of money. If the people of the U. S. were willing to have the relatively small train service of continental Europe or of India, they could have the passenger rates of continental Europe or of India also. If a man is making only 20 cents a day, he can afford to wait the whole day to save 20 cents. If he is making $2 a day he can afford to pay $1 to have a train go at the time it suits him. This is in large measure the explanation of the differences in the table. On the other hand, the differences in freight rates are largely influenced by distance hauled and by character of the traffic. In the U. S. or Russia, where there are long-distance shipments of grain or other similar commodities, the freight rates will be low, independently of railway management. In Great Britain, for the converse reason, freight rates must be high. Here again we may say with some qualification that the lowest rates will be found under competition, the next lowest under government monopoly, and the highest under private monopoly.

With regard to abuses of power in the matter of rates, there is little to be said in favor of one system against the other. Wherever there is competition there is a tendency to make special rates and give secret rebates to those who least need or least deserve it. This was one of the controlling facts which drove Belgium and Prussia to extend their government railway systems. The government could not control the acts of its own agents when those agents were working in competition with private lines. In the years preceding 1870 the very worst abuses of the rate-making power were found in the government lines. The question whether special rates can be avoided depends largely upon the extent to which a monopoly can be secured by the railway companies. Whether that monopoly is in the hands of the government or of private companies does not appear to make any very great difference. In either case the advantage, such as it is, is obtained at a sacrifice of development and cheapness. The leveling process results in leveling up, not in leveling down.

There is no greater mistake than to suppose that because government represents the people, therefore if government owns the roads the people will get lower rates. Most of the advocates of state railway ownership in the U. S. think that there is a large fund of profit which now is divided among stockholders, but which would go to the shippers if the nation owned the railroads. Now, in the first place, there is no such large fund of profit. Railways in the U. S. barely pay interest on their investment. Even if we make all allowance for water in stock, it is not likely that the net earnings of railways are equal to 4 per cent. of the capital actually invested. If it be said that there is a fund of legitimate profits of which the community might get the benefit under a state railway system, we may reply that there is reason to believe that those legitimate profits would be larger rather than smaller under national control. Whatever may be said about the unrighteous stock issues of roads in the U. S. it is certain that, quality for quality, the capitalization of these roads is less than that of any similar railway system in the world. The effective or net capitalization of the railways of the U. S. is about $50,000 a mile. Australia, with a vastly inferior system, has an average capitalization of about $40,000, as nearly as can be ascertained. Germany and Austria, with systems approximately equal to those of the U. S., superior in construction, but inferior in usefulness, are capitalized at nearly $100,000. Whatever water there may be in U. S. railway stocks, and whatever waste or abuse may have been incident to private management, it is certain that the capital accounts of foreign railways show an even greater waste, due to the inefficiency inseparable from government contracts.

The important thing for each country is to get the management of its transportation industries into the hands of the most far-sighted and competent men. If a country like Germany has such traditions that the best administrative talent is to be found in the Government service, it is probable that a state railway system, even with the inevitable evils of monopoly, is on the whole the best. If, on the other hand, the best administrative talent is found in private rather than public business, which is noticeably the case in the U. S., a change from private to public management would be attended with all the evils noted by the Italian commission, and would prove a burden instead of a relief to the business interests of the country. See COMMERCE, RAILWAYS, and STREET-RAILWAYS. A. T. HADLEY.

**Transportation**: as a punishment for crime, the transfer of a convict to a limited part of a kingdom, under pains and penalties for leaving the limits before the expiration of the term of transportation, and with or without other forms of punishment being added. This form of punishment was unknown at the common law in England, although in the case of a criminal's taking sanctuary and confessing his crime he was allowed to leave the kingdom, taking an oath of abjuration, which bound him never to return. Sanctuary and abjuration were abolished by the act of 1 James I., c. 25, and 20 James I., c. 18. The earliest case of transportation seems to have occurred in the reign of Charles II., when transportation was made a condition of pardons granted to persons convicted of capital crimes. This practice was subsequently greatly extended by legislation, and especially by the act of 1768; and transportation was first legalized as a direct punishment, by sentence of the court, by the act of 4 Geo. I., c. 11. During the eighteenth century and the early part of the nineteenth an immense number of acts were passed by which various terms of transportation, with alternative terms of imprisonment, and power, in some cases alternative and in others cumulative, to order whipping, were provided for the punishment of particular offenses. This legislation was utterly lacking in uniformity and was guided by no principle, and the statutes themselves contained so many capricious variations as to be incapable of any systematic classification on principles. A statute providing for punishment by transportation might and generally did contain the following provisions:

(1) A maximum term of transportation.
(2) Intermediate terms of transportation.
(3) A minimum term of transportation.
(4) A maximum alternative term of imprisonment with or without hard labor.
(5) A minimum alternative term of imprisonment.
(6) Power to inflict whipping, publicly or privately, and once or more than once.
(7) Power to inflict solitary confinement during a certain part of the term of imprisonment.

And these seven varieties of punishment were combined in all imaginable ways. In making these provisions a very wide, and yet capriciously restricted, discretion was left to the judge, and in the great majority of cases the judge could inflict as little punishment as he chose. In a few cases only was the punishment prescribed absolutely; in many cases a greater or less minimum of punishment was of necessity inflicted.

This condition of affairs continued until in 1846 an act (9 and 10 Vic., c. 24, § 1) was passed which provided that in all cases where any court was empowered to pass a sentence of more than seven years' transportation it should have power to pass instead sentence of transportation for any term not exceeding seven years, or sentence of imprisonment with or without hard labor for any term not exceeding two years.

The places to which criminals were sent from Great Britain under sentence of transportation were some of her colonies, most notably those in Australia, and the great extent to which this form of punishment was carried was made possible only by the fact of her possessing them. The criminal population in this manner became concentrated in small districts, and there they married, and by the natural increase and the numbers constantly added by newly transported convicts, this population was increasing with great rapidity, and extending throughout the colonies to which they had been transported. Meanwhile the colonies themselves were rapidly becoming more thickly settled by colonists of the better class, and their power and resources enormously developed, and they began to make objection to any further practice of transportation to their territory. Principally owing to these objections the punishment of transportation was gradually abolished between 1853 and 1864, and penal servitude or imprisonment and hard labor on public works was substituted for it. The punishment of penal servitude consists in keeping the offender in confinement, and compelling him to labor in the manner and under the discipline appointed by the acts relating to penal servitude. Imprisonment at hard labor consists of the detention of the offender in prison so that he shall be prevented from having any communication with other prisoners, and in forcing him to work at the treadwheel, shot-drill, crank, capstan, stone-breaking, or some other description of labor lawfully substituted therefor. The Penal Servitude Acts authorized the carrying out of the sentence in any part of the kingdom, and under these acts criminals were kept in confinement at Bermuda till 1862 and at Gibraltar till 1875. The difference between the two punishments is thus rather nominal than real, and the provisions of the act which regulated transportation are still in force as regards prisoners under sentence of penal servitude. Actual transportation, however, was practically discontinued.



The usual minimum term of transportation, when that punishment was commonly inflicted, was seven years, but imprisonment might in many cases be alternatively inflicted for three, four, or in some cases seven years. When penal servitude was substituted for transportation the punishment of imprisonment at hard labor had been made more severe and shorter than it had been, and in nearly every instance two years was the maximum term of imprisonment at hard labor permissible to be inflicted. At first the minimum term of penal servitude was three years; in 1864 it was was raised to five years, and in 1891 it was again reduced to three years.

The use of transportation has been practiced more or less by other nations than the British, but its use has never obtained among British colonies nor to anything like the extent to which it was carried in Great Britain, except in the case of Russia, which still uses the territory of Siberia as a place of transportation of criminals of certain classes. See SIBERIA.

See the articles on PUNISHMENT and PRISON DISCIPLINE, etc.; also Sir James Stephen's *History of the Criminal Law of England*, and *Digest of the Criminal Law*.
F. STURGES ALLEN.

**Transposition** [from Lat. *transpo'nere*, *transpo'situm*, set over, remove, transfer; *trans*, across, over + *po'nere*, put]: in music, the act of removing a composition into a key different from that in which it is written. By this is not meant a change of mode also. A piece of music written in a major key, for instance, can not be transposed into the corresponding minor (as from C major to C minor), unless its construction has been such as to make such a transfer possible. A composition in any major key may be transposed into any other major key; and the same rule applies to compositions in minor keys. Transposition is not simply the moving of all the notes of a piece one or more degrees higher or lower, for such a change would at once destroy or impair its distinctive character. If the scale consisted of a series of regular and equal degrees this might readily be done, and a composition would suffer no injury by being moved from any key to any other. But as the scale is not a regular but an irregular series of sounds, consisting of five whole tones and two semitones arranged in a fixed and invariable order, and as all music is now written on such a scale, and no other, it follows that we can not transfer a composition without injury into a new key until we have brought the scale of that key into conformity with that in which the piece is written. A composition in C major, for instance, if carried three degrees higher—i. e. into the scale of F—would be false on every fourth degree of that scale, because one of the semitones in the series differs in its position from the normal pattern in C. To rectify this we lower the fourth (or B) by placing at the clef a flat on that degree; and by thus changing every B into B♭ we correct the scale, and transposition from C to F requires nothing more than a change of the places of the notes. Again, if we would transpose from C to G, we shall find a defect of an opposite kind on the seventh degree of the G scale, which must be corrected by changing every F into F♯. On the same principle we proceed in transposition into any other key, correcting by sharps or flats the deviations of any desired key from the model scales of C major or A minor. See KEY.
Revised by DUDLEY BUCK.

**Transubstantia'tion** [from Late Lat. *transubstantia'tio*, deriv. of *transubstantia're*, transubstantiate; *trans*, over, across + *substan'tia*, substance]: a scholastic term signifying the change of the substance of the natural elements of bread and wine into the very body and blood of Christ in the Eucharist, while the visible form and the appearance of bread and wine remain. According to the teaching of the Roman Catholic Church, this miracle takes place in the Mass whenever the priest pronounces the words of institution: "This is my body," "This is my blood." The doctrine was more or less clearly suggested by several Greek and Latin fathers (under different terms, such as *transitio*, *transmutatio*); it was controverted in the Middle Ages by Bertram (Ratramnus) and Berengar, but defended by Paschasius Radbertus (831), Lanfranc, and the chief Schoolmen, confirmed by the Lateran Council (1215) and the Council of Trent (Oct. 11, 1551), and learnedly defended by Bellarmine, Bossuet, Möhler, Perrone, and Cardinal Wiseman (in a dissertation on John vi.). The Church teaches not only that Christ is present in the blessed Eucharist, but that he is present by transubstantiation. The very words of consecration, as given in the Gospels, seem to prove this doctrine. The teaching of the Church is conformable to the literal interpretation of these words. See Cardinal Wiseman's *Lectures on the Holy Eucharist*. Revised by J. J. KEANE.

**Transvaal Colony**: See SOUTH AFRICAN REPUBLIC.

**Transylva'nia** (Hung. *Erdély*; Germ. *Siebenbürgen*): the southeast part of the kingdom of Hungary. Area, 21,518 sq. miles. There are fifteen counties; pop. (1890) 2,247,049, of whom about 55 per cent. are Roumanian, 29 per cent. Magyars and Szeklers, 10 per cent. Germans, and nearly 50,000 gypsies. The country is hilly and mountainous, with a mean elevation of 1,444 feet, with the Carpathians on the E. and the bold Transylvanian Alps on the S. The drainage is into the Danube, chiefly westward by the Maros and Körös to the Theiss, but the Aluta and some lesser streams make the traverse of the Transylvanian Alps southward directly to the Danube. Of the soil, 37 per cent. is in forests, 23 in plowed land, and 17 in meadows and gardens. The chief crops are maize, wheat, oats, fruits, tobacco, flax, and hemp. Wine is made in large quantities, especially in the Maros basin. The climate is mild and agreeable in the lower lands. The horses number 188,000, and the breed is excellent. Cattle are reared in large numbers, and the breeding of sheep and swine is general. Mining has been a very important industry, and Transylvania used to be called the gold mine of Europe. Gold has been obtained from time immemorial, and is produced in considerable quantities from both mines and placers. Silver and iron are also mined. Manufactures and other industries are not well developed, and are declining because of the recent political and Slavic tendencies which are driving out the Germans. Trade is largely with Roumania, and is in the hands of Armenians and Greeks. About 12 per cent. of the population is Roman Catholic, 27 per cent. Greek Catholic, 32 per cent. Greek Oriental, 10 per cent. Lutheran, and 14 per cent. Calvinist. There is a university at Klausenburg, and there are many secondary schools.

Transylvania was a part of Dacia, acquired by Trajan and colonized with Dalmatians, Gauls, and people from Roman Asia Minor. When the Roman empire was in decay this region was especially exposed, and was occupied by race after race of the invaders—latest by the Magyars. In the twelfth century colonists were again introduced, this time from the basin of the Rhine (Teuton), and there called Saxon. The Saxons built the most of the existing cities. After the defeat of the Hungarians by the Turks at Mohacs in 1526 Transylvania was independent till 1690. After that it became a grand duchy and crown-land of Austria, and so remained till 1867, when it became, politically and administratively, an integral part of the kingdom of Hungary. See Gerard, *The Land beyond the Forest: Facts, Figures, and Fancies from Transylvania* (2 vols., 1888).

MARK W. HARRINGTON.

**Trap**, or **Trap-rock** [*trap*: Germ. *trapp*, from Swed. *trapp*, deriv. of *trappa*, a stair, stairs; so called from the stair-like arrangement often observable in these rocks]: a name indiscriminately applied to any dark-colored mass of igneous rock, regardless of its composition. On account of its lack of definiteness it is passing out of use as a geological and petrographical term. To a very great extent the name has been applied to basaltic masses. See BASALT, BUILDING-STONE, and ROCKS. J. P. I.

**Trapani**, traa'pāa-nee (anc. *Drepanum*): a town on a scythe-shaped peninsula of the extreme point of the west coast of Sicily; lat. 38° 3′ N., lon. 12° 30′ E. (see map of Italy, ref. 9-E). The churches, the municipal palace, the Giudecca, etc., are worthy of notice, and contain interesting artistic objects. The celebrated sanctuary of the Madonna of Trapani (finished 1332) is outside the town. The harbor is convenient for the coasting trade, and it has been made much more safe of access for foreign vessels by the erection of a mole and of lighthouses. About 3,000 vessels enter this port annually, the trade being chiefly in fish, coral, sponges, wine, oil, fruits, cotton, semolino, etc. Among other local industries are works in marble, alabaster, coral, and shell. The art of cutting cameos in shell is said to have been revived here. Here in 249 B. C. the Carthaginians defeated the Romans in a famous naval battle. Charles V. made this place a great military station for the defense of this coast against the Saracens, and it was at this time called *Invitissima*. Pop. of commune (1893) 47,000.

Revised by M. W. HARRINGTON.

**Trapezun'tios**, GEORGIOS: Italian humanist; b. in Candia, 1395. He fled before the Turkish invaders and reached Venice in 1430, and was employed by Francesco Barbaro as a copyist. He learned Latin under Guarino and Vittorino da Feltre, and acquired so great a proficiency in that language that he became a celebrated teacher of Latin literature and rhetoric. He taught in a number of Italian cities—Venice, Padua, Florence, and Rome. Befriended by Pope Nicholas V., he translated Eusebius, Cyril, the *Homilies* of Chrysostom, Plato's *Laws*, and Aristotle's *Zoölogy* and *Rhetoric*, and the *Almagest* of Ptolemæus, translations characterized by an incredible negligence, wanton omissions and changes *in majorem dei gloriam*. He was engaged in unseemly quarrels with most of the great humanists of the fifteenth century, and is withal one of the most typical, albeit disgusting, figures of the Renaissance. He died in abject poverty in Rome, Aug. 12, 1484. Cf. G. Voigt, *Wiederbelebung des klassischen Alterthums*, ii., pp. 138-144.

ALFRED GUDEMAN.

**Trappists**: a monastic order of the Roman Catholic Church deriving their name from La Trappe, an abbey of the Cistercian order, situated in the department of Orne, Normandy, and founded in the middle of the twelfth century. Here Armand Jean le Bouthillier de Rancé, who was consecrated abbot on July 13, 1664, introduced those severe reforms which made the Trappists one of the most austere orders of the Roman Catholic Church. He was at first opposed both by other Cistercian monasteries and by the monks themselves, whose practices had become so disorderly, by neglect of the ecclesiastical authorities and by other unfortunate circumstances, that they were generally called the "brigands of La Trappe." But after some years' persevering exertions he saw his rules adopted not only in La Trappe, but also in Tamié, a Cistercian monastery near Faverges, in Upper Savoy. Twelve hours of the day were given to religious exercises, and several hours to hard labor. Vegetables and water formed the fare; meat, wine, etc., were forbidden, and conversation between the monks themselves or with outsiders was avoided. The whole life tended to concentrate the mind on the sole idea of death. During the Revolution the order was suppressed in France, and it possessed at that time only two monasteries outside of France—one in Germany and one in Tuscany. In 1817, however, La Trappe was reopened, and in the meantime a Trappist colony had settled in 1803 at Pigeon Hill, near Conewago, Pa., whence they removed in 1805 to Kentucky, and finally, in 1813, to Tracadie in Nova Scotia. A second colony settled in 1848 at Gethsemane, Ky., and a third at New Melleray, near Dubuque, Ia. In France the order was dissolved in 1830, though the law of dissolution was not enforced; in Italy it was suppressed in 1870, and in Germany in 1874. See Marsollier and Maupeau, *Vie de l'Abbé de la Trappe*; Chateaubriand, *Vie de Rancé* (Paris, 1844); *Histoire religieuse et littéraire de l'Abbaye de la Trappe* (Paris, 1824); Gaillardin, *Les Trappistes ou l'Ordre de Citeaux au XIX*[e]. *Siècle, Histoire de la Trappe depuis sa Fondation*, etc. (Paris, 1844). Revised by J. J. KEANE.

**Trasime'nus, Lacus**: See PERUGIA, LAKE OF.

**Tras-os-Mon'tes** [Portug., liter., beyond-the-mountains]: province of Portugal; bounded N. and E. by Spain, S. by the river Douro, and W. by the province of Minho. Area, 4,307 sq. miles. Pop. about 400,000. It is mountainous, and of a rather rugged and wild character, but its valleys are very fertile, and produce, besides more wheat than is demanded for home consumption, excellent fruits, and the famous port wines, whose cultivation is confined to one district, called Alto Douro. The mineral wealth is great, but entirely unused; the mulberry is extensively grown, and silk-culture carried on with success.

**Travancore′**: a feudatory state of the British-Indian empire, on the southwestern end of the Indian peninsula; area, 6,730 sq. miles; pop. (1891) 2,557,736, chiefly Hindus, containing, however, the unusually large number of 500,000 native Christians, 300,000 of them Nestorians, as well as remnants of ancient Jewish colonies. A most turbulent sect are the Mophlas, Mohammedans who inhabit the N. of the state. Owing to a large outlay of state money on public irrigation, works, and roads, the condition of the laboring and agricultural classes has been improved; roads connect the harbors of Quilon and Trivandrum with the interior. The British-Indian penal code, altered to suit the characteristics of the people, has become part of the law of the state. The revenues are quite large and are economically used, the expenditures being less than the income. The palace expenditure is very moderate, the greater part of the revenues being devoted to public works, to religious institutions, to education, and to judicial and police establishments. The state pays to the Indian Government an annual subsidy of £80,000. Besides coffee and pepper, the production of which is on the increase, cardamoms, areca, and cocoanuts are among the chief products. The capital is Trivandrum, on the Malabar coast. Revised by M. W. HARRINGTON.

**Travelers, Legal Rights of**: Many of these are stated in the articles on CARRIERS, COMMON; INNKEEPER; HIGHWAYS; NEGLIGENCE, and ROAD, LAW OF THE. The liability of the state, or of its subdivisions, for damages caused to travelers by defective highways is purely statutory; no such liability existed at common law. As a rule, statutes of this character receive a close construction. (See INTERPRETATION.) It is generally held that they require only the traveled portion of country roads to be free from defects, not the entire surface of the street as in cities. Moreover, the liability does not extend to every one lawfully upon the highway, but to such persons only as are using it for the ordinary and proper purposes of travel. Accordingly, children who use the highway as a playground on their way home from school, or who are coasting for pleasure and not for transit; persons who are loafing by the way as distinguished from those who have stopped temporarily for a purpose incidental to their use of the road as travelers; those who are racing horses, and those who have not reached the traveled portion of the highway, have been judicially denied the statutory rights of travelers. *Brown* vs. *Skowhegan*, 82 Me. 273.

*Tickets.*—Travelers may be required by carriers to provide themselves with tickets before taking passage, and to produce them whenever required, as the only evidence receivable by the carrier's servants of the payment of fare. They may be limited in point of time to the day on which they are issued, or to a through trip, or to an excursion-train. (*Elmore* vs. *Sands*, 54 N. Y. 512.) At times, tickets are formal written contracts by whose terms the purchaser is bound, whether he knows them or not. (*Fonesca* vs. *Cunard Steamship Co.*, 153 Mass. 553.) In the case cited the ticket consisted of a sheet of paper of large quarto size, the face and back of which were covered with written and printed matter. Other tickets do not purport on their face to be formal contracts, although they may contain provisions which if known to both parties would make them such. In these cases the provisions are not binding on the traveler unless he knew of them, or unless the carrier did what was reasonably sufficient to give the purchaser notice of them. (*Richardson, etc., Co.* vs. *Rountree* [1894], Appeal Cases 217.) Still others appear to be mere checks or tokens. These do not constitute the contract between the traveler and the carrier. That consists of the offer made by the carrier and its acceptance by the traveler; and the offer may include the public advertisements of the carrier, the general customs of carriers, the usages of the particular carrier so far as notified to the traveler, the special representations by the carrier or his authorized agents, and the language of the ticket which has been brought properly to the traveler's attention. (*Logan* vs. *Railway*, 77 Mo. 663; *Frank* vs. *Ingalls*, 41 Ohio State 560.) The traveler may demand a seat before surrendering his ticket, and upon giving it up or tendering it may take a seat temporarily in a drawing-room car if none is provided for him in a common coach. (*Thorpe* vs. *N. Y. C. Ry.*, 76 N. Y. 402.) If a seat can not be provided for him, he may retain his ticket, refuse to pay his fare, leave the train, and sue for damages, or he may, and he usually does, accept such accommodations as are afforded him, and surrender his ticket. FRANCIS M. BURDICK.

**Traveling Sidewalk**: a pathway or platform, with or without seats and covering, moving in a continuous manner with a uniform speed and utilized as a means of transportation. The idea is not a new one, even as at present developed, but was conceived about 1870. Such a device was suggested for use in the Paris Exposition of 1889, and has been the subject of numerous patents in the U. S. and in Europe, but it remained for a U. S. company to bring it first into practical use in 1892.

The essential features required in a sidewalk of this nature are, first, that it shall be continuous and in the form of a loop or belt railway, and, second, that one or more intermediate platforms or steps between the first platform and the fast-moving platform, on which the seats are usually furnished, shall be moved at such a low rate of speed as to enable the passenger to step readily from the first platform to the next and faster-moving platform and from that to the third and so on to the seated platform, the differences in speed between each two adjoining platforms or steps being the same. Experience has fixed this difference at from $2\frac{1}{2}$ to 3 miles an hour. The most simple form of such a sidewalk is, of course, one in which separate cars or trucks move on separate tracks, each having its own motive power and each moving at its own proper speed; but as the first platforms are merely steps, and as the difficulty of maintaining with different motive power the proper relative motions between the platforms or steps is very great, a simpler means is requisite. The system was not fully developed until electricity had made practical the economical, compact, and direct application of power by means of trolley wires and motors attached directly to the trucks, and mechanism had been devised for moving one or more step platforms by the same trucks that furnished the propelling power for the fast-moving platform.

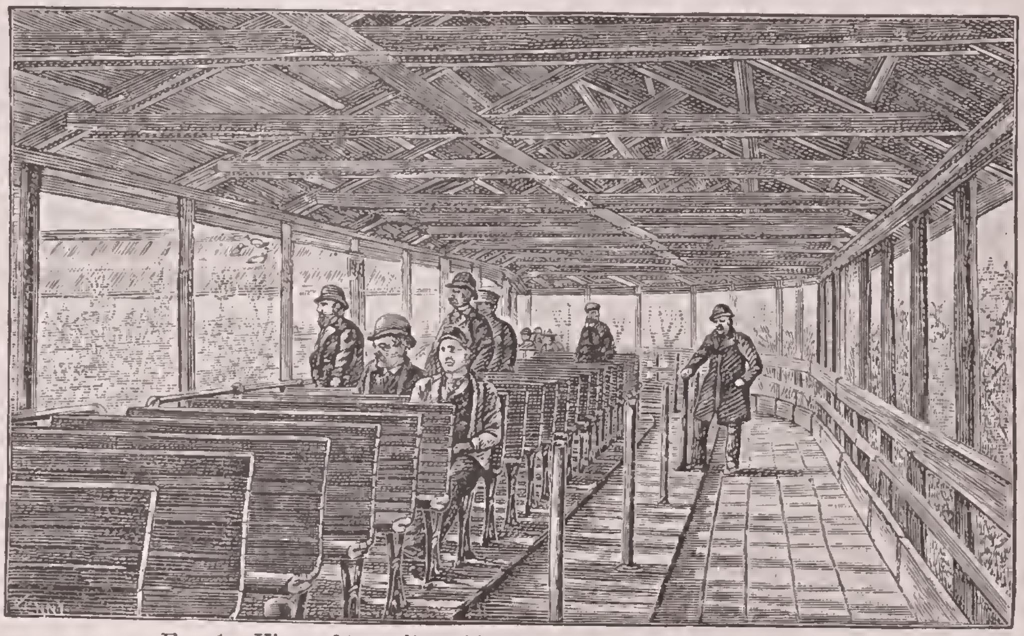


FIG. 1.—View of traveling sidewalk, Jackson Park, Chicago, 1893.

A third and perhaps in many respects the most important feature is a flexible rail to move on the tops of the peripheries of the wheels. These devices and improvements were first put to a practical use on an experimental road constructed under patents issued to Max E. Schmidt and J. L. Silsbee, in the Columbian Exposition-grounds in Chicago. The mechanical and practical success of this device led to its adoption and use on the Long Pier in 1893 and 1894, in the same grounds, where a road in the form of a loop 4,300 feet in length was erected. The radius of the curves on this road was 64 ft. 9 in. at the minimum and 80 feet at the maximum. The gauge was 45 inches and the rails were 30 lb. T-rails. There were 351 cars and the same number of platforms. Of these cars, 12 were motor-cars, carrying each two 15-horse-power motors. It will thus be seen that 360 horsepower was used in starting this road. In running it the average horse-power expended was 130. There were seats for 5,600 persons on the road, and over 1,000,000 people were carried without an accident during the four months that the road was in operation. The total weight of the movable platforms on this road was 450 tons, and the weight of 5,600 passengers would be, on the average, 392 tons, so that the power required as compared with the number of people carried is very small.

Fig. 2 illustrates the methods of construction of this road. The slow-moving platform which is attached to the

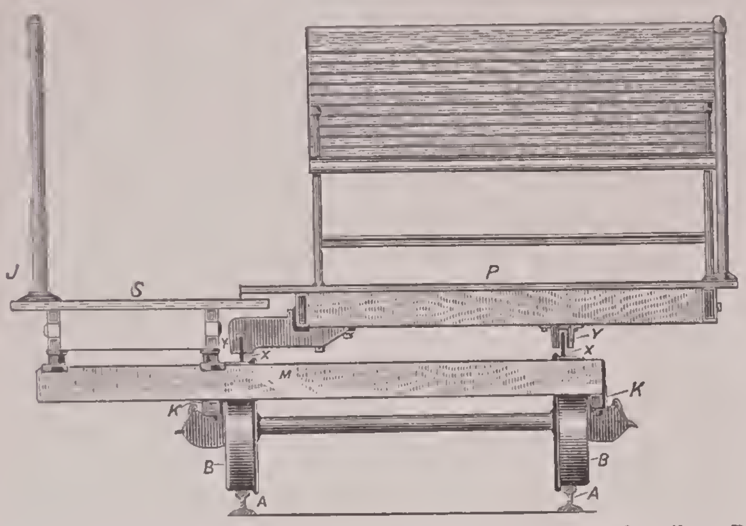



Fig. 2.—End view, showing both platforms: *A*, track-rails; *B*, wheels; *J*, hand-post; *K*, boxes; *M*, transverse frame of slow-moving platform; *P*, fast platform; *S*, slow platform; *X*, traveling flexible rail; *Y*, castings with slots for flexible rail.

trucks may be supposed to move at the rate of 3 miles an hour. The fast-moving platform which rests on the flexible steel rails, that rest in their turn on the peripheries of the wheel, is by the forward motion of the wheels of necessity carried forward twice as fast as the forward motion of the axles of the wheels themselves. If, therefore, the speed of 3 miles an hour be given to the slow platform, the fast platform will of necessity move at the rate of 6 miles an hour. The possible extension of this system is shown in Fig. 3; in

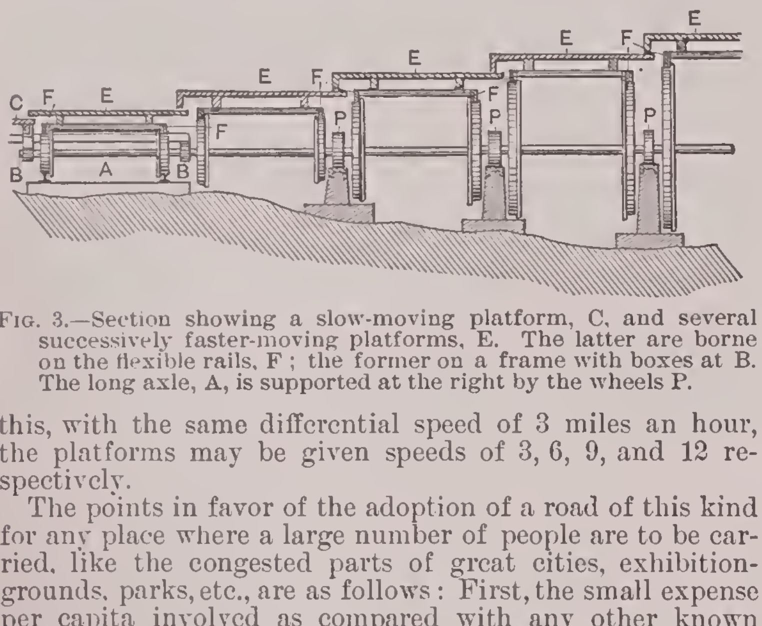



Fig. 3.—Section showing a slow-moving platform, C, and several successively faster-moving platforms, E. The latter are borne on the flexible rails, F; the former on a frame with boxes at B. The long axle, A, is supported at the right by the wheels P.

this, with the same differential speed of 3 miles an hour, the platforms may be given speeds of 3, 6, 9, and 12 respectively.

The points in favor of the adoption of a road of this kind for any place where a large number of people are to be carried, like the congested parts of great cities, exhibition-grounds, parks, etc., are as follows: First, the small expense per capita involved as compared with any other known means of transportation; second, the possibility that the slow speed of the trucks gives of adopting every precaution, like rubber tires, paper wheels, and other light constructions, so that all noise is prevented; third, the great flexibility of the road, which adapts itself to all curves, ascents, and descents; fourth, the facility of heating the train in consequence of the continuity of the system; and fifth, the continuity of the motion, which without great speed, but with great safety and without any waste of time for stops, permits a net running time from one point to another that compares favorably with (and in numbers carried vastly exceeds in its possibilities) any modern urban method of transportation.

In its application to city work it must of necessity be either elevated above the normal street level or sunk below the same, for, as will be evident, grade crossings are not admissible. This system has obtained the indorsement of nearly every engineer of note in the world, and will undoubtedly come into general use. Joseph L. Silsbee.

**Trav′erse City**: city (chartered in 1895); capital of Grand Traverse co., Mich.; on Grand Traverse Bay, and the Chi. and W. Mich., the Gr. Rap. and Ind., and the Manistee and N. E. railways; 70 miles N. E. of Manistee, and 145 miles N. of Grand Rapids (for location, see map of Michigan, ref. 4–H). It is the center of a rich agricultural and fruit-growing region, has a good harbor, and is connected by steamboats with the principal ports on Lake Michigan. The principal industries are connected with the lumber interest. There are 2 electric-light plants, Northern Michigan Asylum for the Insane, a national bank with capital of $50,000, a State bank with capital of $100,000, a library, and a daily, a monthly, and 3 weekly periodicals. Pop. (1880) 1,897; (1890) 4,833; (1900) 9,407.

Editor of "Traverse Bay Eagle."

**Traverse-table**: in surveying, a table from which the latitude and departure of any course can be found by inspection. It is a rough table of the sines and the cosines of arcs, computed to each quarter of a degree from 0° to 90°, and for every radius from 1 to 100. In the ordinary traverse-table the computation is carried out only to two places of decimals.

**Travnik′**: town; capital of the district of Travnik, Bosnia; on the Laskva (see map of Turkey, ref. 2–A). Ill built and unhealthful, its chief importance is due to its manufacture of sword-blades. Pop. (1885) 5,933. E. A. G.

**Trawling** [from O. Fr. *troller*, whence Eng. *troll*]: a method of fishing by means of a trawl, or small bag-shaped net, dragged along the bottom of the sea behind a boat. The name *trawling* is also given to a system of fishing for cod, halibut, and other large fish, by means of a great number of hooks set at intervals along a stout line which lies upon the sea-bottom. From time to time this trawl or ground-line is underrun by men in a boat, and the fish are removed. See Fisheries.

**Trayastrinsha**: See Devaloka.

**Treacle**: See Molasses.

**Treason** [M. Eng. *tresun*, *traisoun*, from O. Fr. *traïson* < Lat. *tradi′tio*, a giving up, betraying, deriv. of *tra′dere*, *tra′ditum*, give over, deliver, betray; *trans*, over + *da′re*, give]: a crime of indefinite and variable limits against the sovereignty of the people or the person of the supreme ruler. The Romans call this crime *perduellio*, and afterward *crimen majestatis*—that is, either hostility to one's own country, such as joining its enemies in war would imply, or afterward hostile attack on the emperor, or, as the latter term denoted, the act of invading the sovereignty of the people. In the expression *lædere majestatem*, to injure the sovereignty of the people or of the state, is found the origin of the term *lèse-majesté*, used by the French to denote treason. The English definition of treason or high treason has included, especially, compassing or imagining the death of the reigning sovereign or his (or her) eldest son and heir; violation of the queen or the king's eldest daughter, being unmarried, or his eldest son's wife; levying war against the sovereign within the realm by a subject; giving aid and comfort in or outside of the realm to the sovereign's enemies; counterfeiting the great or privy seal; importing "false money, counterfeit to the king's money," besides other offenses which at any time of excitement it seemed best to comprehend under the same term. The folly of such legislation led to the simple definition of the U. S. Constitution that "treason shall consist only in levying war against the U. S. or in adhering to their enemies, giving them aid and comfort." It is implied that the crime can be committed only by one owing allegiance to the U. S.

The States of the Union, to some extent at least, have admitted into their codes a crime of treason against themselves similar to that committed against the U. S. But as treason against a State must always be treason against the U. S., and as war against so limited a sovereignty as that of one of the States is hardly an act deserving the name of war, such treason is as little deserving of the name as it is likely to be frequent. If an invading force from a foreign country should land on the territory of a State and be joined by one of its citizens, he would be amenable to the laws of the U. S.; if it were joined by a man from one of the other States, the same would be true, but in this case the State could not try him for treason, as he is in no sense its subject. A general law against seditious or armed assemblages would answer all purposes equally well, and could not come into conflict by any possibility with the laws and judicial arrangements of the Union. On the other hand, if a man were acquitted of treason against a State, he would still be liable to indictment for treason against the U. S. for the same offense.

The law of treason with the growth of monarchy included various offenses against the person of the monarch or his rights or appurtenances, and with the growth of arbitrary power stretched its penalties over various crimes or even peccadilloes that lay outside of its original limits. See on this, and the restrictions which a free government admits into its definition, Lieber's *Civil Liberty*, ch. viii.

Revised by THEODORE S. WOOLSEY.

**Treasure-trove** [*treasure* + O. Fr. *trove* > Fr. *trouvé*, found]: in common law, accidentally found gold or silver coin, plate, or bullion which had been hidden in the earth or in some secret spot so long ago that its existence was forgotten and its owner unknown. Such property technically belonged to the crown, unless the owner were found. In the U. S. the term is not much used.

**Treasury of the United States**: a department of the executive Government of the U. S., having control over the collection, management, and disbursement of the public revenue, and presided over by a secretary, who is, next to the Secretary of State, the most important officer of the cabinet. The present office dates from the law of Sept. 2, 1789, drawn up with such precision and comprehensiveness by Alexander Hamilton, the first secretary, that few changes have since been made in its language. The subordinate officers consist of three assistant secretaries, a treasurer, three comptrollers, six auditors, a register, commissioners of customs and of internal revenue, a solicitor, a director of the mint, and a large number of employees. There are eighteen bureaus, among which are those of the mint, statistics, the coast survey, the life-saving service, and the lighthouse board. Most of the heads of bureaus, etc., are independent of their nominal head, and many of them are appointed by the President.

**Treat**, ROBERT: Governor of Connecticut; b. in England in 1622; emigrated to New England, with his father Richard, in company with Sir Richard Saltonstall; was one of the first settlers of Wethersfield, Conn.; settled in 1639 at Milford, where he was a deputy 1653–59, and an assistant 1659–64; was one of the founders of Newark, N. J., and a deputy to the first assembly 1667–72; returned to Milford 1672; became a major of Connecticut troops 1673; marched to Springfield (1675) to the relief of that place against the Indians; drove them from before the town, subsequently routed them at Hadley; participated in the great Indian battle at the Narragansett Fort on Dec. 19, 1675; was Lieutenant-Governor 1676–83, and 1698–1708, and Governor 1683–98 not including the two years under Andros. D. at Milford, July 12, 1710.—His son SAMUEL, b. at Milford in 1648, graduated at Harvard 1669, and was minister of Eastham on Cape Cod, Mass., from 1672 to his death Mar. 18, 1717. He acquired the language of the Nauset Indians, in which he published a "confession of faith," and was successful in the conversion of those Indians; preached the "election sermon" at Plymouth in 1678 and at Milford in 1713.

**Treaties** [M. Eng. *tretee*, from Fr. *traité* < Lat. *tractatus*, treatise, deriv. of *tractare*, discuss, treat]: compacts or agreements made by two or more nations or sovereigns. States, like individuals, may make contracts. These rest for their fulfillment upon the good faith of the contracting parties. State contracts may be made with private persons—a government bond, for instance—or with other states. These latter are called treaties. A treaty, then, is an engagement between states to do, or to refrain from doing, something which is lawful. Treaties may be considered under the following heads:

I. *The Conditions of a Treaty's Validity.*—1. A state must have capacity to contract. This is lacking to the individual States which compose the United States, being denied them by its Constitution, but may belong to the members of a more loosely organized confederation. It may be lacking, in whole or in part, in the case of a protected state, according to the terms of its dependence. It is lacking also in its fullest extent in the case of a state like Belgium which, under its status of neutrality, has no right of making war save in self-defense, and is thereby debarred from such treaties as alliances which imply the ability to wage war. Yet for most purposes the capacity of Belgium is complete. Such questions of capacity the international status, the history, and constitution of a state will decide.

2. The agents negotiating a treaty must be properly authorized, to make their agreement a valid one. This, again, is a constitutional question which each state must answer for itself. The duty may devolve upon the sovereign or executive head of a country, upon its minister of foreign affairs, or upon agents representing these. For a certain class of state contracts of a military nature, truces, cartels for the exchange of prisoners, and capitulations, for example, the high military and naval officers are competent, and such agreements do not need ratification. Under ancient usage even an unauthorized person might make a treaty, subject, however, to ratification. This was a *sponsio*. A noted case of this kind, referred to by the publicists, was when the consul Postumius (B. C. 321) saved his army by a peace with the Samnites which the Roman senate declared void. Upon this failure of the consideration, good faith demanded that the army should be surrendered to the Samnites, but this did not follow.

3. A third requisite to the validity of a treaty is *freedom of consent* on the part of the negotiators. Duress or intimidation, false representation, bribery, applied to the treaty agent and instrumental in deciding the terms of agreement, will invalidate it. But a mere mistake as to the value of a consideration will not matter. Thus before the thorough exploration of the Mississippi river, the right of free navigation from British territory upon its whole course, a valueless concession, was agreed upon by treaty in return for valuable fishery privileges. Of course force applied to the nation not the mere agent is valid, as when a cession of territory is the result of a war. Or a sovereign in captivity may be of sufficient value to his country to entitle the captor to something in exchange. Where the existence of a nation is at stake it is held that no agents are competent to transfer it by treaty, and yet the partition of Poland has been an accepted fact for a century.

4. Again, treaties are void which involve a violation of accepted principles of international law, which contain stipulations whose execution has become impossible, or which conflict with prior obligations to a third power. For instance, an agreement to engage in the slave-trade or to assert joint control over a portion of the high seas would be invalid.

II. *Forms of Treaties.*—Here the essential fact is the expression of an agreement, no particular form being indispensable. This might be verbal, but in point of fact is always written and signed. The language employed was anciently Latin, then French, as that became the language of diplomacy; but when two states using the same tongue negotiate naturally that will be used. A distinction of small importance is made between treaties and conventions, the former having generally a wider political scope, while the latter relate to some minor specific object. For instance, the Treaty of Washington of 1871, arranging for a settlement of the Alabama claims and the fishery question, was followed by the convention of 1873 settling the place where the sessions called for by its twelfth article should be held.

III. *Ratification of Treaties.*—The general rule may be laid down that ratification of a treaty is expected and necessary to make it valid. Under a Constitution like that of the U. S., where the power of making treaties belongs to the President, while the Senate must confirm or veto (by a two-thirds vote), knowledge of this fact is presumed and notice that ratification is necessary is not required. But also where negotiation and ratification lie in the same hands, the latter is essential and may be withheld if desired. Here we may touch on the question whether, in forms of government where the executive is authorized to conclude a treaty, he is bound by the action of his negotiator, provided the latter proceeded according to instructions. It was formerly held that, if the agent who made the treaty proceeded according to his *full power* but not according to secret instructions, the principal was bound by his action, since the full power, being known to the other party, was the motive in consideration of which he consented to treat. But at present it is held by the best authorities that the principal may withhold his ratification, in certain circumstances, even when the negotiator has followed his private instructions. The refusal is justified in cases like these (see Wheaton, iii., ch. ii., §§ 256–263): (1) "On the ground of the impossibility, physical or moral, of fulfilling the stipulations"; (2) "on the ground of mutual error of the parties respecting a matter of fact, which, if it had been known in its true circumstances, would have prevented the conclusion of the treaty"; (3) on the ground of "a change of circumstances on which the validity of the treaty is made to depend, either by an express stipulation or by the nature of the treaty itself." To which may be added the case where the treaty would involve injury to a third party; or if such representations have been made as to the powers of the negotiator as to make a failure of ratification an act of bad faith.

Ratification should cover the entire treaty. The U. S. Senate in at least two instances has been complained of for loose practice in this regard, in ratifying the main body of a treaty while amending or dropping a particular article, whereas the whole should have been sent back for revision.

Reference may be made here to another point under our usage. In the U. S. if the payment of a sum of money forms one of the conditions of a treaty a majority of the House of Representatives must concur. In this way it would be possible, in certain cases, to defeat the action of the Senate; but to do this, except in extreme cases, would oppose the spirit of the Constitution, which evidently intended to invest the President and Senate finally and absolutely with the treaty-making power. A similar conflict might take place when in Great Britain the king's ministers had made similar agreements with foreign powers; for, as money is voted for particular purposes and not in a lump, the Parliament might refuse to sanction a payment to which the treaty had pledged the country. A question has been discussed as to the extent of power lodged in the hands of the President and Senate by the U. S. Constitution, as it respects the cession by treaty of land belonging to a State. Very high authorities on constitutional law have taken ground which would sanction the idea that the treaty-making power is practically omnipotent. But surely no treaty could alter the relations of the general Government to the States; and as to cessions of land, the better opinion seems to be that while treaty can determine boundaries and so take away from a State what was *supposed* to be its territory, it can not dispose without its consent of territory admitted to belong to a State, unless in the extreme case of conquest, when treaty simply admits the fact of actual transfer of territory to the jurisdiction of another power, and declares this to be inevitable. After the exchange of ratifications a treaty dates back to the time of its signature, so that captures made between these two moments are invalid.

IV. *Interpretation of Treaties.*—Without going at length into this topic the following brief rules of interpretation are given as covering the main ground:

The ordinary meaning of words prevails, but technical language has its technical sense.

Words involving an absurdity should be otherwise construed or else be held void.

Where grants, privileges, or favors are inserted they should be strictly interpreted. For it was the duty of the party for whose benefit they were inserted to make them clear and unmistakable. Obscure expressions may be explained by clearer ones, or interpreted in accordance with the general spirit of the treaty.

Special stipulations are preferred to general ones. If an agreement is inconsistent with an earlier treaty between the same parties, the earlier is superseded by it; but if opposed to treaty provisions made by either with a third power, it is void.

V. *How Treaties may Differ.*—An examination of the collection of its treaties made by every state will show their immense range and variety. Some important ones are led up to by a preliminary treaty and qualified by a subsequent one. Some are common to two states only, while others, like the Act of the Congress of Vienna in 1815, or the Treaty of Paris in 1856, are signed by a number of powers, or receive their subsequent accession. Some make a single commercial or administrative arrangement, like the maintenance of consuls, of a postal service or of copyright privileges, while others cede territory or settle a question of national existence. Some are perpetual in nature or in terms, others are made for a certain number of years, or are terminable at will. Some are of a private nature, to arrange a marriage alliance for instance, while most are of a public character. They may reiterate and enforce a prior treaty or a national right or an accepted principle of international law. On the other hand, they may attempt to introduce some new usage, as was the case in the armed neutrality of the Baltic powers in 1780 and 1800, and in the Declaration of Paris of 1856. Of special classes of treaties the most common are alliances and treaties of guaranty.

*Alliances.*—An offensive alliance is an anomaly, except when made with reference to a particular war. A defensive alliance was made in 1778 between France and the American confederated colonies during the Revolution. A modern example is the Triple Alliance of Germany, Austria, and Italy. An alliance both offensive and defensive binds states together in the strongest way possible short of confederation. It is for the state whose aid is called for to determine whether the circumstances contemplated by the treaty (the *casus fœderis*) have arrived. If only a certain limited aid is promised in case of war, the enemy of either must choose whether in view of this to regard both states as belligerents or only the one.

*Treaties of Guaranty.*—The thing guaranteed may be a particular status, as of neutrality; or the integrity of another treaty or of specific rights under it; or the protection of certain property or territory, as when by treaty of 1778 with France the U. S. guaranteed the French possessions in North America. So likewise by treaty of 1846 with New Granada, the U. S. guaranteed the neutrality of the Isthmus of Panama, free transit across it, and the rights of sovereignty and property of New Granada in it. Under the latter the U. S. has intervened by force to protect the Panama railway. Both of these guarantees were reciprocal in terms.

Here, again, the guarantor must decide whether the occasion contemplated by the treaty has arrived. The guarantor of a money payment differs from a surety in that the latter is bound to make the payment in lieu of the principal, while the former merely uses his influence and offices to secure it. The guaranty of a political status may involve the duty of intervention.

VI. *Execution of a Treaty.*—With this object, hostages were formerly given, but not by present usage, except in military conventions, the last instance being in 1748 to secure the treaty of Aix-la-Chapelle. Solemn oaths to observe a treaty are also out of date. Pledges are still in use. Thus certain French fortresses were left in German hands after 1871, for several years, to secure the carrying out of the terms of the treaty of peace, an enormous money indemnity being one of them. Lastly may be mentioned the guaranty of a treaty by a third power.

VII. *Termination of Treaties.*—When a treaty is made to secure a definite object and that object is attained, the treaty has no longer any reason for existence. Many treaties are of this class, to settle a boundary, to arrange for the arbitration of a special difficulty, to satisfy certain claims. So also when a treaty is made for a specified term or is made for an indefinite term with mutual right of abrogation, or, as is the case with numerous treaties, is made for a term but with a provision for their continuance beyond their limit and until notice of termination is given. Where an evident impossibility of execution appears, there is at least a suspension of the treaty. States may also, unfortunately, terminate a treaty or portions of it by simple repudiation, coupled with a willingness to take the consequences, even war. Though a clear violation of international law, for the fact that a treaty is burdensome is no reason for its violation, such repudiation is practically possible. An excuse for such conduct will of course be given which may or may not be valid. Thus the U. S. formally declared that it should no longer consider the two treaties with France of 1778 as in force, on the ground that France had violated several of their provisions. A treaty is an entire contract, and if one article is violated, the injured party may consider the whole void or may, if it prefers, insist on the enforcement of the remaining articles.

*The Effect of War upon Treaties.*—That a large class of treaties are terminated by war is beyond question. Such are treaties of peace, of commerce, of alliance, of all in fact where friendship is an essential basis. On the other hand, many treaties are by nature or in terms perpetual, like the recognition of our independence within certain boundaries by Great Britain, or the Fishery Treaty of 1818 agreeing that the inhabitants of the U. S. "shall have forever . . . the liberty to take fish" on certain coasts. Moreover, all those treaties which contemplate a state of war must survive, for otherwise they would be useless. Such are treaties laying down the rules of blockade, contraband, convoy, visitation, capture, and so on. Upon a third class of treaties the effect of war must be held doubtful, the special circumstances of each case being considered.

Kent says that "as a general rule the obligations of treaties are dissipated by hostilities." Halleck says, *inter alia*, that "treaties of commerce and navigation are generally either suspended or extinguished by a war between the parties" to them. Of course they must be suspended at least, or war could not exist. Calvo says that "as for postal and custom-house arrangements, conventions relating to navigation and commerce, agreements relative to private interests, they are generally regarded as suspended until the cessation of hostilities." As commercial, postal, and similar conventions are often limited in time by their express terms, it seems safe to say that such arrangements, and others, like them, liable to be changed in these particulars in a few years of peace, ought to be regarded as broken off by war, which brings with it new feelings and interests. We add from Calvo that opinions agree "in favor of admitting the *definitive rupture* of conventional obligations entered into expressly in view of a state of peace, of such as have it for their special object to favor the relations of good harmony between nation and nation, such as treaties of friendship, of alliance, and other acts of the same nature, having a political character." A distinction was made by some of the older writers between the effects of a new war arising from a cause independent of a treaty, which they thought would not affect the provisions of a treaty, and a war growing out of the breach of a treaty by which its provisions would be annulled. Hence, in a given treaty, if one of the articles had been broken, and a war arose out of the breach, the rest of the treaty would be unaffected. It is easy to see that this distinction would complicate affairs between parties wishing to make peace. The practical rule suggested by these doubts is that, as silence may be misinterpreted, it is best always to make mention of the old treaties by way of renewing and confirming them. It is said by Dr. Twiss that Great Britain "in practice admits of no exception to the rule that all treaties, as such, are put an end to by a subsequent war between the contending parties." In conformity with this rule, or to prevent doubt, the Peace of Westphalia and the Treaty of Utrecht were renewed a number of times over when the parties to them after war made new treaties with one another. It may be added to what has been said, that private rights, resulting from rules of admitted justice, are not extinguished by a war; and so a debt due by one nation to another, where the same rules of right prevail as are acknowledged in municipal law, survives a war. An interesting discussion arose between Great Britain and the U. S. after the war of 1812 whether the colonies, after the recognition of their independence, retained the rights of fishery on British coasts, as a matter of course, which they had had while dependencies of Great Britain. John Quincy Adams and others contended that they retained these rights, and in the discussion the question of the effect of war on treaties came up. It seems that the British side of the question had the soundest arguments in its favor. The U. S. placed itself on the footing of an independent nation, and had no more rights than others; nay, even if it had been obliged to submit again to the British crown, this right of fishery might have been taken away.

VIII. *Treaties of Peace.*—The only rational object of war is to secure a state of justice involving reparation and security for the future. Treaties of peace, being appeals to force, do not always bring the adversaries to just terms, but, whatever their result, they are the most important acts of treaty-making powers; they often form epochs in national or in continental history. To name only one or two: the Peace of Westphalia, those of Nymwegen, Ryswick, and Utrecht-Baden, the treaties of Paris and of Hubertsburg in 1763, the Peace of Paris and that of Versailles in 1783, the two treaties of Paris in 1814 and 1815 respectively, the Peace of Zurich in 1859 and of Prague in 1866, and the Peace of Paris in 1856 (on account especially of its international character), indicate memorable changes of relative strength, or mark a new policy, or bring in a new dynasty, or are in some way the eras of some kind of progress. They are the hands of a clock, but the war was the moving force.

Treaties of peace are subject to the same rules of interpretation with others made by the constitutional power in the state. Only two additional points remain to be considered: (*a*) When do treaties go into effect? They bind the parties, as we have seen, when they are signed or when they are ratified. They bind individuals when they receive news that such treaties have been made. In the interval between ratification and knowledge of the peace by military officers or by cruisers, injuries must be made good by the country to which the party committing the injury belongs. Captures made after a peace, but without knowledge of it, have been held to subject the capturing officer to civil damages, for which he would have a right to demand compensation from his government. Captures, again, made before the time for the termination of hostilities, but with knowledge that peace has been concluded, are held to be invalid and subject to restoration. (*b*) The effect of peace is to put an end not only to a war, but also to all complaints relating to the subject for which war was undertaken. It is an oblivion or amnesty of all past difficulties. A new war can be undertaken for similar causes of complaint, but not for the same. They are forgotten and forgiven, whether mentioned in the treaty or passed over in silence. In regard to the state in which the war leaves the parties, if the treaty makes no mention of this point, the principle of *uti possidetis* is admitted. Territory stays in the actual occupant's hands unless passed over by express agreement, and a strong place must be restored without injury to its works. When a part of a country is yielded up at peace to the enemy, the former sovereign is neither bound to make compensation to those who suffer by the change of jurisdiction, nor to secure the new sovereign against resistance from the inhabitants to his authority. All he does is to renounce his own sovereignty and jurisdiction. The cession of Formosa by China to Japan is an instance.

The value of a study of treaties can hardly be overestimated. Quite outside of their statement of the actual relations existing between states, they show the abolition of old usages, the introduction of new ones, and foreshadow the better principles of the future. They mark the growth of international law, while binding only their principals. They furnish an important object lesson to outsiders. Founded upon a mutual sense of moral obligation, they furnish a stable basis upon which the law governing the relations of states is erected, so that the collection of its treaties which every nation will make is the fundamental text-book of principle and of illustration for the international lawyer.

Revised by T. S. Woolsey.

### Notable Treaties.

The following summary of the chief international agreements made between the leading nations is limited to the mention of only the more famous treaties since the year 843, which is taken as the starting-point, because the contract of Verdun, formed in that year, may be regarded as the basis of the international relations of modern Europe.

843. *Contract of Verdun*: the treaty that concluded the war between Lothar, Louis the German, and Charles the Bald over their respective shares of the imperial dominions on the death of their father, Louis the Pious. Lothar claimed the whole inheritance, but was defeated at Fontenay, and though he retained the title of emperor was obliged to content himself with Italy and a narrow strip of land between the dominions of his brothers, extending to the North Sea. This land was afterward called Lotharingia or Lorraine. Charles the Bald governed the western portion of the empire of Charlemagne, comprising chiefly Gallic-Roman inhabitants and corresponding roughly to the limits of modern France, while Louis the German held the eastern portion, peopled by German-speaking inhabitants. In this breaking up of the restored Roman empire the modern nations of France and Germany have their origin. See map of Europe under the Carlovingians in article Europe.

911. *Treaty of St.-Clair-sur-Epte*: concluded the war between the invading Norsemen under Rollo or Rolf and the French king Charles the Simple. The latter's daughter was given in marriage to Rollo, who agreed to become a Christian, and was invested with a part of Neustria, which was afterward known as Normandy.

1122. *Concordat of Worms*: an agreement between the emperor and the pope, closing the long strife known as the war of investitures. Neither obtained by it all that he had been striving for. The emperor renounced his right to confer the ring and crozier as symbols of ecclesiastical office, but retained the right of granting church and other property by the symbol of temporal authority. He also retained the right to be present in person or by proxy at ecclesiastical elections, provided that he abstained from bribery or compulsion. Though a compromise, it was in effect a victory for the Church, which obtained much of what Gregory VII. had striven for and Henry IV. had opposed.

1183. *Treaty of Constance*: between the Emperor Frederick Barbarossa and the Lombard cities. In the peace of Venice (1177), formed in the year after the battle of Legnano, he had acknowledged the independence of the cities and submitted to the pope. In the definitive treaty of Constance the cities recognized his overlordship, but they secured local self-government, together with the right to fortify themselves and levy armies. With this peace a new power appears in the political system of Europe, that of the free cities, and the attempt to re-establish the ancient despotism of the Roman empire failed.

1360. *Peace of Bretigny*: a treaty that interrupted the Hundred Years' war between France and England. Edward III. renounced his claims to Normandy, Maine, Anjou, etc., and to the French crown, but his sovereignty over the south and west of France and over a part of Northern Picardy was recognized.

1397. *Union of Calmar*: the treaty by which the northern powers, Denmark, Sweden, and Norway, were united under the rule of Queen Margaret of Denmark. Its object was forever to put an end to wars and dissensions between the three northern states, and it was enacted that they should henceforth be ruled over by one sovereign, who was to govern with due regard to the laws and customs of each. If the reigning king or queen died without children a joint sovereign should be elected by the senators and deputies of the three realms. National jealousies, however, asserted themselves, and Sweden, who had long been a reluctant member, finally broke up the union in 1523 through the efforts of her national chief Gustavus Vasa.

1420. *Treaty of Troyes*: interrupted the Hundred Years' war between France and England on terms most favorable to the latter. The English king, Henry V., to whom the French princess Catharine was given in marriage, was made heir to the French throne at the death of the insane king Charles VI., and in the meanwhile was to act as regent.

1435. *Treaty of Arras*: a compact between Burgundy and France, in which the former abandoned the English alliance and acknowledged Charles VII. as king of France on condition of réceiving Auxerre and Macon and the towns on the Somme. This weakened the power of the English in France and led the way to their final expulsion.

1466. *Treaty of Thorn*: the instrument by which the Polish conquest of West Prussia was recognized and the rule of the Teutonic Knights was confined to East Prussia.

1482. *Treaty of Arras*: settled the dispute between Louis XI. of France and Maximilian of Austria in favor of the former, who retained the towns on the Somme, and by the betrothal of the dauphin to the daughter of Maximilian was to secure Franche Comté and other territories.

1493. *Bull of Pope Alexander VI.*: arranged the conflicting claims of Spain and Portugal to newly discovered lands. Assuming the authority to apportion the countries of the earth, he fixed a line of demarkation running N. and S. through a point 100 leagues W. of the Azores. All to the E. of this line was assigned to Portugal, all to the W. to Spain.

1494. *Convention of Tordesillas*: between Spain and Portugal, substituted for the line fixed by the papal bull of 1493 one passing through a point 370 leagues W. of the Azores. See TORDESILLAS, CONVENTION OF.

1508. *League of Cambray*: a union formed by treaty between Louis XII. of France and the Emperor Maximilian, which the pope, Ferdinand of Spain, and others were invited to join, for the purpose of crushing Venice and partitioning her territories. War resulted, but the object of the league was not attained, owing to dissensions among the allies, some of whom finally withdrew and joined the Venetians.

1526. *Treaty of Madrid*: formed between the Emperor Charles V. of Germany and Francis I. of France, who had been defeated at the battle of Pavia and was then a prisoner. By it the latter gave up his claims to Genoa, Milan, Naples, Flanders, and Artois, agreed to cede Burgundy to the emperor, and consented to other humiliating conditions. Professing to have signed under constraint, he broke the treaty as soon as he regained his liberty.

1529. *Treaty of Cambray*, known as the *Ladies' Peace*: also between Francis I. and Charles V.; renewed the chief provisions of the Treaty of Madrid except that relating to Burgundy, which Francis was allowed to retain. It pressed too severely on France and the war was renewed.

1544. *Treaty of Crespy*: concluded the fourth and last war between Francis I. and Charles V. with a mutual cession of conquests made since the Truce of Nice in 1538. It left the two contestants in approximately the same condition as before the first war, Charles renouncing his claim to Burgundy, Francis to Naples, Flanders, and Artois.

1552. *Treaty of Passau*: between Charles V. and Maurice of Saxony. The former promised to convoke a Diet to consider the questions at issue, and in the meanwhile granted the Protestants religious toleration.

1555. *Religious Peace of Augsburg*: concluded at the Diet promised by Charles in the preliminary Treaty of Passau; granted toleration to Lutherans, but not to Calvinists; gave each prince the right to choose between the Roman Catholic faith and the Augsburg Confession, and to expel those of his subjects who differed from him in religion. By the *Reservatum Ecclesiasticum*, it was provided that any Catholic ecclesiastic on turning Protestant should forfeit his goods and rights that he had enjoyed by virtue of his ecclesiastical office. This was the source of constant trouble, and led ultimately to the THIRTY YEARS' WAR (*q. v.*).

1576. *Pacification of Ghent*: a union of the seventeen provinces of the Netherlands for mutual defense against the Spaniards. Foreigners were to be driven from the provinces and a meeting of the States-General was to be called to regulate matters of common interest.

1579. *Union of Utrecht*: the union of the seven northern provinces of the Netherlands in defense of their political rights and their religious freedom. It laid the foundation of the Dutch Republic, whose independence of Spain was virtually recognized by the treaty of 1609.

1648. *Peace of Westphalia*: consisting of the treaties of Münster and Osnabrück; concluded the THIRTY YEARS' WAR (*q. v.*), and adjusted the relations of most of the European powers. The provisions of this important peace may be divided into three classes: those making territorial changes, those affecting religion, and those bearing upon the internal constitution of the German empire. I. Territorial arrangements. Sweden acquired Hither Pomerania, the island of Rügen, the archbishopric of Bremen, the bishopric of Verden, the town and port of Wismar, parts of Further Pomerania, etc. These were to continue parts of the empire, of which the King of Sweden was to be a member with three votes in the Diet. Sweden further received a money indemnity. In general she attained much of what Oxenstjerna had striven for, and she ranked for a time, as the leading northern power. France secured the bishoprics of Metz, Toul, and Verdun, the town of Pignerol, Austrian Alsace, the right to garrison Philippsburg, and some minor accessions of territory. Her territorial gains, however, were of less importance than the prestige arising from the strengthening of her friends and the weakening of her enemies by the provisions of the treaty. The aggrandizing policy of Richelieu and Mazarin had completely succeeded, and France stood forth as the first power of Europe. The seed of future strife existed in a clause of the treaty, binding the King of France to permit the bishoprics of Basel and Strassburg, the ten imperial towns in Alsace, and all estates holding immediately of the empire to remain "in that liberty and possession of immediacy toward the empire which they had formerly enjoyed." Brandenburg was compensated for territory ceded to Sweden, by the bishopries of Minden, Halberstadt, and Kammin, and the archbishopric of Magdeburg. Mecklenburg and Brunswick-Lüneburg were also compensated by territorial accessions, and the house of Hesse-Cassel gained important rights and a money indemnity. The Lower Palatinate, with the right of reversion to the Upper, was restored to the family of the unfortunate Elector Frederick V., and an eighth electorate was created in its favor, Bavaria retaining the old electoral dignity and the Upper Palatinate. Switzerland, long independent in fact, was acknowledged to be so of right. The independence of Holland was also formally recognized. II. Religious provisions. Toleration was extended to Calvinists as well as Lutherans. The possession of ecclesiastical property and rights was determined by the status of the parties in 1624. A benefice held by a Protestant or Catholic in Jan., 1624, should forever belong to the same religion, but in the Palatinate, Würtemberg, and Baden 1618 was taken as the normal year. Thus the *Reservatum Ecclesiasticum* of the Peace of Augsburg was superseded. The holder of an ecclesiastical benefice on changing his religion was to vacate his benefice without restoring its former fruits. If a prince changed his religion he could not alter the existing Church, but could enjoy only his own domestic worship. Even if an entire community followed their sovereign in the new faith the old state of things in Church and school must continue. Those subjects of a sovereign differing in faith from their own who had not enjoyed the right of worship in 1624 could be compelled to emigrate, but must receive notice several years beforehand. III. Provisions affecting the constitution of the empire. The weakening of the imperial authority which had resulted from the war was legalized. The emperor was thenceforth of less importance in the political system than the Diet, which alone could make the laws, declare war, and conclude treaties. The separate states of the empire were free to make alliances with one another or with foreign states, subject only to the condition that such alliances be not prejudicial to the empire or the emperor.

The chief features of the Peace of Westphalia are the following: It established the equality of the Calvinists, Lutherans, and Catholics in Germany. It made the states of the empire almost independent of the emperor, thus preventing the attainment of national unity, and preparing for the rise of Prussia as a great Protestant power and the rival of Austria. It further gave to Sweden and France the right of continual interference in the internal affairs of the empire. Its adjustment of European affairs was of course not permanent, but it is the basis of almost all European treaties down to the time of the French Revolution, and it marks the end of the period of religious wars between European nations, whose points at issue were thenceforth to be mainly political.

1659. *Peace of the Pyrenees*: brought to a close the long war between France and Spain, confirming the former power in the possession of Roussillon, granting her Artois with places in Flanders, Hainault, and Luxemburg, and a portion of Cerdagne, and restoring Lorraine to the Duke of Lorraine. The Prince of Condé was pardoned and reinstated in his dignities. A special contract arranged the marriage of Louis XIV. to the Infanta Maria Theresa, who was to renounce her claims to the crown of Spain in consideration of a dowry of 500,000 crowns.

1660. *Treaty of Oliva*: between the King of Poland and his allies and the King of Sweden. By it Poland gave up to Sweden Esthonia and Livonia, and renounced suzerainty over the duchy of Prussia in favor of the Elector of Brandenburg.

1660. *Treaty of Copenhagen*: between Denmark and Sweden, secured to the latter power Schonen, Blekingen, Halland, Hween, and Bohus, and restored to Denmark Bornholm and Drontheim in Norway.

1667. *Treaty of Breda*: between England and Holland; restored the conquests made during the war and secured in the interest of the latter power a modification of the English Navigation Acts.

1668. *Triple Alliance*: between England, Holland, and Sweden to defend Spain against Louis XIV. It was successful and peace was formed in the same year between Spain and France, but within two years from its formation Louis succeeded in detaching Sweden from the alliance and winning over the English king Charles II., so that France was free to avenge herself on Holland.

1668. *Treaty of Aix-la-Chapelle*: between France and Spain, the former retaining a chain of strong fortresses on the northern frontier, but restoring Franche-Comté to Spain.

1668. *Treaty of Lisbon*: between Spain and Portugal through the mediation of England. Spain recognized the independence of Portugal.

1678. *Peace of Nymwegen*: ended the Dutch war. Treaties were formed between Holland and France, France and Spain, and in the following year between France and the other parties to the war. Holland recovered all the territory that she had lost to France, but the latter power acquired Franche-Comté from Spain.

1697. *Peace of Ryswick*: brought to a close the war between France under Louis XIV. and the principal states of Europe, sometimes called the War of the Palatinate or the War of Orleans; comprised the mutual restoration by France and England of the conquests made during the war, the recognition by the former power of William of Orange as the lawful King of England, and the relinquishment by France of a large part of the districts which she had seized from Spain and the emperor through the courts of "reunion" established by Louis after the peace of Nymwegen, but Alsace lost all connection with the empire and became an integral part of France.

1699. *Peace of Carlowitz*: between Turkey on the one hand and the Emperor of Germany, the King of Poland, and the republic of Venice on the other. It was agreed that Transylvania should remain an Austrian province, that the southern bank of the Danube should separate Hungary from the sultan's dominions, and that Venice should hold a part of Dalmatia and her acquisitions in Greece, except Lepanto.

1713–14. *Treaties of Utrecht, Rastadt, and Baden*: concluded between the states that had taken part in the war of the Spanish Succession (see SUCCESSION WARS); comprised nine treaties formed at Utrecht and one between France and the empire at Rastadt, which was subsequently finished with some modifications at Baden. Among the important features of these treaties were the stipulation that the crowns of France and Spain should be forever separate, the cession or restoration by France to Great Britain of Hudson Bay, St. Kitts, Nova Scotia, Newfoundland, etc., the cession by Spain to Great Britain of Gibraltar and Minorca, the transfer of Naples, Sardinia, Milan, and the Spanish Netherlands to Austria, and the confirmation of the Duke of Savoy in the possession of Sicily. A notorious clause of the treaty between Great Britain and Spain granted a company of British merchants the exclusive right to supply Spanish America with Negro slaves.

1717. *Triple Alliance*: between Great Britain, France, and Holland, in which these powers engaged to maintain the treaty of Utrecht, and in which France promised to give no aid to the Pretender to the throne of Great Britain.

1718–19. *Quadruple Alliance*: between Great Britain, France, Holland, and the emperor against the aggressions of Spain, which finally was obliged to give way and acceded to the alliance in 1720. Spain gave up all claim to the Netherlands and the Spanish part of Italy, and the emperor in return acknowledged Philip V. as rightful King of Spain. The emperor exchanged Sardinia for Sicily with the Duke of Savoy.

1718. *Peace of Passarowitz*: between the sultan and the emperor, granted the latter the portion of Hungary previously held by Turkey and extensive territories in Servia and Wallachia.

1721. *Peace of Nystadt*: between Sweden and Russia, granting the latter Esthonia, Livonia, Ingermanland, and part of Carelia, in return for parts of Finland which had been conquered. By it Russia succeeded to the position among the northern powers formerly held by Sweden.

1738. *Treaty of Vienna*: between France and Germany. France received Lorraine and agreed to the Pragmatic Sanction of Charles VI., naming Maria Theresa as his successor to a great part of the Austrian dominions. Austria ceded Naples and Sicily to a younger branch of the Spanish reigning family and received in exchange Parma and Piacenza. Tuscany was bestowed on the Duke of Lorraine.

1742. *Peace of Breslau*, subsequently confirmed by the *Peace of Berlin* and the *Peace of Dresden*: between Frederick II. of Prussia and Maria Theresa of Austria, secured Silesia to Prussia. By the Peace of Dresden Frederick acknowledged Maria Theresa's husband as emperor.

1748. *Peace of Aix-la-Chapelle*: between Great Britain, France, and Holland; Austria, Spain, Sardinia, Genoa, and Modena being accessories; ended the war of the Austrian Succession with the mutual restoration of conquests, but Frederick II. of Prussia kept Silesia.

1761. *The Family Compact*: between the Bourbon rulers of France and Spain, binding them in a close offensive and defensive alliance to which none but members of the Bourbon family should be parties.

1763. *Peace of Paris*: terminated the Seven Years' war, known in the American colonies as the French and Indian or Old French war. Its chief provisions related to the possessions of France and Great Britain in North America, where the latter power gained Canada and secured all lands E. of the Mississippi with the exception of New Orleans, but restored some of her conquests in the East and West Indies and in Africa to France.

1763. *Peace of Hubertsburg*: the treaty by which Prussia ended the Seven Years' war, retaining all that had been recognized as hers in the treaties of Breslau, Berlin, and Dresden.

1772. *First Partition of Poland*: carried out by treaties between Russia, Austria, and Prussia, giving as a reason for their action their insecurity against the internal dissensions of their neighbor.

1774. *Peace of Kutschuk-Kainardji*: between Russia and Turkey; restored Bessarabia, Wallachia, and Moldavia to the latter power, which engaged to protect the Christian inhabitants of these principalities in their religion. Russia obtained freedom of navigation in Turkish waters and arranged for a minister resident at Constantinople. To this treaty Russia afterward appealed as granting her a protectorate over the Christian subjects of the Porte.

1783. *Treaty of Paris*: the treaty in which Great Britain acknowledged the independence of the North American colonies and granted them important fishing privileges in the British dominions in America.

1783. *Treaty of Versailles*: signed at the same time as the above between Great Britain, France, and Spain; was a mutual restitution of conquests.

1792. *Peace of Jassy*: between Russia and Turkey; made the left bank of the Dniester the boundary between their respective territories.

1792. *First Coalition against France*: comprised ultimately all the powers except Sweden, Switzerland, Denmark, Tuscany, Venice, and Genoa.

1793–95. *Second and Third Partitions of Poland*: carried out by treaties between Russia, Prussia, and Austria. See the article POLAND.

1795. *Peace of Basel*: between France and Prussia, the latter withdrawing from the first coalition. It gave up the left bank of the Rhine to France.

1795. Treaty between the U. S. and Great Britain, known as the *Jay Treaty*. See the article JAY, JOHN.

1797. *Treaty of Tolentino*: between the French republic and the pope. The latter surrendered to France Avignon, the Venaissin, and the legations of Ferrara, Bologna, and Romagna, renounced the coalition, and agreed to pay an excessive indemnity and to give up 100 works of art, etc.

1797. *Treaty of Campo Formio*: between Napoleon and the Emperor of Germany. Austria had been humbled in the Italian campaigns and was forced to consent to an unfavorable peace. See the article NAPOLEON I.

1798. *Second Coalition against France*: initiated by Russia; afterward comprised England, Austria, Naples, Portugal, and Turkey. It was formed for the purpose of checking French aggressions, and was at first successful, but its power was broken by the French victories of Hohenlinden and Marengo, and it fell to pieces after the Treaty of Lunéville.

1801. *Treaty of Lunéville*: between France and Germany; renewed several of the most important provisions of the Treaty of Campo Formio. See NAPOLEON I.

1802. *Peace of Amiens*: between Great Britain on the one hand and France, Spain, and the Batavian republic on the other. It was hardly more than a truce, war being renewed in 1803. See NAPOLEON I.

1803. *Treaty between France and the U. S.* touching the purchase of Louisiana. See UNITED STATES (*History*).

1805. *Peace of Pressburg*: between Austria and France. The former gave up to France the Austrian spoils of the old republic of Venice, acknowledged the French seizures in Italy, and recognized the kingdom of Italy established by Napoleon. The terms were most humiliating to Austria, and in the following year occurred the formation of the Confederation of the Rhine, and the disruption of the ancient Holy Roman Empire. The Hapsburg ruler was thenceforth merely Emperor of Austria.

1807. *Treaties of Tilsit*: concluded between France, Prussia, and Russia after Napoleon had successively humbled the last two powers in the campaigns of 1806–07. Prussia gave up all her territory W. of the Elbe and almost all that she had gained by the partitions of Poland, the latter territory to constitute the grand duchy of Warsaw, which was to be dependent upon France; submitted to the occupation of her remaining territory by a French army; was forced to limit her own army to 42,000 men, and to conclude an offensive alliance against Great Britain. She lost about half her territory and was reduced to a condition of virtual vassalage to France. Russia also entered into an offensive alliance with France against Great Britain, promising to make common cause with the former if the latter persisted in her maritime policy. See NAPOLEON I.

1809. *Treaty of Schönbrunn or Vienna*: between France and Austria, preceded by the armistice of Znaym, closing the campaign which had resulted in the French victory of Wagram. Austria lost extensive territories, with a population of about 4,500,000.

1812. *Peace of Bucharest*: between Russia and Turkey; secured Bessarabia to the former, making the Pruth the boundary between the territories of the two powers. The navigation of the Danube was to be free to both nations.

1814. *First Peace of Paris*: between France and the principal European powers; formed after the defeat of Napoleon at Leipzig and the invasion of France by the allies. It cut down the limits of France to what they had been in 1792, and provided for the meeting of a European congress.

1814. *Treaty of Ghent*: between the U. S. and Great Britain; brought to a close the war of 1812, leaving matters substantially as they were before the war. No mention was made of the right of search and the impressment of U. S. seamen by the British, though these were the especial grievances that had provoked the U. S. to declare war. See UNITED STATES (*History*).

1815. *Congress of Vienna*: held according to the provision of the first Peace of Paris, and attended by the principal European powers. See VIENNA, CONGRESS OF.

1815. *Second Peace of Paris*: concluded between France and the allies after the defeat of Napoleon at Waterloo. France was reduced nearly to her limits of 1790, and was obliged to submit for a time to the occupation of her territory by a foreign army.

1815. *Holy Alliance*: an agreement formed at Paris between the monarchs of Russia, Austria, and Prussia, who were afterward joined by other European powers. Its avowed objects were of a vague and general nature, but in its operations it proved to be a league of sovereigns against peoples. See the article HOLY ALLIANCE.

1818. *Congress of Aix-la-Chapelle*: attended by the representatives of Great Britain, Russia, Prussia, and France to settle the affairs of Europe pursuant to the principles of the HOLY ALLIANCE (*q. v.*). See AIX-LA-CHAPELLE, CONGRESS OF.

1820. *Congress of Troppau*: a meeting of the members of the Holy Alliance to take action against the revolutionists in Italy. See TROPPAU.

1821. *Congress of Laibach*: a continuation of the Congress of Troppau; decided upon intervention in Italy. See LAIBACH.

1822. *Congress of Verona*: the fourth and last meeting of the members of the Holy Alliance to suppress the revolutionary spirit. It was here decided to interfere in Spain. See VERONA, CONGRESS OF.

1827. *Treaty of London*: between Great Britain, Russia, and France, to put an end to the war between Turkey and Greece. When the Turks persisted in hostilities the allies destroyed their fleet at Navarino and effected the liberation of Greece, but with narrower limits than she afterward obtained.

1829. *Treaty of Adrianople*: between Russia and Turkey after the war of 1828–29. Russia restored her conquests, but secured a money indemnity and the possession of the islands at the mouth of the Danube and the ports of Anapa and Poti on the eastern shore of the Black Sea. The hospodars of the principalities were to hold office for life, and the opportunities for Russian interference in behalf of the Porte's Christian subjects were greatly increased.

1833. *Convention of Unkiar-Skelessi*: an agreement between Russia and Turkey, which, if carried out, would have reduced the latter to the position of vassalage. It was opposed by the other powers.

1840. *Quadruple Treaty of London*: between Great Britain, Austria, Prussia, and Russia on the one hand and Turkey on the other; formed to settle the dispute between the sultan and his rebellious vassal, Mehemet Ali of Egypt, who for a time seemed likely to receive aid from France. Mehemet was checked in his aggressions, and limited to the pashalik of Egypt, which was made hereditary in his family. France afterward joined the alliance.

1842. *Treaty of Nanking*: concluded the so-called "Opium war" between Great Britain and China, securing to the former a money indemnity, the possession of the island of Hongkong, and the opening of five ports to British trade and residence, a privilege later extended by supplementary treaty to all foreigners. This is one of the most important treaties of modern times.

1842. *Ashburton Treaty*: signed at Washington to define the northeastern boundary between the U. S. and British North America. It also contained provisions concerning the suppression of the slave-trade and the surrendering of fugitives from justice.

1848. *Treaty of Guadalupe-Hidalgo*: between the U. S. and Mexico. It ceded to the former country New Mexico, Texas, and Upper California, but all other conquests by the U. S. were to be given up to Mexico and the sum of $15,000,000 paid her.

1854. *Treaty between the U. S. and Japan*: negotiated by Commodore M. C. Perry; secured humane treatment for U. S. sailors shipwrecked on the coasts of Japan, and the right to appoint a consular agent to look after their interests. It led the way to the establishment of commercial intercourse. Important trading privileges were secured by the U. S. and Great Britain in 1858, and subsequent treaties have added to these and extended them to other nations.

1856. *Treaty of Paris*: after the Crimean war, between Russia, France, Great Britain, Austria, Sardinia, and Turkey, Prussia also being invited to participate. The Black Sea was neutralized and thrown open to commerce. The Danube was also thrown open to commerce, and the limits of Bessarabia were altered with the design of taking from Russia the control of the mouths of the Danube. While Wallachia and Moldavia were confirmed in their privileges by the Porte, no exclusive protectorate was granted to any of the contracting powers.

1858. *Treaties of Tientsin*: concluded between China and each of the four nations, Great Britain, France, Russia, and the U. S. The affair of the lorcha Arrow had caused war between Great Britain and China, and in the treaty of peace the former secured a money indemnity. The chief features of the four treaties are the increase of the number of ports open to foreign trade, the guarantee of protection to both native and foreign Christians in the practice and propagation of their religion, the opening of the country to foreign travel, and the sanctioning of the residence of foreign ambassadors at Peking.

1859. *Peace of Zurich*: the settlements of the points in dispute between France and the kingdom of Sardinia on the one hand and Austria on the other, after the war of 1859, preliminaries of peace having already been signed earlier in the same year at Villafranca. Austria retained Venetia, but ceded to France nearly all of Lombardy, which was transferred to Sardinia. Austria and France promised to favor the establishment of an Italian confederation under the presidency of the pope, and Venetia, while still owning the supremacy of Austria, was to be a member of this confederation. In return for Lombardy, and for the aid given by France in the war, Sardinia ceded to her Savoy and the arrondissement of Nice. This peace and the events which resulted from it put an end to the arrangements respecting Italy made by the Congress of Vienna, and prepared for the unification of Italy under the house of Savoy.

1864. *Peace of Vienna*: between Austria, Prussia, and Denmark, concluded the war that arose out of the Schleswig-Holstein question. The Danish king renounced his rights over Lauenburg, Schleswig, and Holstein in favor of Prussia and Austria.

1865. *Convention of Gastein*: a compact between Prussia and Austria, arranging for the control of the three duchies gained from Denmark by the war of 1864. Prussia was to control Schleswig, and on the payment of a stipulated sum to Austria the Prussian king was to acquire possession of Lauenburg, while the government of Holstein was committed to Austria. Prussia, however, was to have the command and police of the port of Kiel in Holstein, with the right to maintain two military routes and to construct a canal through the duchy. The arrangement was merely provisional, and did not affect the rights of the two powers to both duchies; but it brought Prussia somewhat nearer to the realization of her object, namely, the annexation of the duchies.

1866. *Peace of Prague*: concluded the war of 1866 between Prussia and Austria. The latter power recognized the dissolution of the German Confederation and the establishment of the North German Confederation under the leadership of Prussia; renounced all rights over Schleswig and Holstein in favor of Prussia; agreed to the union of Lombardy and Venetia with the kingdom of Italy, and agreed to pay to Prussia an indemnity of 20,000,000 thalers.

1871. *Treaty of Frankfort*: between France and Germany after the war of 1870-71, preliminaries having been signed at Versailles earlier in the same year. France ceded Alsace and part of Lorraine to Germany and paid an indemnity of 5,000,000,000 francs. A district containing over 1,500,000 inhabitants was thereby annexed to Germany.

1871. *Treaty of Washington*: between the U. S. and Great Britain to settle questions pending between the two countries. To adjust the so-called Alabama claims it was agreed to submit them to a tribunal of arbitration to meet at Geneva and consist of members appointed by each of the parties and by three neutral nations. (See ALABAMA CLAIMS.) With regard to difficulties concerning the fishing privileges of U. S. vessels on the coasts of British America, the treaty adjusted the points at issue on the basis of the Reciprocity Treaty of 1854, giving to the persons of each nation the right of fishing on the coasts of the other. There was a mutual concession of important privileges, such as the privilege of transit without payment of duties, and of transportation from one place to another in the territory of one nation across the territory of the other, and the opening of Lake Michigan, the lower course of the St. Lawrence river, and certain rivers in Alaska to the people of both nations. It was further agreed to submit the question respecting the running of the boundary-line on the Pacific to the German emperor, whose decision, rendered in the following year, was in favor of the U. S.—that is, accepted the line run through the Canal de Haro, leaving the island of San Juan and its group in the territory of the U. S.

1878. *Treaty of San Stefano*: the preliminary treaty of peace at the close of the RUSSO-TURKISH WAR (*q. v.*). The final settlement was reached at the Congress of Berlin.

1878. *Congress of Berlin*: a congress of the chief European powers to settle the questions that grew out of the Russo-Turkish war. See BERLIN, CONGRESS OF.

1879. *Treaty of defensive alliance between Austria and Germany*: Its text was first published in 1888, when the signatory powers were alarmed by the attitude of Russia. It provided that if Russia attacked either party the other was bound to come to the latter's aid, and that if either party should be attacked by some other power than Russia, the other party should remain neutral. In 1882 Italy was reported to have entered this alliance, thus forming the *Dreibund* or TRIPLE ALLIANCE (*q. v.*).

1895. *Treaty of Shimonoseki*: concluded the war between China and Japan on terms most advantageous to the latter power, which secured the island of Formosa, the Pescadores, the acknowledgment of the independence of Korea (the original cause of the war), important commercial privileges, and a money indemnity of about $160,000,000. In addition to these benefits Japan was granted possession of the Liaotung peninsula on the mainland from Port Arthur northward as far as the fortieth parallel of latitude, but the protest of Russia, indorsed by France and Germany, induced Japan to withdraw her claims to any portion of the mainland, on the understanding that she should be compensated by an increase in the amount of the money indemnity. F. M. COLBY.

**Treb'bia**: the ancient *Trebia*, a river of Northern Italy. It rises in the Ligurian Apennines 15 miles N. E. of Genoa, flows northward, and joins the Po 3 miles above Piacenza. On its banks the Romans under Sempronius were defeated by Hannibal in 218 B. C. and the French under Macdonald by Suwaroff June 17-20, 1799.

**Trebel'lius Pollio**: See AUGUSTAN HISTORY.

**Treb'izond**, or **Tarabozan** (Gr. Τραπεζοῦς, gen. Τραπεζοῦντος; Lat. *Trape'zus*; Turk. *Trabizon* or *Tárabzon*): town; in Asia Minor, in the vilayet of Trebizond; on the southeastern coast of the Black Sea (see map of Turkey, ref. 4-I). It is beautifully situated on a slope, facing the water; is surrounded with walls, and fortified. It is the Turkish terminus of the main route to Armenia and Persia, but the trade formerly centering here is being rapidly diverted to Batoum. Regular lines of steamers connect Trebizond with the Danube and Constantinople. The imports are mainly manufactured European goods. The exports are wool, mohair, skins, wax, gum, resin, gall-nuts, tobacco, oil, opium, fruit, shawls, and carpets, brought overland by camel caravans; also timber and box-wood. Trebizond, founded by a colony from Sinope, was a flourishing city in the time of Xenophon, and gave a memorable reception to the TEN THOUSAND (*q. v.*). Trajan made it the capital of Pontus-Cappadocia. In 1204 Alexius Comnenus founded the empire of Trebizond, which lasted till its overthrow by Sultan Mohammed II. in 1461. Population (1889) 45,000, of whom 29,000 were Ottomans, 10,000 Greeks, and 5,000 Armenians. E. A. GROSVENOR.

**Tredegar**, treed'gaar: town; in Monmouthshire, England; 7 miles E. N. E. of Merthyr Tydvil (see map of England, ref. 12-F). It is in a coal district, and is the seat of great iron and steel works. Pop. (1891) 17,484.

**Tredgold**, THOMAS: engineer; b. at Brandon, near Durham, England, Aug. 22, 1788; was for some years a journeyman carpenter; was for ten years (1813-23) employed in London in an architect's office, extending his studies to embrace chemistry, geology, mechanics, and engineering, and for the last six years of his life practiced with great success as a civil engineer, contributing meanwhile scientific articles to *The Philosophical Magazine*, *The Annals of Philosophy*, and the *Encyclopædia Britannica*. He was the author of *The Elementary Principles of Carpentry* (1820); *A Practical Essay on the Strength of Iron and other Metals* (1821); *Description of Iron Suspension Bridges* (1826); and *The Steam-engine* (1827), which was subsequently edited by W. S. B. Woodhouse (2 vols., 1838-40), with 125 plates in atlas folio, and in an enlarged edition (3 vols., 1850-53). D. in London, Jan. 28, 1829.

**Tredïakov'skiĭ**, VASILIĬ KIRILOVICH: author; b. in Astrakhan, Russia, 1703. After a stay of some years in foreign countries he settled in St. Petersburg, where he was made secretary of the Academy of Science. He was a prolific writer, but his verse was so bad that Catherine II. in her games used to punish her courtiers by making them learn lines of it, and his name has remained proverbial in Russia as that of the pretentious, talentless poet who made his way by cringing for court favor. As a prose writer he was of more importance, for some of his critical works, and especially his *Method of Russian Versification*, were of considerable value. He also translated Boileau's *Art Poétique*, Rollin, Fénelon, etc. D. Aug. 18, 1769. A. C. COOLIDGE.

**Tree** [O. Eng. *trēo* : Icel. *trē* : Goth. *triu* < Teuton. *trewo-* : Russ. *drevo* : Welsh, *derw*, oak : Gr. δρῦς, oak : Sanskr. *dru*, tree]: a woody plant with a single trunk rising to more than the height of a man. There are all gradations between shrubs and trees. Some woody-stemmed plants are properly called trees, although of dwarf stature, the branches being elevated upon a single trunk; some, which branch or divide from the ground or near it into a cluster of trunks, reach such a height and magnitude that they must be called trees rather than shrubs. Most common trees increase in thickness by the addition each year of a cylinder of wood around the wood of the preceding years. They are therefore said to be *exogenous* in growth. The seedling stem, almost as soon as it is formed, is traversed longitudinally by some woody threads (fibro-vascular bundles), which are so arranged as to surround a central portion that remains destitute of woody matter; and these increase in size and number until they form a cylindrical layer of wood (in cross-section a ring) between the soft central core, the pith, and an outer more or less soft portion, the bark. When this layer of wood in the seedling stem or other shoot of the season is completely formed, no additions are made to its inner portion, but new wood may continue to be formed on its outer surface, between it and the bark, all through the season. When, after a suspension of growth consequent upon the diminution of temperature in all climates which have a winter, or of moisture where vegetation is arrested or checked by dryness, a second season of growth supervenes, a new layer of wood is formed upon or external to the old one, and so on year after year. Consequently the section of an exogenous tree-trunk exhibits concentric layers—in all ordinary cases one for each year of its age—the oldest next the pith, the youngest next the bark. As the tree has made annual increments of growth in length as well as in diameter, a cross-section at the base of the trunk exhibits a number of annual layers equal to the whole age of the tree, while one at the summit has only a single layer, interposed between the pith and the bark. Radiating plates—in the cross-section lines more or less conspicuous—traverse this layer of wood from the pith to the bark, dividing it into wedges; these are continued through the succeeding layers, and new ones are interposed between them as the wedges widen; these are the *medullary rays* or *silver grain*. The bark of an exogenous tree is always clearly distinguishable from the wood, and for the most part is readily separable from it, the demarkation between the two being a thin zone of undifferentiated cells, called the *cambium*. From this cambium are developed on the one side additions to the wood—on the other to the bark. While the wood, once formed, remains unaltered except as changing from sap-wood to heart-wood, the bark is subject to distension from within, from the increasing size of the woody cylinder. The older and outer bark is consequently sooner or later fissured and riven as well as worn and weathered by exposure to the elements.

The port or character of the tree depends much upon its mode of branching, and this primarily upon the arrangement of leaves upon the twigs; for the branches of the spray proceed from lateral buds, of which there is usually a single one in the axil of each leaf. Accordingly, when the leaves are opposite, so will be the branches of the spray, while alternate leaves originate alternate branchlets; but this symmetry, however evident in the branchlets, is usually more or less obscured in the larger branches by the non-development of some of the buds and the destruction of many branchlets. When the main trunk persists and leads throughout, not being rivaled or supplanted by any of the branches, the tree is said to have an excurrent trunk; when the main trunk is lost in or replaced by the main branches, it is said to be deliquescent.

Palm-trees are the more common but not the exclusive representatives of the type of arboreous vegetation in which the stems do not increase in thickness exogenously. They rise by a simple columnar trunk, not tapering as it ascends, terminated with a crown of large and long-stalked leaves, which are either pinnate or plume-like, as in date-palms, or palmate, as in palmetto. This simple and mainly cylindrical trunk comes from their whole vegetation being the development of a single terminal bud. Such axillary buds as they develop form the inflorescence, and therefore do not result in permanent branches. Nevertheless, a few palms branch habitually and normally after a certain age. The doum-palm of Upper Egypt and Nubia is the best-known example. In contrast with the wood of exogenous trees, that of palms and their relatives has no concentric layers surrounding a central pith, and no proper bark. The wood is made up of separate fibro-vascular bundles, longitudinally traversing and separately imbedded in the cellular and softer fundamental tissue which is represented in the exogenous stem by the central pith and the radiating medullary rays. When these wood-bundles can be traced, they are found to have their upper termination in leaf-stalks, their lower in the circumference or rind, in their course describing more or less of an arch or long curvature. The central portion of the trunk contains fewer of the woody bundles; toward the circumference they are more crowded. Consequently, the denser wood is at the circumference, the softer at the center. The center sometimes remains pithy, as it were, and sparsely traversed by threads of wood, but in many palm-stems nearly the whole becomes so closely packed with woody bundles as to form a very compact and hard wood. On account of this structure such trees have been called *endogenous*, "inside growing," but the term is inaccurate, and is becoming obsolete in this sense. Exogenous trunks increase indefinitely in diameter; palm trunks soon become incapable of further enlargement, except in height. They are accordingly cylindrical up to the crown of leaves, and in place of a bark, distinct, separable, and of different layers, they are invested by an inseparable, more homogeneous, and permanent rind, which, along with the more solidified wood of the circumference, restricts and limits distension. Some such trunks, however, notably those of dragon-trees and yuccas (of the lily family), continue distensible, and therefore continue to increase in diameter; they also branch when old, usually only after blossoming, which takes place from a terminal bud, thus arresting the vegetative growth, which is resumed from axillary buds. Such stems therefore fork at each flowering or other arrest of the terminal bud, and so in time form a branched head, in some respects imitating that of an ordinary exogenous tree.

*Trees as to climate* and distribution can hardly be here treated of, but it must be stated that arboreal growth, of any ordinary type, supposes and requires a considerable amount of moisture, and accordingly of rainfall, either through the year or through a growing season. An ordinary tree expands a large extent of evaporating surface, chiefly in its foliage. Leaves dry up and perish if not supplied with moisture to replace that which is evaporated or transpired. Therefore, not only are rainless districts treeless (except as water is supplied by irrigation), but regions of scanty and precarious summer rain are sparsely wooded or without forest, according to the amount of aridity or length of the dry season; or their arborescent vegetation meets the exigency and stress by some special adaptation. Broad-leaved evergreens abound where rains fall throughout the year, and especially where winter is unknown. Narrow-leaved or needle-leaved evergreen trees are chiefly in cooler or cold climates, well supplied with moisture through the year or through the season of activity. Trees with expanded foliage survive the rainless hot season of the drier tropical and sub-tropical regions only by dropping their leaves, upon which the stress first comes, and thereby reducing the evaporating surface to a minimum. Those which retain their foliage are such as have some peculiar provision—by fleshiness with thick epidermis in the case of succulent foliage, or by firm coriaceous texture, superficially or throughout, to which, especially in Australia, is sometimes added a vertical instead of horizontal position of the leaves, which thus present their edges instead of one face to the high sun. This prevails among the Australian acacias and myrtaceous trees, which compose the larger part of the arboreal vegetation. In climates in which vegetable growth and action are arrested by winter, the trees are nearly all deciduous, except the coniferous evergreens, the leaves of which are peculiarly organized for resisting cold, and individually expose a small surface to the elements.

*Duration of Trees.*—An exogenous tree, renewing annually its twigs and foliage above, its growth of roots beneath, and zone of new wood and bark connecting the two, has no definite limits to its existence. Its actual duration depends upon external circumstances, and upon some inherent liabilities which may practically result in a certain average of life in any particular species, which, however, certain favored individuals may be expected to overpass. Increase of size, height, or spread of branches, and other inevitable consequences of age, however, bring increasing, and at length inevitable, disadvantages and liabilities, so that practically, although most trees, like most men, die an accidental death, the longest survivors may be said to die of old age in the sense in which the oldest of the human race do—that is, of the diseases or accidents which the younger generally resist or recover from, but to which the older succumb in consequence of the disadvantages of age. Suffice it to say, however, that exogenous trees are known, by the actual counting of their layers, throughout or in great part, to have attained the age of from 1,200 to fully 2,000 years; it is probable that some extant trees are considerably older. The tallest trees known rise little less than 500 feet (*Eucalyptus*, in Australia). The largest in girth are trees of *Eucalyptus*, up to 81 feet; giant redwoods in California, up to 91, and possibly 100 feet; baobab-trees of Senegal, some of which have reached the latter circumference, but they are low trees of rapid growth even when old, and probably of no extreme age; and, finally, there is a Mexican *Taxodium* or bald cypress, a slow-growing tree, which measures 112 feet in circumference. If this does not consist of two or more original trunks which have grown into one—of which there are no external indications—it is probably the oldest existing tree known.

Trees like palms, which do not continue to increase in girth, are more strictly and inherently limited in their duration; perhaps they never live more than 200 or 300 years. When such a trunk has a soft living rind, capable of unlimited expansion, and also produces branches, perhaps it may live as long as an exogenous tree. Dragon-trees (*Dracæna*) are examples of this. The celebrated great dragon-tree of Orotava, Teneriffe (now destroyed by a series of storms, but which was in full vigor when Humboldt visited it), was probably as old as any of the existing redwoods of California. Revised by Charles E. Bessey.

**Tree**, Herbert Beerbohm: actor; b. in London in 1853; educated in Germany and England; entered the office of his father, a grain-merchant in London, in 1870, but became devoted to amateur acting, and made his *début* at the Globe theater, London, as Grimaldi in 1878. In Mar., 1884, he made a hit as the timid curate in *The Private Secretary* at the Prince of Wales's. In 1887 he became lessee of the Comedy theater, and later of the Haymarket theater, where he has produced a number of very successful plays, among which are *The Pompadour*, *Hypatia*, *A Woman of No Importance*, and *John-a-Dreams*. In 1894–95 he paid a visit to the U. S. He is remarkable for the very different styles of the parts which he has assumed. He has written several papers on the actor's art, and in 1893 he lectured at the Royal Institution on the imaginative faculty.

**Tree-duck**: any one of ten or a dozen species of ducks of the genus *Dendrocygna*, deriving their name from their arboreal habits. They are readily distinguished by their long legs and the length of the hind toe. They nest in holes in trees, often at some distance from the water, to which they carry their newly hatched young. They are chiefly confined to the tropics, but two species, *Dendrocygna fulva* and *D. autumnalis*, occur in the U. S. F. A. L.

**Tree-ferns**: large ferns having a tree-like form and size, with much the habit of the palms. Tree-ferns formed an important part of the vegetation of the coal-measures. At present they are mostly tropical or insular, but are abundant in Tasmania, New Zealand, and parts of Australia and in the Himalayas. A few species yield a useful starchy pith resembling sago. See Fernworts and Plants, Fossil.

**Tree-frogs**, or **Tree-toads**: those species of tailless batrachians (order *Salientia*) which are adapted for life among trees, and which are provided with terminally dilated toes. This character of dilatation of the tips of the toes, although regarded by some authors as of systematic importance, is of mere teleological significance, and is not co-ordinated with true morphological characteristics. The tree-frogs and tree-toads are now mostly to be found in the families *Hylidæ*, *Cystignathidæ*, *Engystomidæ*, *Dendrobatidæ*, and *Ranidæ*. The North American species, however, all belong to

The squirrel tree-toad.

the family Hylidæ (*q. v.*). The *Hyla squirella*, which is about 1¼ inches in length, is of a brownish or light ash color. It is a southern species. Revised by F. A. Lucas.

**Trefoil**: See Clover.

**Tregelles**, tre-gelz', Samuel Prideaux, LL. D.: New Testament critic and author; b. at Wodehouse Place, near Falmouth, England, Jan. 30, 1813, of Quaker parentage; educated at Falmouth Classical School; was for some years in the iron-works at Neath Abbey, Glamorganshire, 1828–34; was in 1835–36 a private tutor at Falmouth; shortly after devoted himself to the task of preparing a critical edition of the text of the New Testament from the most ancient MSS. and versions, and pursued that object through life; studied the Oriental languages; was long associated with the Plymouth Brethren, though he never joined that organization, and died in the communion of the Church of England. He was stricken with paralysis in 1861, and again in 1870. The second stroke so crippled him that he could not take part in the revision of the New Testament to which the Convention of Canterbury invited him. In the pursuit of his scheme he visited the principal libraries of Europe for the purpose of collating MSS. He published the first specimen in 1837, and the first part, the Revelation, 1844; then his great work in parts, *The Greek New Testament, edited from Ancient Authorities, with the Latin Version of Jerome, from the Codex Amiatinus* (1857, *seq.*; the 6th part completed the text, 1872; the 7th and last part, containing the prolegomena, addenda, and corrigenda, edited by F. J. A. Hort and A. W. Streane, 1879). By this labor he put himself in the line of illustrious scholars who have brought the text of the Greek New Testament to its present perfection. In recognition of this service he received a pension of £100 in 1862, which was doubled after 1870. He was an active philanthropist as well as scholar. D. at Plymouth, Apr. 24, 1875. Besides his New Testament, he published many books. His chief publications were: *Passages in the Book of Revelation connected with the Old Testament Scriptures* (1836); *The Englishman's Greek Concordance to the New Testament* (1839); *The Englishman's Hebrew and Chaldee Concordance to the Old Testament* (2 vols., 1843); *Hebrew Reading Lessons* (1845); *Heads of Hebrew Grammar* (1852); *Gesenius's Hebrew and Chaldee Lexicon* (1847); *The Prophetic Visions of the Book of Daniel* (1847; 5th ed. 1864); *The Book of Revelation Translated from the Ancient Greek Text* (1848); *On the Original Language of St. Matthew's Gospel* (1850); *The Jansenists* (1851); *Historic Evidence of the Authorship and Transmission of the Books of the New Testament* (1852); *Account of the Printed Text of the Greek New Testament* (1854); *Codex Zacynthius, Greek Palimpsest Fragments of the Gospel of St. Luke obtained in the Island of Zante* (folio, 1861), the fourth volume of the 10th ed. of Horne's *Introduction* (1856). Revised by S. M. Jackson.

**Treitschke**, trītsh'ke, Heinrich Gotthardt, von: historian; b. in Dresden, Saxony, Sept. 15, 1834; studied history and political economy in various German universities; was privat docent at Leipzig 1858–63: appointed professor in the University of Freiburg im Breisgau 1863–66. As an ardent adherent of Prussia he resigned in 1866, and removed to Berlin, where he edited the *Preussischen Jahrbücher*. He was called to the chair of History at Heidelberg in 1867, and to that in the University of Berlin in 1874. In the meanwhile (1871) he was elected to the Reichstag, where he continued as a member of the liberal party till 1888. He succeeded Prof. von Ranke, who died in 1886, as Prussian historiographer. He published *Zehn Jahre Deutscher Kämpfe 1865–74* (1874); *Der Sozialismus und seine Gönner* (1875); *Der Sozialismus und der Meuchelmord* (1878); *Deutsche Geschichte im 19ten Jahrhundert* (1879–85); *Zwei Kaiser* (1888); and several other works. D. Apr. 28, 1896.

**Trelaw'ney**, Edward John: author and soldier of fortune; descended from an old Cornish family, and b. Mar. 10, 1792. He is known especially as the author of a novel, in great part autobiographical, entitled *Adventures of a Younger Son* (1830), and *Recollections of Shelley and Byron* (1858), reissued in 1878 as *Records of Byron, Shelley, and the Author*. At the age of eleven he was sent to sea, and after many adventures and some experience in privateering he settled in London and wrote for the magazines. He made the acquaintance of Byron and Shelley at Pisa in 1821, and was present with Byron and Leigh Hunt at the burning of Shelley's body. In 1823 he joined Byron in Greece, and fought in the Greek war of liberation as aide-de-camp to the partisan leader Odysseus. He afterward returned to London, and was prominent in Lady Blessington's circle. D. at Sompting, Sussex, Aug. 13, 1881. His body was cremated, and the ashes interred near Shelley's at Rome. His portrait is preserved in Millais's painting, *The Northwest Passage*. H. A. Beers.

**Trelease**, William, D. Sc.: botanist; b. at Mt. Vernon, N. Y., Feb. 22, 1857; educated in Cornell and Harvard Universities; instructor in botany in Cornell University 1880; Professor of Botany in University of Wisconsin 1881–85; director of Shaw School of Botany, Washington University, St. Louis, 1885–; director of Missouri Botanical Garden 1889–; has published an English translation of Poulson's *Botanical Microchemistry* (1883); *The Botanical Works of the Late George Engelmann* (1887, with Asa Gray); an English translation of Salomonsen's *Bacteriological Technique* (1889); *Annual Reports of the Missouri Botanical Garden* (1890–91–92–93); and many papers in various journals and the proceedings of societies. Charles E. Bessey.

**Tremato'da** [Mod. Lat., from Gr. τρηματώδης, full of holes, deriv. of τρῆμα, τρήματος, hole]: a group of parasitic flatworms (see Plathelminthes) in which parasitism has produced but slight degeneration. The body is usually flattened, lacks cilia and all traces of segmentation; the mouth is anterior and communicates with a digestive tract which forks after a short extent. Upon the lower surface are one, two, or more suckers for adhesion to the host, and sometimes these are re-enforced by hooks. Like all flatworms they lack a body-cavity and distinct circulatory organs, while the excretory system is well developed. Most species have the sexes separate. The group is usually subdivided into the Monogenea, in which the egg develops directly into the adult form without the intervention of an asexual form, and the Digenea, in which there is an alternation of generations, one or more asexual forms being introduced in the life cycle. Correlated with this is a difference in their habits of parasitism. Thus the Monogenea inhabit a single host and usually attach themselves to the external surface of the body. The Digenea, on the other hand, have more than one host, one being usually an invertebrate, the adult living in some vertebrate. Among these last are found some of the most dangerous parasites, especially that group known popularly as flukes (*Distoma*). Some of these cause serious distempers among domestic animals and eight occur in man. The history of a few flukes has been followed, and reveals a wonderfully complex series of alternation of generations. See Leuckart, *Die menschlichen Parasiten* (1867); Cobbold, *Entozoa*; Thomas, *Quar. Jour. Micros. Science* (1883). J. S. Kingsley.

**Tremblay**, François Leclerc, du: See Joseph.

**Trembles**: See Milk-sickness.

**Tremont'**: town; Hancock co., Me.; on the Atlantic Ocean; 25 miles S. of Ellsworth, and 25 miles E. by S. of Castine (for location, see map of Maine, ref. 9–F). It was formerly a part of the town of Mt. Desert, from which it was set off and incorporated in 1848 under the name of Mansel, subsequently changed to its present name. It contains the villages of Tremont, Southwest Harbor, Seal Cove, West Tremont, Sea Wall, Tremont Center, and Manset, and has 5 churches, public high school, public library, 11 hotels, and a savings-bank. Pop. (1890) 2,036; (1900) 2,010.

**Tremont**: borough: Schuylkill co., Pa.; on the Phila. and Reading Railroad; 13 miles W. of Pottsville, the county-seat, and 50 miles N. W. of Reading (for location, see map of Pennsylvania, ref. 5–H). It is in an agricultural and mining region, and contains 8 churches, graded schools, improved water-works, electric lights, a private bank, and 2 weekly newspapers. Pop. (1880) 1,785; (1890) 2,064; (1900) 1,947.
Editor of "West Schuylkill Press."

**Tremulous Poplar**: See Aspen.

**Trench**, Richard Chenevix, D.D.: archbishop and author; b. in Dublin, Ireland, Sept. 9, 1807; educated at Trinity College, Cambridge, and graduated in 1829; spent some years in travel; took orders in the Church of England 1833; was curate at Hadleigh, Suffolk, 1833–35; incumbent of Curdridge 1835–40; curate to Archdeacon (afterward Bishop) Samuel Wilberforce at Alverstoke 1840–44; rector of Itchenstoke 1844–45; was appointed examining chaplain to the Bishop of Oxford (Dr. Wilberforce) 1845; was Hulsean lecturer 1845–46, and select preacher at Cambridge 1843 and 1856; Professor of Theology at King's College, London, 1846–58; Dean of Westminster 1856–63, and was ordained Archbishop of Dublin, as successor to Dr. Whately, Jan. 1, 1864; resigned 1884. In the field of philology he achieved distinction, and his paper on the *Deficiencies in our English Dictionaries* gave the first impulse to the great *New English Dictionary* edited by Dr. James A. H. Murray. D. in London, Mar. 28, 1886. He was the author of many works, including *Poems from Eastern Sources* (1842); *Elegiac Poems* (1846); *Poems, collected and arranged anew* (1865); *Notes on the Parables of our Lord* (1841; 15th ed. 1884); *Notes on the Miracles of our Lord* (1846; 13th ed. 1886); *Exposition of the Sermon on the Mount, from St. Augustine* (1844); 2 vols. of Hulsean lectures, *The Fitness of Holy Scripture for unfolding the Spiritual Life of Men* (1845); *Christ the Desire of all Nations* (1850); *On the Study of Words* (1851; 15th ed. 1874); *On the Lessons in Proverbs* (1853); *Synonymes of the New Testament* (1854; 2d series 1863; 8th ed. recast, 1 vol., 1876); *English, Past and Present* (1855; 11th ed. 1881); *Calderon, his Life and Genius* (New York, 1856); *Some Deficiencies in our English Dictionaries* (1857); *The Authorized Version of the New Testament, in Connection with some Recent Proposals for its Revision* (1858); *Select Glossary of English Words used formerly in Senses different from their Present* (1859); *Commentary on the Epistles to the Seven Churches in Asia* (1861); *Studies on the Gospels* (1867); *Lectures on Mediæval Church History* (1877; 2d ed. 1879); edited several volumes of poetry, and *Remains of the Late Mrs. Richard Trench* (1862), his mother. See his *Letters and Memorials* (2 vols., 1886). Revised by S. M. Jackson.

**Trenchard**, Stephen Decatur: naval officer; b. in New York, July 10, 1818; entered the navy as a midshipman Oct. 23, 1834, serving in the Seminole war in Florida; became lieutenant in 1847, and was on the Saratoga in the war with Mexico; commander in 1862, captain in 1866, commodore in 1871, rear-admiral in 1875; commanded the Rhode Island in both the Fort Fisher fights; retired in 1880. D. in New York, Nov. 15, 1883.

**Trendelenburg**, Friedrich Adolf: classical philologist and philosopher; b. at Eutin, near Lübeck, Germany, Nov. 30, 1802; studied at Kiel; appointed professor extraordinary at Berlin 1833; ordinary 1837; member of Academy of Sciences in 1846. D. in Berlin, Jan. 24, 1872. Trendelenburg's claim to distinction as a thinker rests on his acute criticism of the formal logic of Kant and the dialectical method of Hegel. In his own system he took motion as a starting-point, from which he deduced all other philosophical conceptions, including time and space. The foundation of his teaching is Platonic and Aristotelian. His most noteworthy works are *Elementa Logices Aristoteliceæ* (8th ed. 1878); an edition of Aristotle's *De Anima* (2d ed. by Chr. Belger, 1877); *Historische Beiträge zur Philosophie* (3 vols., 1846–67), in which the *History of the Doctrine of Categories* and the essays on *Kant, Spinoza, Leibnitz*, and *Herbart* are especially valuable; and *Naturrecht auf dem Grunde der Ethik* (2d ed. 1868). See H. Bonitz, *Zur Erinnerung an Trendelenburg* (Berlin, 1872); E. Bratuschek, *Adolf Trendelenburg* (1873). Alfred Gudeman.

**Trent**: a river of England. It rises in Biddulph Moor in Staffordshire, at an elevation of about 600 feet above the level of the sea, flows in a southeasterly direction, and forms the Humber after joining the Ouse, about 15 miles W. of Hull. Its length is about 150 miles, and it is navigable for about two-thirds of its course.

**Trent**: a tributary of Lake Ontario, rising in Rice Lake, Northumberland County, Ontario, and draining a large system of northern lakes and rivers; partly navigable. The Trent itself affords good water-power, and large quantities of lumber are floated upon it. It is 150 miles long, has a basin of 4,000 sq. miles, and discharges its waters into the Bay of Quinté at Trenton. M. W. H.

**Trent** (anc. *Tridentum*): town of Austria, in the southern part of Tyrol; on the Adige (see map of Austria-Hungary, ref. 7–A); beautifully situated and well-built, and traversed by canals. Its cathedral, begun in 1212, is a magnificent edifice of white marble; the palace, in which the famous council held its sittings, and several other buildings are also remarkable. It manufactures leather, glass, sugar, tobacco, bells, cards, and silks, and carries on an important transit trade between Italy and Germany. Pop. (1890) 21,486.

**Trent**, William Peterfield: See the Appendix.

**Trent Affair**: the seizure of the Confederates Slidell and Mason on board the British steamer Trent in 1861, and the resulting international complications. See Slidell, John.

**Trent, Council of** (*Concilium Tridentinum*): the nineteenth œcumenical council of the Catholic Church, held at Trent in Tyrol.

*Occasion of the Council.*—Its convocation was owing to two motives: (1) the desire to stay the spread of Protestantism, and (2) to bring about a much-needed reform within the Church. For several years the project of the council had been discussed between the papal and the imperial authorities without much headway, the former being anxious to convoke the council in some Italian city, like Mantua or Vicenza. The imperial view obtained, and a compromise was effected which resulted in the calling of the council by Paul III. for Nov. 1, 1542, at Trent, an imperial free city under a prince bishop. It was finally opened Dec. 13, 1545, by the papal legates, the cardinals del Monte, Cervini, and Pole, in the presence of four archbishops, twenty-two bishops, five generals of orders, theologians, ambassadors, etc. The Protestants were invited to attend, and such was the sincere desire of the emperor and the King of the Romans, but they refused.

*Procedure.*—It was decided to take up in each session matters of dogma and discipline, and this, too, was a compromise, the pope desiring doctrinal questions to be first decided, and the emperor leaning toward a speedy reform of practical abuses. The subject-matter was proposed by the papal legates, who presided, and was then divided among private congregations, in which the *pro* and the *con* were argued at length by learned and experienced men. Afterward the private congregations met as a body or general congregation, and the final session was usually a formal confirmation of what had already been settled. The doings of each of the twenty-five sessions are divided into *decrees*, i. e. statements of Catholic doctrine or resolutions concerning disciplinary reform, and *canons*, or condemnations of heretical teaching.

*History of the Council.*—The first eight sessions were held at Trent, but in Mar., 1547, owing to the prevalence of the pest, it was transferred to Bologna, where the ninth and tenth sessions were held in spite of the absence of the bishops subject to the emperor, and of the latter's protestations, Sept. 17, 1549. It was therefore indefinitely prorogued. Julius III., Mar. 14, 1550, issued another call to the bishops to assemble at Trent, and May 1, 1551, the twelfth session was held. Neither the emperor nor the King of France desired to look on it as a continuation of the original council because of the susceptibilities of their Protestant subjects. The victories of Maurice of Saxony and his near presence at Innsbruck decided the fathers to suspend the council Apr. 28, 1552. It was again convoked by Pius IV. Jan. 18, 1562, and closed its work Dec. 4, 1563. Nine cardinals, 3 patriarchs, 33 archbishops, 237 bishops, 8 abbots, 8 generals of orders, and 150 theologians and canonists had taken part. Of the bishops, 187 were Italian. Queen Elizabeth was twice asked to take part, but refused. Mary, Queen of Scots, excused herself by the lamentable condition of the Church in her kingdom. Cardinal Pole and Thomas Goldwell, Bishop of St. Asaph, represented England, and three Irish bishops, Thomas O'Herlaghy, of Ross, Eugene O'Hart, of Achonry, and Donald McCongail, of Raphoe, represented Ireland.

*Work of the Council.*—The direct results of the council were visible in doctrinal statements and resolutions for reform. The rule of faith, the nature of original sin, the nature and office of grace (justification), the doctrine of the sacraments in general and particular, the Mass, orders, marriage, the censorship of books, the Catholic practices and traditional beliefs, the invocation of saints, purgatory, the veneration of relics and images, were all treated in the council with great wisdom, moderation, and exactness. The reforms were thorough and extended to the entire Church in the intention and provision of the fathers. Its results were a great relief to the conscience and intelligence of Catholics, and inaugurated at once a counter-reformation, personified in men like St. Charles Borromeo and St. Francis de Sales. It unified Catholics throughout the world, and put an end to the mental wavering and indecision of a great many, while it pointed out the evil and the false in the non-Catholic teachings. Altogether it marks a complete awakening in the Church, and is the starting-point of the modern ecclesiastical law, discipline, administration, and to a large extent of the theological formation itself, so much so that it can be said that no council since that of Nice has had a more profound influence. The council was acknowledged in most Catholic countries; in those whose civil authorities, like France, refused to accept its decrees, provincial councils and public opinion made it the ecclesiastical law and binding. Its doctrinal and disciplinary regulations are binding in the entire Catholic Church, though in some countries the decree *Tametsi* on the necessary presence of the parish priest and two witnesses for the validity of the marriage contract has never been proclaimed, this especial promulgation having been ordered by the council before the decree can obtain the character of a law in any given territory. See Tridentine Profession of Faith.

Literature.—The acts of the council are best found in Le Plat, *Monumenta ad historiam Concilii Trid.* (7 vols., Louvain, 1781–87). The original acts and debates, as prepared by the secretary, Angelo Massarelli, are in the Vatican Library, and were published in part, but unsatisfactorily, by Theiner, *Acta Genuina SS. Œcum. Concilii Trid.* (2 vols., Leipzig, 1875). Döllinger, Calenzio, and Sickel have published diaries, correspondence, and other information concerning the council. The original and authentic edition of the *Canones et Decreta Concilii Tridentini* is of 1564 (Rome). The history of the council has been written by Paolo Sarpi (Pietro Soave Polano) and Sforza Pallavicino, the former a Venetian Servite, the latter a Jesuit and a cardinal. The work of Sarpi appeared at London in 1619; that of Pallavicino in Rome 1652, and after many editions, *ibid.*, with notes of Zaccaria 1833. The work of Sarpi is written with great art, and he dissimulates much of his own feelings by indirect methods. Bossuet declared it the work of an enemy and not of an historian of the council. Pallavicino wrote his history out of the original acts preserved in the Vatican, and in many places has successfully exposed the inaccuracies and evil animus of Fra Paolo, who was for the rest an able, learned, many-sided writer, but proud, and bitterly opposed to the court of Rome. The Catechism of the Council of Trent, the diocesan seminaries, the new editions of the liturgical books and of the Vulgate, etc., are the outcome of the council, which committed to the care of the pope a number of projects left over at the closing. On Sarpi and Pallavicino, see Brischar, *Beurtheilung der Controversen Sarpis und Pallavicinos* (Tübingen, 1843); Ranke, *History of the Popes* (vol. iii., app. 2); L. Maynier, *Études critiques sur le Concile de Trente* (Paris, 1874). Other literature in Hergenroether, *Kirchen-Geschichte*, iii., 231, *seq.*, and Kraus, *Kirchen-Geschichte*, p. 567. The second edition of Hefele's *History of the Councils* (German) will contain the history of that of Trent. Cardinal Hergenroether undertook it (vol. ix., 2d ed.), but did not get beyond the preparatory period. J. J. Keane.

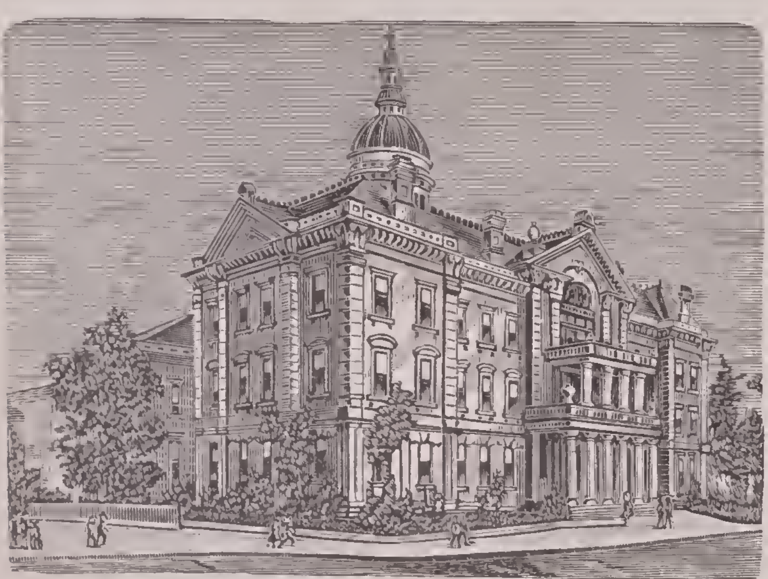
**Trente-et-Un**: See Rouge-et-Noir.

**Trenton**: port of entry of Hastings and Northumberland Counties, Ontario, Canada; on the Bay of Quinté, on both sides of the Trent, and on Grand Trunk and Central Ontario railways; 101 miles E. of Toronto (see map of Ontario, ref. 4–F). Immense quantities of timber are rafted down the river and shipped at this place, and it has large manufactures. Pop. (1891) 4,364.

**Trenton**: city; capital of Grundy co., Mo.; on the Welden fork of the Grand river, and the Chi., Rock Is. and Pac. and the Quincy, Om. and Kan. City railways, 85 miles N. E. of St. Joseph, 101 miles N. E. of Kansas City (for location, see map of Missouri, ref. 2–F). It is in an agricultural and stock-raising region, and has 6 churches for white people and 2 for colored, a public school with 22 rooms and over 1,500 enrolled pupils, Avalon College (United Brethren, chartered 1881), the Jewett Norris library with endowment of $15,000, a national bank with capital of $75,000, a State bank with capital of $75,000, 3 daily and 3 weekly newspapers, 3 flour-mills, 2 cigar-factories, 2 coal-shafts from which 35,000 tons of coal were taken in 1894, butter and cheese factory, gas and electric light plants, water-works, and street-railway. Trenton was founded in 1841, was chartered as a town sixteen years later, and became incorporated as a city with enlarged territory in 1893. Pop. (1880) 3,212; (1890) 5,039; (1900) 5,396.

EDITOR OF "REPUBLICAN."

**Trenton**: city; capital of New Jersey and of Mercer County; on the Delaware river, at the head of steamboat and sloop navigation; on the Delaware and Raritan Canal, and on the Penn. and the Phila. and Reading railways; 33 miles N. E. of Philadelphia, 59 miles S. W. of New York (for location, see map of New Jersey, ref. 4–C). Two iron bridges span the Delaware, connecting the city with its suburb, Morrisville, and the fertile farm-land of Bucks co., Pa. Trenton surrounds an apex in the course of the Delaware, is closely built through eleven of the fourteen wards, and has many wide streets lined with handsome residences. Cadwalader Park and its residential plot, Cadwalader Place, Monument Park, Tenth Ward Park, and Spring Lake Park are the well-kept and beautiful breathing-places. The city has an excellent sewerage system, good water-supply, paid fire and police departments, and an economical administration of local affairs.



State Capitol, Trenton, N. J.

*Public Buildings.*—There are a public library (other than the State Library in the Capitol), large opera-house, Y. M. C. A. building, three hospitals (the Mercer, City, and St. Francis), county court-house, Union Industrial Home, the State School for Deaf Mutes, State prison, arsenal, U. S. Government building, State Asylum for Insane, and the Industrial School for Girls. The Odd Fellows' Home stands in Ewing, near the city line. The Widows' and Single Women's Home, near the State-house, was formerly the barracks used during the French and Indian war.

*Churches and Schools.*—Trenton is the seat of a Protestant Episcopal and of a Roman Catholic bishopric. There are 48 churches and places of worship, including 10 Methodist Episcopal, 8 Roman Catholic, 7 Presbyterian, 6 Baptist, 5 Protestant Episcopal, 3 Lutheran, 2 African Methodist Episcopal, 2 synagogues, a church of the Messiah, and a Hicksite and an Orthodox meeting-place of Friends. The public schools embrace a high school and a score of subordinate schools. The first public school to be founded in the State was located at Trenton. Besides the common schools, the city contains the State Normal and Model Schools with over 1,000 scholars, 3 business colleges, 7 parochial schools and the Franciscan Convent of Minor Conventuals, the Union Industrial Home (formerly Children's Home), and a dozen private schools.

*Business Interests.*—An energetic board of health and a board of trade advance the city's interests. The First National, the Trenton Banking Company, the Mechanics' National, each with a capital of $500,000, and the Broad Street Bank are large financial institutions. Other important organizations are the Trenton Saving Fund Society, the Trenton Trust and Safe Deposit Company, and the Real Estate Title Company. Trenton is pre-eminently a manufacturing city. Thirty potteries making all classes of ware from drain-pipe to Belleek china, two tile companies, and several brick-yards comprise an industry which gives the northeast portion of the city (old Millham) the name Staffordshire of America. Iron and steel works, woolen-mills, flouring-mills, rubber and oilcloth works, and a large brewery are other representative establishments. Here also are located the great wire-works of the Roeblings, famous as the builders of the East river bridge between New York and Brooklyn.

*History.*—Trenton's site attracted settlers as early as 1679, when the place was called "Yᵉ ffalles of yᵉ De La Ware." It took its name from the rifts of rock in front of the town. Mahlon Stacy and other members of the Society of Friends purchased land, and Stacy built on the Assanpink in 1680 the second flour-mill in West Jersey. About 1715 Judge Trent bought a large plantation, and the place came to be called Trent Town (Trenton). A royal charter created Trenton a borough town about the middle of the eighteenth century, but the plan was soon abandoned. The Legislature frequently met here before Trenton became the State capital (1790). In 1792 the town was incorporated. The Continental Congress once met here after the Revolutionary war, and a project to have Trenton made the capital of the U. S. was defeated by State jealousies. Trenton is best known to history as the place where that battle was fought which perhaps turned the tide of the Revolution. On the morning of Dec. 25, 1776, Washington, with about 2,500 men, crossed the Delaware from Pennsylvania about 8 miles above Trenton, and after a forced march surprised Col. Rall, the Hessian commander, and captured his entire force. This event was followed by the battle of Princeton Jan. 3, 1777. A shaft costing $75,000, standing in Monument Park at the old Five Points, commemorates the event. A statue of Washington in the posture of directing his forces at Trenton surmounts the shaft. Previous to 1890 the township of Millham and Chambersburg borough were annexed, forming the eighth, ninth, tenth, and eleventh wards of the city. Pop. (1880) 29,910; (1890) 57,458; (1895) 62,518; (1900) 73,307.

FRANCIS BAZLEY LEE.

**Trenton**: city; capital of Gibson co., Tenn.; on the Mobile and Ohio Railroad; 32 miles N. by W. of Jackson, and 59 miles S. of Columbus, Ky. (for location, see map of Tennessee, ref. 6–B). It is in an agricultural region, and has 8 churches, Peabody High School, Laneview Academy, electric lights, 2 State banks (combined capital $83,000), 3 weekly papers, an extensive cotton-mill, 2 large roller flour-mills, cottonseed-oil mills, several foundries, and a box-factory. Pop. (1880) 1,383; (1890) 1,693; (1900) 2,328.

EDITOR OF "GIBSON COUNTY DEMOCRAT."

**Trenton Falls**: a series of falls and rapids in Trenton township, Oneida co., N. Y.; on the West Canada creek, a branch of the Mohawk river; on the N. Y. Cent. and Hud. Riv. and the Rome, Water. and Ogdens. railways; 17 miles N. by W. of Utica (for location, see map of New York, ref. 4–H). The stream flows through a ravine or chasm in the Trenton limestone from 70 to 200 feet deep, and the water has a descent of 312 feet in a distance of 2 miles by several falls, the most notable of which are Sherman's, 35 feet; High, 80 feet; Milldam, 15 feet; and Prospect, 20 feet. The surrounding scenery is remarkably wild, and the clearly defined stratification of the rocks affords an interesting study. The locality has many other attractions, such as the Alhambra amphitheater and the Rocky Heart, and is a place of popular resort.

**Trenton Group**: a division of the rocks deposited during the Lower Silurian period, and named from Trenton, N. Y., where they were first studied. The terrane is composed principally of limestone, and forms the surface over large areas in the U. S. and Southern Canada. In New York it is about 100 feet thick, and increases to 2,000 in Pennsylvania, but becomes thinner southward along the Appalachians. It has also a broad development in the upper Mississippi valley, where the average thickness is 300 feet. The subdivisions or stages usually recognized are the Trenton, Utica, and Cincinnati. Invertebrate marine fossils abound. It is from the Trenton limestone in Ohio that most of the petroleum of that State is obtained. ISRAEL C. RUSSELL.

**Trepang**: See BÊCHE-DE-MER and HOLOTHURIANS.

**Trephining**, or **Trepanning** [*trephining* is from Fr. *tréphine*, a trephine, an arbitrary deriv. of *trépan*, trepan; *trepanning* is from O. Fr. *trepaner*, to trepan, deriv. of *trepan*, a trepan < Late Lat. *tre'panum*, from Gr. τρύπανον, borer, auger, trepan, deriv. of τρυπᾶν, bore]: the surgical procedure of removing a "button of bone," or circular section of bone, by means of the circular instrument known as the trepan or trephine. The cutting part consists of a circular saw-toothed edge, different sizes having diameters of half an inch to two inches, the older instruments having a vertical body and smooth sides, the more modern having a slightly conical body and burred, cutting sides. The old instrument, the trepan, was worked by a wimble or curved auger-handle; the modern, the trephine, has a short handle with crossbar like a gimlet, and is worked by one hand. A center-pin is provided, which acts as a pivot upon which the sawing edge can revolve; this pin is to be raised after the saw has entered the bone. The trephine is used chiefly upon the skull, although sometimes employed in other parts to evacuate pus in bony cavities, as of the face, the ends and shafts of long bones. Trephining the skull was heroically and recklessly practiced by the ancients, and especially by empirics, for every fancied brain disease; often at several points, and many times upon the same person. Modern surgery limits it to cases of fracture of the skull, where bone is depressed or symptoms of intracranial irritation are present; to the removal of clots from the surface of the brain; to the exposure of the brain to facilitate the removal of tumors or cicatrices from that organ; and to the evacuation of pus which has formed within the cranium, either the result of injuries and disease of the skull or of acute cerebral abscess. The trephine by its conical shape and rough sides is protected from cutting the brain. As soon as the inner table of the skull is cut through, the button of bone is pried out or removed by forceps, and the edges of the circular opening are cleared of all spiculæ of bone. The depressed bone is then elevated by means of a lever, clots are washed out, or the abscess is incised, etc., care being taken never to cut into the great venous sinuses. Trephining is more often performed for the relief of cerebral abscess or tumor than formerly, since modern diagnosis of the site of brain lesions is more definite. But for the relief of depressed bone in fractures of the skull it is less often resorted to. Hey's saw, or "rongeur" forceps, obviates the necessity of trephining in many cases. By these instruments the points and angles of bone may be removed, and a place of entrance for the lever or "elevator" secured, without the loss of sound bone, which the trephine involves. Revised by JOHN ASHHURST, Jr.


FIG. 1.—The trephine.

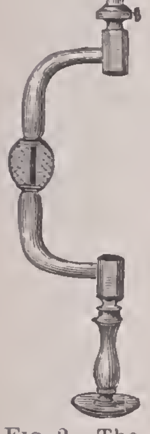


FIG. 2.—The ancient trepan.


FIG. 3.—Hey's saw.

**Trescot**, WILLIAM HENRY: diplomatist; b. in Charleston, S. C., Nov. 10, 1822; graduated at the College of Charleston 1840; admitted to the bar 1843; U. S. secretary of legation in London 1852–53, and Assistant-Secretary of State of the U. S. 1857–60; elected to State Legislature, South Carolina, 1862, 1864, 1866; in 1877 appointed counsel for the U. S. on the fishery commission at Halifax, N. S.; in 1880 one of the plenipotentiaries to China to revise the treaties with that country; in 1881 continued and concluded the negotiations with the Colombian minister, and the protocol in reference to the rights of the U. S. on the Isthmus of Panama; in same year became special envoy extraordinary and minister plenipotentiary of U. S. to Chili, Peru, and Bolivia; in 1882 plenipotentiary with Gen. Grant to negotiate a commercial treaty with Mexico; afterward practiced law in Washington, D. C.; author of several works, including *The Diplomatic History of the Administrations of Washington and Adams* (Boston, 1857). D. May 4, 1898.



**Trespass** [from O. Fr. *trespas*, deriv. of *trespasser*, pass over, transgress, die; *tres-* ( < Lat. *trans*, over, beyond) + *passer*, pass]: in law, a species of tort, consisting in an unlawful act done to the person or property of another by means of direct violence, actual or constructive. The essential feature of this delict in legal contemplation is the direct violence, which may be actual, as in the case of an assault and battery, or constructive, as in the case of an unauthorized entry upon the land of another, and doing thereby mere nominal damage. This notion was expressed in the common-law pleading by the necessary allegation that the act was committed *vi et armis*. The amount of force used, the intent, and the extent of the injury done are immaterial elements in constituting the tort, and only affect the damages recovered. Trespasses are separated into three classes—to person, to personal property, and to real property. The principal trespasses to the person are ASSAULT AND BATTERY and FALSE IMPRISONMENT (*qq. v.*). Trespass to personal property may consist either in forcible direct injury to the chattel, or in taking and carrying it away from the custody of its owner. Trespass to real property is an unlawful entry upon the land of another—in the old legal language, "the breaking and entering another's close." The damages may be aggravated by wrongful acts done on the land, but such acts do not form the gist of this species of tort. The commission of a legal act in an illegal manner may be a trespass, as the abuse or wrongful execution of process by an officer, and the like. It is a general doctrine of the law that if one begins to do a legal act in a proper manner, and then in its further prosecution is guilty of wrongs which amount to a trespass, he thereby becomes a trespasser from the beginning (*ab initio*). The remedy in all cases of this tort is the recovery of compensatory damages by the injured party; and if the wrong was willful, malicious, and without excusing circumstances, exemplary or punitive damages may be added by the jury.

The term "trespass" is also the name of the common-law form of action which must be used to recover damages from the wrongdoer when the delict complained of is a trespass. Revised by F. M. BURDICK.

**Trevel'yan**, Sir CHARLES EDWARD: statesman; b. in England, Apr. 2, 1807; entered the civil service of the East India Company; was employed in important posts; made to the viceregal government at Calcutta elaborate reports on various subjects, one of which led to the abolition of some oppressive imposts; secured the aid of the government to the promotion of European literature and science among the natives of India; in 1840 was appointed assistant secretary to the treasury; was knighted in 1848 for services in connection with the Irish famine; was instrumental in the revision of the civil establishment and in throwing open the civil service to competition. As finance minister in India, 1862–65, he made reforms in the system of accounts, and cooperated in the immense extension given at that time to public works; on his return resumed his efforts to secure the abolition of the system of purchasing commissions in the army, which system he had long opposed; was created a baronet 1874, and took a leading part in several important charities. Among other works he wrote *Education of the People of Ireland* (1838); *The Irish Crisis* (1848); *The Purchase System in the British Army* (2d ed. 1867); *The British Army in 1868* (1869); *Christianity and Hinduism* (1881). D. in London, England, June 19, 1886.

**Trevelyan**, Sir GEORGE OTTO: statesman and author; son of Sir Charles Edward; b. July 20, 1838, at Rothley Temple, Leicestershire, England; educated at Harrow School and Trinity College, Cambridge; entered the East Indian civil service; returned from India, and was elected to Parliament from Tynemouth as a Liberal 1865; became civil lord of the admiralty under Mr. Gladstone's second administration Dec., 1868, but resigned office July, 1870, being opposed to the Government Education Bill. He was secretary for Scotland 1885-86, and held that office again from 1892 to 1895. Among his writings are *Letters of a Competition Wallah*, republished from *Macmillan's Magazine* (1864); *Cawnpore* (1865); *The Ladies in Parliament, and other Pieces* (1869); *The Life of Lord Macaulay* (2 vols., 1876; 2d ed. 1877); *The Early History of Charles James Fox* (1880).

**Treves**, treevz (Germ. *Trier*): town of Rhenish Prussia, 69 miles by rail S. W. of Coblenz; on the right bank of the Moselle, beautifully situated among the vineclad hills of that river (see map of German Empire, ref. 6-C). It has a cathedral, chiefly of the eleventh century, containing among its relics the famous HOLY COAT OF TREVES (*q. v.*); a church dedicated to the Virgin dating from the thirteenth century (Liebfrauen Kirche), and other ecclesiastical buildings; a library containing 100,000 volumes, a hospital, manufactures of woolens, cottons, and linens, and a large trade in timber, grain, and wine. The Moselle is here crossed by an eight-arched bridge, 623 feet long. Treves is the most ancient city of Germany (a fabulous Latin inscription on the wall of the Rothe Haus says it was built *before Rome*). The Emperor Augustus established here a Roman colony under the name of *Augusta Trevirorum*. In later days it was the residence of the Emperors Constantius, Constantine, Julian, Valentinian, Gratian, and Theodorus, and if not—as Ravenna was a little time afterward—the head of the Western world, at least the head of all the lands beyond the Alps. Almost annihilated during the subsequent barbarian invasions, it rose under the archbishops of Treves to nearly its earlier splendor. It is now a decayed town, but one of high antiquarian interest from its numerous Roman remains. Pop. (1890) 36,166. Revised by M. W. HARRINGTON.

**Treviso**, trā-vee'sō (anc. *Tauri'sium*, or *Tarvi'sium*): town; province of Treviso, Italy; on the Sile; 17 miles N. of Venice by rail, in a very fertile region (see map of Italy, ref. 2–D). It is an agricultural town, and a center for the silk industry, besides manufacturing hardware, paper, and other articles. The cathedral is an imposing building, the five cupolas producing a grand effect, and in its interior, as well as in that of the Church of S. Niccolò di Bari, pictures and sculpture of much merit are preserved. Treviso has a public library, a theater, a chamber of commerce, and several educational institutions. Pop. of commune (1893) 35,200.

**Trev'ithick**, RICHARD: inventor; b. at Illogan, Cornwall, England, Apr. 13, 1771; was brought up to the business of a mechanical engineer in the Cornish mines; constructed several steam-engines, introducing various improvements, one of which was the introduction of wrought-iron cylindrical boilers (see RAILWAYS), but, his engine having blown up, popular prejudice was aroused and the practical use of the invention postponed for many years. Trevithick devoted himself anew to engineering work in the Cornish mines, continually inventing and making improvements in machinery; sent to Peru in 1814 nine of his small high-pressure condensing engines, for use in some mines in which he acquired an interest; went thither himself in 1816 as directing engineer; returned to England 1827; resumed operations as an engineer; made various inventions and mechanical improvements of widely different kinds, including warming apparatus, iron stowage-tanks, iron buoys, a gun-carriage for single-decked ships, a furnace for purifying silver ores, an hydraulic engine, a salt-water distilling apparatus, and floating docks, some of which were patented by him. D. at Dartford, Kent, Apr. 22, 1833.

**Trev'or**, GEORGE, D. D.: clergyman and author; b. in England in 1809; graduated at Oxford 1836; chaplain on the Madras establishment 1836–45; became chaplain to the high sheriff of Yorkshire, rector of All Saints, York, and canon of York minster 1847; was elected chaplain of the parish church at Sheffield 1850, but was refused induction by the vicar, a proceeding which led to suits in chancery and in the court of queen's bench, in which he was successful; became rector of Burton Pidsea 1868, was the most active promoter of the revival of the house of convocation for the archdiocese of York, in which body he was actuary of the lower house and synodal secretary to the two houses, and was in 1871 collated to the rectory of Beeford-with-Lisset, near Hull. He published a number of works, including *Christ in his Passion* (1847); *Sermons on Doctrines and Means of Grace* (1851); *Origin, Constitution, and Form of Proceedings in the Convocation of the Two Provinces of Canterbury and York* (1852); *The Catholic Doctrine of the Sacrifice and Participation of the Holy Eucharist* (1869); *India, its Natives and Missions* (1862); *Russia, Ancient and Modern* (1862); *Egypt from the Conquest of Alexander to Napoleon* 1866); and *Rome from the Fall of the Western Empire* (1869). D. June 18, 1888.

**Trevor**, Sir JOHN: politician; b. at Brynkinallt, Denbighshire, Wales, about 1633; was a cousin of Chancellor Jeffreys, by whom he was favored in his professional career; was elected to Parliament 1679; chosen Speaker of the new House of Commons May, 1685; became master of the rolls Oct. 20, 1685; sworn of the privy council July 6, 1688; was dismissed from office by William and Mary; was an energetic opponent of the Government in the Convention Parliament 1689, but soon made his peace with the court, with the consent of which he was unanimously elected Speaker Mar. 20, 1690; was intrusted by the Government with the task of conciliating political opponents by means of promises and rewards; made first commissioner of the great seal May 14, 1690; restored to the office of master of the rolls Jan., 1693; reported by a parliamentary committee guilty of bribery Mar. 12, 1695, and by vote of the House, to which he himself as presiding officer had to put the question, was declared guilty of a high crime and misdemeanor; resigned the speakership, and was a few days later formally expelled. He retained, however, the position of master of the rolls for the rest of his life, more than twenty-two years, and seems to have filled that office without reproach, his decisions being still quoted with respect. D. May 20, 1717, and was buried in the Rolls' Chapel.—He must not be confounded with his cousin and contemporary, Sir JOHN TREVOR (1626–72), who was envoy to France and Secretary of State under Charles II., and son-in-law to the celebrated Hampden.

**Triacan'thidæ** [Mod. Lat., named from *Triacan'thus*, the typical genus; Gr. τρεῖς, τρία, three + ἄκανθα, thorn, spine]: a family of teleost fishes of the order *Plectognathi* and sub-order *Scleroderma*, and the most fish-like of the order. The skin covered with small, rough, closely adherent scales; the head compressed and conical in profile; the eyes lateral; the opercular bones comparatively well developed; the mouth small and terminal; the upper jaw has its elements very imperfectly united; teeth are developed on the jaws in variable form; the branchial apertures are narrow slits in front of the pectoral fins; the branchiostegal rays are completely concealed; the dorsal fins are two in number—(1) spinous, with from four to six spines, and (2) an oblong soft one; ventral fins represented mostly by a pair of strong spines articulated with a long and compressed pelvic bone; the air-bladder is closed and simple. The family is composed of three well-marked genera—(1) *Triacanthus*, confined to the Indian and Australian seas; (2) *Triacanthodes*, of which a single species only has been found in Japan; and (3) *Hollardia*, one species of which has been found in Cuba. Revised by E. A. BIRGE.

**Triad** [from Gr. τριάς, τριάδος, the number three, a three of anything, trio]: in music, a chord consisting of a bass or root, with a third or fifth. See HARMONY and MUSIC.

**Trial** [from O. Fr. *trial*, deriv. of *trier*, try < Lat. **tritare*, frequentative of *te'rere*, rub]: the formal judicial examination and decision of the issues, whether of law or fact, pending between the parties to an action, preliminary to the judgment which finally determines the rights and liabilities of the litigants. For convenience, forensic trials in the U. S. may be divided into three generic classes—the trial of (1) legal actions, (2) equity suits, (3) admiralty causes.

*Legal Actions.*—Though formerly all legal actions were ordinarily tried before a jury, recent legislation, both in England and the U. S., has provided that by the consent of the parties, and in some cases without their consent, the jury may be dispensed with and the issues submitted to the court or to a referee; but since the only difference between the proceedings before a court or referee and those before a jury is that in a jury trial there are certain additional details, viz., the selection of the jurors, the judge's charge to them, and their verdict, these three modes of trial (before a jury, judge, or referee) may be described together.

The first step in the proceeding, after a cause has been called and is ready for trial, is (in a jury trial) the drawing and impaneling of a jury, the members of which must be taken, as a general rule, from men who have their domicile within the county where the court sits. From all the names of the jurors, written upon slips of paper and deposited in a box, the clerk draws at random the names of twelve who are to act in the particular case. As each one is announced, either party may challenge the person and proceed to ascertain whether for any reason he is incompetent to sit as a juror in that cause, the qualifications for jury duty being usually fixed by statute and referring to residence, political status, prejudice or liability to bias, mental condition, property, etc.; and a stricter rule of qualification is applied in criminal than civil cases. Besides such challenges for cause, in criminal trials the accused, and in many States the prosecution, are allowed a certain number of peremptory challenges; that is, they may exclude a certain number of the jurors drawn without giving any reason therefor; and a smaller number of peremptory challenges are in some States allowed to the parties to a civil action.

When the twelve men have been obtained they are sworn by the clerk to render a true verdict according to law and the evidence given; and this brings the proceedings to their second stage, which consists of the production of the proofs in the presence of the jury. The counsel for the party holding the affirmative, who is almost always the plaintiff, briefly explains the nature of his client's claim, and examines his witnesses, who are then cross-examined by his opponent, and sometimes re-examined directly. The opposite party then proceeds in the same manner to state and prove his version of the case. At the close of the plaintiff's evidence the defendant may move for a non-suit; and if in the opinion of the court no cause for action has been shown, even assuming the truth of all the facts stated by the witnesses, the motion will be granted and the case at once dismissed. On the other hand, a verdict may be directed for the plaintiff if his right to it clearly appears from uncontradicted proof, but this seldom happens, there being usually a conflict of evidence which must be submitted to the judgment of a jury. The court entirely regulates the admission of evidence, and either party may except to its rulings of what facts are competent and what are not competent, to be proved, and what questions are proper and what improper, and the points of law thus raised are examined upon appeal.

When the evidence is all in, the counsel address the jury on behalf of their respective clients. The order of these addresses varies in the different States, but, as a general rule, the party holding the affirmative closes and sometimes also opens the argument, though in some States the right of closing in criminal cases is given to the accused. Next comes the judge's charge to the jury. This charge is in many States restricted by statute to a simple statement of the legal rules, and in several of them it must be in writing; but at common law the judge may comment upon the facts, and, as it has been held, may even express an opinion, provided the jury is left free to decide. Either party may request particular instructions to be given, and may except to the charge, or a portion thereof, or to a refusal to charge as requested, such exceptions presenting questions of law for review by the appellate court.

After they have been charged, the jury retire to a private room to determine upon their verdict, which must be unanimous. After the jurors have retired to consider their verdict, they are not allowed to separate till it is found and delivered in open court, except in some cases after the finding of a sealed verdict. When they have agreed, they return into court, announce their verdict, and it is recorded by the clerk in his minutes. If they can not agree upon a verdict the court may, in most cases, at least, dismiss them after a reasonable time. If at any time in the trial of a cause it becomes necessary to discharge a jury because of the serious illness or the insanity of one of its members, or because the jury can not agree upon a verdict, the discharge has been held, in the majority of cases, not to constitute a bar to a second prosecution. When the trial is before the court or a referee, instead of a verdict, a written find is filed by the judge or referee containing his conclusions of fact and of law.

The general rules of evidence are the same in criminal as civil cases, i. e. the best evidence must be given. The court decides as to the admissibility of evidence, but it is the peculiar province of the jury to pass upon the weight of evidence and the creditibility of witnesses. See EVIDENCE.

*Equity Suits.*—The original practice in chancery was for witnesses to be examined privately, without the presence of counsel, by an examiner or one or more commissioners appointed by the court. The examination was conducted by means of written interrogatories and cross-interrogatories, prepared by the counsel for the respective parties, or by the court itself, and the testimony was kept secret till all the witnesses had been examined. The reading of the depositions thus obtained, and of the pleadings, together with the arguments of counsel, constituted the trial, and the chancellor then gave his decision as suited his convenience. The great objection to this practice was that till publication of the testimony each party was left in ignorance of what facts his opponent would attempt to establish, so that, although it is still retained by a few States, in most of them the methods and proceedings in the trial of an equity suit have been made the same as those in a legal action before a judge or referee. The testimony of witnesses is reduced to writing, and an accurate transcript of all proceedings preserved by means of official stenographers, who are now generally employed in the superior courts both of the U. S. and of England.

*Admiralty Causes.*—The usual practice in the trial of civil causes in admiralty is very much like that which originally prevailed in equity, the evidence being taken by the clerk, and the court merely hearing the case summed up; but in some States of the U. S. the testimony is taken in open court. The common-law rules of evidence do not apply. In admiralty, trial by jury is not a right unless expressly given by statute; but when it is so given, and in criminal cases within the jurisdiction of admiralty, the same forms are employed as in a jury trial in legal actions. In the U. S. the federal courts alone have jurisdiction of admiralty cases. See the articles on PROCEDURE, PRACTICE, ADMIRALTY, EQUITY, COURTS, and JURISPRUDENCE; and also the treatises on practice by Chitly and Daniell, and John W. Smith's *Elementary View of the Proceedings in an Action at Law*; Stephen's *History of the Criminal Law of England.* Revised by F. STURGES ALLEN.

**Triangle** [viâ O. Fr. from Lat. *trian'gulum*, triangle, liter., neut. of *trian'gulus*, three-cornered; *tres*, three + *an'gulus*, angle, corner]: a surface bounded by three sides, and consequently having three angles. A triangle may be *plane*, *spherical*, or *spheroidal*.

*Plane Triangles.*—A plane triangle is a plane surface bounded by three straight lines. These lines are called *sides*, and the points at which the sides meet are called *vertices* of the triangle. Plane triangles may be classified either with respect to their sides or with respect to their angles. When classified with respect to their sides, we have—(1) *scalene* triangles, in which no two sides are equal; and (2) *isosceles* triangles, in which two of the sides are equal; the *equilateral* triangle is a particular case of the isosceles triangle in which all of the sides are equal. When classified with respect to angles, we have—(1) *right-angled* triangles, which have one right angle; and (2) *oblique-angled* triangles, in which all of the angles are oblique; triangles of the latter class may be *acute-angled* triangles, all of whose angles are acute, or *obtuse-angled* triangles, each of which has one obtuse angle. The sides and the angles of a triangle are called *elements*; the side on which it is supposed to stand is termed the *base*; and the vertex of the opposite angle is then called a *vertex* of the triangle; the distance from the vertex to the base is the *altitude* of the triangle. The area of a triangle is equal to the product of its base by half its altitude.

*Spherical Triangles.*—A spherical triangle is a spherical surface bounded by arcs of three great circles. These arcs are called *sides*, and the points at which the sides meet are *vertices*. The diedral angles between the planes of the sides are the angles of the triangles. In most cases of practice the sides of the triangles considered are supposed to be less than semicircles. Spherical triangles are classified in the same manner as plane triangles, and corresponding parts receive corresponding names. There is, however, this difference: a spherical triangle may have two right angles, or it may have three right angles; it may even have three obtuse angles. In addition to the terms common to both plane and spherical triangles, we may add the following, peculiar to the latter class: Two spherical triangles are *polar* when the vertices of each are poles of the sides of the other; in this case any element of either is the supplement of the opposite element of the other. A *quadrantal* triangle is one in which one side at least is a *quadrant*. The following are some of the properties of spherical triangles: (1) The greater of two sides lies opposite the greater of the two opposite angles, and conversely; if two sides are equal, their opposite angles are equal, and conversely. (2) Any side is less than the sum of the other two, and greater than their difference. (3) The sum of the three angles may have any value between two right angles and six right angles. (4) The difference of any two sides is less than two right angles, and the sum of the three sides is less than four right angles. (5) The sum of any two angles is greater than the supplement of the third. (6) If the sum of any two sides is equal to two quadrants, the sum of their opposite angles is equal to two right angles, and conversely. (7) If the angles are all acute, each of the sides is less than a quadrant; if the angles are all obtuse, each of the sides is greater than a quadrant; if the angles are all right angles, each side is a quadrant. (8) The area of a spherical triangle is equal to its spherical excess multiplied by the square of the radius of the sphere; the spherical excess is found by subtracting 180° from the sum of the three angles; the area of the trirectangular triangle is equal to one-half of a great circle. See TRIGONOMETRY. Revised by S. NEWCOMB.

**Triangle of Forces**: a modification of the parallelogram or polygon of forces from which it may be stated that "if three forces in one plane be in equilibrium about a point, and if on that plane any three mutually intersecting lines be drawn parallel to the directions of the three forces, a triangle will be formed, the lengths of whose sides will be proportional to the magnitude of the forces."

**Triangular Numbers**: See FIGURATE NUMBERS.

**Triangula'tion**: the operation of determining the relative positions of points by means of measured base-lines and angles. A precise triangulation is essential for the accuracy of a survey covering a large area. The base-line, which is rarely more than 10 miles long, is measured with great precision by a special apparatus. This is connected through a series of triangles with the stations whose positions are to be determined, and all the angles being carefully measured, the data are at hand for computing the distances, directions, and differences o. latitude and longitude.

Although the determination of distances by triangles was known to the ancients, it was not until 1617 that the possibility of an extended accurate triangulation from a short measured base was demonstrated. This was done in 1617 by Snellius, who measured such a base at Speyer in Germany. Many triangulations were made during the seventeenth and eighteenth centuries for the purpose of measuring the length of a degree and the size of the earth; those made in Lapland in 1736 and in Peru in 1740 decided that the shape of the earth was that of an oblate spheroid. Near the end of the eighteenth century a triangulation in France and Spain was undertaken for the purpose of finding an accurate value of the length of the earth's quadrant in order that the meter might be made one $\frac{1}{10000000}$th part of this length. During the nineteenth century triangulations have been carried on in all civilized countries for the location of stations for topographical surveys, and also incidentally for the determination of the figure of the earth. Central Europe is covered with a network of triangles, while many long series exist in India and the U. S.

Besides the measurement of base-lines and of angles, triangulation involves the astronomical operations for finding the azimuths of lines and the latitudes and longitudes of stations. These being observed at a few points, those of the others are computed from the angles and distances. See COAST AND GEODETIC SURVEY, and GEODESY.

MANSFIELD MERRIMAN.

**Trias'sic Period**: the division of geologic time following the Carboniferous and preceding the Jurassic. The name originated in Germany, and records the fact that German formations of that date were grouped in three series. These are the Bunter sandstone below, the Muschelkalk, and the Keuper marls above. Modern usage adds the overlying Rhetic clays and sandstones. Formations of this age are extensively developed in Europe and Asia, and are less confidently correlated in Africa, New Zealand, and Australia. The Newark sandstone of the eastern part of the U. S. is probably Triassic, and the red beds of the Rocky Mountain region are with much doubt referred to the same period. On account of the difficulty of classifying the American Mesozoic formations according to European standards, and especially the difficulty of distinguishing Triassic formations from Jurassic, the U. S. Geological Survey, in the publication of its atlas of the U. S., substitutes a single period, the Jura-Trias, for the Triassic and Jurassic periods of the European chronology. See JURA-TRIAS PERIOD, and for the flora of this period, PLANTS, FOSSIL. G. K. GILBERT.

**Tribe** [Lat. *tribus*]: originally a third part of the Roman people—one of the three tribes that founded the city of Rome; hence in historical literature a name for a subdivision of a nation or stock not yet organized as a civil state; hence, further, in sociology and ethnology a name for any union of hordes or clans which is a subdivision of a folk.

*Clan, Tribe, and Nation.*—No ethnographic term has been more often used in the pages of historians, travelers, and missionaries than "tribe," and none has been used more unintelligently. As a rule, it is almost impossible to determine whether a writer means by "tribe" a horde, a village, a clan or gens, or a nation. A horde is an aggregation of four or five to twenty or thirty simple families—each family consisting of father, mother, and children. The horde is found only among the lowest savages, such as the Australian Blackfellows, the Bushmen of South Africa, the Fuegians at the southern extremity of South America, and the Arctic Highlanders of Northern Greenland, or as a degenerate form in civil communities. It has no political organization. A totem-kin (see TOTEMISM), clan, or gens, is a group of real or nominal kindred, claiming descent from a common ancestor, and tracing relationship through mother names (metronymic) or through father names (patronymic), but never through both, and usually forbidding marriages between men and women of the same gentile name. A phratry is a union or brotherhood of clans which is not an independent tribe, but only a subdivision of one. A tribe is a union of hordes under the leadership of a chief for common defense or common aggression, or it is a similar union of clans or of phratries. A tribe always claims a certain territorial region as its domain. A nation, in the ethnic as distinguished from the civic sense of the word, is a federation of tribes which speak dialects of a common language, which have a common culture, and which are crossed by the same clan lines. The nation is essentially a political organization; the tribe is essentially a military organization; the phratry is a religious organization; the clan or gens is a juridical organization; the family is an economic organization.

*Savage and Barbarous Tribes.*—The lowest Australian hordes are loosely united in tribes that number 200 or 300 each. In the more advanced Australian tribes hordes and tribes are crossed by elaborate totemistic kinships.

The North American Indians afford the finest examples of metronymic tribal organization. The Seneca tribe of the Iroquois, for example, was constituted of eight totem-kins, namely, Wolf, Bear, Turtle, Beaver, Deer, Snipe, Heron, Hawk. The Cayuga tribe was constituted of the same eight totem-kins, with the exception of the Eel in place of the Heron. The Onondagas had the same totem-kins as the Cayugas, except the Ball in place of the Hawk. The Oneidas had the Wolf, Bear, and Turtle totem-kins, and the Mohawks had the same as the Oneidas. These five tribes, mistakenly called the Five Nations by historians, were the famous Iroquois confederation, or nation. Each totem-kin religiously maintained the following rights and obligations, namely: The right to elect its sachem and chiefs—women shared in the election; the right of deposing its sachem and chiefs; the obligation not to marry in the totem-kin; mutual rights of inheritance of the property of deceased members; reciprocal obligations of help, defense, and redress of injuries; the right of bestowing names upon its members; rights in a common burial-place. The totem-kin regulated its affairs through a council. The affairs of the tribe were governed by a council of chiefs. As a rule, each tribe occupied more than one village. A similar organization, but patronymic in its relationships, may be studied at the present time among the Wyandottes and among the Omahas.

In patronymic society, where the wife follows the residence of the husband, the clan may become easily identified with a local group, and there is always a probability, therefore, that the hasty observer of patronymic communities has confounded the village with the clan or with the tribe. The local group, nevertheless, upon examination may turn out to be a subdivision of a clan or a cluster of clans, or even a cluster of tribes. All of these forms may be studied among the Semites of the Arabian desert, among the Ostyaks inhabiting the dreary northern country along the banks of the Obi and its tributaries, and elsewhere in Asia and in Africa.

*Historical Tribes.*—Tribes that history represents as descended from an eponymous ancestor were seldom so in fact. More often they were confederations compacted by war. W. Robertson Smith's studies (*Kinship in Arabia*) have shown how artificial were the Arabian and Hebrew genealogies. Artificial, too, was the division of the Hebrews into twelve tribes, of the Athenians into ten tribes. The clans of the Hebrew tribes are designated in the English translation of the Old Testament as "houses" (e. g. Numbers i. 2, 4; Joshua xxii. 14). The organization of the Grecian φυλή and of the Roman tribe, of the Grecian φράτρα and of the Roman curia, of the Grecian γένος and of the Roman gens, were, in essential respects, like those of the tribe, phratry, and clan among uncivilized peoples to-day. The tribal organization of the ancient Irish, as revealed in the Brehon laws, was not less elaborate. The Tuath or Cinel was the tribe, occupying a defined territory, and paying homage to its flaith or chief, sometimes called a king. The Sept was the true clan or gens, though the name *clann* was often applied to the Tuath. The Fine was a sub-clan closely resembling the compound patriarchal family, or "house," that still survives in Slavonic communities. The tribal organization of the Germanic stock has never been satisfactorily made out. The one thing certain is that the so-called seven great tribes—namely, the Swabians, Frisians, Saxons, Alemanni, Franks, Thuringians, and Bavarians—were not tribes, but nations. Each was subdivided into tribes, which, in turn, were subdivided into clans.

*Tribal and Civil Divisions.*—The substitution of territorial subdivisions for tribal lines, and therewith the transition from gentile to civil societies, was brought about, after tribes had settled down to a permanent agricultural life, by the intrusion of men whose ties of kinship had been broken, and whom it was necessary to include in the military and tax-paying population. The transition was marked in the Athenian commonwealth by the institution of the local tribe. The subdivision of the local tribe into demes roughly followed the subdivision of the tribe into gentes. It is probable that English counties correspond roughly to Saxon tribal domains and hamlets to clan settlements. See SOCIOLOGY.

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FRANKLIN H. GIDDINGS.

**Tribonia'nus**: b. at Side, Paphlagonia; quæstor, consul, and master of the offices to Justinian, who in 528 appointed him one of the ten commissioners to form the first *Codex*, in 530 as president of the sixteen lawyers commissioned to compile the *Digest* or *Pandects*, and in 532 one of the three to edit the *Institutes*. He is described as a learned and highly gifted man, but avaricious and of low moral standing. It is hardly possible to form any estimate of the services of Tribonianus as distinct from those of the other commissioners. He had the superintendence of the *Digest*, and may have taken the chief part not only in gathering and sifting the materials, but also in forming the plan. D. about 545.

Revised by M. WARREN.

**Tribune** [from O. Fr. *tribun* < Lat. *tribu'nus*, tribune; liter., chief of a tribe; deriv. of *tri'bus*, tribe]: a person holding any one of several different Roman offices.

1. The military tribunes (*tribuni militum*) were officers standing directly under the commander-in-chief and above the centurions. There were six such tribunes in each legion. They were originally appointed by the king, and, in the republic, by the consuls. In the later republic a portion—ultimately the twenty-four tribunes of the four older legions—were annually elected by the people in the assembly of the tribes (*comitia tributa*). Under the kings there was also a special tribune of cavalry (*tribunus celerum*), an officer who reappeared in the republic when a dictatorship was proclaimed, as master of the horse (*magister equitum*).

2. *Consular Tribunes.*—During the conflict between the orders, when the plebeians were agitating for admission to higher offices, the election of consuls was discontinued for a series of years (444 to 367 B. C.). In their stead were annually elected from three to six military tribunes (an office which plebeians had long been capable of filling) with consular powers (*consulari imperio*).

3. The plebeian tribunes (*tribuni plebis*) were the defenders of their order against the patrician magistrates, and its leaders in its long struggle for civil and political equality. When this struggle ended with the complete triumph of the plebeians and their admission to all the higher offices, the tribunate, endeared to the people by service to liberty, continued to exist, representing, however, not the interests of the plebeians only but those of the whole people.

This office, according to the Roman tradition, was established in consequence of the first secession of the plebs (494 B. C.), and it is probable that the first plebeian tribunes were the *tribuni militum* who had led the plebs across the Anio. Later, ten tribunes were annually elected by the plebeians. Their "right of help" (*jus auxilii*) was made effective by giving them a general power of arrest (*jus prensionis*), from which the consuls themselves were not exempt, and, later, a power of fining (*multæ dictio*). Their persons were inviolable; in the early republic he who offered violence to a tribune could be slain without trial. Their right of help, originally exercised in single cases of injustice and oppression, grew into a general right of prohibiting or "vetoing" any action of the magistrates or senate. They also summoned and presided over the councils of the plebs (*concilia tributa*), and when these councils became regular assemblies (*comitia*), with legislative and judicial powers, the tribunes exercised an initiative in legislation and in criminal prosecution—powers theoretically concurrent with those of the regular magistrates who presided over the centuriate assembly (*comitia centuriata*), but actually superior, since measures proposed by a consul or prætor could be vetoed by a tribune, while only a tribune could veto the act of a tribune. In the later republic, accordingly, the most important bills originated with the tribunes, and they regularly took the lead in the prosecution of political offenses. To the end of the republic the tribunes were always chosen from among the plebeians, patricians being legally ineligible; and they usually represented the popular as opposed to the aristocratic party—a fact which induced Sulla to limit their influence. During the social struggles which preceded the downfall of the republic, the powers of the tribunate (restored by Pompey) were utilized to support the dictatorial authority exercised by Pompey himself and other popular leaders; and the *potestas tribunicia* accorded to Augustus and his successors was one of the most important elements of the imperial power. Under the empire, tribunes were still elected, at first by the popular assembly and afterward by the senate, but the office was "an empty shadow and a name without honor" (*Pliny*). At first the tribunes interposed occasional vetoes—at the instance always of the emperor—later they were charged with minor judicial and administrative duties. The name of the office survived as late as the fifth century.

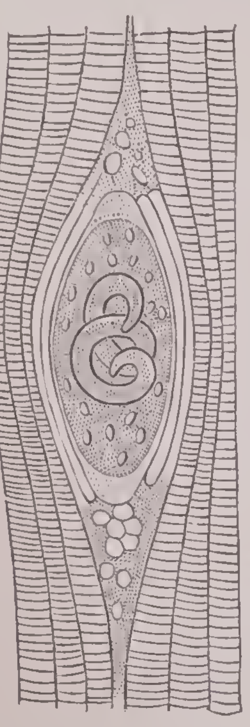
*Mediæval Tribunes.*—The development of the Italian city-republics in the later Middle Ages, and the influence of ancient Roman traditions, occasioned a sporadic reappearance of the title of tribune. It was usually connected, as in the case of Rienzi, with the leadership of the people against the feudal nobles.

MUNROE SMITH.

**Trichechidæ**, trī-kek'i-dē̆e, or **Manat'idæ** [*Trichechidæ* is Mod. Lat., named from *Tri'chechus*, the typical genus; (irreg.) from Gr. θρίξ, τριχός, hair + ἔχειν, have; *Manatidæ* is Mod. Lat., named from *Ma'natus*, another name for the genus, from Span. *manati*, from the Haitian name]: a family of placentiferous mammals of the order *Sirenia*, typified by the manatees of tropical and sub-tropical regions. The form is fish-like and elongate: the skin very thick and rugose; the head naked and depressed, and with a truncated snout; the eyes are very small; the nostrils are close together on the upper surface near the end of the snout, and are simple lunate fissures convex backward; the mouth is small; the molar teeth are typically nine (8–10) in each jaw, each provided with two large tuberculate and two smaller external transverse ridges; they have severally three roots, two on the outer and one on the inner side; incisor teeth wanting in the adult; the pectoral limbs are elongate, and oar-shaped, paddles mostly kept flexed at the elbows; rudimentary nails are developed; the tail is broad, depressed, and somewhat fan-shaped, having a convex border with a median notch or grove. The skull is noteworthy, as distinguishable from that of the other members of the order in that the intermaxillary bones have their branches not prolonged backward, and the anterior portions nearly or quite straight; the last or caudal vertebræ (i. e. $5+x$) are subcylindrical and destitute of transverse processes. Another peculiarity is the possession of only six cervical vertebræ, instead of seven, as in almost all other mammals; the missing one has been regarded by Murie and Chapman as the third. The manatees are found along the coasts of seas and rivers, and live upon the herbage that grows on or near the banks. (See MANATEE.) The name *Trichechidæ* is also used as a synonym of ODOBÆNIDÆ (*q. v.*), in which case the generic name *Trichechus* is considered equivalent to *Odobænus* (walrus) instead of *Manatus*. Revised by F. A. LUCAS.

**Trichi'na** [Mod. Lat., dimin. of Gr. θρίξ, τριχός, a hair]: a genus of parasitic nematode worms, the only species of which (*Trichina spiralis*) has acquired great prominence as, possibly, the most dangerous parasite of man. Its history is rather complicated. Besides man, it inhabits rats, swine, and some other animals. Usually, when found it is in the encysted stage, occurring in the voluntary muscles, inclosed in an ovoid or spindle-shaped capsule or cyst, secreted partly by the parasite, partly formed by the host, in the walls of which are minute particles of carbonate of lime. Inside this capsule occurs the immature worm coiled in a spiral, to which the specific name alludes. The cysts are about $\frac{1}{80}$th of an inch in length and $\frac{1}{100}$th in diameter. The contained worm, when stretched out, is about $\frac{1}{25}$th of an inch in length, cylindrical, and slender. In the cyst it exhibits but slight motion, but its vitality is very great, living worms having been found in man eighteen years after infection. When flesh containing encysted worms is taken into the alimentary canal the flesh and cysts are dissolved by the digestive fluids and the immature worms are set free. In the intestine they rapidly increase in size and attain sexual maturity, the male then measuring 1·5 mm. in length, the female 3 to 3·5 mm. The slender cylindrical body tapers to the anterior end, the posterior end being bluntly rounded. The greater size of the female is due in part to the number of eggs and embryos, a single female giving rise to 1,500 to 2,000 living young. These embryos are very minute, scarcely 0·1 mm. in length. They bore through the intestinal walls and rapidly make their way to the voluntary muscles, either by boring to them or by entering the blood or lymph vessels and by being carried by the circulating fluids. In the muscles they become encysted, as did their parents, and they can not become mature until freed of the cyst by the digestive juices of some animal.

This migration of the young from the intestine to the muscles produces serious and even fatal results in both man and other animals. When the parasites are comparatively few in number recovery usually follows, but when they are numerous severe illness—trichinosis—follows, characterized by many of the symptoms of lead-poisoning. First there are intestinal pains, vomiting, and diarrhœa, then pain in the limbs and muscles accompanied by dropsical swelling. Death may ensue in two days owing to the intestinal disturbances. More frequently it occurs in the fifth or sixth week. If the person survive that period the chances for recovery are increased. In bad cases of infection the number of worms is almost beyond belief, 90,000 having been found in a cubic inch of muscle in the shoulder of a man who died from trichinosis. With man the source of the infection is almost invariably from eating raw or imperfectly cooked pork in which are the encysted worms. It is only the lean meat which is dangerous, as rarely, if ever, are the *Trichinæ* found in the fat. The presence of the cysts in the pork can not be recognized by the naked eye. None of the processes—pickling, smoking, etc.—used for preserving pork serve to kill the parasites, and ham or bacon, unless thoroughly cooked, is as dangerous as fresh pork. In the U. S. cases of trichinosis are comparatively rare, one of the most serious being at Marshalltown, Ia., in 1891, which resulted in several deaths. The worst epidemics on record are those at Hedersleben (1865) and Emersleben (1884), Germany. In the first, in a village of 2,000 inhabitants, 337 were attacked and 101 deaths resulted. At Emersleben 361 cases were traced to one pig, and fifty-seven deaths followed.



A trichina encysted in human muscle (enlarged).

The question arises, how are the swine infected? There is considerable uncertainty upon this point. Examination has shown that pigs fed upon the house offal and the refuse from slaughter-houses are far more apt to be infected than those fed upon corn, and there is not a little evidence which goes to show that rats may play an important part in the process.

Doubtless the disease trichinosis has existed for ages, and probably the observation that the eating of pork was apt to be followed by serious results led to the Levitical prohibition of the flesh of swine as food. The worm was discovered by Richard Owen in 1835. Its connection with the disease was demonstrated in 1860, by Herbst, Zenker, Leuckart, Pagenstecher, and Virchow almost simultaneously. The literature of the subject is large. The most important papers are Pagenstecher's *Die Trichinen* (Leipzig, 1865); Leuckart's *Untersuchungen über Trichina spiralis* (2d ed. Leipzig, 1866), and *Die menschlichen Parasiten* (Leipzig, 1863–66); also numerous papers in the reports of the State boards of health. J. S. KINGSLEY.

**Trichini'asis**, or **Trichino'sis** [Mod. Lat., derivs. of *Trichina*]: a disease induced by eating the trichinous flesh of swine. See TRICHINA.

**Trichinop'oli**: town of British India; capital of the district of Trichinopoli, in the province of Madras; on the Caveri, 56 miles from the sea (see map of S. India, ref. 7–E). It is a very hot place and poorly built, mostly consisting of mud huts, but it is the station of a division of the Madras army, and it has important manufactures of cutlery, jewelry, saddlery, and cheroots; an excellent tobacco is grown in the surrounding district. It is the seat of a Roman Catholic bishopric, and there are missions of several Protestant denominations. It is connected with Madras by rail. Pop. (1891) 90,609.

**Trichiu'ridæ** [Mod. Lat., named from *Trichiu'rus*, the typical genus; Gr. θρίξ, τριχός, a hair + οὐρά, tail]: a family of fishes of the order *Teleocephali* and sub-order *Acanthopteri*, related to the mackerels, but distinguished by the elongated form and the imperfectly developed anal fin. The body is more or less elongated and compressed, and terminates in a slender tail, which sometimes is filiform, but generally capped by a caudal fin; the skin is naked; the lateral line continuous; the head compressed; dorsal fin long, generally single and uninterrupted, sometimes divided into two, with the spinous portion longer than the soft; anal fin represented by numerous almost concealed spines; pectoral fins well developed; ventral fins obsolete, or represented by scale-like spines behind the pectoral region. The skeleton has very numerous vertebræ (e. g. A. 39–43 + C. 57–120). The family is composed of few genera, mostly restricted to the high or deep seas, and comprises three sub-families. (1) *Trichiurinæ*, in which the dorsal fin is undivided, the tail filiform and finless, and the pectorals extended (as usual) toward the upper angles, including the genera *Trichiurus* and *Eupleurogrammus*; (2) *Lepidopodinæ*, in which the dorsal is also entire, but the caudal fin is well developed, and the pectoral fins are produced toward the lower angles, with the genera *Lepidopus* and *Evoxymetopon*; and (3) *Aphanopodinæ*, in which the dorsal is divided. See Gill in *Proc. Acad. Nat. Sci.* (Philadelphia, 1863), pp. 224–229.

Revised by F. A. LUCAS.

**Trichodon'tidæ** [Mod. Lat., named from *Tri'chodon*, the typical genus; θρίξ, τριχός, a hair + ὀδούς, ὀδόντος, tooth]: a family of fishes of the order *Teleocephali* and sub-order *Acanthopteri*. The body is elongated and compressed, and regularly tapers from the head toward the tail; the skin is naked and smooth; the lateral line continuous; the head subquadrate and compressed; the preopercula each armed with five spines; the mouth has a very oblique and lateral cleft; branchiostegal rays five; dorsal fins two, oblong, and of nearly equal length, the first with rather numerous (fourteen) spines, the second with simple branched rays; anal fin very long; caudal separate; pectorals large, and with the lower rays not branched; ventral fins approximated and thoracic, and each with a spine and five rays. The family has been constituted for a single genus (*Trichodon*), which is confined to the western coast of North America.

Revised by F. A. LUCAS.

**Trichome**: See HAIRS and MORPHOLOGY, VEGETABLE.

**Trichomycter'idæ** [Mod. Lat., named from *Trichomycterus*, the typical genus; Gr. θρίξ, τριχός, a hair + μυκτήρ, nostril]: a family of catfishes, containing small species peculiar to South America. The form is long and slender, skin naked, lateral line imperfect, gill covers unarmed or furnished with small prickles; branchiostegal rays eight to twelve. The species range high up in streams on the slopes of the Andes, and many bear a striking resemblance to the loaches of the northern hemisphere. F. A. L.

**Trichonot'idæ** [Mod. Lat., named from *Trichono'tus*, the typical genus; Gr. θρίξ, τριχός, a hair + νῶτον, back]: a family of acanthopterygian fishes containing a few small species peculiar to the East Indian Archipelago and the Australasian seas. The body is long; the scales cycloid and of moderate size; the lateral line continuous; the head depressed and pointed; the eyes directed upward; the opercula unarmed; the upper jaw is longest; teeth are developed in villiform bands on the jaws as well as palate; the branchial apertures are very wide; branchiostegal rays seven; dorsal fin single, long, with articulated but not branched rays, and without a distinct spinous portion; anal fin long; ventrals jugular, each with a spine and five rays; no pyloric appendages; no air-bladder. Two genera have been recognized, *Trichonotus* and *Hemerocœtes*. F. A. LUCAS.

**Trichop'tera** [Mod. Lat.; Gr. θρίξ, τριχός, hair + πτερόν, wing]: that order of insects which contains the caddis-flies or case-flies. The adult insects closely resemble moths, even to the dense clothing of hairs upon the wings, but they differ from these latter in having rudimentary biting rather than sucking mouth-parts. The most interesting, however, are the larval stages. The larvæ are aquatic, and to protect the soft body they build cases by cementing together with silken threads bits of bark, sand, shells, etc., so that a tube is formed in which the animal stays like a hermit-crab in its shell. Each species builds its own type of case. When the time for pupation comes the tube is closed by silken threads. Most of the caddis-flies feed on vegetable matter, but a few are known to be carnivorous. See Hagen, *Synopsis of Neuroptera* (Washington, 1861); McLachlan, *Monographic Revision of Trichoptera* (London, 1874–84). J. S. KINGSLEY.

**Tri'color** [from Fr. *tricolore*, three-colored; Lat. *tres*, three + *color*, color; cf. Fr. *drapeau tricolore*, three-colored flag, tricolor]: the French national flag, colored blue, white, and red in vertical divisions. It was first adopted during the First Revolution, and it is stated (though not generally believed) that the colors of the livery of Philippe, Duke of Orleans (Citizen Égalité), were selected for the national flag. In point of fact, many other national flags are tricolors.

**Tricoupis**, tree-koo'pis, CHARILAOS: statesman; son of Spiridion Tricoupis; b. at Nauplia, Greece, July 23, 1832; educated in Paris and Athens; served in the Greek legation at London 1852–63; was elected deputy from Missolonghi to the Greek chamber in 1863; and was charged with the negotiations concerning the cession of the Ionian islands to Greece. He was made Minister of Foreign Affairs in 1866, and was Prime Minister in 1875, 1878–79, 1882–85, 1886–90, and 1892–95, in the last three changes of government being succeeded by his chief rival, Delyannis. D. at Cannes, Apr. 11, 1896. He was an able orator, a sound financier, and the leading statesman of modern Greece. E. A. G.

**Tricoupis**, SPIRIDION: statesman and author; b. at Missolonghi, Greece, Apr. 20, 1788; studied in France and England; served in the army during the Revolution; was sent as ambassador to London and Paris several times during the reign of King Otho, and continued to participate very actively in public life till his death Feb. 24, 1873. He enjoyed a great reputation as an orator, poet, and historian. His principal work was Ἱστορία τῆς Ἑλληνικῆς Ἐπαναστάσεως (History of the Greek Revolution, 1853–57).

**Trident'ine Profession of Faith** (Lat. *Profes'sio Fid'ei Tridentin'æ*), or the **Creed of Pius IV.**: a clear and concise summary of the doctrines of the Council of Trent, suggested by that council, prepared by a college of cardinals under the supervision of Pope Pius IV., and issued by him Nov. 13, 1564. It consists of twelve articles, including the Nicene Creed, and is put in the form of an individual profession and solemn oath (*profiteor, spondeo, voveo ac juro*). It is binding upon all Roman Catholic priests and public teachers in seminaries, colleges, and universities. It is also used for converts to the Roman Catholic Church, and hence called the Profession of Converts. (For converts from the Greek Church a modified formula was introduced by Pope Gregory XIII. in 1575.) The tenth article reads: "I acknowledge the holy Catholic Apostolic Roman Church as the mother and mistress of all churches, and I promise and swear true obedience to the Bishop of Rome as the successor of St. Peter, prince of the apostles and vicar of Jesus Christ." (See the Latin text in the two papal bulls of Nov. 13 and Dec. 9, 1564, and in Denzinger's *Enchiridion*, pp. 292–294.) A history of this creed was written by Mohnike, *Urkundliche Geschichte der Professio Fidei Tridentinæ* (Greifswald, 1822; Eng. trans. in Schaff's *Creeds*, ii., 96–99). See CREED and ORIGINAL SIN.

**Trid'ymite** [Gr. τρίδυμοι, triplets, or trines, from the crystals being compounds of threes]: an allotropic modification of silica, discovered in 1868 by von Rath in a volcanic porphyry from Cerro San Cristoval in Mexico, and since identified elsewhere. It is hexagonal in crystallization, like quartz, but differs from the latter in possessing double refraction, like calcite, and in having a lower specific gravity (2·2).

**Triest**, tree-est', or **Trieste**, tree-es'te (Slav. *Térst*, anc. *Tergestum*); city of the Austrian empire, and its most important port; on the Gulf of Triest, at the northeast extremity of the Adriatic Sea; 370 miles by rail S. S. W. of Vienna (see map of Austria-Hungary, ref. 8–C). The old town, which mostly consists of narrow and tortuous streets, is built on a steep acclivity, at the foot of which the new town extends along the harbor: between the two parts of the town runs the Corso, a broad, elegant thoroughfare, opening into large squares lined with magnificent edifices and ornamented with fountains and monuments. Ship-building is an important industry. White lead, candles, wax, soap, rosoglio, leather, spirits, and earthenware are extensively manufactured. It is from its commerce, however, that Triest principally derives its importance. Its harbor consisted originally of a safe but small inner port and a rather exposed roadstead; but in 1884 a new and excellent harbor was finished. By running out three piers, 700 feet long and from 250 to 275 feet broad, the old roadstead on the N. E. was transformed into three large inclosures of 85 acres of water-surface and nearly 2 miles of length of quays, protected by a pier 3,600 feet long running parallel with the shore at a distance of 1,000 feet. The value of the annual imports amounts to about $66,000,000, and that of the exports to about $62,000,000. The city has a naval and mercantile academy and a school of navigation, and is the headquarters of the Austrian Lloyds Steam-packet Company, which has magnificent docks and arsenals here. Among the principal exports are grain, rice, wine, oil, flax, hemp, tobacco, silk, iron, lead, copper, and liqueurs. Cotton, cotton goods, dried fruits, etc., are imported. The old town contains a cathedral built between the fifth and fourteenth centuries. Triest was acquired by Austria in 1382. Administratively is a small district of 37 sq. miles, including the city and vicinity, with a population (1890) of 158,344, mostly Italians. Pop. of city, 120,333.

Revised by M. W. HARRINGTON.

**Trifo'rium**, or **Blindstory**: a gallery in a mediæval church above the aisle and opening into the nave, choir, or high central part of the transept corresponding to the nave. The theory of the triforium is that it occupies the space under the sloping penthouse-roof of the aisle and above the vaulting. Such a gallery would be from 8 to 12 feet high at the inner side, where were the openings looking into the nave, etc., which openings formed a part of the architectural design of the interior, coming as they do above the great arches of the nave and below the clearstory windows. It is therefore to be distinguished from a great gallery like that of Notre Dame at Paris, or the Cathedral of Tournay in Belgium, which has its own vaulted ceiling and perhaps even a triforium proper above that vault. In some churches, especially in England, the triforium is built up with a solid wall on the inner side, so that the ornamental arcade serves no longer as an opening from which persons in the triforium could look into the church. In other instances, as in the Cathedral of Rheims, the triforium is a very narrow passage left between an outer solid wall and an open arcade on the inner side, in which case the space beneath the sloping roof of the aisle is shut out and becomes a mere garret. R. S.

**Trigem'inus** [from Lat. *trige'minus*, born three together; *tri-*, *tres*, three + *ge'minus*, twin]: the fifth pair of cranial nerves, which take superficial origin from the side of the pons varolii by two roots, a larger sensory and a smaller motor; the sensory root bears the important Gasserian ganglion, situated at the apex of the temporal bone. The trigeminus, the great sensory nerve of the head, divides into three trunks, the *ophthalmic*, the *superior maxillary*, and the *inferior maxillary* divisions. The first two of these are entirely sensory, the third is a mixed nerve, being both sensory and motor. The ophthalmic nerve enters the orbit, the contents of which, including the eye, it supplies with sensory filaments, and finally is distributed to the forehead, brow, eyelids, and, to a limited extent, the nose. The superior maxillary nerve passes to the face, including the side of the nose, the cheeks and lips, and the upper teeth, and secondarily, through the connections of the spheno-palatine ganglion, the palate and the interior of the nasal cavity. The inferior maxillary nerve is a mixed nerve, and supplies motor filaments to the muscles of mastication and sensation to the lower teeth and the part of the face. One important branch, the lingual, is distributed to the tongue, and, in addition to supplying common sensation to that organ, very probably is also intimately related to the special sense of taste. Each division of the trigeminus is connected with one or more special masses of nervous matter known as the ganglia of the nerve. With the ophthalmic nerve is connected the *lenticular* ganglion; with the superior maxillary, the *spheno-palatine*; and with the inferior maxillary, the *otic* and the *submaxillary* ganglia. Those ganglia are of importance as affording points at which sensory, motor, and sympathetic fibers become intermingled, the nerves passing from the centers containing fibers of all three kinds. See FACIAL NERVES. GEORGE A. PIERSOL.

**Trig'lidæ** [Mod. Lat., named from *Trigla*, the typical genus, from Gr. τρίγλα, mullet]: a family of acanthopterygian fishes, related to the *Cottidæ*, including species popularly known as gurnards, sea-robins, flying fishes, etc. The elongate body may be covered with scales or with bony plates; the head is usually covered with rough, bony plates, some of which bear spines. The eyes are set high in the head; one of the suborbitals is very large, covering the cheek, and articulates with the preoperculum; the upper jaw is slightly protracted and longer; teeth villiform, on the jaws and generally the palate; branchiostegal apertures continuous below; branchiostegal rays in seven pairs; dorsal fins two, the first spiny; anal fin opposite the dorsal; pectorals more or less enlarged, and with their lower rays simple and generally isolated and distinct from the rest of the fin; ventral fins thoracic, separated by a wide area, and each with a spine and five soft rays; pyloric appendages developed in moderate number; an air-bladder is present. The family contains three distinct sub-families—viz.: (1) *Triglinæ*, in which the three lowermost rays of the pectorals are elongated, enlarged, and entirely free, and the scales are small, including the genera *Trigla*, *Prionotus*, etc.; (2) *Peristethinæ*, in which the two lowermost rays of the pectorals are enlarged and separate, and the scales large and plate-like, represented only by the genus *Peristethus* or *Peristedion*; and (3) *Dactylopterinæ*, in which the lowermost rays of the pectorals are mostly united with the others, the whole forming a very large wing-like fin, which enables the animal to skim over the water, and the scales are moderate and carinated, typified by the genus *Dactylopterus*. The family is represented on the eastern coast of North America by five species of *Prionotus* and one of *Dactylopterus*, and elsewhere, in almost every sea, by one or more generic forms. Revised by F. A. LUCAS.

**Trigonom'etry** [from Gr. τρίγωνον, triangle + μέτρον, measure]: a branch of mathematics whose primary object is to explain the method of solving triangles; it also treats of the general relations of circular functions. It is divided into three great branches—*plane*, *spherical*, and *analytical*. *Plane trigonometry* treats of the relations between the sides and angles of plane triangles; *spherical trigonometry* treats of the relations between the sides and angles of spherical triangles; and *analytical trigonometry* treats of the general relations between trigonometric functions.

*Measure of an Angle.*—For the purposes of plane and spherical trigonometry, angles are expressed in *degrees*, *minutes*, and *seconds*, denoted by the symbols °, ′, ″; and in analysis they are expressed in terms of the radius of the arcs which subtend the angles. In the former case the right angle is the *primary* unit; in the latter case the primary unit is the angle whose subtending arc is equal to its radius. In both cases the angle is expressed in terms of the subtending arc. To explain these methods of measurement, let A C D be a right angle; then with C as a center, and with a radius C A equal to 1, describe an arc A P D intersecting the sides of the angle at A and D. Let the angle A C D be divided into 90 equal parts by radii; these will divide the arc A P D into 90 equal parts; the equal parts, both of the angle and the arc, are called *degrees*. If we draw any radius, as C P, the intercepted arc A P will contain as many degrees of the quadrant as the angle A C P does of the right angle. It is in this sense, and in this sense only, that we say an angle is measured by an arc. For convenience of expression, each degree is divided into 60 equal parts called *minutes*, and each minute is divided into 60 equal parts called *seconds*. Again, let the arc A P be equal in length to the radius C A; that is, to 1. If we take A C P as the unit angle, any other angle, as A C Q, will contain as many units as there are units in the quotient of the arc A Q by A P. Because the circumference whose

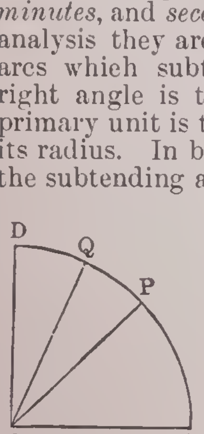



FIG. 1.

radius is 1 is equal to $2\pi$, or 6·2832, the arc A P, in degrees, is equal to $\frac{360}{6\cdot2832}^{\circ}$; that is, to 57·3° nearly, or, more exactly, to 206265″. If the arc A Q contains 75·5°, the linear measure of the angle A C Q is equal to 1·3 nearly; that is, it contains the unit angle 1·3 times.

*Trigonometric Functions.*—Angles are most readily compared by means of certain lines, whose values depend on the subtending arcs, and which are called *functions*. The nature of these lines will be most readily explained by the aid of a diagram. Let a circumference be described from C as a center, and with a radius C A equal to 1. Draw A L and M D, dividing the circumference into four quadrants, and call A L the *initial* diameter. Suppose every arc considered to begin at A, which is then called the *origin of arcs*, and to be estimated around in the direction A D L; let the point where the arc terminates be called its *extremity*. An arc beginning at A, and estimated around in the direction A M L, is said to be *negative*. The *complement* of an arc is the distance from its extremity around to D; it may be either positive or negative; thus E D is the complement of A E, and E′ D is the complement of A E′, the former being positive, and the latter negative. In addition, all distances estimated upward are regarded as positive, all distances downward as negative, all distances counted to the right as positive, and all to the left as negative. We have, then, the following definitions and conclusions:

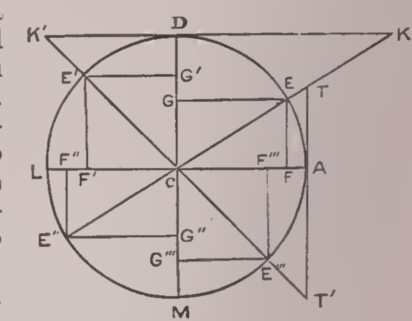



FIG. 2.

(1) The *sine* of an arc is the perpendicular distance from the initial diameter to the extremity of the arc; thus F E is the sine of A E, F′ E′ is the sine of A E′, F″ E″ the sine of A E″, and F‴ E‴ the sine of A E‴. Hence if an arc terminates in either the first or second quadrant—in which case it is said to lie in the corresponding quadrant—its sine is *plus*; if it lies in the third or fourth quadrant, its sine is *minus*.

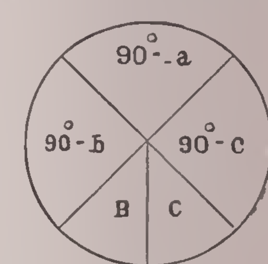



FIG. 3.

(2) The *cosine* of an arc is the distance from the center to the foot of the sine; thus C F is the cosine of A E, and C F′ is the cosine of A E′, etc. If an arc lies in the first or in the fourth quadrant, its cosine is *plus*; if it lies in the second or in the third quadrant, its cosine is *minus*.

(3) The *tangent* of an arc is a portion of a tangent to the arc at the origin, which is included between the origin and the prolongation of the diameter through the extremity of the arc; thus A T is the tangent of A E and A E″, and A T′ is the tangent of A E′ and A E‴. If an arc lies in the first or in the third quadrant, its tangent is *plus*; if in the second or fourth, its tangent is *minus*.

(4) The cotangent of an arc is the tangent of its complement, the origin of the complement being taken at D; thus D K is the cotangent of A E and A E″, and D K′ is the cotangent of A E′ and A E‴. If the arc lies in the first or in the third quadrant, its cotangent is *plus*; if in the second or fourth, it is *minus*.

(5) The *secant* of an arc is the distance from the center to the extremity of the tangent; thus C T is the secant of A E, and C K′ is the secant of A E′. The secant, being radial, is said to be positive when estimated from the center in the direction *toward* the extremity of the arc, and negative when estimated in the direction *from* the extremity. In the first and fourth quadrants the secant is *plus*; in the second and third it is *minus*.

(6) The *cosecant* of an arc is the secant of its complement; thus C K is the cosecant of A E, and C K′ of A E′. In the first and second quadrants the cosecant is *plus*; in the third and fourth it is *minus*.

(7) The *versed sine* of an arc is the distance from the foot of the sine to the extremity of the arc; thus F A is the versed sine of A E, and T′ A of A E′. The versed sine is always *plus*.

(8) The *co-versed sine* of an arc is the versed sine of its complement; thus G D is the versed sine of A E, and G′ D of A E′. The co-versed sine is always *plus*.

The general relations between the circular functions of any arc from 0° to 360° are expressed by the following equations, in which $x$ denotes the arc, and this whether the arc is *plus* or *minus*:

$\sin^2 x + \cos^2 x = 1.$ $\tan x \cot x = 1.$

$\text{ver. } \sin x = 1 - \cos x.$ $\sec x = \frac{1}{\cos x}.$

$\text{co-ver. } \sin x = 1 - \sin x.$ $\operatorname{cosec} x = \frac{1}{\sin x}.$

$\tan x = \frac{\sin x}{\cos x}.$ $\sec^2 x = 1 + \tan^2 x.$

$\cot x = \frac{\cos x}{\sin x}.$ $\operatorname{cosec}^2 x = 1 + \cot^2 x.$

Analytical Trigonometry.—Besides these formulas expressing the relation between the functions of a single arc the following, which express more extended relations, are of continual use in analysis:

$$\sin (a \pm b) = \sin a \cos b \pm \sin b \cos a.$$
$$\cos (a \pm b) = \cos a \cos b \mp \sin a \sin b.$$
$$\tan (a \pm b) = \frac{\tan a \pm \tan b}{1 \mp \tan a \tan b}.$$
$$\sin 2a = 2 \sin a \cos a; \ \cos 2a = \cos^2 a - \sin^2 a.$$
$$\sin \tfrac{1}{2} a = \sqrt{\tfrac{1}{2}(1 - \cos a)}; \ \cos \tfrac{1}{2} a = \sqrt{\tfrac{1}{2}(1 + \cos a)}.$$
$$\sin a \pm \sin b = 2 \sin \tfrac{1}{2}(a \pm b) \cos \tfrac{1}{2}(a \mp b).$$
$$\cos a + \cos b = 2 \cos \tfrac{1}{2}(a + b) \cos \tfrac{1}{2}(a - b).$$
$$\cos b - \cos a = 2 \sin \tfrac{1}{2}(a - b) \sin \tfrac{1}{2}(a + b).$$

Plane Trigonometry.—Every plane triangle consists of six parts—three sides and three angles. When three of these parts are given, at least one of which is a side, the remaining parts may be computed. The operation of finding the unknown parts is called the *solution* of the triangle. The solution is made by means of formulas which express the relations between the parts of the triangle.

*Solution of Right-angled Triangles.*—The following formulas express all the essential relations between the sides and angles of a right-angled triangle. In them the right angle is denoted by A, the acute angles by B and C; the hypothenuse is denoted by $a$, and the sides opposite B and C are represented by $b$ and $c$. Because the angles B and C are complementary, either may be found when the other is known by simple subtraction; hence the formulas take account of only one of them. The symbols $sin^{-1}$, $cos^{-1}$, etc., are read, *The arc whose sine is, The arc whose cosine is*, etc.:

$$a = \sqrt{b^2 + c^2} = \frac{b}{\sin B} = \frac{c}{\cos B}; \quad (1)$$
$$b = \sqrt{a^2 - c^2} = a \sin B = c \tan B; \quad (2)$$
$$c = \sqrt{a^2 - b^2} = a \cos B = b \cot B; \quad (3)$$
$$B = \sin^{-1}\frac{b}{a} = \cos^{-1}\frac{c}{a} = \tan^{-1}\frac{b}{c}. \quad (4)$$

In applying these formulas the multiplications and divisions are made by means of logarithms.

*Solution of Oblique-angled Triangles.*—The solution of every case of oblique triangles may be effected by means of the following formulas, in which A, B, and C denote the angles of a triangle, and $a$, $b$, and $c$ the sides lying opposite to them, and $s = a + b + c$:

$$a : b : c :: \sin A : \sin B : \sin C; \quad (1)$$
$$a + b : a - b :: \tan \tfrac{1}{2}(A + B) : \tan \tfrac{1}{2}(A - B) \quad (2)$$
$$\sin \tfrac{1}{2} A = \sqrt{\frac{(\frac{1}{2} s - b)(\frac{1}{2} s - c)}{bc}} \quad (3)$$

The sine of an arc is equal to the sine of its supplement; hence, when an angle is determined by means of its sine, there may be two solutions. Whether there are two or one must be determined by a discussion of the particular case.

Spherical Trigonometry.—Every spherical triangle contains six parts—three sides and three angles. When any three of these parts are given, the other three may be found.

*Solution of Right-angled Spherical Triangles.*—A right-angled spherical triangle may be solved when we have given any two parts besides the right angle, by two simple rules called Napier's rules for circular parts. If we denote the angles by A, B, and C, A being the right angle, and the opposite sides by $a$, $b$, and $c$, the sides about the right angle, the complement of the hypothenuse, and the complements of the angles B and C are called *circular parts*. Let these parts be arranged in order, as shown in Fig. 3; then each part will be *adjacent* to two other parts, or will be separated from two other parts called *opposite*. When so arranged, the parts are subject to the following rules: (1) *The sine of any part is equal to the rectangle of the tangents of the adjacent parts.* (2) *The sine of any part is equal to the rectangle of the cosines of the opposite parts.*

*Solution of Quadrantal Spherical Triangles.*—A quadrantal spherical triangle is one in which one of the sides is a *quadrant*. Such triangles may be solved by passing to the corresponding polar triangles, which will be right-angled. These triangles are then solved by Napier's rules for circular parts, and from the results we may find the corresponding parts of the given triangles by the reverse process of passing back to the given triangles.

*Solution of Oblique Spherical Triangles.*—Let A, B, and C denote the angles of an oblique spherical triangle, and let $a, b$, and $c$ denote the opposite sides; also let $S = A + B + C$; and $s = a + b + c$; we shall then have the following formulas for solving oblique spherical triangles:

$$\frac{\sin A}{\sin a} = \frac{\sin B}{\sin b} = \frac{\sin C}{\sin c}.$$
$$\cos \tfrac{1}{2} A = \sqrt{\frac{\sin \frac{1}{2} s \sin (\frac{1}{2} s - a)}{\sin b \sin c}}.$$
$$\cos \tfrac{1}{2} a = \sqrt{\frac{\cos (\frac{1}{2} S - C) \cos (\frac{1}{2} S - B)}{\sin B \sin C}}$$
$$\tan \tfrac{1}{2}(A + B) = \cot \tfrac{1}{2} C \times \frac{\cos \frac{1}{2}(a - b)}{\cos \frac{1}{2}(a + b)}.$$
$$\tan \tfrac{1}{2}(A - B) = \cot \tfrac{1}{2} C \times \frac{\sin \frac{1}{2}(a - b)}{\sin \frac{1}{2}(a + b)}.$$
$$\tan \tfrac{1}{2}(a + b) = \tan \tfrac{1}{2} c \times \frac{\cos \frac{1}{2}(A - B)}{\cos \frac{1}{2}(A + B)}.$$
$$\tan \tfrac{1}{2}(a - b) = \tan \tfrac{1}{2} c \times \frac{\sin \frac{1}{2}(A - B)}{\sin \frac{1}{2}(A + B)}.$$

When any part is determined by means of its sine, there may be one or two solutions. Whether there are one or two can only be determined by a discussion of each particular case.

The solution of a spherical triangle may often be facilitated by the introduction of an auxiliary angle. Thus if two sides and their included angle be given, the third side may be found by the formula

$$\cos a = \frac{\cos b \sin (c + \phi)}{\sin \phi}, \text{ where } \cot \phi = \tan b \cos A.$$

In like manner, if two angles and their included sides be given, the remaining angle may be found by the formula

$$\cos A = \frac{\cos B \sin (C - \phi)}{\sin \phi}, \text{ where } \cot \phi = \tan B \cos a.$$

Formulas of this kind are particularly useful when it is desired to determine a single part without completing the solution of the triangle. Revised by S. Newcomb.

**Trilin'ear Co-ordinates** [*trilinear* is from Lat. *tri-, tres*, three + *li'nea*, line]: a system of co-ordinates in which the position of a point is determined by the ratios of its distances from three sined lines. The equation of any right line in Cartesian co-ordinates may be put in the form

$$x \cos \phi + y \sin \phi - p = 0,$$

in which $\phi$ is the angle made by the lines with the axis of $x$, and $p$ is length of a perpendicular upon it from the origin. If $x'$ and $y'$ be the co-ordinates of any point whatever, $x' \cos \phi + y' \sin \phi - p$ will express the length of a perpendicular from the point, or the *distance* of the point $x'\ y'$ from the line. Call this distance $\alpha$. Let $\beta$ and $\gamma$ be in the same manner the distances of the point $x'\ y'$ from any two other arbitrarily chosen lines. We may imagine a system of *trilinear* co-ordinates in which the position of a point is defined by its distances from three fixed lines, and in which the position of any right line is defined by a homogeneous equation between these distances of the form

$$l\alpha + m\beta + n\gamma = 0.$$

See Ferrers, *Trilinear Co-ordinates*; Salmon, *Conic Sections*; Newcomb, *Analytic Geometry*; Clebsch, *Vorlesungen über Geometrie*, part i. (Leipzig). Revised by S. Newcomb.

**Tril'lium** [Mod. Lat; cf. Lat. *tres, tri-*, three, and *trilix*, triple-woven, triple, the parts being in threes]: a genus of perennial herbaceous monocotyledonous plants, of the lily family, embracing a dozen species, all of which occur in

Eastern North America, the Himalaya region, and Japan. Each plant consists of a naked stem a foot or less high, sur-

Large flowered trillium (*Trillium grandiflorum*).

mounted by three ovate netted-veined leaves, a large flower, and a purple or red three-celled berry. *T. grandiflorum* bears a white flower, changing with age to rose color; *T. erectum*, a dark reddish-purple flower. The trilliums are cultivated in gardens, are highly valued for their beauty, and are commonly known as three-leaved nightshade, wake-robin, birth-root, or Indian balm. They have astringent, expectorant, and tonic qualities, and yield resin, tannic acid, and a volatile oil. Revised by CHARLES E. BESSEY.

**Tril'obites** [from Gr. τρεῖς, τρι-, three + λοβός, lobe]: a group of *Crustacea* which became extinct in Palæozoic times. Their affinities have long been uncertain, but the discovery in 1893 of specimens with antennæ places their position beyond a doubt. The body is divisible into three regions—a head with compound eyes, a thorax composed of a varying number of movable segments, and an abdomen (or pygidium) in which several segments firmly united to each other may be recognized. Until recently all knowledge of appendages was lacking, but at present the evidence goes to show that the head bore a pair of antennæ and at least four pairs of leg-like appendages, the basal joints of which served for the mastication of food. In the thoracic region the feet were two-branched, and bore gills of peculiar character, while in the pygidial region the appendages were lamellate. The trilobites are among the most abundant fossils in the older rocks. They appear in the Cambrian and die out in the Carboniferous. The species are very numerous. Besides the various geological reports, see for structure, Walcott, *Bulletin* Museum Comp. Zoölogy, viii. (1881), papers in *American Journal of Science* (1893–94), and Bernard, *Quarterly Journal of the Geological Society* (London, 1894); for development, Barrande, *Système silurien du Centre de la Bohême*, vol. i. (1852). J. S. KINGSLEY.

**Trimble**, ROBERT: jurist; b. in Berkeley co., Va., in 1777. His parents, in 1780, removed to Kentucky, where he received a scanty early education, but became a school-teacher; studied law under George Nicholas; was admitted to the bar 1803; settled at Paris, where he was chosen to the Legislature; became judge of the court of appeals 1808, chief justice of Kentucky 1810, U. S. district attorney 1813; was district judge of Kentucky 1816–26, and justice of the U. S. Supreme Court from 1826 to his death Aug. 25, 1828.

**Trimeter**: See METRES.

**Trimūrti**, trē̆e-moor'tē̆e [Sanskr.; literally, having three forms; *tri*, three + *mūrti-*, body, form]: the Hindu triad or trinity, consisting of Brahma, Vishnu, and Śiva, considered as an inseparable unity, and as representing the creating, the preserving, and the destroying and regenerating principles of the deity respectively. They were produced by Brahma, the one self-existent spirit, from his own body—Brahma from the right, Vishnu from the left, and Śiva from the middle. When represented pictorially or in sculpture the Trimūrti has one body with three heads—that of Brahma in the middle, that of Vishnu at the right, and that of Śiva on the left.

**Trincomalee'**: town of Ceylon; a seaport and naval station on the northeastern coast of the island (see map of S. India, ref. 8–F). It has a large landlocked harbor, but the place is exceedingly hot and unhealthful. Its great renown in ancient time it owed to religious rather than to geographical considerations, as the seat of the temple of a thousand columns, to which pilgrims flocked from all parts of India. Pop. (1891) 11,411. Revised by M. W. HARRINGTON.

**Trinidad**, Span. pron. trē̆e-nē̆e-*thaath'*: an island of the West Indies, belonging to Great Britain; near the northeastern coast of Venezuela, and N. of the delta of the Orinoco. Area, 1,754 sq. miles. It is nearly square in form, with peninsular projections at the angles. These, with the peninsula of Paria and the delta, form the narrow passages called the Serpent's Mouth and Dragon's Mouth, noted for their dangerous currents; and they inclose the Gulf of Paria, between the island and the continent. Trinidad is generally classed as the southernmost of the Caribbean group; but by its structure, fauna, and flora, it belongs to South America, and in all probability was formerly united to it. A range of low mountains, a continuation of those of Paria, follows the northern coast, some of the peaks attaining an altitude of more than 3,000 feet. The remainder of the surface is hilly, or low, with tracts of swamp; a line of hills lines the southern coast. There are no true volcanoes, but some small crater-like cavities emit sulphuretted hydrogen, and sometimes, it is said, flames. The celebrated asphalt lake, called La Brea, is near the southwestern end; it covers about 100 acres, the asphalt bubbling up in the center but hardening around the margins, where it is extracted; it is largely exported for roofing and paving. The soil of Trinidad is fertile, and there are large tracts of forest, especially in the northern and eastern parts. The climate is warm, but generally healthful, and rains are abundant from May to October; during the winter months the ground is watered by heavy dews. Hurricanes are never felt. A large proportion of the inhabitants are Negroes, mixed races, and Hindu coolies. Of the latter Trinidad has more than any other West Indian island. They are imported under contract to work for five years, but often remain and acquire considerable wealth. The whites are of English, Scotch, or French descent, with many refugees from Venezuela. Most of the population is gathered in the western part of the island, where are the principal towns. Port of Spain, the capital, is the commercial center, and is connected with San Fernando by railway. Agriculture is the principal occupation, and the island has an unusually large number of peasant proprietors. The exports are sugar, cacao, asphalt, etc. By its position, Port of Spain controls much of the trade of Venezuela. Trinidad was discovered and named by Columbus in 1498. The Spaniards, after carrying off the Indian inhabitants as slaves, had only small establishments, later increased by French immigrants from Grenada. The British seized the island in 1797, and have since held it. With Tobago it forms the crown colony of Trinidad. Pop. (1891) 208,028. See Charles Kingsley, *At Last* (1871); Hart, *Trinidad* (1865); Wall and Sawkins, *Report on the Geology of Trinidad*. HERBERT H. SMITH.

**Trinidad**: a small rocky island of the Atlantic, in lat. 20° 31' S., lon. 29° 20' W.; about 700 miles E. of Brazil, whose claim to it is now acknowledged.

**Trinidad**: a city near the southern coast of Cuba; 3 miles by railway from its port of Casildas (see map of West Indies, ref. 4–C). It is beautifully situated on high land overlooking the sea. Owing to its mild and very equable climate it is a favorite resort for invalids. It is one of the oldest towns in the island, and was long the center of the coffee-trade, but has lost much of its commercial importance. Pop. (1899) 11,120. H. H. S.

**Trinidad**: capital of the department of Beni, Bolivia, on low land near the Mamoré (see map of South America, ref. 5–D). It was founded by the Jesuits, and was long the most celebrated mission town of the Madeira valley, having a population of over 20,000. The mission buildings remain, but the place is much decayed. Pop. (1885) 4,535. H. H. S.

**Trinidad**: city; capital of Las Animas co., Col.; on Las Animas river, and the Atch., Top. and S. Fé, the Denver and Rio Gr., and the U. Pac., Denver and Gulf railways; 200 miles S. of Denver, and 650 miles W. of Kansas City, Mo. (for location, see map of Colorado, ref. 6–E). It is in an agricultural, stock-raising, bituminous coal, and coking region, and contains 9 churches, 4 large public-school buildings, an academy, business college, parochial school, 2 national banks (combined capital $200,000), 2 savings-banks (combined capital $50,000), a loan and trust company (authorized capital

$150,000), and 3 daily and 4 weekly papers. There are gas and electric light plants, extensive railway-shops, brewery, wool-scouring plant, and coking ovens. Pop. (1880) 2,226; (1890) 5,523; (1900) 5,345. EDITOR OF "ADVERTISER."

**Trinitarians**: See REDEMPTIONISTS.

**Trinitrocarbolic Acid, Trinitrophenol**, or **Trinitrophenic Acid**: See PICRIC ACID.

**Trinity**: See GOD.

**Trinity**: port of entry; capital of Trinity district, Newfoundland; on Trinity Bay: lat. of harbor, 48° 22′ N., lon. 53° 24′ W. It has an excellent harbor. In 1858 the first Atlantic cable was landed in Trinity Bay. The fisheries are the leading pursuit. Pop. about 2,000.

**Trinity College**: an institution of learning in Hartford, Conn., founded in 1823, and bearing until 1845 the name of Washington College. Its first president was Bishop Thomas Church Brownell, 1824–31. The college buildings, three in number, stood on a slight eminence, now the site of the State Capitol. In 1872 the campus was sold to the city of Hartford and a site of 78 acres was purchased, about a mile S. of the former location. Here has been erected a fine range of buildings, forming part of a new structure, which is intended to comprise three quadrangles, in all 1,050 feet by 370, with an aggregate area of 4 acres. It is in the early French secular Gothic style of architecture, and has an imposing effect. There are also, outside the limits reserved for these quadrangles, an observatory, a gymnasium and alumni hall, a hall of science, and a president's house. There is a valuable cabinet and a library of 40,000 volumes. The college offers four courses of study, leading to degrees in arts, science, and letters, with liberal provision for elective and special work; and there are numerous scholarships, in part competitive, for the assistance of deserving students, chiefly for those wishing to enter the ministry of the Protestant Episcopal Church. The Rev. Dr. George Williamson Smith has been president since 1883. SAMUEL HART.

**Trinity College, Dublin**: See DUBLIN, UNIVERSITY OF.

**Trinity River**: a river which rises in the northeast part of Trinity co., Cal., and after a course first to the S. W. and then to the N. W., falls into Klamath river, in Humboldt County. Its length is about 130 miles.

**Trinity River**: a river in Texas, formed by two branches, the Elm or East Fork and the West Fork, which rise in the northern part of the State, the latter in Archer County, and unite in Dallas County. Trinity river is a noble stream, flowing through a fertile, well-timbered country. At its lowest stage it is navigable to Liberty, about 22 miles from its mouth in Trinity Bay, and at high water small boats have ascended 500 miles. The length of the main stream is 550 miles.

**Trinity Sunday**: in the Roman Catholic, Anglican, and other Churches (but not the Greek Church), the Sunday next after Pentecost. It was established as a church festival, in honor of the Holy Trinity, by Pope John XXII. in 1320. It had previously been long celebrated in some Western dioceses, but not very generally before 1400.

**Triodon′tidæ** [Mod. Lat., named from *Tri′odon*, the typical genus; Gr. τρεῖς, τρι-, three + ὀδούς, ὀδόντος, tooth]: a family of fishes of the order *Plectognathi*, so named because the upper jaw is divided by a central suture while the under jaw is entire, thus forming three tooth-like pieces. The body is oblong, with a very dilatable abdomen, and with a slender conic tail; the lateral line well marked; the head oblong, with the snout rather long; the nostrils double; the mouth small; the gill openings narrow clefts in front of the pectoral fins; the branchiostegal rays entirely concealed; dorsal and anal fins very short and far behind; caudal distinct; pectorals narrow; ventrals wanting. An air-bladder is present. The skeleton is well ossified, and ribs are developed; the so-called pelvic bone is large, and serves to keep expanded the abdominal sac-like expansion, "the lower part of which is merely a flap of skin into which the air does not penetrate" (*Günther*). The family is especially interesting as serving to demonstrate the affinity of the gymnodonts with the scleroderms. But one species is known, the *Triodon bursarius* of the Indian Ocean and Archipelago.
Revised by F. A. LUCAS.

**Trionych′idæ** [Mod. Lat., named from *Tri′onyx*, the typical genus; Gr. τρεῖς, τρι-, three + ὄνυξ, ὄνυχος, claw]: a family of turtles containing the soft-shelled tortoises, and distinguished by the leathery and scaleless shell. "The principal habitat of the members of this family is the muddy bottom of shallow waters. They bury themselves in the soft mud, leaving only the head, or a small part of it, exposed. They take breath from time to time, without moving the body, by raising up the long neck and head and carrying the leathery snout above water." They rarely emerge from the water to take to the land, and when on the land their locomotion is laborious and constrained. In the water, however, they are very active and quick in their movements. "They feed upon shells, especially upon anodontas and paludinas." "They lay from twelve to twenty and more eggs, of a spherical form and above the size of a musket-ball, which they deposit on the shore by the water's edge. The shell of these eggs is thick, but very brittle." (Agassiz, *Contributions to the Natural History of the United States of America.*) Representatives of the family are found most abundantly in the tropical regions of Asia and Africa, but a number of species also extend through a considerable area in the U. S., and equally far northward in Asia.
Revised by F. A. LUCAS.

**Tripe de Roche**, treep′de-rōsh′ [Fr., rock tripe]: a name applied by French Canadian *voyageurs* and hunters to several species of *Umbilicaria* and *Gyrophora*, tough and bitter lichens of the barren grounds of British North America. *Tripe de roche* is often used as food when other provisions are exhausted, and, though cathartic and unpalatable, it will sustain life. The genera have representatives growing upon rocks in many high arctic and alpine regions.

**Tripit′aka** [Sanskr., three baskets; *tri*, three + *pitaka*, basket]: the sacred scriptures of the Buddhists; so called because made up of three collections called respectively *Sūtra*, or aphorisms; *Vinaya*, or discipline; and *Abhidharma* or *Abhidhamma*, metaphysics. (See PĀLI LITERATURE.) The name Tripitaka is also sometimes applied to the Chinese *San-tsang* (three storehouses; in Japanese *San-zō*), which consists of translations, from the first century onward, of original Sanskrit texts, and of commentaries and other matter. A complete copy of this (in 2,200 vols., requiring 108 feet of shelf-room) is in the library of the India office, London. An edition in over 500 vols., printed from movable metal type, was issued in 1881–85 by one of the monasteries in Tokio.

**Triple Alliance**: (1) the league between England, Sweden, and the States-General (1668) for the protection of the Spanish Netherlands against Louis XIV. (2) The league of Great Britain, France, and the Netherlands against Spain and the Pretender in 1717. (3) The league of Austria, Great Britain, and Russia, concluded in 1795. (4) The *Dreibund*, or league of Germany, Austria, and Italy, formed for the purpose of mutual protection in case of attack by other powers. A dual alliance between Austria and Germany had been formed in 1879, and Italy was admitted as a third member in 1882. In spite of the opposition of the Italian republicans and Irredentists the alliance has been maintained, and in July, 1891, the Emperor of Germany publicly declared that it had been resumed for a period of six years.

**Trip′oli** [named from the city Tripoli]: one of the thirty-eight vilayets or provinces of Turkey, and, including Barca on the E., the only region in Africa now directly controlled by Turkey. It has over 700 miles of sea-frontage on the Mediterranean, adjoins Egypt and the Libyan waste on the E., includes Fezzan on the S., and has Tunis on its western frontier. Though about one-third larger than Texas, its population is only 800,000 to 1,000,000. Seventeen explorers have visited it since 1800, but they followed chiefly the main routes leading S. from the city of Tripoli, and many parts of the interior remain to be studied in their geological, ethnological, and other aspects. Its coast towns are the natural points of departure for caravans to the Western Sudan, because the coast-line on the deep indentation of the Gulf of Syrte shortens the journey to the Sudan about one-fourth. The routes S. across the desert are also better than those from Algeria, because mountains and sand-dunes oppose few difficulties and wells are comparatively abundant. The explorer Rohlfs urged Italy to acquire Tripoli, on the ground that the Western Sudan would easily fall to its possessor. In other respects Tripoli is much less favored than Tunis and Algeria. Lying farther S. the mean temperature is much higher and the climate is of continental rather than maritime character. Most of the region is poor and sandy, and the sands from the eastern and southern deserts, together with vast quantities blown inland

from the sea-border, have greatly restricted the areas where agriculture can flourish. Nine-tenths of the country has no population because it does not differ from the great sandy and rocky plateau, inhabited only in a few scattered oases, that extends from Alexandria to Tunis. The rainfall is small, and Tripoli has not a single perennial stream. Although thus pertaining to the region of the desert rather than to that of the littoral, Tripoli has a considerable number of small areas that are very fruitful, particularly along the slopes of the low mountains that nearly bisect it from E. to W. and from N. to S., and along the usually dry water-courses. The almond-tree, olive, and date flourish, and the vine is widely cultivated, though not for wine-making. The fauna, like the flora, is poorer in species and in numbers than in countries of the littoral farther west. Neither lions nor panthers are found in the mountains, crocodiles can not live where permanent rivers do not exist, and the elephants that once roamed over the country were long ago driven out by widespread deforestation. Foxes, hares, wolves, some varieties of monkeys, gazelles, and antelopes are the only game. There are a few varieties of reptiles, but not many birds, most of them being birds of passage, which are seen only for a few weeks in spring and autumn during their migrations. Camels and asses are the chief domestic animals, but a diminutive variety of cattle and also horses and dogs are found in small numbers. Fat-tailed sheep are raised to some extent, but goats are much more numerous. The population consists mainly of Arabs and Berbers. The Berbers, representing the ancient inhabitants, are probably more numerous, but there has been great admixture of these families. In many places the Berbers have adopted the language of their conquerors, and it is difficult to distinguish them from the Arabs. In other places, particularly in the oases, the two peoples live in distinct groups, having each its own name and social organization. The Berbers who have most successfully maintained their primitive character live among the mountains of Ghurian and Yefren. Here center the insurrections that, now and then, are a source of much trouble to the Turkish authorities. Thousands of slaves from the Sudan form an important element in the population. The Turks, though in absolute control of the country since 1835, form only a small minority. They hold themselves above the people they govern and are looked upon as strangers. Arabic, and not Turkish, is the official language. The Jews are a very old element in the population and suffer much ill treatment. The only port of importance is the capital, Tripoli, and the chief exports are esparto grass, ostrich feathers, and a little wheat. The total export and import trade with Europe amounts only to about $6,000,000 a year. See Nachtigal's *Sahara und Sudan* (2 vols., Berlin, 1879–81); Barth's *Travels and Discoveries in North Africa* (5 vols., 1857–58) and *Wanderungen durch die Küstenländer des Mittelmeeres* (Berlin, 1849); Rohlfs's *Land und Volk in Afrika* (Bremen, 1870); Vatonne's *Mission de Ghadâmès*; Duveyrier's *Exploration du Sahara, les Tuaregs du Nord* (1864); and Reclus's *Nouvelle Géographie Universelle* (vol. xi., Paris, 1876).
C. C. ADAMS.

**Tripoli** [Lat. *Tri'polis*, Gr. Τρίπολις, liter., three-town]: a port built on the site of three ancient towns on the African coast of the Mediterranean (see map of Africa, ref. 1–D). It is the capital of the Turkish province of Tripoli. The city is strongly fortified, has considerable trade with Europe and a large caravan trade with the Western Sudan, but it is far inferior, in commercial importance to several other cities on the southern shores of the Mediterranean. It presents a charming aspect from the sea, but first impressions are modified by a nearer view of dilapidated buildings, narrow and tortuous streets, and abounding dirt and refuse. It is most cosmopolitan in its architecture, the Arab style with its white, bare walls and courts surrounded by galleries predominating. Almost all the Government buildings resemble the Turkish structures of Stamboul, while the 3,000 Maltese residents, who form the Christian element, have many buildings of Italian aspect, and the water-front is lined with structures like those in the smaller commercial ports of Europe. Negro slaves have introduced in some quarters cabins like those in which they lived in the Sudan. Much has been done in recent years to improve the appearance and sanitary conditions of the city. The town nearly covers a small promontory jutting out into the sea, and behind it is a wide belt of plantations given chiefly to the raising of olives. The capital has a far larger trade with the Sudan than any other Mediterranean port. Of late years its largest source of prosperity has been the export to Europe of esparto grass. The commercial value of the port is considerably impaired by the shallow waters of the roadstead, and the northern winds at times, particularly in the winter months, make it very dangerous to approach the city. Pop. about 40,000.
C. C. ADAMS.

**Trip'oli** (Arab. *Tarābulus*, anc. Τρίπολις, *Tri'polis*): seaport town of Syria; in the vilayet of Beyrout, about 40 miles N. N. E. from Beyrout (see map of Turkey, ref. 7–G). The ancient town consisted of three distinct quarters, each surrounded by its wall and inhabited by colonists from Aradus, Sidon, and Tyre respectively. It was hence called Tripolis, "the triple city," by the Greeks. Renowned for its commerce in antiquity, it was specially important during the crusades. It occupied a triangular promontory projecting into the Mediterranean, and inclosed on the E. by a wall 18 feet thick, which may still be traced, while the entire promontory is strewn with ruins. N. is the harbor, from which the modern town is about a mile distant, embowered in apricot, orange, and lemon orchards. El-Kadisha, "the sacred river," which rises among the grove of cedars on Lebanon, renders the vicinity fertile and unhealthful. Tripoli is the natural outlet of the interior cities Hama and Homs. It has a fine and safe harbor, and French, British, and Russian steamers touch here regularly. It exports raw silk, sponges, soap, olive oil, cotton, and fruits. Pop. 24,000, mainly Mussulmans.
E. A. GROSVENOR.

**Tripolit'za**: town; in Arcadia, Greece (see map of Greece, ref. 17–J). Founded by the Ottomans in 1770, its buildings were constructed from the *débris* of Pallantium, Tegea, and Mantinea. The capital of the Morea, it was taken by the Greek revolutionists (1821) and retaken by Ibrahim Pasha (1825), who razed it to the ground three years later. It is now an enterprising and prosperous place. Pop. (1889) 10,698.
E. A. G.

**Tripos**: the system of honors examination at the University of Cambridge, England. The derivation of the name goes back to a very early period, when the student who was being examined sat on a three-legged stool. The examinations are held at the end of May or beginning of June in each year. The tripos is usually taken at the end of the third year of residence at the university. There are the mathematical tripos, classical tripos, moral sciences tripos, natural sciences tripos, theological tripos, law tripos, historical tripos, Semitic language tripos, Indian language tripos, mediæval and modern language tripos. The one who obtains the highest place in the mathematical tripos is called the senior wrangler.
C. H. THURBER.

**Triptych** [Gr. τρίπτυχος, consisting of three layers; πτύσσειν, to fold]: a set of three tablets or panels hinged together. The use of the appliance is generally to hold either writing or painting in such a way that it is protected from injury. (See DIPTYCH.) Whenever it became necessary to increase the size of the tablets beyond that of an object easily carried in the hand, and especially when one leaf was made fast to a wall or desk, it must have been found better to divide the upper or covering leaf into two. This, then, became the type of folding tablet used for early devotional pictures—a stout panel which could be set upon an altar or secured to a wall, and two thinner leaves or doors, one hinged to each side of the larger leaf, the two meeting in the middle of it and exactly covering it. One picture being painted on the larger leaf, or a large one with a smaller one below, it was natural to paint also the inside of the two doors; next, when greater richness was required, the outside of the doors was painted. The famous altarpiece

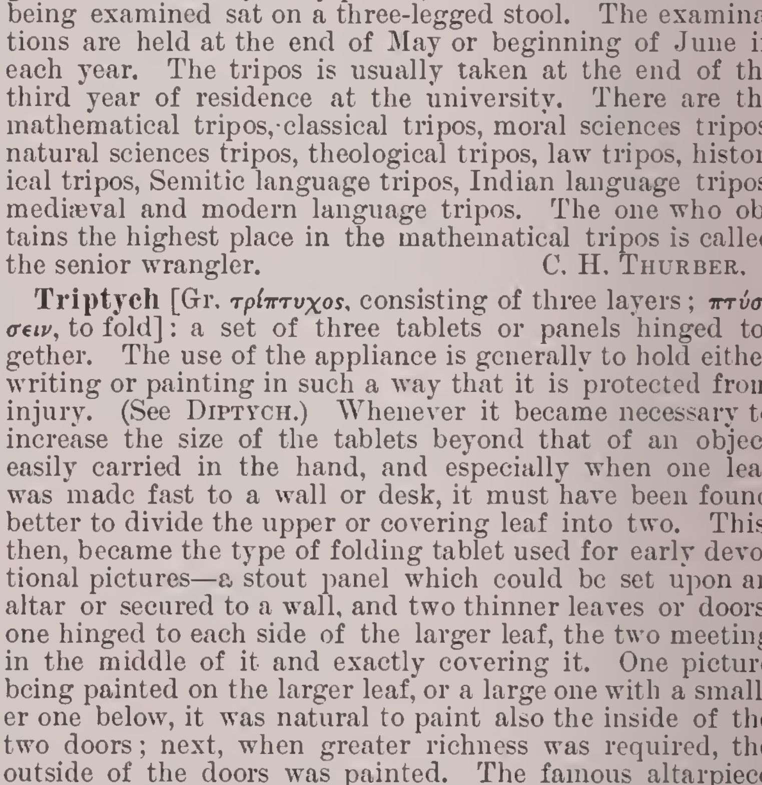


Diagram of the *Last Judgment*, by Rogier van der Weyden.

of the brothers Van Eyck (see EYCK, JOHN VAN) was a double triptych; an upper and a lower back panel had each two doors, but, as each door was itself divided into two folds, a word expressing division into five rather than three is needed to fully explain it. In like manner the *Last Judgment*, by Rogier van der Weyden, in the hospital at Beaune, in Burgundy, has a back panel of the shape of a smaller parallelogram above a larger one, with two small leaves above and two large ones below. The subject of the Judgment Day fills all the irregular-shaped surface offered when the leaves are opened wide; the outside has six different and separate pictures. These examples are, however, of late date, and show the triptych form giving way to the new requirements of an advanced art. RUSSELL STURGIS.

**Triqueti**, trēē'ke-tee', HENRI, Baron de: painter and sculptor; b. at Conflans, department of Loiret, France, in 1802; studied at the Academy of Art in Paris; exhibited in 1831 several pictures and a marble group, which attracted much attention, *Death of Charles the Bold*; devoted himself subsequently exclusively to sculpture; was for a long time engaged in the interior decoration of the Madeleine. Among his works are *Dante*, *Jesus feeding the Birds*, *Bacchus*, *The Holy Family*, and many busts. D. in Paris, May 11, 1874. Revised by RUSSELL STURGIS.

**Trirat'na** [Sanskr., three jewels; *tri*, three + *ratna*, a jewel]: the Buddhist triad or trinity, consisting of (1) Buddha, the founder of the system; (2) *Dharma*, the law or doctrine which he taught; and (3) the *Sangha*, or monastic order which he established. The two latter have been personalized and deified by later Buddhists as the "Three Precious Ones," in whom the seeker after deliverance from individual existence and its sorrow and pain takes refuge. Hence they are also known as the "Three Refuges."

**Trisection of Angle** [*trisection* is from Lat. *tri-*, three + *seca're*, *sec'tum*, cut]: a celebrated problem among the ancient geometers. It belongs to the same class of problems as the duplication of the cube and the insertion of two geometrical means between two given lines. Like them, it can not be solved by the methods of elementary geometry. It may, however, be solved by means of an auxiliary curve called a conchoid; it can also be solved in several ways by the principles of higher geometry. S. N.

**Trismegistus**: See HERMES TRISMEGISTUS.

**Trissi'no**, GIANGIORGIO: grammarian and poet; b. at Vicenza, Italy, June 18, 1478. Exiled from Venice in 1508, he studied philosophy at Ferrara, and then went to Rome, where Leo X. received him. Desirous of reforming the Italian alphabet, he set forth his plans in the *Epistola a Clemente VII.* (1524), and published with it the *Canzone a Clemente VII.*, the *Sofonisba*, the *Ritratti*, and other works. The *Sofonisba*, an attempt to establish a tragic drama in the sixteenth century, was not very successful. As the ban had long been removed from him, he settled down in his home as a papal delegate (about 1526), still applying himself to his favorite scheme of improving the alphabet. The *Alfabeto*, the *Dubbi grammaticali*, the *Grammatichetta*, and the first portion of his *Poetica* and *Rime* appeared there after 1526, and were followed by the *Volgare Eloquio* (1529), a translation of Dante's *De Vulgari Eloquio*, which in this form appeared in print for the first time; the *Castellano*, a dialogue on the proper name for the Italian tongue; and the *Encomion*, a poem in Latin hexameters. During the remainder of his life he traveled about Italy not a little, and at the same time wrote the *Grammatices Introductionis Liber Primus* (1540); the *Italia liberata dai Goti* (1548); the *I Simillimi*, a comedy; and the rest of the *Poetica*. The *Italia liberata dai Goti* is a noteworthy endeavor to revive the historic epic, and on it Trissino's fame came chiefly to rest. Indeed, it was for a time accepted throughout Europe as belonging to the same class of poems as the *Iliad* and the *Æneid*. It is now, however, little read. Trissino died in Rome, Dec. 8, 1550. J. D. M. FORD.

**Tristan da Cunha**, -daa-koon'yā̈a: the largest of a group of islands in the Southern Atlantic, in lat. 37° 6' S., lon. 12° 19' W. Area about 40 sq. miles. It is mountainous, its center rising into a volcanic peak 7,640 feet high, but fertile, well provided with water, and healthful. It was discovered in 1506 by the Portuguese navigator Tristan da Cunha, and occupied by British troops during the captivity of Napoleon on St. Helena. Pop. (1895) 61. Property is held in common; there is no crime and no strong drink. The other islands are Inaccessible island and the three Nightingale islands, Nightingale, Stoltenhoff, and Middle isle. These are frequented by seals and sea-fowl.

**Tristram**, HENRY BAKER: See the Appendix.

**Triton** (Gr. Τρίτων): in Greek mythology, a marine deity, sometimes the son of Poseidon and Amphitrite, sometimes a subordinate sea-god, and sometimes even localized as the god of the Libyan Sea. In art he is represented as a young man with the body ending in a fish-tail, and with a trumpet of conch-shells with which at the command of Poseidon he bade the waves be still.

Revised by J. R. S. STERRETT.

**Triton**: a name given (1) to a gasteropod mollusc; (2) to the aquatic salamanders, especially of Europe.

**Tritone** [from Gr. τρίτονος, of three tones: τρι-, three + τόνος, tone. See TONE]: in music, the interval of the augmented fourth, which consists of three whole tones, or rather of two whole tones and two semitones, as C–F♯, G–C♯, an interval studiously avoided by the old musicians.

**Triumph** [viâ O. Fr. from Lat. *trium'phus* < O. Lat. *trium'pus*, deriv. of *trium'pe*, an exclamation used in solemn processions of the Arval brethren; cf. Gr. θρίαμβος]: in ancient Rome, a state pageant in which a victorious general or naval commander, preceded by the senate and by the spoils and prisoners, was drawn by four horses along the Sacred Way and followed by his army to the temple of Capitoline Jove, where solemn sacrifice was offered. In order to triumph, the general must be in possession of the highest magisterial power as dictator, consul, proconsul, prætor, or proprætor. The war, too, must be one against foreign foes, and must have been brought to a conclusion. There were also other conditions which were not uniformly observed. The triumphal procession was very brilliant, and sometimes lasted two or three days. It was customary to put to death some of the hostile chiefs during the triumphal march. There are in all about 350 recorded triumphs; the last seems to have been celebrated by Diocletian in 302 A. D.

Revised by CHARLES H. HASKINS.

**Trium'virs**, or **Tres'viri** [= Lat.; *tres* (gen. *trium*), three + *viri*, plur. of *vir*, man]: in ancient Rome, a board of three men. Besides certain permanent boards, the name was applied to various extraordinary commissions appointed to perform some special public duty. The coalition of Cæsar, Pompey, and Crassus in B. C. 60 is often, though improperly, called the first triumvirate. The men who constituted it bore no official title, and exercised only an usurped power. The second triumvirate, which was that of Octavian, Mark Antony, and Lepidus, was officially recognized by the senate, and the three magistrates bore the name of *Tresviri reipublicæ constituendæ* (triumvirs for arranging public affairs).

Revised by CHARLES H. HASKINS.

**Triv'ium**: name applied in the Middle Ages to the arts, grammar, rhetoric, and dialectic, which were taught in the cloister and cathedral schools. The trivium and quadrivium—music, arithmetic, geometry, and astronomy—made up the seven liberal arts. See West, *Alcuin and the Rise of the Christian Schools* (1892). C. H. T.

**Trochaic Metres**: verses whose fundamental foot is the trochee (τροχαῖος, running; called also choree, from χορεῖος, dancing). The measure is the dipody, resembling the $\frac{6}{8}$-bar of music in form and lively movement. The most common verse is the tetrameter catalectic, with diæresis between the two diameters. See METRES.

**Trochil'idæ** [Mod. Lat., named from *Tro'chilus*, the typical genus, from Gr. τροχίλος, some kind of small bird; cf. τρέχειν, run]: a family of birds comprising the humming-birds. See HUMMING-BIRD.

**Troch'ophore** [Gr. τροχός, wheel + φορεῖν, to bear]: a term applied to the typical annelid larvæ in allusion to the circles of cilia (one to three or more) which surround the body, and which are the wheels referred to in the name. A trochophore stage is more or less clearly recognized in other worms and in molluscs.

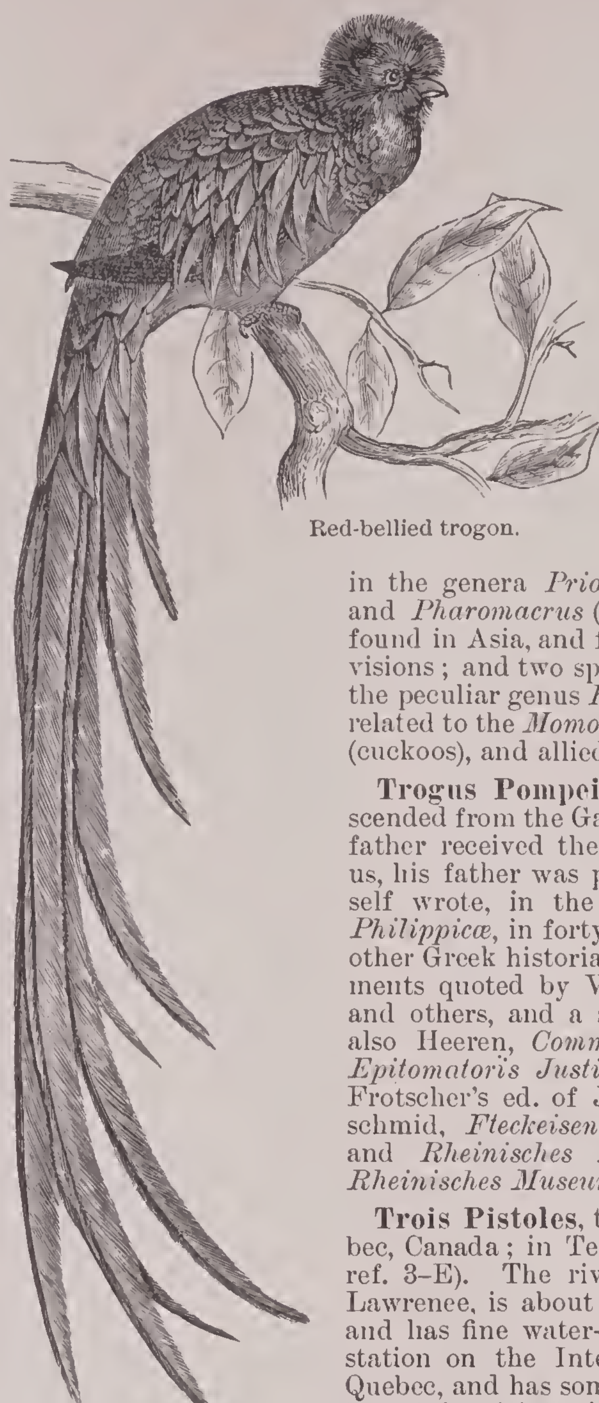
**Trochu**, trō'shü', LOUIS JULES: soldier; b. at Le Palais, department of Morbihan, France, Mar. 12, 1815; made his military career chiefly as aide-de-camp and in the ministry of war. He was aide-de-camp to Marshal Bugeaud in Algeria, to Marshal Saint-Arnaud, and afterward to Gen. Canrobert, in the Crimea, and distinguished himself at the storming of the Malakoff as commander of the first brigade of the First French Corps. He was in command of a division at the battle of Solferino. On account of his scientific education he was generally considered as the future Minister of War, but by his pamphlet *L'armée française en 1867*, which ran through twenty editions in three years, and, revealing the weaknesses of the French army, advocated the adoption of Prussian methods, he lost the favor of the Emperor Napoleon, and received no more offices of confidence. This circumstance, however, made him a favorite with the opposition, and when in 1870 the French army broke down, he was called to the imperial council and appointed governor of Paris Aug. 17. When the Revolution broke out in Paris after the disaster of Sedan, he was also made commander-in-chief of all the forces defending the capital, and president of the government of national defense, which position he held until the surrender of the city. He was chosen to the National Assembly in 1871, but retired to private life in 1873. Author of *Pour la Vérité et pour la Justice* (1873); *La Politique et le Siège de Paris* (1874); and *L'Armée française en 1879*. D. Oct. 7, 1896.

**Trœzen**, tree'zen, or **Trœze'ne** (Gr. Τροιζήν): one of the oldest cities of ancient Greece; in a fertile plain (Trœzenia) which occupied the southeastern part of Argolis. It was founded by Ionian settlers, and was under the authority of Argos at the time of the Trojan war; but although it subsequently, by the conquest of Peloponnesus by the Dorians, received a colony of Doric settlers and became a Doric city, it maintained its Ionian sympathies and traditions. It early grew into an important maritime place. It founded Halicarnassus and Myndus in Caria, and after the battle of Thermopylæ its harbor was appointed the place of rendezvous for the Greek fleet. It received with the greatest kindness the Athenians who fled from Xerxes, and fought with five ships and 1,000 men in the battles of Artemisium, Salamis, Platæa, and Mycale. Up to the Peloponnesian war it was a firm ally of Athens, but after that time it sided with Lacedæmon, and subsequently it became a Macedonian possession. In the second century of the Christian era it was still a splendid city, as shown by the description Pausanias has given of its public buildings, of which some ruins are still found near the village of Damala.
Revised by J. R. S. STERRETT.

**Trog'lodytes** [from Lat. *Troglo'dytæ* = Gr. Τρωγλοδύται, the pygmies, cave-dwellers, liter., plur. of τρωγλοδύτης, cave-dweller; τρώγλη, cave + δύνειν, enter]: with the ancient writers the name of races found in the Caucasus, in Moesia near the lower Danube, and elsewhere, but especially along the coasts of the Red Sea, both the Arabian and the African, which region was called *Regio Troglodytica*. Common to these tribes was their low grade of civilization. They lived in caves and depended on herds of cattle for their livelihood. The name is now applied to cave-dwellers generally. *Troglod'ytes* is the name both of a genus of wrens and of the genus containing the chimpanzee and gorilla.

**Troglodyt'idæ** [Mod. Lat., named from *Troglo'dytes*, the typical genus. See TROGLODYTES]: a family of oscinine birds containing the wrens. They have a ten-primaried wing, slender bill, inner toe united by at least half its basal joint to the middle toe, and scutellate tarsi. See WREN. F. A. L.

**Trogon'idæ** [Mod. Lat., named from *Tro'gon*, the typical genus, from Gr. τρώγων, pres. partic. of τρώγειν, gnaw, chew]: a family of birds common to the tropical and subtropical regions of America, as well as Asia and Africa, distinguished from all others by having the second as well as the first toe turned backward. The bill is rather short, stout, broad at the base, and rapidly narrowed forward, with the edges more or less toothed: the wings are moderate and rounded; the legs are rather weak; the tarsi short; the tail is more or less elongated and graduated. The species are mostly showy birds of moderate size, which in great part live in the depths of the equatorial forests, often perched on the highest branches. They are believed to subsist to a large extent on fruits and berries, but also prey on insects. They nest in holes in trees, or those abandoned by woodpeckers. The most gorgeous species is the resplendent trogon, or quetzal (*Pharomacrus mocinno*) of Guatemala, which is of a brilliant metallic green above and red below. The scapulars and upper tail coverts are long, the latter extending far beyond the tail feathers and often mistaken for them. About fifty species are known, thirty-five occurring in America, comprised in the genera *Prionoteles*, *Temnotrogon*, *Trogon*, *Leptuas*, and *Pharomacrus* (= *Calurus*); some dozen or more are found in Asia, and form the genus *Harpactes* and its subdivisions; and two species in Africa have been isolated to form the peculiar genus *Hapaloderma*. The family is most nearly related to the *Momotidæ*, *Alcedinidæ* (kingfishers), *Cuculidæ* (cuckoos), and allied forms. Revised by F. A. LUCAS.



Red-bellied trogon.

**Trogus Pompeius**, -pom-pee'yŭs: a Latin author descended from the Gaulish tribe of the Vocontii. His grandfather received the citizenship of Rome from Cn. Pompeius, his father was private secretary to Cæsar, and he himself wrote, in the time of Augustus, a work, *Historiæ Philippicæ*, in forty-four books, based upon Timagenes and other Greek historians, of which there exist a few brief fragments quoted by Vopiscus, Cassiodorus, Servius, Priscian, and others, and a series of excerpts by JUSTIN (*q. v.*); see also Heeren, *Commentationes de Trogi Pompeii ejusque Epitomatoris Justini Fontibus et Auctoritate*, printed in Frotscher's ed. of Justinius (Leipzig, 1827–30). A. v. Gutschmid, *Fleckeisens Jahrbücher*, supplement ii., p. 187; and *Rheinisches Museum*, 37, 548; also Wachsmuth, *Rheinisches Museum*, 46, 465. Revised by M. WARREN.

**Trois Pistoles**, trwaa'pees'tōl': river and town of Quebec, Canada; in Temiscouata County (see map of Quebec, ref. 3–E). The river is a right-hand affluent of the St. Lawrence, is about 50 miles long, discharges several lakes, and has fine water-powers. The town is at its mouth, a station on the Intercolonial Railway, 145 miles N. E. of Quebec, and has some trade in wood and stone. The fishing of the vicinity is excellent. Pop. 2,500. M. W. H.

**Troja**: See TROY.

**Trolley**: See ELECTRIC RAILWAYS.

**Trollope**, trol'ŭp, ANTHONY: novelist; third son of Frances M. Trollope; b. in London, Apr. 24, 1815; educated at Winchester and Harrow; from 1834 to 1867 was connected with the British postal service, for which he made many voyages, and subsequently traveled extensively in the U. S., the West Indies, and Australia. In 1869 he was an unsuccessful candidate for Parliament, in the Liberal interest, for Beverley. He wrote several books of travel and many novels. Most of his later novels were originally published serially and simultaneously in British and American magazines. Among his books, which number about seventy, are *The Macdermots of Ballydoran* (1847); *The Kellys and the O'Kellys* (1848); *La Vendée* (1850); *The Warden* (1855); *Barchester Towers*, his first decided success (1857); *Doctor Thorne*, one of his best works (1858); *The Bertrams* (1859); *Castle Richmond* (1860); *Framley Parsonage* (1861); *Tales of all Countries*, stories which had appeared in various magazines (1861; 2d series 1863); *Orley Farm* (1862); *North America*, a book of travel (1862); *Rachel Ray* (1863); *The Belton Estate* (1864); *Hunting Sketches* (1864); *Can You Forgive Her?* (1865); *Clergymen of the Church of England* (1866); *The Claverings* (1867); *The Last Chronicles of Barset* (1867); *Phineas Phinn, the Irish Member* (1869); *He Knew He was Right* (1869); *Sir Harry Hotspur of Humblethwaite* (1870); *The Vicar of Bullhampton* (1870); *Ralph the Heir* (1871); *The Golden Lion of Granpère* (1872); *Phineas Redux* (1873); *Australia and New Zealand*, a book of travel (1873); *The*

*Way we Live Now* (1874); *The Prime Minister* (1875); a series of *Short Stories* (1876) published simultaneously in England and America; *The American Senator* (1877); *The Duke's Children* (1880); *Dr. Wortle's School* (1881); and a *Life of Cicero* (2 vols., 1881). D. in London, Dec. 6, 1882. An *Autobiography*, begun in 1875 and added to in 1879, was published in 1883. In this he described his methods of work, which were very systematic, and testified that for the last twenty years his books had yielded him nearly £70,000. Trollope's fiction is of the realistic type, honest in purpose, truthful, and solid, but often dull and creeping in style. He excelled in the portrayal of clerical characters and the humdrum life of rural parishes. See ENGLISH LITERATURE.
Revised by H. A. BEERS.

**Trollope**, EDWARD, D. D., F. S. A.: clergyman and author; b. Apr. 15, 1817, the younger son of a baronet; was educated at Eton and at Christ Church, Oxford; graduated in 1839; took holy orders; received successive preferments, becoming archdeacon of Stow and prebendary of Liddington in 1867, and bishop suffragan of Nottingham in 1877. Among his works on architecture, etc., are *Illustrations of Ancient Art* (1854); *Life of Pope Adrian IV.* (1856); *Introduction of Christianity into Lincolnshire* (1857); *Labyrinths, Ancient and Mediæval* (1858); *Fens and Submarine Forests* (1859); *Monastic Gatehouses* (1860); *Life of Hereward, the Saxon Patriot* (1861); *Battle of Bosworth Field* (1862); *Shadows of the Past* (1863); *The Raising of the Royal Standard at Nottingham* (1864); *Spilsby and other Churches* (1865); *Norman Sculptures of Lincoln Cathedral* (1866); *Grantham and other Churches* (1867); *The Roman Ermine Street* (1868); *The Norman and Early English Styles of Gothic Architecture* (1869); *Boston and other Churches* (1870); *Church Spires* (1874); *Little Hugh of Lincoln* (1880).

**Trollope**, FRANCES (*Milton*): author; b. in Hampshire, England, about 1778. She was the daughter of Rev. William Milton, vicar of Heckfield, Hants, and in 1809 contracted an unhappy marriage with Thomas Anthony Trollope, a barrister. In 1829 she went to the U. S. and attempted to establish herself in some kind of business at Cincinnati; failing in this, she returned to England, where she published her *Domestic Manners of the Americans* (1831; new ed. New York, 1894), a broad and rather offensive caricature, which met with great favor in England. She followed up this success by writing a novel, *The Refugee in America* (1832), and entered upon a career of literary activity which lasted more than twenty years, the greater part of her works being novels. About 1844 she went to Italy, where her eldest son was residing, and where she passed the remainder of her life. Among her novels are *The Abbess* (1833); *Tremordyn Cliff*, one of her best (1835); *Life and Adventures of Jonathan Jefferson Whitelaw* (1836; republished in 1857 under the title *Lynch Law*); *The Widow Barnaby* (1839); *The Widow Married* (1840); *The Barnabys in America* (1843); *Father Eustace, a Tale of the Jesuits* (1846); *Petticoat Government* (1850); *Life and Adventures of a Clever Woman* (1854); and *Fashionable Life, or Paris and London*, her last work (1856). D. in Florence, Oct. 6, 1863. Revised by H. A. BEERS.

**Trollope**, THOMAS ADOLPHUS: eldest son of Frances M. Trollope; b. Apr. 29, 1810; educated at Winchester and Oxford; traveled on the Continent; published *A Summer in Brittany* (1840), *A Summer in Western France* (1841), and took up his residence in Florence. In 1873 he left Florence for Rome, where he acted as correspondent for the London *Standard*. In 1888 he returned to England and took up his residence in Devonshire. He was a constant contributor to English literary periodicals, and was the Italian correspondent of *The New York Tribune*. Most of his writings relate directly to Italian history, life, and manners. Among these are *La Beata* (1861); *Marietta* (1862); *Giulio Malatesta* (1863); *Beppo the Conscript* (1864); *History of the Commonwealth of Florence* (4 vols., 1865); *Gemma* (1866); *Leonora Casaloni* (1869); and *Life of Pius IX.* (2 vols., 1877). On subjects not Italian he published *Lindisfarn Chase* (1864); *Artingdale Castle* (1867); *Dream Numbers* (1868); *The Garstangs of Garstang Grange* (1869); *A Siren* (1870); *Durnton Abbey* (1871); *Sketches from French History* (1878); and *What I Remember* (3 vols., 1887–89). D. at Clifton, Nov. 11, 1892. Revised by H. A. BEERS.

**Trolls** [= Icel.; cf. Eng. *droll* and Low Germ. *droll*, troll, droll]: a name often applied to the giants of Scandinavian mythology and to a similar class of beings in modern Scandinavian folk-lore. The trolls of folk-lore are very powerful, and hostile to man. They are regarded as extremely stupid, and hence men usually defeated them in their attempts to capture fair maidens. Princesses taken into the subterranean mansions built of gold and silver easily deceive the credulous trolls, and so make their escape.
RASMUS B. ANDERSON.

**Tröltsch**, Baron ANTON FRIEDRICH, von, M. D.: aurist; b. at Schwabach, near Nuremberg, Germany, Apr. 3, 1829; educated at the gymnasia of Bamberg, Augsburg, and Nuremberg; studied law at Erlangen 1847–48, after which he entered on a course of natural history at Munich; entered the University of Würzburg in 1849, graduating M. D. in 1853; then studied under von Gräfe in Berlin, Arlt in Prague, in Dublin under Wilde, in London under Toynbee, and in Paris in 1855–56. In the early part of the latter year he announced a new method of investigating the inner ear by means of a concave mirror and daylight, a procedure that revolutionized the treatment of aural diseases. In 1861, after five years of study at Würzburg, he qualified himself for the post of docent in aural medicine, and in 1864 he was promoted professor extraordinary in that department; in 1864 founded the *Archiv für Ohrenheilkunde*, the first special journal on ear diseases. The immense progress made in aural surgery since 1860 may be largely ascribed to the influence of his teachings. Among his classic works are *Die angewandte Anatomie des Ohres* (Würzburg, 1860); *Lehrbuch der Ohrenheilkunde* (Würzburg, 1862); and papers in Pitha and Billroth's *Handbook of Surgery* and in Gerhard's *Handbook of Children's Diseases*. D. at Würzburg, Jan. 9, 1890. S. T. ARMSTRONG.

**Trombone** [= Fr. = Ital., augmentative of *tromba*, trumpet]: a large brass wind instrument of the trumpet species, supposed to be the same as the sackbut of early writers. Its peculiarity consists in the facility of deepening the tones by means of sliding tubes, making it one of the most effective instruments in an orchestra. There are three kinds—alto, tenor, and bass.

**Tromp**, MAARTEN HARPERTZOON, van: admiral; b. at Briel in 1597; entered the Dutch navy, and in 1624 was placed in command of a frigate. In 1637 he was made lieutenant-admiral, and in 1639 gained a European fame by his two great victories over the Spanish fleet off Gravelines and in the Downs. He was at first less successful in the war between England and Holland, and, having been defeated by Blake, he even lost his command for some time in 1652. He was soon reinstated, however, and defeated Blake completely in the Downs Dec. 10, 1652 (N. S.). In Feb., 1653, he fought against the combined fleet of Blake, Monk, and Deane, and, though somewhat worsted in the encounter, showed remarkable courage and skill and effected a successful retreat. He fought another indecisive battle in June. In July, 1653, he again attacked the English fleet. The battle lasted two days, but was finally lost by the Dutch; Tromp himself was killed Aug. 8 (N. S.), 1653. He is buried in the church of Delft, where a splendid monument has been erected to him.—His son, CORNELIS TROMP, b. in Rotterdam, Sept. 9, 1629, achieved almost an equal fame, held the highest positions in the Dutch navy, and served with great distinction for some time in Denmark. D. in Amsterdam, May 29, 1691.

**Trompe**: See BLOWING-MACHINES.

**Trom'sö**: port of Northern Norway and one of the most northerly towns in the world; lat. 69° 38′ N., lon. 18° 45′ E.; on the eastern shore of an island of the same name in the Tromsö fiord (see map of Norway and Sweden, ref. 2–G). The town is well built, though of wood, and is in attractive surroundings. It has an ethnographic museum rich in material relating to the Lapps. The port is commodious, and is most frequented by Russians, who come for salt and smoked fish. The fishing industry is active, and is devoted to the herring, cod, hake, seal, and whale. The chief exports are fish, oil, pelts, nickel ore, and eider-down. The town was founded in 1794, but did not become important until the middle of the nineteenth century. Pop. (1891) 6,080 with the commune, but the rural population is very small.
MARK W. HARRINGTON.

**Trona** [Egypt. or N. Afr., perhaps connected with *natron*]: the mineralogical name of a native sodium carbonate, the most common native form of that salt. It has the composition when crystallized $Na_2CO_3.2HNaCO_3.2H_2O$, and is known by the name sodium sesqui-carbonate. It occurs as a natural deposit in Egypt, Africa, South America, and elsewhere.

**Trondhjem**, trond'yem, or **Drontheim**: the ancient *Nidaros*, the oldest town of Norway (founded 996); beautifully situated on the southern shore of Trondhjemsfjord, in lat. 63° 25' N.; 250 miles by rail N. of Christiania (see map of Norway and Sweden, ref. 7–D). Of its cathedral, which once was the largest church-building in Scandinavia, only the choir remains, in which the kings are crowned, but the restoration of the entire cathedral was undertaken by the Government in 1880. Its breweries and distilleries are extensive and celebrated. Much copper, salt and dried fish, oil, and timber are exported. Pop. (1891) 29,162.

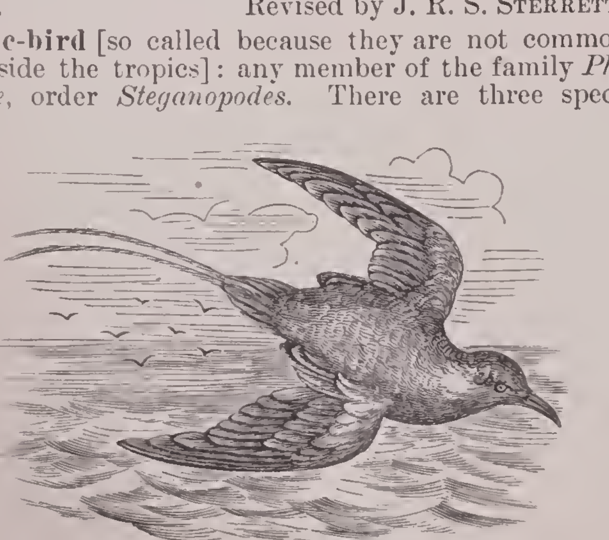
**Troopial** [from Fr. *troupial*, deriv. of *troupe*, troop]: a name used for many of the orioles (*Icteridæ*), and apparently first bestowed on the birds of the genus *Cassicus*, possibly from their associating in flocks or troops. Thus the BOBOLINK (*q. v.*) or rice-troopial, the cow-bunting or cow-troopial (*Molothrus pecoris*), and many others are occasionally called by this vague name. F. A. L.

**Troost**, GERARD, M. D.: geologist; b. at Bois-le-Duc, Holland, Mar. 15, 1776; educated at Amsterdam and Leyden; studied medicine and natural science; served in the army, both as a private soldier and afterward as a medical officer; was enabled by Louis Bonaparte, King of Holland, to devote himself to his favorite studies in Paris, where he translated Humboldt's *Aspects of Nature* into Dutch; embarked in 1809 on a scientific mission to the East Indies, but was taken by a French privateer and carried to Dunkirk; resided a year at Paris; proceeded to the U. S. 1810; settled in Philadelphia, where he was one of the founders and the first president of the Academy of Natural Sciences (1812–17); established at Cape Sable, Md., the first alum-factory in the U. S. 1814; was appointed Professor of Mineralogy in the Philadelphia Museum 1821; settled at New Harmony, Ind., with Owen and McClure 1825; became Professor of Chemistry and Mineralogy in the University of Nashville 1827, and was State geologist of Tennessee 1830–49. D. at Nashville, Aug. 14, 1850. His mineral and geological cabinets were the largest in the U. S. He was the author of geological reports upon Tennessee and upon the environs of Philadelphia (1826), and of numerous contributions to periodicals. Revised by G. K. GILBERT.

**Trope** [from Lat. *tro'pus* = Gr. τρόπος, turn, way, manner, style, trope, deriv. of τρέπειν, turn]: the application of a word or expression to some other than its normal or ordinary use, for the purpose of giving life or impressiveness to a statement. The three principal tropes are METAPHOR, METONYMY, and SYNECDOCHE (*qq. v.*). B. I. W.

**Trophy** [from O. Fr. *trophee* < Lat. *trophæ'um*, *tropæ'um* = Gr. τροπαῖον, monument to commemorate a victory (or defeat of an enemy), liter., neut. of τροπαῖος, pertaining to turning or defeat, deriv. of τροπή, turning, rout, defeat, deriv. of τρέπειν, turn]: among the ancient Greeks a memorial erected on the battle-field by the victors on the spot where the enemy turned to flight or retreat. Originally, trophies were of wood or of simple armor affixed to a tree. It was equally unlawful to destroy or repair a trophy, since it was very justly considered unwise to perpetuate hostile feelings. In later times the Romans adopted the custom of erecting trophies. Revised by J. R. S. STERRETT.

**Tropic-bird** [so called because they are not commonly seen outside the tropics]: any member of the family *Phaëthontidæ*, order *Steganopodes*. There are three species,



Tropic-bird.

somewhat larger-bodied than a pigeon, having the plumage white with fine black markings above, pure white or rosy below; the bill is red or yellow, feet dark. The two central tail-feathers are much longer than the others, and from their faint suggestion of a marlinspike these birds have been dubbed boatswain-birds by sailors. The two species of the Atlantic, *Phaëthon æthereus* and *P. flavirostris*, occur occasionally on the southern coasts of the U. S. F. A. L.

**Tropics**: See SOLSTICE, CAPRICORN, and CANCER.

**Troplong**, tro'lōṅ, RAYMOND THÉODORE: jurist; b. at St.-Gaudens, department of Haute-Garonne, France, Oct. 8, 1795; practiced as an advocate; held various judicial positions; was made a peer of France in 1846, president of the court of Paris in 1848, a senator and president of the court of cassation in 1852; and president of the Senate in 1854. D. Mar. 2, 1869. His principal work is *Code civil expliqué* (28 vols., 1833–58), parts of which—*Des Privilèges et Hypothèques* (4 vols.), *De la Vente* (2 vols.), *De la Prescription* (2 vols.), *Du Contrat de Mariage* (4 vols.), *Des Donations* (4 vols.)—have been published separately, and often reprinted. Revised by F. STURGES ALLEN.

**Troppau**, trop'pow: capital of Silesia, Austria; on the Oppa; 184 miles by rail N. E. of Vienna (see map of Austria-Hungary, ref. 3–G). It is fortified, contains many fine buildings, and is generally well built. Its manufactures comprise woolen and linen fabrics, soap, leather, beetroot sugar, and ironware, and its trade is very active. A congress of representatives of the five great powers was held here in Oct., 1820, to consider measures for the suppression of the revolutionary outbreaks in Italy. No action was taken, and the congress adjourned in November, resuming its session at Laibach in Jan., 1821. Pop. (1890) 22,867.

**Trot**: See GAITS.

**Trotz'endorf**, VALENTINE (real name FRIEDLAND): educator; b. at Trotzendorf, Germany, Feb. 14, 1490; studied at Wittenberg, where he joined the Reformers and was a pupil of Melanchthon; rector (1523–27, 1531–54) of the Latin School at Goldberg, which became under his direction one of the most famous classical schools of the age. He anticipated somewhat the monitorial system of Bell and Lancaster, and introduced a successful plan of student self-government. D. at Liegnitz, Apr. 26, 1556. See Barnard, *German Teachers and Educators*; Williams, *History of Modern Education*. C. H. THURBER.

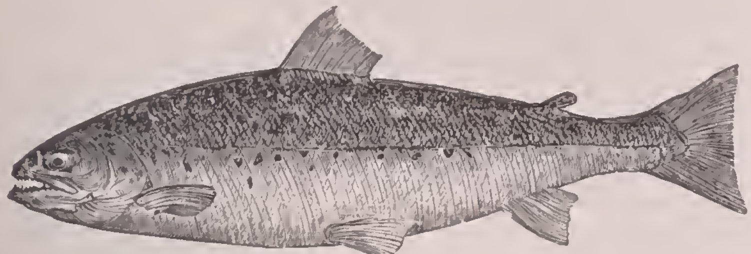
**Troubadours**: See TROUVÈRES.

**Troup**, ROBERT, LL. D.: soldier and lawyer; b. in New York in 1757; graduated at Columbia College 1774; studied law under John Jay; entered the Revolutionary army as lieutenant 1776; became an aide to Gen. Woodhull; was taken prisoner at the battle of Long Island; confined in the prison-ship Jersey and the provost prison, New York; exchanged in 1777; became aide to Gen. Gates at Saratoga; was secretary to the board of war 1778-79; studied law at Princeton under Judge Patterson; was for several years U. S. district judge in New York and member of the Legislature; was an intimate friend of Hamilton, and during his later years resided at Geneva, N. Y., as agent of the great Pulteney estate; published occasional political pamphlets. D. in New York, Jan. 21, 1832.

**Trous-de-loup**: See FORTIFICATION (*Field Fortification*).

**Trout** [O. Eng. *truht*, from Lat. *trūc'ta* (>Fr. *truite*), from Gr. τρώκτης, a sea-fish, liter., gnawer, deriv. of τρώγειν, gnaw]: a name given to several fishes, but originally applied to the trout of England and Northern Europe (*Salmo fario*), and properly used for members of the family *Salmonidæ* only. Trout are mainly restricted to fresh waters, where they reside the year around, not, like salmon, merely visiting fresh water to spawn; but some, like the sea-trout of Labrador (*Salvelinus stagnalis*), may have the same habits as the salmon, while others which thrive in landlocked waters visit the sea when opportunity offers. Trout are all naturally inhabitants of the northern hemisphere only, but some species have been introduced into such southern localities as New Zealand and Australia. They are active and powerful, and on this account, as well as for their beauty and fine flavor, are favorites with anglers. They reside in clear cold streams and lakes, and are among the most northern species of fresh-water fishes. They feed on small fishes, insects, and larvæ, those of the mosquito forming a considerable portion of their food in the lakes of Greenland.

The trout of Europe (*Salmo fario*) belongs to a group having teeth on the body of the vomer as well as on the anterior portion. The scales are quite small, about 120 along the lateral line; the body and head are usually thickly marked with more or less irregular red and black spots, and the anterior edges of the dorsal, anal, and ventral fins are yellowish. The species reaches a length of 30 inches. The brook-trout (*Salvelinus fontinalis*) of the U. S. represents a genus in which there are no teeth on the body of the vomer,



The salmon-trout (*S. trutta*).

these fishes being termed charrs by English naturalists. The scales are minute, numbering something like 200 on the lateral line; there are numerous yellowish spots and many vermilion dots on the body, and the dorsal is marked with dark spots. The ventrals and anal are edged with white, preceded by a dark bar. This species has been known to attain a weight of 7 to 12 lb., but this is very unusual, the American trout averaging much smaller than the European. There are about a score of species in North America, to which the term trout is applied, but only eight belong to the genus *Salvelinus*. The salmon-trout of Europe is *Salmo trutta*, a species residing in salt water and ascending rivers. The salmon-trout or lake-trout of North America is *Salvelinus namaycush*, a large species restricted to fresh water. The rainbow trout (*Salmo irideus*) and Dolly Varden trout (*Salvelinus malma*) occur on the Pacific slope. In the southern parts of the U. S. the name is applied to the weakfish (*Cynoscion*) and to the black bass (*Micropterus*). See BULL-TROUT, CHARR, CUT-THROAT TROUT, DOLLY VARDEN, and NAMAYCUSH. F. A. LUCAS.

**Trouvères**, troo'vãr' [plur. of *trouvère* = Fr. : Prov. *trobador* (whence Fr. *troubadour*, whence Eng. *troubadour*), deriv. of *trobar* : Fr. *trouver*, find. The strict Mod. Fr. form should be *trouveur*, which is preferred by many scholars]: the courtly lyric poets of mediæval France, who must be sharply distinguished from the popular poets, the *jongleurs*, to whom was due the composition of the *chansons de geste* and of the earliest indigenous French lyric poetry. The beginning of courtly poetry in France proper is to be put about the middle of the twelfth century, and the inspiration to it was almost exclusively Provençal. The event which more than any other brought together Provence and France was the marriage of the famous Eleanor of Poitiers (later wife of Henry II. of England) to Louis VII. of France, in 1137. The granddaughter of the first of the *troubadours*, William VII. of Poitiers, this gay and brilliant woman carried with her to France the chivalrous practices and the amorous poetry of the south. Her court and later that of her daughter, the Countess Marie of Champagne, at Troyes, became centers from which the ideas and the poetical forms of the *troubadours* proper diffused themselves through Northern France.

The poetry of the *trouvères* falls into two decidedly distinct periods: the first, that of direct imitation of Provençal poetry, including the twelfth and thirteenth centuries; the second, that of modification and development of this earlier manner along original lines, reaching from the beginning of the fourteenth century down to the Renaissance (about 1550). The chief representatives of the first period are Chrestien de Troies, Conon de Béthune (d. 1224), Gace Brulé, Blondel de Nesle, Guy de Couci (d. 1203), Gautier d'Espinaus, Gontier de Soignies, and, perhaps most famous of all, Thibaut de Champagne, King of Navarre (d. 1253), whom Dante mentions in his *De vulgari eloquio* (i., 9; ii., 5, 6) among the exemplary poets of love. The second period was opened by Guillaume de Machaut, who introduced important musical innovations, and brought elaborate and artificial poetical forms, the *ballade*, the *chant royal*, the *rondeau* (*triolet*), the *lai* with twelve strophes, into favor. The new style was cultivated by Eustache Deschamps (d. about 1410), later by Froissart, Christine de Pisan, Charles d'Orléans, and others. It was finally superseded by the classical and Italianizing manner of which Ronsard and the Pléiade were the aggressive champions. See PROVENÇAL LITERATURE. A. R. MARSH.

**Trover** [from O. Fr. *trover* > Fr. *trouver*, find]: the common-law form of action by which damages are recovered for the *conversion* of chattels. It was originally designed for the particular case of the defendant's *finding* a thing belonging to another, and appropriating it to his own use; whence the plaintiff's pleading necessarily contained an averment of the loss and finding—in law French, *trouver*. See CONVERSION.

**Trowbridge**: town; in Wiltshire, England; on the Biss; 12 miles by rail S. E. of Bath (see map of England, ref. 12–G). There is a fine Perpendicular church (1475) and a town-hall opened in 1889. Woolen cloth, cassimeres, kerseys, and tweeds are manufactured. Pop. (1891) 11,717.

**Trowbridge**, EDMUND: lawyer; b. at Newton, Mass., in 1709; graduated at Harvard 1728; became a lawyer of great eminence; was appointed attorney-general of Massachusetts 1749; was for several years a member of the council, but lost favor with the popular party in 1766 on account of lukewarmness in resisting British aggressions; became chief justice of the Supreme Court 1767; presided with great fairness at the trial of the British soldiers charged with the "Boston massacre" 1770, and resigned his office 1772 in consequence of the impending conflict with England, and remained in seclusion during the Revolution. D. at Cambridge, Mass., Apr. 2, 1793.

**Trowbridge**, JOHN: physicist; b. in Boston, Mass., Aug. 5, 1843; graduated at the Lawrence Scientific School of Harvard University in 1866, and continued as tutor there until 1869, when he became Assistant Professor of Physics in the Massachusetts Institute of Technology. In 1870 he returned to Harvard to establish the laboratory course of instruction in physics, out of which has been developed the Jefferson Physical Laboratory, which has become one of the largest and best-equipped laboratories of its kind in the U. S. He became Professor of Experimental Physics in 1880, and was in 1888 given the Rumford chair of the Application of Science to the Useful Arts, succeeding Dr. Wolcott Gibbs, who had been made emeritus. Prof. Trowbridge has devoted much time to original research, and his many investigations have been issued chiefly as *Contributions from the Physical Laboratory of Harvard College*. These have included the demonstration of the existence of platinum and carbon in the sun, and a study of the so-called oxygen lines in the solar spectrum. In electricity, to which he has devoted much attention, he is well known for his invention of the closed magnetic circuit transformer, which is in general commercial use in the alternate-current system of electric lighting; for his researches on the damping of electric waves on iron wires; and for his photographic studies of electrical oscillations, including a new determination of the velocity of electrical waves. The degree of S. D. was given to him by Harvard in 1873, and in 1878 he was elected to the National Academy of Sciences; also in 1884 he presided over the physical section of the American Association for the Advancement of Science. Besides his scientific papers he was one of the editors of the *Annals of Scientific Discovery for 1869* (Boston, 1870) and since 1879 has been an associate editor of *The American Journal of Science* in the department of physics. He is the author of *The New Physics* (New York, 1884) and *What is Electricity?* (1896). M. B.

**Trowbridge**, JOHN TOWNSEND: author; b. at Ogden, N. Y., Sept. 18, 1827; after teaching and working on a farm, settled in New York 1846 as a writer for periodicals; removed in 1847 to Boston, where he has since resided; became editor of *The Yankee Nation* 1850; wrote many popular tales for the young over the signature *Paul Creyton;* has been a prominent contributor to the *Atlantic* and other magazines; was editor of *Our Young Folks* (1870–73); has published many works of adventure, travel, and fiction, including *Father Brighthopes* (1853); *Neighbor Jackwood* (1857); *Cudjo's Cave* (1863); *The Drummer Boy* (1863); *The South* (1866); *The Vagabonds, and other Poems* (1869); *Lawrence's Adventures* (1870); *Coupon Bonds, and other Stories* (1871); *The Emigrant's Story, and Other Poems* (1875); *The Lost Earl, and other Poems* (1888); *The Satinwood Box*; etc. Revised by H. A. BEERS.

**Trowbridge**, WILLIAM PETIT, Ph. D., LL. D.: scientist and engineer; b. in Oakland co., Mich., May 25, 1828; graduated first in his class at the U. S. Military Academy 1848. Soon after his graduation, he was ordered back to the academy as assistant in the astronomical observatory, where he fully prepared himself for duty on the Coast Survey, to which, at his own request, he was ordered. In this survey he at first acted as assistant to Prof. Bache in the primary triangulation of the coast of Maine, which in 1852 was placed under his immediate charge. In 1853 he was ordered to the Pacific coast to conduct a series of magnetic and tidal observations extending from San Diego to Puget Sound, a work which occupied three years. He was promoted to the rank of first lieutenant in 1854, and two years later accepted the professorship of mathematics in the University of Michigan, but in 1857 accepted a permanent office on the Coast Survey. Upon the breaking out of the civil war he was assigned to the duty of preparing minute descriptions of the harbors, inlets, and rivers of the Southern coast for the use of the navy. In 1862 he was ordered to execute a hydrographic survey of Narragansett Bay, where there was a design to erect a navy-yard, but the results of the survey were not favorable to the project. He was subsequently transferred to the War Department, and was during the remainder of the war in charge of the branch office of the engineer department in New York. He was Professor of Dynamic Engineering in the Sheffield Scientific School, Yale College, 1870–77; adjutant-general of Connecticut 1872–76; and in charge of the engineering department of the School of Mines, Columbia College, from 1877 to his death at New Haven, Conn., Aug. 12, 1892. He was elected to the National Academy of Sciences in 1878, and was a well-known contributor to the leading scientific journals, and author of *Steam Generators*, *Heat as a Source of Power* (1874), and other works. He is said to have been the first engineer to suggest the idea of the cantilever bridge.

Revised by C. H. THURBER.

**Troy**, **Troja**, or **Il'ium**: the scene of the Homeric *Iliad*, and the metropolis of the Troad, the coast region extending from Cape Lectum on the Ægean to Dardanus and Abydus on the Hellespont. The Troad comprised a broad, undulating plain sloping from the foot of Mt. Ida to the sea, and traversed by the rivers Scamander and Simoïs. This plain was densely peopled by a mixed race of Pelasgians and Phrygians, and contained many cities (Achilles boasts of having destroyed eleven), of which, however, Troy was by far the most splendid and powerful. Troy was founded by Ilus, the son of Tros, the grandson of Dardanus, and developed rapidly and magnificently; legend tells how, under Laomedon, the son of Ilus, Poseidon himself built its walls. It had a fortified acropolis, called Pergamum, which overlooked the town proper, and contained the temples of the gods and the royal palaces. Under Priam, the son of Laomedon, it reached its highest splendor and experienced its downfall. Priam's son, Paris, carried off Helen, the wife of Menelaus, and in order to punish this outrage a Greek army landed in Troas, besieged Troy for ten years, and finally destroyed it, though the Trojan state, the kingdom of Troy, seems to have continued to exist for several centuries after the destruction of its capital. The exact site of the city is disputed. According to the Homeric description it was not situated in the plain, but stood on a hill between the Scamander and the Simoïs, which united in front of it. In ancient times it was generally believed that New Ilium, a city of little importance on the right bank of the Scamander, and of which some ruins are still extant near the present village of Hissarlik, occupied the same site as Old Ilium. When this New Ilium was founded is not known. It stood on a low spur of Mt. Ida, separating the basins of the Scamander and the Simoïs. In the time of Alexander the Great it existed, and by the partiality which Sulla showed for it, it even became prosperous. There were, however, even in antiquity, scholars who doubted the identity of the sites of New and Old Ilium; as, for instance, Strabo, who moved the site of Old Ilium several miles farther inland to a village called Ilium. In 1785 Lechevalier discovered at the village of Bunarbashi, on the left bank of the Mendereh, 5 miles S. of New Ilium, a hot and a cold spring which corresponded to those mentioned in the *Iliad*, and some ruins on the hill of Balidagh, beyond the springs, which he identified as the remains of the citadel of Pergamum. Although further excavations did not bring to light any marked traces of a great city, the views of Lechevalier were generally accepted by classical scholars. (See Lechevalier, *Voyage de la Troade*, 3 vols.) Later scholars have returned to the views of antiquity since the extensive excavations of Schliemann at Hissarlik (1871–73, 1876–1878, 1879, 1882). See Schliemann's *Ilios* (London, 1879), but better Schuchhardt's *Schliemann's Excavations* (London, 1891), pp. 17–92, and Perrot and Chipiez's *History of Art in Primitive Greece* (London, 1894), pp. 154–254.

Revised by J. R. S. STERRETT.

**Troy**: city; capital of Pike co., Ala.; on the Ala. Mid. and the Cent. of Ga. railways; 74 miles S. by E. of Montgomery, and 85 miles S. W. of Columbus (for location, see map of Alabama, ref. 6–E). It is an important cotton-trade center, and contains 2 private banks and a daily and 2 weekly newspapers. Pop. (1890) 3,449; (1900) 4,097.

**Troy**: city; capital of Lincoln co., Mo.; on the St. L. and Hannibal Railway; 15 miles W. of the Mississippi river, and 55 miles N. W. of St. Louis (see map of Missouri, ref. 3–I). It is in a region containing coal, iron, glass-sand, and other mineral deposits, and rich farm lands, and has a high school, 2 State banks, a weekly newspaper, flour-mill, and several tobacco-factories. Pop. (1890) 971; (1900) 1,153.

EDITOR OF "FREE PRESS."

**Troy**: city (chartered in 1816, enlarged by annexation in 1901); capital of Rensselaer co., N. Y.; at the head of steamboat navigation on the Hudson river, and on the Del. and Hudson, the Boston and Maine, the N. Y. C. and Hud. River, and several local railways; 150 miles N. of New York (for location, see map of New York, ref. 5–K). It is at the junction of the Hudson and Mohawk rivers; is laid out regularly with streets generally 60 feet wide; and is surrounded by the municipalities of Watervliet, Green Island, Cohoes, and Waterford, whose people are largely employed in Troy and whose local enterprises are chiefly carried on by Troy capital. The city is noted for its extensive industries, which include laundrying and the manufacture of iron, steel, stoves, ship-chains, cotton cloth, knit goods, laundry machinery, valves, horse-shoes, bells, fire-brick, paint, paper, engineering instruments, brushes, oilcloth, and linen shirts, collars, and cuffs. Troy has more than 25,000 persons and $9,000,000 capital employed in the shirt, collar, cuff, and laundry industries, and makes $1,000,000 worth of valves yearly.

There are 63 churches and chapels, of which 11 are Methodist Episcopal, 11 Roman Catholic, 15 Presbyterian, 8 Protestant Episcopal, 6 Baptist, 3 Jewish, 1 Church of Christ, 1 Christian Science, 1 Congregational, 1 Unitarian, 1 Universalist, and 4 Lutheran. The public-school system comprises a high school and 21 grammar schools, and has property valued at nearly $800,000. The most widely known educational institution is the Rensselaer Polytechnic Institute, which was founded in 1824 by Stephen Van Rensselaer, and incorporated in 1826 under the name of the Rensselaer School. It was established as a school of practical science. Much of its early success was due to its first principal and senior professor, Amos Eaton, well known at that time as a scientific investigator and teacher. In 1832 its name was changed to Rensselaer Institute; in 1835 a department of civil engineering was opened; in 1850 the curriculum was completely reorganized; and in 1861 the Legislature sanctioned a change to its present name. Courses in natural science, electrical engineering, and civil engineering have been added since. It has 17 instructors, 215 students, 5,000 volumes in its library, and nearly 1,100 living graduates.

The second institution of note is the Emma Willard School, founded by Emma Willard in 1821, and enlarged in 1895 by a donation of $150,000 by Russell Sage, and by a Gurley Memorial building and a Plum Memorial building. Other schools are the Troy Academy, the St. Joseph's Academy, the La Salle Institute, and the St. Peter's Academy.

The charitable and benevolent institutions include the Church Home (Protestant Episcopal), Day Home, Home for the Aged Poor, House of the Good Shepherd, Marshall Sanitarium, Presbyterian Church Home, Troy Hospital, Samaritan Hospital, Troy Orphan Asylum, Troy Male Orphan Asylum (Roman Catholic), three houses of the Sisters of Charity, the Young Men's Association, with a free library of 40,000 volumes, the Young Men's Christian Association, the Mohawk and Hudson Humane Society, and a Young Woman's Association.

Troy has large business interests aside from its manufactures. Four-fifths of all the merchandise carried on the Erie and Champlain Canals enters into and is discharged from the canals at this point. The city has a daily line of passenger steamers to New York and daily lines of water transportation to the principal Atlantic coast cities. The U. S. Government has a building for post-office, court, and other Federal purposes, constructed at a cost of $500,000. Has a State armory valued at $250,000; and the Earl crematory in Oakwood Cemetery cost $400,000, and is the finest in the world. There are 9 national banks with combined capital of $2,000,000, 2 savings-banks with aggregate deposits of over $8,000,000, and a private bank. The city has an assessed valuation of $59,000,000, and a net debt of $1,300,000.

The city was distinguished for its patriotism during the war of 1861–65, and the remains of three celebrated major-generals in the Union army, John E. Wool, George H. Thomas, and Joseph B. Carr, rest in its beautiful Oakwood Cemetery. The grave of Gen. Wool is marked by an obelisk with a shaft 75 feet high. A soldiers' monument, 90 feet high, is on Washington Square. Pop. (1880) 56,747; (1890) 60,956; (1900) 60,651. JAMES H. POTTS.

**Troy**: village; capital of Miami co., O.; on the Miami river, the Miami and Erie Canal, and the Cin., Ham. and Dayton and the Cleve., Cin., Chi. and St. L. railways; 80 miles N. by E. of Cincinnati (for location, see map of Ohio, ref. 5–C). It is in an agricultural region, and contains a public high school, a public-school library, 2 national banks with combined capital of $300,000, a daily and 5 weekly newspapers, several iron-foundries, planing-mills, and bentwood and buggy factories. Pop. (1890) 4,494; (1900) 5,881.

**Troy**: borough (founded in 1802, incorporated in 1845); Bradford co., Pa.; on the North. Cent. Railway; 25 miles S. of Elmira, N. Y. (for location, see map of Pennsylvania, ref. 2–G). It has public, high, and graded schools; Baptist, Methodist Episcopal, Presbyterian, Protestant Episcopal, Disciples, Roman Catholic, and Universalist churches; water-works, electric lights, farmers' club, with extensive fair-grounds, large creamery, 3 flour-mills, 2 tanneries, 2 foundries, 2 carriage-factories, 2 planing-mills, marble-works, engine-shops, furniture-factory, 2 hotels, 2 banks, and 2 weekly newspapers. It is the center of a noted butter-making region. Pop. (1880) 1,241; (1890) 1,307; (1900) 1,450. EDITOR OF "GAZETTE."

**Troyes**, trwaa: capital of the department of Aube, France; on the Seine; 104 miles E. S. E. of Paris by rail (see map of France, ref. 4–G). The town has many splendid buildings, but is in general an old-fashioned place, partly in a state of decay, partly rebuilding. Its old ramparts have been changed into promenades, and of its many churches that of St. Urbain and the cathedral are remarkable. It has a library of 110,000 volumes, a museum, and a normal school and other educational institutions. Cotton fabrics, cloths, bombazines, calicoes, prints, lace, and hosiery are extensively manufactured; also wax, leather, paper, and sausages. Being the center of a fertile and well-cultivated district, its general trade is very active. It has given its name to an important treaty concluded here between Henry V. of England and Charles VI. of France in 1420. See TREATIES. Pop. (1896) 52,998. Revised by M. W. HARRINGTON.

**Troyon**, trwā̈a'yōn', CONSTANT: landscape and animal painter; b. at Sèvres, France, Aug. 25, 1810; d. in Paris, Feb. 21, 1865; pupil of Riocreux and Poupart; studied later with Roqueplan, and began to exhibit landscapes about 1836. He visited Holland in 1847 and studied the works of the Dutch masters in the museums. He received a third-class medal at the Salon of 1838; second-class 1840; first-class 1846 and 1848, and at the Paris Exposition of 1855; Legion of Honor 1849. He introduced cattle in his landscapes after about 1848, and painted them, as well as sheep, with great knowledge and admirable simplicity. His pictures rank with those of his contemporaries Corot, Daubigny, Rousseau, Diaz, and Millet, among the finest works of the modern French school. He was a colorist of great strength, and his pictures are composed with nobility and grandeur of line. *Morning* and *Evening*, both large canvases, are in the Louvre, and so also is a fine example, *Return to the Farm.* One of his finest works is *The Valley of La Touque*, painted in 1853, which belongs to the Goldschmidt estate, Paris, and was exhibited at the Retrospective Exhibition in Paris in 1889. Many fine works by Troyon are in the U. S. In the Wolfe collection, Metropolitan Museum, are *Cow* and *Landscape and Cattle.* WILLIAM A. COFFIN.

**Troy Weight**: See WEIGHTS AND MEASURES.

**Trüb'ner**, NICOLAS: bookseller and bibliographer; b. at Heidelberg, Germany, June 12, 1817; settled in early life in England; became a bookseller and publisher in London 1852, in which capacity he rendered eminent service to American bibliography, as well as to Oriental and comparative philology, and was himself distinguished for linguistic attainments, especially in Sanskrit and Basque. He published a *Bibliographical Guide to American Literature* (1855; 2d ed. 1859); issued many elaborate sale-catalogues containing important bibliographical data; and edited Dr. Ludewig's posthumous *Literature of American Aboriginal Languages* (1858). He was also a frequent contributor to periodicals. D. in London, England, Mar. 30, 1884.

**Truce**, or **Armistice** [*truce* < M. Eng. *trewes*, plur. of *trewe*, pledge < O. Eng. *trēow*, troth, faith]: a temporary stoppage of hostilities contemplating a longer duration and a wider application than the brief cessation of hostilities at a particular place or for a particular purpose which is called a suspension of arms. A truce implies a return to a state of war, while a peace presupposes that the causes of war have been removed. The former, however, though limited usually in terms, as for a certain time or to secure a certain object, may actually outlast the latter. The cessation of hostile operations may apply to an individual only, through a flag of truce, a passport, or a safe conduct; or it may apply to the whole or a portion of the armies of the belligerent. A flag of truce, a white flag to which attention is called by the sound of a trumpet, is used to open negotiation for any cause during hostilities. There is no obligation to receive it, and in the midst of a battle it may be that injury is done to its bearers inadvertently; nevertheless by law and usage they are inviolable. Of course the flag of truce must not be employed to spy out an enemy's position or to delay a battle until reserves can be brought up; a belligerent can take measures to prevent such abuses.

A truce is *partial* if it relates to a particular district or military force, *general* if it relates to all the forces and the military operations of belligerents in their entire extent. The latter can only be made by the sovereign power of a state. A truce is binding from a certain declared date. If military operations are carried on in widely separated regions, the beginning of a truce may be set at different times for various places, to allow for spreading the news of it. But a force is bound by knowledge arriving prior to such time, and, on the other hand, if war has been carried on subsequent to the date set for the truce, but in ignorance of its existence, compensation for damage inflicted is not due, though property and prisoners captured during this interval must be restored.

*Acts Lawful during a Truce.*—The theory of a truce is that neither party shall be helped in his military operations by it; that such affairs shall be in the same position at its end as at its beginning. But this principle is not carried out so fully as to forbid those operations which could have been carried on without military interference had no truce existed. Thus in the case of a besieged town or fortress, nothing can be done during a truce by either party which the other, by his guns or his forces, was in a position to prevent, but fortifications not under fire could be built or strengthened, and supplies could be brought in by ways beyond the other's control. With regard to revictualing a besieged place, a truce should specify what rule is to be adopted. The allowance of a supply of provisions equal to the amount consumed during the truce would seem to be necessary to put the parties at its termination into the same relative position, for, if the reduction of a place was being attempted by starvation, to bar out provisions would be directly in line with the plan of campaign. Yet, on the other hand, provisions under such circumstances are really material of war; their introduction is unlawful if impossible but for the truce; and the policy of a truce is to be decided with this fact in view. In November of 1870 an armistice was proposed between the French army in Paris and the Germans besieging it, which turned on just this point. Bismarck declined to allow a supply of provisions for a time equal to the truce to be passed through the German lines, and so the negotiations fell through. No changes have been made in the rules governing truces of late years, the articles on this topic in Lieber's code, which governed the U. S. armies in 1863, and those of the Brussels conference in 1875 agreeing with what is here laid down.

Two or three minor rules remain to be mentioned. Violation of a truce by one party causes its immediate termination. So, too, if made for a definite time, and that time has expired, hostilities are resumed without further notice.

Finally, a truce is a form of treaty and to be similarly interpreted. See also INTERNATIONAL LAW and TREATIES. THEODORE S. WOOLSEY.

**Truce of God** (*treuga Dei*): in the Middle Ages, an institution which sprang up in France and Germany by which nobles and princes bound themselves to keep the peace, to abstain from unlawful wars, and to protect clerics, women, merchants, pilgrims, peasants, and other non-combatants.

In the council of Charroux in 989 the Church decreed a special peace to the unarmed clerk and laborer (*pax ecclesiæ*). This attempt to check violence extended throughout France during the opening years of the next century and was in part successful, but the task of maintaining a general peace was hopeless and the Church contented itself with limiting the feudal warfare. Accordingly, at the synod of Tuluges in 1027 it was decreed that warfare should be suspended from Saturday till Monday. This was afterward extended to the interval from Wednesday evening to Monday morning in every week and to nearly all the more important fasts, feasts, and holy seasons of the Church. England and Italy adopted the custom, which was confirmed by several church councils, among which were the second and third Lateran Councils (1139 and 1179). The final triumph of legal over feudal government did away with this institution and with the necessity for it.

**Truckee′**: town; Nevada co., Cal.; on the Truckee river, and the South. Pac. Railroad; 120 miles N. E. of Sacramento, the State capital (for location of county, see map of California, ref. 5-E). It is the center of an extensive timber region, and is principally engaged in cutting and manufacturing lumber. Pop. (1880) 1,147; (1890) 1,350; not returned separately in 1900. EDITOR OF "REPUBLICAN."

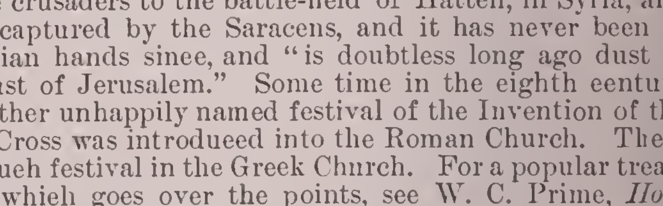
**Trudel**, FRANÇOIS XAVIER ANSELME, Q. C.: Canadian senator, and editor; b. at Ste. Anne de la Pérade, Quebec, Apr. 29, 1838; educated at Nicolet College, and admitted to the bar in 1861. He was editor of *La Minerve*, Montreal, in 1860; is the founder, coproprietor, and editor of the daily newspaper *L'Étendard*, the monthly *La Revue Canadienne*, and the weekly *L'Ouvrier*. He represented Champlain in the Quebec Assembly 1871–73, and was appointed a Canadian senator in the latter year. He was one of the authors of the *Programme Catholique* in 1871, and has written largely on politics and other subjects. NEIL MACDONALD.

**Trueba y Quintana**, troo-ā'baā-ee-keen-taa'naā, ANTONIO, de la; novelist and poet; b. in the Basque village of Montellana, Spain, Dec. 24, 1821. Sent to Madrid to prepare for a mercantile life, he entered the university, and soon gave himself up entirely to literature. In 1862 Queen Isabella made him archivist of Biscay and *Poeta de la Reina*. The former office he lost through the revolution of 1868. D. in Madrid, Mar. 10, 1889. His poems, which are collected in the *Libro de los Cantares* (Madrid, 1852, etc.), are in the main concerned with his native district, and are marked by depth of feeling and mournfulness of tone. They are very popular in Spain. As a novelist he wrote many pleasant little tales of country life that have found ready appreciation. Among them are *Cuentos de color de rosa* (1859); *Cuentos campesinos* (2d ed. 1862); *Cuentos de vivos y muertos* (1866); *María Santa* (1874); *Cuentos de varios colores* (1874); *Narraciones populares* (1875); *Cuentos de madres é hijos* (1879); *Nuevos cuentos populares* (1880). In the *Cid Campeador*, the *Redentor moderno*, and a few other stories, he has essayed the historical novel. Among his later works are *Arte de hacer versos* (1881); *De flor en flor* (1882); *El gabán y la chaqueta* (1884). J. D. M. FORD.

**True Cross**, or **Holy Rood** [*rood* is O. Eng. *rōd*, cross: Germ. *rute*, staff]: the cross on which Jesus was crucified, alleged to have been discovered by Helena, mother of the Emperor Constantine, in Jerusalem, during her visit in 326, in a cave which now is covered by the Church of the Holy Sepulchre. The story as first told further stated that the three crosses were found lying together, but the true cross was known because it raised to life a dead man who was touched by it. The title on the cross of Jesus was found, and also the four nails. Two of them were used by Constantine in his bridle, and another in the head of his statue, while the fourth, dropped by Helena into the sea on her return voyage, calmed a storm which was then raging. The tale is told with variations upon each of the points mentioned. In itself it is one of the most remarkable legends in church history. That the location of the tomb of Jesus had been traditionally identified from the earliest times is not improbable; and that, in removing the structures which had been put upon it in order that Constantine might build a church in front of the holy sepulchre, a cave was found in which was wood which was honestly believed to have been that of the true cross, may be accepted as the basis of the story which afterward received many embellishments. It is incredible that Helena was an impostor, and there is no necessity for adding to Constantine's other crimes that of deliberately deceiving his aged and pious mother. But honesty requires the acknowledgment that there is no contemporary proof that Helena had anything to do with the discovery, or that the cross was discovered in her time, for the earliest witness, the Bordeaux pilgrim to Jerusalem in 333, in his itinerary, only seven years after Helena's visit, says nothing about her in the discovery of the cross (*Itinera*, ed. Tobler, Geneva, 1879, p. 18); nor does Eusebius in his *Life of Constantine*, written in 338, wherein he expatiates upon Helena's visit to Jerusalem and her church-building (iii., xlii.–xlvi.), say anything about her discovery of the holy sepulchre, much less of the true cross. The first mention of the true cross is by Cyril of Jerusalem in his *Catechetical Lectures*, written in 348, who says, "the whole world has been filled with pieces of the wood of the cross" (iv., 10); "the holy wood of the cross bears witness, seen among us to this day and from this place, now almost filling the whole world, by means of those who in faith take portions from it" (x., 19); "the wood of the cross confutes [him if he denied the Passion], which was afterward distributed piecemeal from hence to all the world" (xiii., 4). But he makes no mention of Helena, nor gives any details of the discovery of the true cross. From Cyril, however, we do learn that the true cross was commonly believed to have been discovered, and that pieces of it were even then distributed. Chrysostom in 387, in his *Contra Judæos et Gentiles quod Christus sit Deus* (ed. Migne, *Pat. Gr.*, xlviii., 826), speaks of the desire to possess portions of the true cross, and how they were encased in gold. Sulpicius Severus (*Sacred History*, ii., 34), writing in 395, is the first one to tell of the discovery of the true cross, and he connects it with Helena, and says that it was known because it restored a dead man to life. Ambrose, in a highly rhetorical and irrelevant passage in his oration on the death of Theodosius, delivered in 395, expatiates upon Helena's discovery of the true cross (*De Obitu Theodosii*, ed. Migne, *Patrologia Latina*, xvi., 1399–1402). The story having been thus started, it was repeated in different forms by later writers. Helena was without further question accepted as the discoverer, and the true cross was set up in the church Constantine built, which was dedicated 335. Part, however, she sent to Constantine, who directed that it be put in a statue he was erecting in Constantinople. The title was sent to Rome and there put in the basilica of Santa Croce in Gerusalemme, specially erected by Constantine in 331. It is still shown on Easter Sunday. Portions, generally mere splinters, were sold to persons of eminence or wealth. It is a common jibe that enough fragments of the true cross are shown as relics to make a dozen crosses. But as a matter of fact it is not so, but rather all of these pieces together would not make a piece of any size. On July 5, 1187, the true cross was carried by the crusaders to the battle-field of Hatten, in Syria, and there captured by the Saracens, and it has never been in Christian hands since, and "is doubtless long ago dust of the dust of Jerusalem." Some time in the eighth century the rather unhappily named festival of the Invention of the Holy Cross was introduced into the Roman Church. There is no such festival in the Greek Church. For a popular treatment which goes over the points, see W. C. Prime, *Holy Cross* (New York, 1877). SAMUEL MACAULEY JACKSON.

**True Reformed Dutch Church**: a body that withdrew from the Reformed Dutch Church in America in 1822, and was absorbed into the Christian Reformed Church in 1889. See REFORMED CHURCH IN AMERICA and PRESBYTERIAN CHURCH.

**Truffle** [from O. Fr. *trufle* (Fr. *truffe*) < Lat. *tuber*: Lat. *terræ tuber* > Ital. *tartufo*, Fr. *tartoufle*, whence Germ. *kartoffel*, potato]: any fungus of the genus *Tuber* and other closely allied genera (*Terfezia*, *Chæromyces*, *Hydnotrya*, etc.). Truffles belong to the order *Tuberoideæ*, and are nearly all subterranean in growth, and are from an inch to 6 inches in diameter. There are many species; the best known are *Tuber æstivum* and *T. melanosporum*, both of Europe. The truffle is one of the choicest of the edible fungi, and its cul-



French truffle (*Tuber melanosporum*).

ture has been attempted with some success. Some species are found to a limited extent in the U. S. See FUNGI and VEGETABLE KINGDOM. CHARLES E. BESSEY.

**Trujillo**, or **Truxillo**, troo-*k*heel'yō: capital and largest town of the department of Libertad (formerly *intendencia* of Trujillo). Peru; about 3 miles from the coast, and connected by railway with the port of Salaverry (see map of South America, ref. 4–B). It was founded by Pizarro in 1535, and was long the most important town in Northern Peru; it is now decadent, but controls the trade of the department. The surrounding region is a desert, but before the Conquest it was rendered very fertile by the elaborate Indian system of irrigation. Near Trujillo are the ruins of CHIMU (*q. v.*). Pop. (1889) about 11,000. H. H. S.

**Trujillo**: a town and port of the northern coast of Honduras, near lon. 86° W., on a bay which forms an excellent and secure harbor (see map of Central America, ref. 3–H). It was founded in 1525. The exports are hides, sarsaparilla, etc. It is the capital of a department of the same name. Pop. about 3,000. H. H. S.

**Trullan Councils**, or **Synods**: two ecclesiastical councils; the first convened in 680 by the Emperor Constantinus Pogonatus for the purpose of reconciling the MONOTHELITES (*q. v.*) with the orthodox Church; the second in 692 by the Emperor Justinianus II. in order to confirm and enforce the statutes of the fifth and sixth œcumenical councils, whence it is also called Quinisextum. (See QUINISEXT COUNCIL.) The epithet *Trullan* is derived, like that of Lateran, from the place in which the assembly sat—namely, a great hall in the imperial palace of Byzantium, surmounted by an oval dome, τροῦλλα. Revised by J. J. KEANE.

**Trumansburg**: village; Tompkins co., N. Y.; on the Lehigh Valley Railroad; 2 miles W. of Cayuga Lake, and 11 miles N. W. of Ithaca (for location, see map of the State of New York, ref. 5–F). It contains several flour-mills, foundries, and mower-factories, and has a private bank and two weekly newspapers. Pop. (1890) 1,211; (1900) 1,225.

**Trumbull**, BENJAMIN, D. D.: historian; b. at Hebron, Conn., Dec. 19, 1735; graduated at Yale College in 1759; was pastor of the North Haven Congregational church from 1760 to his death; served as a volunteer soldier, and also as a chaplain, in the war of the Revolution; wrote *A Plea in Vindication of the Connecticut Title to the Contested (Western) Lands* (1776), which influenced the decision of Congress upon the validity of the Susquehanna purchase; *A Complete History of Connecticut 1630–1764* (2 vols., 1797–1818); and began a *General History of the United States of America* (vol. i., 1492–1765, 1810), which was incomplete at his death Feb. 2, 1820. He also published *Twelve Discourses on the Divine Origin of the Holy Scriptures* (1790).

**Trumbull**, GURDON: See the Appendix.

**Trumbull**, HENRY CLAY, S. T. D.: author and editor; b. at Stonington, Conn., June 8, 1830; educated at Williston Seminary, East Hampton, Mass.; settled at Hartford, Conn., in 1851; was appointed State missionary of the American Sunday-school Union for Connecticut in 1858. Ordained as a Congregational clergyman in 1861, he served during the war as chaplain of the Tenth Connecticut Volunteers, and was taken prisoner before Fort Wagner in 1863; was appointed missionary secretary for New England of the American Sunday-school Union in 1865, and normal secretary in 1871; removed in 1875 to Philadelphia, where he became the editor and chief owner of *The Sunday-school Times*. In 1881 he visited the East, and discovered the long-lost site of Kadesh-barnea, on the southern border of Palestine. He has published many books, including *The Sabbath School Concert* (1861); *The Knightly Soldier* (Boston, 1865; rev. ed. 1892); *Childhood Conversion* (1868); *The Captured Scout of the Army of the James* (Boston, 1869); *The Model Superintendent* (New York, 1880); *Kadesh-Barnea* (1884); *Teaching and Teachers* (Philadelphia, 1884); *The Blood Covenant: a Primitive Rite and its Bearings on Scripture* (New York, 1885); *The Sunday School: its Origin, etc.* (1888); *Principles and Practice* (1889); *Friendship the Master Passion* (1891); and *Studies in Oriental Social Life* (1894). Five of his books have been republished in England. Revised by G. P. FISHER.

**Trumbull**, JAMES HAMMOND, LL. D., L. H. D.: philologist and historian; b. at Stonington, Conn., Dec. 20, 1821; entered the class of 1842, Yale College, but did not graduate; aided Rev. James H. Linsley in compiling catalogues of the mammalia, reptiles, fishes, and shells of Connecticut 1842–43; was assistant secretary of State of Connecticut 1847–52 and 1858–61; secretary 1861–65; corresponding secretary of the Connecticut Historical Society 1849–63; was its president, and also librarian of the Watkinson Free Library in Hartford from 1863 to 1891; member of the National Academy of Science 1872; was an original member of the American Philological Association 1869, and its president 1874–75, and was appointed in 1873 lecturer in Yale College on the Indian languages of North America, a subject to which he devoted much time since 1858. Editor of *The Colonial Records of Connecticut 1636–89* (3 vols., Hartford, 1850–59); Roger Williams's *Key into the Language of America* (Narragansett Club, vol. i., Providence, R. I., 1866); Lechford's *Plain Dealing* (Boston, 1867); Pierson's *Some Helps for the Indians* (1873); of vols. i. and ii. of the *Collections* of the Connecticut Historical Society; and of *The Memorial History of Hartford County* (2 vols., Boston, 1886); author of *The Origin of McFingal* (1868); *The Composition of Indian Geographical Names* (1870); *The Best Methods of Studying the Indian Languages* (1871); *Some Mistaken Notions of Algonkin Grammar* (1871); *Historical Notes on the Constitutions of Connecticut* (1872); *Notes on Forty Algonkin Versions of The Lord's Prayer* (1873); *On the Algonkin Verb* (1876); *The True Blue Laws of Connecticut* (1876); *Indian Names of Places, etc., in Connecticut, etc., with Interpretations* (1881); and of many other contributions, historical or philological, to literary periodicals and the proceedings of learned societies. He prepared a glossary to a large portion of Eliot's Indian Bible. D. in Hartford, Conn., Aug. 5, 1897.
Revised by J. W. POWELL.

**Trumbull**, JOHN: lawyer and author; b. at Westbury (now Watertown), Conn., Apr. 24, 1750; was admitted to Yale College on account of extraordinary precocity at the age of seven years, but did not pursue the course until some years later, graduating 1767; wrote with Timothy Dwight a series of essays in the style of *The Spectator* (1769); was tutor at Yale 1771–73, during which time he published *The Progress of Dulness* (3 parts, 1772–73), a satire on methods of education; studied law; was admitted to the Connecticut bar Nov., 1773; continued his studies in the office of John Adams at Boston 1773–74; wrote for the political periodicals; settled as a lawyer at New Haven, Nov., 1774; published anonymously his poetical *Elegy on the Times* (1774), and in the following year, in Philadelphia, the first canto of his *McFingal*, a revolutionary satire, in Hudibrastic verse (completed in 4 cantos in 1782), of which more than thirty unauthorized editions were sold. He settled at Hartford, June, 1781; was associated with Humphreys, Barlow, and Hopkins in the production of *The Anarchiad* (1786–87); was State attorney for Hartford 1789–95, member of the Legislature 1792 and 1800, judge of the superior court 1801–19, and also judge of the court of errors 1808–19; was several years treasurer of Yale College; in 1825 removed to Detroit, Mich., where he died May 10, 1831. Editions of his *McFingal* appeared in 1856, 1860, and 1864, the latter with notes by Benson J. Lossing. His *Poetical Works* appeared at Hartford (2 vols., 1820). Revised by H. A. BEERS.

**Trumbull**, JOHN: painter; son of Jonathan Trumbull, colonial Governor of Connecticut; b. at Lebanon, Conn., June 6, 1756; graduated at Harvard College in 1773; joined the army in 1775 as adjutant; accompanied the army to New York, and went as adjutant-general with Gates, who was appointed to the command of the Northern army; left the service in 1777, owing to his dissatisfaction in regard to the date of his commission; in 1780 went to Paris, thence to London, and studied painting with West; was suspected as a spy during the excitement caused by the execution of André, and imprisoned eight months; released through West's intercession, he returned to the U. S. in 1782, and remained till peace was concluded, then went back to England to resume his studies. His first historical work, *The Battle of Bunker Hill*, familiar through engravings, was exhibited in 1786, and was followed by *The Death of Montgomery before Quebec* and the *Sortie from Gibraltar*, both well known. In 1789 he returned to the U. S. with the purpose of commemorating on canvas the chief persons and events of the Revolution; among the likenesses taken were several of Washington. He returned to England as secretary to John Jay, and passed nearly ten years, from 1794 to 1804, in diplomatic service. Four years afterward he went once more and for the last time to England, and remained till 1815. The next seven years were devoted to painting four grand pictures for the rotunda of the Capitol at Washington—the *Declaration of Independence*, the *Surrender of Burgoyne*, the *Surrender of Cornwallis*, and the *Resignation of Washington at Annapolis*. About 1827 he disposed of his whole collection, fifty-seven pictures in all, to Yale College, in consideration of an annuity of $1,000 for the rest of his life. Trumbull passed the last twenty-seven years of his life mainly in New York; was president of the American Academy of Fine Arts till 1825. D. in New York, Nov. 10, 1843, and was buried in New Haven. See his *Autobiography* (New York, 1841). Revised by RUSSELL STURGIS.

**Trumbull**, JONATHAN: statesman; b. at Lebanon, Conn., in 1710; graduated at Harvard College 1727; studied theology and was licensed to preach, but soon devoted himself to mercantile business, and ultimately to the law; was elected to the Assembly 1733; was its Speaker 1739; became an assistant 1740, to which office he was re-elected; was made judge of the county court and assistant judge of the superior court; was chosen Lieutenant-Governor 1766, thereby becoming *ex-officio* chief justice of the superior court; became Governor 1769; held that office throughout the Revolution, resigning in 1783; was an energetic supporter of the popular cause; was considered a leader of the Whigs of New England, and his advice was much valued by Washington. The popular epithet "Brother Jonathan," now applied as a personification of the U. S., is said to have originated from Washington's habit of addressing him by that familiar title when requesting his opinion. D. at Lebanon, Aug. 17, 1785. See the *Life* by Isaac W. Stuart (Boston, 1859).

**Trumbull**, JONATHAN: Governor of Connecticut; son of Gov. Jonathan Trumbull; b. at Lebanon, Conn., Mar. 26, 1740; graduated at Harvard 1759; was for several years before the Revolution a member of the Legislature and Speaker of the House; was paymaster in the army 1775–80; became in 1780 secretary and first aide-de-camp to Gen. Washington, and as such was a member of his family until the close of the war; was a member of Congress 1789–95; Speaker of the House of Representatives 1791–95; U. S. Senator 1795–96; Lieutenant-Governor of Connecticut 1796–98, and Governor from 1798 until his death, at Lebanon, Aug. 7, 1809.

**Trumbull**, LYMAN: lawyer and politician; b. at Colchester, Conn., Oct. 12, 1813; educated at Colchester Academy; taught an academy at Greenville, Ga., 1833–36; studied law in Georgia; was admitted to the bar 1837; settled at Belleville, Ill.; was elected to the Legislature 1840; was Secretary of State 1841–42, justice of the Supreme Court 1848–53; was a Democrat till repeal of the Missouri Compromise in 1854; elected member of Congress 1855, and U. S. Senator 1855–73; was prominent as a Republican during the civil war; became chairman of the judiciary committee 1861; voted against the impeachment of President Johnson in 1867. In 1872 he joined the Liberal Republican party; after that date supported the Democratic party, and in 1880 was Democratic candidate for Governor of Illinois. From 1863 he resided in Chicago, where he died June 25, 1896.

**Trumpet** [from O. Fr. *trompette*, dimin. of *trompe*, trump, trumpet, appar. from Low Lat. **triumpa're*: Lat. *triumpha're*, triumph, exult. See TRIUMPH]: in acoustics, any instrument used for the conveyance to the ear of articulate sound from a distance. In music a well-known wind instrument, usually consisting of a brass tube some 8 feet in length, expanding at the end into a bell-like shape. By means of slides and keys the capacity of the trumpet has been largely increased. See FOG-SIGNALS.

**Trumpeter**: a peculiar wading bird (*Prophia crepitans*) of South America. See AGAMI and PSOPHIIDÆ.

**Trumpeter**: a breed of domestic pigeons, so called from the deep sound of their coo. The tarsi are heavily feathered, but the characteristic feature of the bird is the thick spreading crest which overhangs the eyes to such an extent that these birds can not care for their young until it is trimmed. The preferred colors are white and black. F. A. L.

**Trumpet-fish**: a name applied on the Atlantic coast of North America to the *Fistularia tabacaria* (family *Fistulariidæ*), and on European coasts to *Centriscus scolopax* (family *Centriscidæ*, which, like the *Fistulariidæ*, is of the order *Hemibranchi*). The first mentioned is without scales, and has a greatly elongated snout, with the mouth at the end of a bony tube. The forked tail has one or two long central filaments. The European trumpet-fish or BELLOWS-FISH (*q. v.*) has a large and very sharp dorsal spine, and a snout much like that of the foregoing. Revised by F. A. LUCAS.

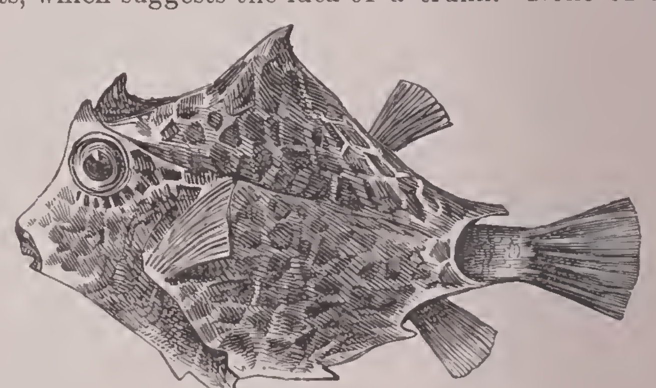
**Trumpet-flower**: a popular name for various species of *Bignonia* and *Tecoma*, mostly shrubs and woody vines, though in tropical regions some of the species are large trees. They belong to the family *Bignoniaceæ*. The native

Trumpet-flower (*Tecoma radicans*).

species of the U. S. are *Bignonia capreolata*, *Tecoma radicans*, and *T. stans*. The first and second are fine climbers. *T. capensis* from South Africa, *T. grandiflora* from Japan, and other fine species are often cultivated.
Revised by CHARLES E. BESSEY.

**Trumpet-wood**: See CECROPIA.

**Trunk-fish**: any one of various fishes of the order *Plectognathi* and the sub-order *Ostracodermi*, forming the family *Ostraciontidæ*. They are so called on account of being incased in an angular case-like development of the integuments, which suggests the idea of a trunk. None of these



The trunk-fish.

fishes are in demand as an article of food, their flesh being small in quantity, and in some species even thought to have a poisonous effect. But the liver is very large and yields a considerable supply of oil. All the trunk-fishes are natives of the tropical seas. Revised by F. A. LUCAS.

**Trunk-turtle**: a name for the LYRE-TURTLE (*q. v.*).

**Tru'ro**: town; in Cornwall, England; at the junction of the Allen and Kenwyn; 54 miles W. of Plymouth (see map of England, ref. 15–C). It is the center of a rich mining district, and exports large quantities of tin ore. The ancient bishopric of Truro was revived in 1876, and a new cathedral, which incorporates the old parish church of St. Mary's, was consecrated in 1887. Pop. (1891) 11,131.

**Truro**: a handsome town; capital of Colchester County, Nova Scotia; at the head of Cobequid Bay, and on the Intercolonial Railway; 61 miles N. of Halifax (see map of Quebec, etc., ref. 2–C). It contains a provincial normal school and has a daily and three weekly newspapers, and manufactures of woolens, boots and shoes, hats, furniture, pianos, organs, etc. Ship-building, fishing, agriculture, and mining are also carried on near Truro, which is a place of some wealth. Pop. (1891) 5,102.
Revised by M. W. HARRINGTON.

**Truro**, BARON (*Thomas Wilde*): jurist; b. in London, England, July 7, 1782; third son of an eminent solicitor;

was educated at St. Paul's school, articled to his father for the study of law, and, after running away in disgust, devoted himself studiously to that profession; was admitted as an attorney in 1805; entered as a student of the Inner Temple in 1811, pursuing with great success the calling of special pleader until called to the bar Feb. 17, 1817. During the next three years he became prominent as a pleader at the bar, and attained distinction as junior counsel in the defense of Queen Caroline; was made serjeant-at-law in 1824 and king's serjeant in 1827. He entered politics as a Whig, and sat in Parliament 1831–32 and 1835–39. In Dec., 1839, or Feb., 1840, he became solicitor-general, and was knighted; June to Aug., 1841, was attorney-general; was prominent in a famous debate on parliamentary privilege; was again sent to Parliament in 1841, and in June, 1846, again became attorney-general, and chief justice of the common pleas July, 1846. On the formation of Lord John Russell's administration in 1850 he was made Lord Chancellor and Baron Truro of Bowe's Manor, Middlesex, but resigned in Feb., 1852. D. at Southgate, Middlesex, Nov. 11, 1855, after a protracted illness. He was during his whole life a progressive Liberal, of untiring industry, and was active in aiding many of the reforms which were accomplished during his time. F. STURGES ALLEN.

**Truss** [from O. Fr. *trousse*, *tourse*, truss < Low Lat. **tur'sus*: Lat. *thyr'sus* = Gr. θύρσος, stalk, stem, staff; possibly akin to Lat. *fustis*, cudgel]: in surgery, a device worn to support a HERNIA (*q. v.*). It consists of a pad so arranged with a spring and straps that it may be retained in position without interfering with the patient's movements. In engineering a truss is a framed structure so arranged that the principal members take only stresses of tension or compression. A simple truss is one supported at its two ends, and it exerts only vertical pressures on the supporting walls or piers, while an arched truss exerts horizontal pressures also. A truss consists of an upper chord, a lower chord, and bracing, which connects them. In bridge trusses the two chords are often parallel, one being in tension and the other in compression, while the braces are alternately tensile and compressive under dead load. The economic depth of a truss of given length is such that the quantity of material is a minimum. Various forms of trusses are described in the articles BRIDGES and ROOF. See also ARCH, CARPENTRY, MOMENT, and STRESSES. MANSFIELD MERRIMAN.

**Trust Companies**: See the Appendix.

**Trusts** [M. Eng. *trust*, *trost*; cf. Icel. *traust*, confidence, security: Germ. *trost*, comfort: Goth. *traust*, convention, covenant. The ordinary meaning is confidence—hence intrusting of property, property intrusted, the organization which controls such property]: in law, peculiar species of ownership, whereby property, real or personal, is vested in certain persons for the use or benefit of others. The persons who hold the legal estate are the "trustees"; those for whose benefit the property is held or administered are known as the *cestuis que trustent*, or beneficiaries. Although trusts—whereby one person holds property on a trust or confidence which another person can enforce by legal proceedings—are of great antiquity, they are, in their present form and variety, essentially modern, dating back only to the Statute of Uses, passed in the twenty-seventh year of Henry VIII. (A. D. 1535). Prior to that statute the practice of conveying lands to one person to the "use" (*ad opus* or *ad usum*) of another, the former having a bare naked title without any rights of control or enjoyment in the lands conveyed, the latter having no legal estate or interest whatever, but being clothed with all the substantial rights and privileges of ownership, had become so common as to affect a large proportion of the land in the kingdom. The article on USES (*q. v.*) describes the inconveniences to which this practice gave rise and the successive efforts—usually all but futile—made by the legislature to restrain or destroy it. The most marked result of the Statute of Uses, which was the most radical as well as the latest of these legislative attempts, was to elevate the *use*, theretofore illegitimate and wholly without legal recognition, into a lawful estate, recognized and protected by the legal tribunals. There remained, however, within the exclusive cognizance of the equity tribunals certain of these uses which, by a narrow and technical construction of the statute referred to, escaped its operation. These were, 1, uses raised on terms of years or other personal estate; 2, uses charged upon other (precedent) uses; and 3, and most important of all, active uses, i. e. those with the performance of which some duty on the part of the trustee (*feoffee to uses*) was connected. These three varieties of unexecuted uses (i. e. uses not covered by and "executed" by the statute), under the name of *trusts*, continued to be fostered and administered by the court of chancery upon substantially the same principles which it had applied to the regulation of uses before the statute. But while the leading principles of the jurisdiction of equity over trusts have long been established, its doctrines have, in very recent times, received enormous expansion, so that they constitute to-day by far the most important part of that jurisdiction.

In consequence of the fact above adverted to, that the *cestui que trust*, or beneficiary, is invested with the whole beneficial enjoyment of the trust estate, the trustee having the title vested in him only for the benefit of the *cestui que trust*, the latter is often spoken of as the "real owner," or, more commonly, as the "equitable owner," and his interest is described as an "equitable estate" in contradistinction to the "legal estate" of the trustee. But this language is in the highest degree improper and misleading. There is only one kind or species of "estate"—that, namely, which is recognized by the courts of law. The interest of the beneficiary of a trust is in no sense an estate or interest in the land or other property affected by the trust. He has, at the most, a right of action against the trustee in whom the "legal title," or estate, is vested. This right of action enables him by the aid of the equity tribunals to hold his trustee to a strict performance of the duties imposed upon him, and even, in certain cases, where the trust is only nominal, to compel the conveyance of the trust estate to himself, but until such conveyance the beneficiary has no right to deal directly with the estate. Not only is he without power to convey the property to another, but he can maintain no action at law for its protection, either against the trustee or a stranger, and he can bring no action of ejectment or trespass for a wrongful possession thereof. It has, however, been held from an early period that equity will recognize the right of the *cestui que trust* to assign his rights in the trust estate, so as to enable his assignee to enforce the trust as the beneficiary thereof; and such is the rule to-day, except where, as in New York, it has been modified by statute. See 1 N. Y. Rev. Stat. 730, § 63.

*Jurisdiction of Equity over Trusts.*—The jurisdiction of equity over the trustee is confined to the ascertainment and enforcement of the trust imposed upon him. There is no authority in the courts to alter the character of the trust, to enlarge or to reduce the powers of the trustee, nor, except in the case of charitable trusts (see below), to confer the benefits of the trust on any person other than the beneficiary designated by the act creating it. Ordinarily, therefore, the trustee of a trust for the life of another can not be empowered by the court to lease the estate for a longer period than such life, nor to sell or mortgage the estate, even where the interests of the estate or of the beneficiary clearly demand such action. In some jurisdictions, however, these rules have been modified by statute so as to give trustees or to authorize the equity tribunals to give them the power to lease, sell, or mortgage the trust estate in cases where it appears to be necessary for the protection of the trust estate, or to the best interest of the persons beneficially interested therein so to do. See, e. g., N. Y. Rev. Stat., vol. i., p. 730, sec. 65, as amended by Laws of 1886, ch. 257.

On the other hand, the power of the courts to enforce the performance of trusts is complete. They may remove a trustee and appoint another; may restrain him by injunction; may call him to account and hold him personally responsible for the results of his fraud or neglect, for improper investments, for profits made or which ought to have been made, and for interest; may avoid conveyances made to himself, and those made to third parties in breach of the trust; may follow the property into the hands of such third persons, as implied trustees, unless they are purchasers in good faith for a valuable consideration; may, in fact, do anything which will give equitable protection to the rights of the beneficiary. The office and function of the trustee are in the highest degree fiduciary and conscientious. He is bound to diligence and discretion in the performance of his duties as well as to the utmost measure of good faith.

*Kinds of Trusts.*—Ordinary private trusts, as usually classified, are of three kinds, viz., *express*, *resulting*, and *constructive trusts*.

*Express trusts* arise from the direct and intentional act of the parties, evidenced by some declaration which is generally contained in a written instrument. The most common examples of this class are those created by marriage settlements, by assignments for the benefit of creditors, by deeds of conveyance, and by wills. Such trusts may, in the absence of statute, be created by parol as well as by a written declaration, but it has been enacted by the Statute of Frauds that no trust over or concerning lands shall be created, assigned, or declared except by a deed or conveyance in writing, but that this provision shall not affect trusts created by will and those implied by law.

*Resulting* (*or implied*) *trusts* arise, in the absence of any express declaration, by implication from the acts of the parties. Where the circumstances attending an assignment or conveyance of property are such as to raise a presumption that a trust, although unexpressed, was intended, such a trust is said to "result" from the transaction. Trusts of this sort are not uncommon. They arise (*a*) where an intended trust can not take effect, either by reason of a failure to declare the beneficiary or because the intended trust, not being capable of execution as a charitable trust, is too indefinite to be carried into effect; (*b*) where an expressed trust fails to exhaust the entire property transferred to the trustees; (*c*) where the legal title is transferred, and a trust declared as to a part of the property, but no intention expressed as to the rest; and (*d*) where the purchase-money is paid by one person and the conveyance is taken in the name of another. In the first case (*a*) a trust results to the person who made the conveyance or, where the property is transferred by will, to the heir or personal representative, as the case may be, of the testator; that is to say, while the transfer to the grantee, devisee, or legatee holds good, and vests the legal title according to the intention of the parties, equity will compel such transferee to hold the property as a trustee for the donor or his lawful successors to the title; in the second and third cases (*b* and *c*) a trust results either to the donor (as in case *a*) or to the grantee, according to the apparent intention of the parties, as expressed in the instrument of transfer; in the last case (*d*) the person taking title is compelled to hold it as trustee for the one who paid the purchase-money. The only general exception to this rule is where the person who pays the consideration stands in the position of a husband or in *loco parentis* to the party to whom the property is conveyed. Where such relationship exists, a presumption arises that the payment was intended as a provision for the wife, or an advancement to the child, and no trust results, unless the presumption is rebutted.

A *constructive trust* is raised by a court of equity "wherever a person, clothed with a fiduciary character, gains some personal advantage by availing himself of his situation as trustee." The trust is in such cases said to arise by *construction*, without reference to any intention of the parties, either expressed or presumed. The power to raise or impose trusts by "construction," in order to obviate the effects of the fraudulent acquisition of property, constitutes a most salutary, important, and constantly growing exercise of equity jurisdiction. As it is impossible to enumerate here all of the cases in which this jurisdiction may be invoked, only a few of the most important and comprehensive rules will be given. (*a*) Where property is acquired by one person by the wrongful use of the property of another—as, e. g., where a trustee, executor, or agent misapplies money or other property which he holds in his fiduciary capacity to the purchase in his own name of other property—the dishonest agent or trustee will hold the property so acquired in trust for the person whose property was misapplied. (*b*) Where a person acquires for himself an interest in property in regard to which, by reason of his fiduciary position, he has a duty to perform for another, he will hold such interest in trust for the person to whom such duty was due. A good illustration of the application of this rule is found in the familiar doctrine that a person occupying a position of trust or responsibility toward another in regard to leasehold property—as a trustee, executor, guardian, mortgagee, tenant for life, cotenant, partner—can not take a renewal of the lease for his own benefit, but shall hold it, when taken, for the benefit of all parties interested in the old lease. (*c*) Where there is a valid contract for the sale of real estate "the vendor becomes in equity a trustee for the purchaser of the estate sold, and the beneficial ownership passes to the purchaser, the vendor having a right to the purchase-money," together with a charge or lien on the estate for the security of that purchase-money. This lien or charge, belonging to the class of interests known as "equitable liens," is sometimes also, although improperly, included among the constructive trusts.

*Statutory Changes.*—In many of the U. S. the law of trusts, as developed by the equity tribunals, has been extensively modified by legislation. The New York statute may serve as a type of the law of trusts as thus modified. Implied, or resulting, and constructive trusts and all trusts of personal property are left substantially unaltered by this legislation. All express passive trusts of land and all express active trusts of land, except certain classes, are abolished. The express trusts which are permitted are the following: (1) to sell lands for the benefit of creditors; (2) to sell, mortgage, or lease land for the benefit of legatees or to satisfy any charge thereon; (3) to receive the rents and profits of land, and apply them to the use of any person during his life or for a shorter period; (4) to accumulate rents and profits of land for the benefit of minors during the continuance of their minority. GEORGE W. KIRCHWEY.

CHARITABLE TRUSTS.—In the ordinary private trusts there must be both a known trustee and a certain, determinate beneficiary, although, if the trustee should die, resign, or refuse to accept, the court can supply the place by appointment. But property may be given in trust for specified objects where the beneficiaries are completely indeterminate—as, for example, a gift to aid in spreading the gospel or to relieve the poor—or where the beneficiaries constitute a known class, but the individuals are uncertain, as a gift to provide for the poor of a particular town or to support the scholars in a designated school. Dispositions of this form and nature, whether made by deed or by will, are termed "charitable trusts." They first appeared in the Roman empire after it became Christian, and were both legalized and fostered by several constitutions of Christian emperors. The researches of modern jurists have established the fact beyond a doubt that the English court of chancery at an early day, by virtue of its own intrinsic authority, assumed jurisdiction over, upheld, and enforced this species of trusts. In the 43d Elizabeth (A. D. 1601) a statute was passed known as the Statute of Charitable Uses, which regulated the whole subject of charitable gifts. It created a new and special jurisdiction of the chancellor, and contained an enumeration of lawful charitable objects. In determining what trusts should be upheld as charitable, the doctrine was firmly settled that all objects embraced within the spirit as well as the letter of the statutory enumeration are lawful. As the result of this principle, all trusts created for any one of the following general purposes are charitable: (1) The support, maintenance, or spread of the Christian religion; (2) the relief, aid, or support of the poor, the sick, or those in any manner disabled; (3) the foundation, erection, or support of institutions, organizations, societies, or other means of general beneficence, either for all needy persons or for particular classes, such as asylums, hospitals, dispensaries, reformatories, and the like; (4) the maintenance and promotion of education, learning, literature, science, or art by the establishment, erection, support, or aid of universities, colleges, schools, libraries, reading-rooms, museums, scientific lectures, societies, art schools or galleries, etc.; (5) any and all objects of interest or advantage to the public, as highways, parks, public gardens, water or gas supplies, and the like.

In administering charitable trusts the English court of chancery exhibited the utmost liberality in carrying out the designs of the donors and in sustaining the gifts. It even invented and applied a special doctrine, known as the principle of *cy pres* (as near to), in pursuance of which, when it was found impossible to carry out the design of the donor in the manner which he had indicated, the court would contrive and establish another scheme or mode, preserving the same general intent, and differing as little as possible in details from the original plan.

The statute of 43 Elizabeth has not been re-enacted in the U. S. In most of the States, however, the courts have adopted the general doctrines which had been formulated by the English chancery, so that charitable trusts as above described are recognized in their local jurisprudence and upheld by their judiciary. In other States the whole system has been rejected as inconsistent with the institutions of the U. S., and especially because it tends to create perpetuities, which are opposed to the policy of the laws. In New York, for example, it has, after some vacillation, been settled that charitable trusts were abrogated by the revised statutes, and that the only mode of establishing a charity is through the instrumentality of a corporation, which shall receive and administer the trust. This narrow and illiberal policy of the New York law has been subjected to much criticism, as tending to make charitable gifts unnecessarily precarious, and thus frequently defeating the benevolent intentions of the donors of such gifts.

Revised by George W. Kirchwey.

Commercial Trusts. — The great trade combinations which, under the denomination of trusts, have become such a marked feature of modern industry, especially in the U. S., owe their form and designation, though not their importance, either in law or in the industrial organization of society, to the trust proper, as developed in Anglo-Saxon jurisprudence. (See above.) The term is therefore not wholly a misnomer, though it becomes so when it is popularly applied to such combinations irrespective of their form and mode of creation, or when the term is employed in a peculiar and exclusive sense to describe the gigantic modern trusts created for industrial purposes. A commercial trust, whatever its magnitude, is neither more nor less a "trust" than any other vesting of property in one person to the use and benefit of another person, while, on the other hand, a trade combination may be equally effectual for the purposes of its creation, and equally obnoxious to public sentiment or to the law, if it is nothing more than an agreement between individuals to prevent competition or if it take on the form of a copartnership of corporations. Not every trade combination is a trust, nor is every trust an industrial monopoly. For the purposes of the present discussion, however, the whole subject of the legal status of all forms of capitalistic combination, whether trusts or not, may most conveniently be considered together.

Notwithstanding the fact that commercial trusts of the modern type had their origin in England before the middle of the nineteenth century, and that they were developed much later in America, by far the greater part of the law of the subject is to be found in the reports and statute-books of the U. S. and Canada. Indeed, in England these combinations of capital, directed either to general investment purposes or to the management and control of industry, have been regarded in the light of a normal development of industrial forces, like great corporations, and the attitude of the courts has been singularly liberal and free from the suspicion and hostility which have attended similar manifestations in North America.

The legality of the combinations under consideration may be considered from three different points of view: (1) Where the combination is of the normal type, the property of several individuals or corporations being vested in trustees, to be administered for the common benefit, it presents the question whether it constitutes a true trust within the scope and the terms of equity jurisdiction and entitled to protection and enforcement by the equity tribunals; (2) where, as has usually been the case, the parties to the combination are corporations or the stockholders of corporations, the question arises whether its organization constitutes an offense or, at least, an unauthorized and therefore unlawful act on the part of the persons of whom it is composed; (3) whatever be the form of the combination, and whether its constituent elements be corporations or private individuals, the question still remains whether the objects of the combination are consistent with the public welfare, and therefore lawful. These positions will be separately examined.

1. "*Trusts*" *in Equity*.—There is nothing in the form, the organization, or the methods of the modern industrial trust to render it obnoxious to law. It is in all essential particulars a trust of the normal, familiar type, such as are habitually enforced by the courts. In these external aspects it differs from ordinary trusts only in the magnitude of the interests involved. But neither the amount of property vested in the trustees, the extensive and secret powers of administration conferred upon them, nor the number and wide distribution of the beneficiaries of the trust affords any reason for refusing to recognize the title of the trustees or the right of the beneficiaries to protection against them. These principles are now undisputed, so far as the law of trusts, as that has been developed by the equity tribunals, is concerned. It is only in those jurisdictions where that law has been radically altered by legislation that any question can arise as to the validity of trusts of this description, and the jurisdiction of equity over them. Thus in New York and several other States it is provided by statute that express trusts of real property can be created only for certain enumerated purposes, not including such a use as is here under consideration. (See N. Y. Rev. Stat. 1, 727, secs. 45 and 55; see also above.) But this difficulty is successfully obviated by the method usually employed for the creation of such trusts. The property vested in the trustees, and forming the basis of the trust, is not the real and personal property of the corporations forming the combination, and with which its business is to be carried on, but the shares of the stockholders of such corporations. These shares are always personal property, whether the corporate property which they represent be real or personal; and, as the restriction of the statute is confined to trusts of real property, its application in the case of corporate trusts is thus ingeniously excluded. When individuals or firms desire to join such a trust, they first become incorporated, and then enter as shareholders of the corporation thus formed. Of course the possession of the shares gives the trustees the actual control, though not the legal ownership, of the property, real as well as personal, of the several corporations composing the "trust."

It is true that equity may refuse to enforce a trust, notwithstanding its regularity and outward conformity to equitable principle, if its objects are unlawful and contrary to public policy. But as such a trust always comes into existence by virtue of an agreement, and as such agreement, if it be really illegal, can more conveniently be directly attacked in an action at law than by invoking the interposition of equity, there is seldom any motive for resorting to the latter course of proceeding. It should, moreover, be borne in mind that equity acts only upon the petition of the beneficiary, showing that the management of the property is wasteful or otherwise hostile to his interests; and, on the other hand, that if these facts are made to appear it is only where the performance of the trust would be manifestly illegal and *contra bonos mores* that the court will allow the trustee to continue to violate the terms thereof. Accordingly, in the litigation which has attended the development of these trust combinations their character as trusts has played little or no part, and those combinations that have been organized on the trust principle have been attacked and defended on precisely the same grounds as those which have taken on some other form. The field over which the battle of the trusts has been waged is covered by the two following points.

2. *Corporate Trusts*.—Corporations, being "artificial persons," created by the state for specific purposes and having only such powers as are conferred upon them for carrying those purposes into effect, have a very much more restricted range of activity than is permitted to the natural man. Many acts which the individual may lawfully perform are forbidden to the corporation. The former can retire from business, or turn his business over to some one else to be managed for him; the latter can not retire without dissolution, nor has it any power to delegate to another corporation or person the duties which its charter requires it to perform. A corporation which abandons the business for which it was organized and allows its property to be controlled and its operations to be carried on by a person or group of persons who have no direct relations to it, and who are not its agents, is acting *ultra vires* and in violation of its organic law, and thereby forfeits its right to exist at all. These principles suggest an obvious ground of attack on trust combinations made up of corporations, and it is upon this ground that the principal and most successful assault upon them has been made. But when the courts would have enforced this principle against the corporate trusts, so called, it was objected that the several corporations whose property and business was administered by the trust were not actually parties to it, and that the corporation, having a distinct legal personality and being capable of acting only by its duly appointed officers, could not be held responsible for the unauthorized, but yet lawful, acts of its individual stockholders in vesting their interests in the obnoxious trust. The courts, however, swept away this reasoning, plausible though it was, as sophistry, and laid down the principle that where the corporation acquiesces in the transfer of the corporate stock to such a trust, and in the real control and management of its interests by trustees, the act shall be deemed to be the act of the corporation, and the latter may be dealt with accordingly.

These principles once settled, the mode of attack is simple enough. Although the trust is, as we have seen above, impregnable against direct attack, it can be effectually undermined and destroyed by breaking down the several corporations from which it draws its strength. Although no stockholder or creditor of the corporation complains, it can be punished for its unlawful and unauthorized abuse of power, in the name and behalf of the people of the State, by a proceeding instituted by the attorney-general for the forfeiture of its charter. It was in this way that the Sugar Trust was broken up in New York, and the great Standard

Oil Trust in Ohio. In each case the attack was directed against one of the numerous corporations alleged to be a party to the trust, and the forfeiture of one charter, with the liability to a similar forfeiture in the case of all the other corporations concerned, operated effectually to dissolve the trust in each case. (*People of State of New York* vs. *North River Sugar Refining Company*, 121 New York Reports, 582; *State of Ohio* vs. *Standard Oil Company*, 49 Ohio State Reports, 137.) The principles of corporate liability were even more conspicuously violated in the organization of the Chicago Gas Trust, where a gigantic corporation, without express legislative sanction, assumed to control the operations of a multitude of lesser corporations by acquiring their capital stock. *People* vs. *Chicago Gas Trust Company*, 130 Illinois Reports, 268.

The principles upon which these cases were decided have been accepted as conclusive, excepting for purposes of academic discussion, by the parties concerned in the trust combinations as well as by the general public, and it is hard to see how they can be disputed. It is to be observed, however, that they are applicable only to the state of facts under examination in those cases—namely, where corporations, acting officially or by their stockholders, have transferred their property and concerns to trustees to be managed for them, or have in some other way exceeded their lawful powers. But this is only one—though it is certainly the easiest, as it has been the most popular—form of capitalistic combination. There are several other forms, of at least equal potency, with which the principles above discussed have nothing to do. Thus they do not touch the case of individuals, not corporations, forming trust combinations of precisely the character and type of those under consideration. They do not reflect upon the right of corporations or of individuals to enter into far-reaching agreements, regulating the rate and character of production and the prices to be charged for goods and services. They are not infringed by the consolidation of many corporations into one, or the acquisition by one gigantic corporation of all of the property and business engaged in a certain line of industry. The "trust," after it has been driven out of one form of organization, can easily take refuge in another and different form. Indeed, this is precisely what has occurred in the case of the trusts "destroyed" by the adverse decisions in New York, Ohio, and elsewhere. Of the large number of such combinations in existence at the date of those decisions, it is not known that a single one has gone out of operation as a result thereof. They have disappeared as corporate trusts, but they have promptly reappeared and are in full operation as great corporations or as combinations held together by contract. And yet the evils, real or imaginary, threatened by the corporate trusts are equally to be feared from the combinations of capital and industry which have generally succeeded them. How are these evils to be met? The question brings us to the third and most comprehensive ground of attack on such combinations.

3. "*Trusts*" *as Monopolies.*—Whether a given industrial combination be made up of individuals or of corporations, whether it be more or less closely held together by contract or be consolidated into a trust, if it constitutes or "tends to create" a monopoly, or if it is found to be a conspiracy in restraint of trade, it is obnoxious to law. This does not signify that it is liable to destruction at the instance of the State, nor that its promoters are subject to criminal prosecution, but only that the agreements and covenants on which it is based, being unlawful and contrary to public policy, will not be enforced by the courts, and that it will thus be reduced to a mere voluntary association without binding force upon its members. Where the monopoly is not based on agreement, but is exerted by a single corporation or individual who has gained control of the market, the rule here laid down has no application. As thus limited and defined, the rule against monopolies is one of the landmarks of the common law. But no rule of that law is more difficult of application. The crucial question as to whether a given combination is or is not a monopoly, as to whether a given agreement is or is not a conspiracy against the common weal, is well-nigh as broad as the rule itself, and the judicial attempts to answer it have thus far failed to develop any clear guiding principle. The common law relating to monopolies and the trade offenses of *engrossing, forestalling, and regrating* (by which were intended the buying of necessaries of life in order to sell them again), founded, as they were, on economic ideas and industrial conditions which have long passed away, are wholly obsolete. Of the common-law doctrine of the invalidity of agreements in restraint of trade and competition, there survives only the general principle that a restriction which is unlimited in respect both of time and place is unreasonable and therefore void. But where, as in New York, the courts lend their aid to enforce a contract made by a competing manufacturer to refrain for ninety-nine years from carrying on a certain business within the United States and Territories, excepting only in Montana and Nevada, especially where the contract in question is part of a general scheme on the part of the plaintiff to gain control of the entire business in the country, even that doctrine becomes too nebulous to serve as a guide. (*Diamond Match Company* vs. *Roeber*, 106 New York Reports, 473). The only principle which has clearly emerged from the mass of conflicting decisions is that a contract restraining competition will be decreed to be unlawful if, in the opinion of the tribunals before which it is brought, it is unnecessary and unreasonable so far as the due protection of the parties is concerned, or is prejudicial to the public interest; and that an industrial enterprise will be deemed to be a monopoly when, in the judgment of the courts, it actually becomes a menace to the public welfare and is not justified or required by the existing conditions of trade and industry.

These principles solve the question as to the monopolistic and therefore unlawful character of trade combinations, so far as it is yet capable of solution. The tendency in most of the States has been to declare against such combinations; but in the great case against the Sugar Trust (above referred to) the New York Court of Appeals refused to follow the lower courts in declaring the combination to be essentially monopolistic and hostile to the welfare of the State. It is believed that, in the absence of legislation, this more temperate and conservative view will ultimately prevail.

*Legislation.*—The epidemic of trust legislation has produced so few conclusive results that it would be unprofitable to go much into detail concerning it. The popular agitation against trusts resulted in 1888 in legislative investigations by the U. S. House of Representatives, the New York Senate, and the Canadian Parliament, and these were followed, in 1889 and the years immediately succeeding, by a crop of hastily conceived and more or less stringent repressive acts. The act of Congress passed in 1890, and known as the National "Anti-Trust Act," is so indefinite in its terms and so inconclusive in character that it is generally regarded as an abortive and practically worthless measure in the campaign against monopoly. Moreover, it is by reason of the limitations of congressional authority confined to acts which come within the definition of interstate commerce. Anti-trust laws have also been enacted in Illinois, Michigan, and several other States in the West and South. In the eastern parts of the country the fulminations of social reformers and legislative committees have thus far (1895) produced but little result, though Maine has a comprehensive law, passed in 1889, and New York one of narrower scope and of doubtful utility, passed in 1893 (chap. 716). All of these statutes are penal in character, and declare all combinations or agreements regulating the supply or the price of "any article or commodity" to be criminal conspiracies, and prescribe penalties therefor. In addition to this the statutes usually declare such contracts or combinations to be null and void. Most of these statutes appear to be sufficiently explicit and drastic to produce the result intended by them, though there is considerable question as to the constitutionality of such legislation on account of its interference with vested property rights. There have been no decisions under these statutes as yet which have conclusively demonstrated their efficacy and legality. Probably it will not be difficult for the combinations at which they are aimed to adopt a form of organization which will avoid their operation. It will be remarked that this legislation does not affect any form of capitalistic organization which does not involve a contract or combination of several parties, and that a single corporation, owning and controlling all of the industries in a given territory or in a certain line of enterprise, is wholly outside its scope. Such an organization, therefore, would clearly seem to be lawful in the present state of the law, though it could doubtless be reached and partially controlled by legislation limiting the amount of the capital-stock which may be issued and of the property which may be held by industrial corporations.

Authorities.—The most comprehensive and practical treatise on the subject of trusts is that of Lewin (*The Law of Trusts*), though Perry on *Trusts*, the works of Story and

Pomeroy on *Equity Jurisprudence*, and the article on *Trusts and Trustees* in the American and English *Encyclopædia of Law* (vol. xxvii.) may also be consulted. There are also several treatises dealing particularly with charitable trusts, among them those by Dwight (Am.), Finlason (Eng.), and Tudor (Eng.). The literature dealing with commercial trusts is very large, but scattered, and usually of inferior quality. Even the law writers have too often substituted denunciation for exposition and reasoning. Spelling's *Trusts and Monopolies* contains the fullest discussion of the subject. See also *The Legality of "Trusts,"* by T. W. Dwight, 3 *Political Science Quarterly*, 592; several articles in vols. i., iv., and vii., of the *Harvard Law Review*; and the article MONOPOLIES. A very complete bibliography of commercial trusts, down to 1890, by William H. Winter, can be found in 7 *Railway and Corporation Law Journal*, 236.

GEORGE W. KIRCHWEY.

**Trutch**, Sir JOSEPH WILLIAM: statesman; b. at Bath, England, Jan. 18, 1826. He was educated at Exeter, studied civil engineering under Sir John Rennie, and removed to the Pacific coast in 1849. He practiced his profession in California and Oregon until 1856; removed to British Columbia in 1859, and till 1864 was employed in constructing public works for the colony. He was chief commissioner of lands and works and surveyor-general of British Columbia from 1864 until 1871, when the colony joined the Dominion; delegate to Ottawa in 1870 to arrange terms of union with Canada; and in 1871 to Ottawa and London to finally settle details of union. He was lieutenant-governor of British Columbia 1871–76; appointed resident agent of the Canadian Government in British Columbia in 1879, and was knighted in 1889. NEIL MACDONALD.

**Truth**, SOJOURNER: See SOJOURNER TRUTH.

**Truxillo**: See TRUJILLO.

**Truxtun**, THOMAS: naval officer; b. on Long Island, N. Y., Feb. 17, 1755; went to sea at the age of twelve years; was impressed into the British navy; became in 1776 lieutenant of the American privateer Congress; equipped and commanded in 1777 the Independence, with which he took valuable prizes; afterward commanded the Mars (20 guns) and other ships, and in 1781 the St. James (30 guns), with which he disabled a British ship of superior force after a severe engagement; was engaged in the East India trade for several years after the war. On the organization of the U. S. navy, 1798, he was selected as one of its six captains, and assigned to the frigate Constellation, with which he captured the French frigates L'Insurgente, Feb. 9, 1799, and La Vengeance, Feb. 1, 1800; was made commander of the West Indies squadron of ten vessels 1801, and appointed 1802 to the command of the naval expedition against Tripoli, but retired from the service, and after living on a farm in New Jersey removed to Philadelphia, where he was sheriff of the county 1819–21, and where he died May 5, 1822. He was the author of *Remarks, Instructions, and Examples relating to Latitude and Longitude, also the Variation of the Compass* (Philadelphia, 1794).

**Trygon'idæ** [Mod. Lat., named from *Try'gon*, the typical genus, from Lat. *try'gon* = Gr. τρυγών, sting-ray]: a family of selachians, of the order *Raiæ*, typified by the sting-rays. The disk constituted by the union of the pectoral fins with the body is rhomboid or oval, and oblong or transversely expanded: the tail is thin and, toward its extremity, whip-like, but otherwise variously developed, being mostly very long, but sometimes very short; the skin is generally more or less armed with scattered spines or tubercles; the head is produced into a pointed snout or at least angulated in front; the mouth is moderate; the teeth mostly transversely elliptical, and ridged or cuspidate; on the back of the tail are generally one or more spines, which, in the typical forms, are compressed from before backward, and armed at their lateral edges with teeth or serrations directed downward, but these are sometimes wanting; there generally are only rudimentary dorsal and caudal fins, or none at all. The species are quite numerous, and disseminated in all seas except the extreme polar ones. They are to be feared on account of their spines. See STING-RAY.

Revised by F. A. LUCAS.

**Tryon**, DWIGHT WILLIAM: landscape-painter; b. at Hartford, Conn., Aug. 13, 1849; pupil of Daubigny, Jacquesson de la Chevreuse and Guillemet, Paris; member of the Society of American Artists 1882; National Academician, 1891; member of the American Water-color Society. He won the second Hallgarten prize, National Academy, 1887 and the Webb prize, Society of American Artists, 1889. His pictures are poetic in sentiment and fine in color; he paints very skillfully in water-color. His studio is in New York.

WILLIAM A. COFFIN.

**Tryon**, WILLIAM: colonial Governor; b. in Ireland about 1725; received a good education: became a distinguished officer in the British army; married Miss Wake, a relative of the Earl of Hillsborough, Secretary of State for the colonies, through whose influence he was appointed Lieutenant-Governor of North Carolina 1764; became Governor by the death of Gov. Dobbs July 20, 1765; suppressed the revolt of the Regulators, treating the prisoners with cruelty; erected at the cost of the province a magnificent residence at Newbern; was advanced to the governorship of New York July 3, 1771; became colonel 1772 and major-general 1777; was detested by the patriots for his many acts of rigor and severity, and especially for the destruction of Danbury, Fairfield, and Norwalk, Conn., by expeditions conducted by him in person; resigned his post Mar. 21, 1778, and returned to England, where he became a lieutenant-general 1782; was given the degree of LL. B. by King's (Columbia) College in 1774. D. in London, Feb. 27, 1788.

**Tsad**: another spelling of the name CHAD (*q. v.*).

**Tsanpo**: See DIHONG.

**Tsar**: See CZAR.

**Tsaritsyn'**, or **Zaritzin**: town; once an important fortress of Saratoff government, southeast Russia; at the great bend of the lower Volga, terminus of an important railway from the N. and of a short line to Kalach to the W. (see map of Russia, ref. 9–F). It is the center of the trade between Astrakhan and the North Caspian districts and Central Russia. It is especially the center for the naphtha, salt, and mustard trades. The town has become the gathering-place for the poor seeking work, and their quarters, especially in summer, contain much misery and filth. It has a large theater, a public library, two gymnasia, and a fine church in the architecture of the sixteenth century. Pop. (1897) 55,914.

MARK W. HARRINGTON.

**Tsars'koye-Se'lo**, or **Zarskoye-Selo**: town of Russia; 14 miles S. of St. Petersburg (see map of Russia, ref. 5–C). It contains two magnificent palaces which are used by the imperial family as summer residences. The park and pleasure-grounds of the palaces cover an area 18 miles in circumference, and the buildings contain many valuable collections. The cathedral of St. Sophia is a copy in miniature of the mosque in Constantinople. Pop. 16,838.

Revised by M. W. HARRINGTON.

**Tschaikows'ki**, PIETER ILIITSCH: composer; b. at Wotkinsk, Russia, Apr. 25, 1840; began the study of music in 1862 in the St. Petersburg Conservatory. His first composition was a cantata to Schiller's *Ode to Joy*. From 1866 to 1877 he was Professor of Harmony, Counterpoint, and Musical History in the Moscow Conservatory: after that he devoted himself entirely to composition. His works include several operas, symphonies, overtures, and other orchestral pieces, solos for piano and other solo instruments with and without orchestra, chamber music, and many vocal pieces sacred and secular. At the opening of the Carnegie Music Hall he visited New York and conducted several of his own compositions. D. in St. Petersburg, Nov. 5, 1893.

D. E. HERVEY.

**Tschudi**, choo'dē, ÆGIDIUS: historian; b. in Glarus, Switzerland, in 1505; studied at Basel, Vienna, and Paris; traveled much in his native country and Italy; held various important offices in Baden and Glarus; went in 1559 as ambassador to the Emperor Ferdinand I. in Augsburg; was banished in 1562 on account of his strong adherence to the Roman Catholic Church, but recalled in 1564. On his travels and in his various offices he made very comprehensive investigations with respect to the history of Switzerland, and the last years of his life he spent in preparing his rich materials for publication, but only *Die uralt wahrhafftig Alpisch Rhätia*, published in Latin and in German, appeared before his death. His principal work is the *Schweizerchronik*, covering the time down to 1470, published by I. R. Iselin in 2 vols. (Basel, 1734–36). In 1758 his *Beschreibung Galliæ Comatæ*, appeared under Gallatis's editorship. D. at Glarus, Feb. 28, 1572.

**Tschudi**, JOHANN JAKOB, von: naturalist, traveler, and diplomatist; b. in Glarus, Switzerland, July 25, 1818. He studied medicine and natural sciences at Neuchâtel, Leyden, and Paris. In 1838–43 he traveled in Peru, making a special study of the Quechua language and antiquities; subsequently he made an extended tour through Brazil, Bolivia, etc. The results of these expeditions were embodied in several works, including *Fauna Peruana* (1844–47); *Peruanische Reiseskizzen* (1846); *Reisen durch Südamerika* (1866–68); and *Organismus der Kechua-Sprache* (1884). With Rivero he wrote the *Antigüedades Peruanas* (1851). He was ambassador of Switzerland to Brazil (1860), and to Austria (1866–83). D. at Jakobsthal, Lower Austria, Oct. 8, 1889. H. H. S.

**Tsêng** (or **Tsŭng**), MARQUIS, whose full name was *Tsêng Ki-tsêh*: Chinese diplomatist; b. in the province of Hunan in 1848; son of Tsêng Kwoh-fan (1807-72), who, though less known to Europeans than his son, was a statesman of wider fame in his own country, having won especial distinction as governor-general of the two Kiang provinces during the Tai-ping rebellion. The young Tsêng was his father's secretary at this time, and accompanied him in his successful campaign. In 1878 he was appointed minister to Great Britain and France, and afterward was sent as special ambassador to Russia to settle the Kulja difficulty, which he succeeded in doing in a satisfactory manner, obtaining the treaty of St. Petersburg, which restored Kulja to China. In 1886 he returned to China, where he was made a grand secretary and president of the admiralty board. D. in Peking, Apr. 12, 1890. F. M. COLBY.

**Tset'se** [S. African]: a dipterous insect, *Glossinia morsitans*, a little larger than the common fly. It abounds in some parts of South Africa, but is absent from large districts. Its bite is nearly always fatal to the ox, horse, and dog, though harmless to man, as well as to goats, asses, mules, and the wild beasts of the regions it inhabits.

**Tsing-tu** [Chinese, liter., pure land]: the Chinese name for SUKHĀVATĪ (*q. v.*), the heaven of Amitabha Buddha, and also of the Buddhist sect which reverences Amitabha and makes re-birth in his heaven their chief aim. In the mouths of the Japanese Tsing-tu becomes *Jōdō*. The SHINSHIU (*q. v.*) is a Japanese development of the Jōdō.

**Tsi-tsi-har**, chee'chee'haar: the most northerly of the three provinces of Chinese Manchuria, known among the Chinese as the *Heh-lung-Kiang*, or Amur province; bounded N. by the Amur, E. and S. by the Sungari, a tributary of the Amur, and W. by the Nonni and Mongolia. Area, 195,000 sq. miles. It is cultivated chiefly in valleys of the Nonni and Sungari, pulse, maize, millet, tobacco, wheat, and the poppy being the chief crops. The rest of the country is mostly an uninhabited mountain wilderness. The inhabitants consist of Manchus, Korchin Mongols, Yakuts (of whom 6,600 families emigrated from Siberia, and settled in the valley of the Nonni in 1687), and Chinese, chiefly from the northern provinces. The chief cities are Tsi-tsi-har (on the Nonni, lat. 47° 21' N., lon. 124° E.), Mergen, and Hurunpir. The city of Tsi-tsi-har, built in 1692 by order of the emperor ruling in the period K'ang-hi in order to overawe the neighboring tribes, is surrounded with a stockade and a ditch. At Igun, in the northeastern part of the province, are a penal settlement and a large garrison. See S. Wells Williams, *Middle Kingdom* (New York, 1883).

**T-Square**: an instrument used in mechanical and architectural drawing. It consists of two arms, one of which is called the *stock* or *helve*, and the other the *blade*. The blade is attached to the stock at its middle point. The stock projects below the blade, forming a shoulder, which, when used, is pressed firmly against the edge of the drawing-board. To use the instrument the blade is first set so as to make the desired angle with the stock; the shoulder of the stock is then pressed firmly against the edge of the drawing-board and moved along that edge; the blade will remain parallel to its first position. In the simplest form of T-square the blade is firmly fixed at right angles with the stock.

**Tsu'ga** [a Japanese name]: a genus of coniferous trees related to the spruces and firs, and including the common hemlock (*T. canadensis*) of Eastern North America, the Californian hemlock spruce (*T. mertensiana*), and a few other species, one or two of which occur in Japan and the Himalayan region. They are distinguished from the spruces (*Picea*) by their flat, petioled leaves, and from the firs (*Abies*) by their pendulous cones, whose scales are persistent. See CONIFERS. CHARLES E. BESSEY.

**Tsuga'rn**: the ancient name of a district which lies in the extreme north of the main island of Japan, and gives its name to the strait separating this from the island of Yezo. The family holding sway in the district also bore this name, their castle-town being at Hirosaki (pop. 33,000), a garrison town, the barracks of which occupy the site of the old castle. The finely symmetrical mountain Iwaki San (4,500 feet) is known as Tsugaru Fuji from its resemblance to Fujiyama. The mottled green and red lacquer known as seaweed also takes its Japanese name from the district. J. M. DIXON.

**Tsuru'ga**: a town in Central Japan; on the west coast, about 50 miles N. of Kioto and 20 miles from Lake Biwa (see map of Japan, ref. 6–C). It is the terminus of a branch line of railway, leaving the trunk line at Nagahama, and possesses the best harbor on the northwest coast of Japan, a coast, however, singularly destitute of good harbors. The deep bay at the head of which the town is situated is much exposed, but is protected by a breakwater, and vessels of the largest draught can anchor in safety. Pop. (1892) 12,000. J. M. DIXON.

**Tsu'shima**: two islands in the sea of Japan, midway between the Korean peninsula and the island of Kiushiu; separated from the former by the Broughton Channel, from the latter by Krusenstern Strait. Area, 361·69 sq. miles. Their distance from the harbor of Fusan, in Korea, is only 30 miles, and their military importance is fully recognized; they are known as the western gate of Japan. During the troubles of the restoration period of 1868–70 the Russians were a short time in occupation; since then the islands have been strongly fortified and well garrisoned. Though the climate is mild, the soil is not productive, and the inhabitants depend almost entirely on fishing for a livelihood. The chief town is Itsukubara, which has a fine harbor. Pop. (1895) 32,135. J. M. DIXON.

**Tuamotu**, twā̆a-mō'too, or **Pomotu**: a Polynesian archipelago belonging to the French, to the E. of the Society islands, extending N. W. and S. E. between 14° and 23° S. lat. and 136° and 149° W. lon., and passing to the S. E. into the Gambier and Mangareva groups. The islands are very numerous and comprise an area of 347 sq. miles, with a population of 4,775 in 1889. The islands are coral, often atols, seldom have an area, individually, of more than 10 sq. miles, and the largest is Turcia or Papakina, with an area of 37 sq. miles. They are divided into three groups, northern, central, and southern, and the central has the greatest aggregate area and population. Navigation among them is difficult and dangerous. The climate is regular, moderate, and salubrious. The soil is poor, the vegetation not abundant, and the principal source of wealth is the pearl-oyster. The language and people of Tahiti have the supremacy, but the racial relations are with Raratongo. MARK W. HARRINGTON.

**Tu'aregs** (*Tawarek*): a race of Mohammedan nomads inhabiting a great part of the Sahara or great African desert, from Fezzan W. to the Atlantic. They are believed to be allied by race to the Berbers, and are fanatic, faithless, and predatory. Their hair is straight, their features are Caucasian rather than African, and their physical development is fine. They have a written alphabet, but no literature. The alphabet contains Hebrew, Greek, and Roman letters, with others. The Tuaregs are divided into large tribes, and greatly oppress the Tibbus (Tebu) their neighbors. Their number is estimated at 300,000. Revised by M. W. HARRINGTON.

**Tuat'**: group of oases in the Western Sahara; to the S. of Oran, Algeria, on the Timbuctu route, in the French sphere of influence. They stretch over an area about 150 miles long by 40 broad, between the Tuareg country and that of the western dunes. The fertility of these oases depends on the waters of the Messaud river and its tributaries, and, to a greater extent, on subterranean water. The climate is rigorous, but salubrious. The soil is a rich alluvium, very fertile and productive. The chief reliance for support is the date-palm, and the number of these trees in the Tuat has been estimated at from 3,500,000 (Deporter) to 4,300,000 (Pouyanne). Barley, wheat, sorghum, pomegranates, melons, and onions are also raised in considerable quantities. Pop. about 100,000, comprising Arabs, Negroes, Sherifs, black and white Berbers, and their intermixtures. M. W. H.

**Tuatara**: See HATTERIA.

**Tuber** [= Lat., swelling, hump, tumor, knob, truffle]: in plants, a thickened subterraneous portion of the stem, often bearing latent buds or eyes, and usually composed of cellular substance richly stored with starch or some other equivalent principle. Many of the tubers, like that of the common potato, are of great value as sources of human food.

**Tubercula Quadrigemina**: same as *Corpora Quadrigemina*. See BRAIN.

**Tubercular Meningitis**: See MENINGITIS.

**Tuber'culin** [from *tubercule* + chemical suffix *-in*]: a dark-brown fluid obtained from the pure culture of the specific germ of tuberculosis, and first prepared by Prof. Robert Koch, of Berlin, in 1891, for the cure of the early stages of tuberculosis; hence known also as *Koch's lymph* and *Koch's specific*. The remedy acts curatively upon lower animals, especially guinea-pigs and rabbits, and many undoubted cures have followed its use in the human subject also; but it was quickly brought into discredit by the exaggerated accounts of its virtue which appeared in the public press, and by its injudicious use upon far-advanced cases. It was also found that the remedy contained some toxic substances which, although well tolerated by lower animals, proved highly poisonous to man in doses several hundred times smaller than could be safely given to a guinea-pig. Those, however, who appreciated the significance of its curative influence in the animal continued the use of tuberculin and increased the dose very gradually, and thousands of apparent cures are now on record by the best authorities both in Europe and America. The treatment was, however, tedious, and successful only in well-selected cases, and efforts were made at an early period for its purification, notably by Prof. E. Klebs in Germany and Dr. Hunter in England. In the meanwhile it was found that tuberculin, when given in larger doses, has a decided diagnostic value by its producing fever in tubercular animals and in man, whereas no such effect follows its application when the subject of such a trial is free from tuberculosis. This test is now largely applied to milch cows, and its benefits in thus preventing the use of the milk and flesh of tuberculous animals as food is of the greatest value in the prevention of human infection, as milk especially is now considered the usual mode by which the disease is communicated to man. Its diagnostic use for the early recognition of human tuberculosis is only a matter of time, and the test can be made perfectly safe. The efforts to purify tuberculin have also been successful, especially in the hands of Prof. E. Klebs, who separated the poisonous principles in the form of a toxalbumen and proved the curative effect of the purified remedy both in animals and in man; he also showed the absolute safety of it in doses many thousand times greater than could be given of the non-purified substance. This purified tuberculin Prof. Klebs called antiphthisin, and it as well as the original crude tuberculin are now being produced both in the U. S. and in Europe. All those who have so far employed it testify to its safety even in large doses, and to its curative value, the time required for treatment being very much shortened. This is confirmed by the present writer's experience of over a year in several hundred cases in which the remedy was employed.

KARL VON RUCK.

**Tuberculo'sis** [Mod. Lat., deriv. of *tuber'culum*, small swelling, tubercle, dimin. of *tuber*, swelling, hump]: an infectious and somewhat contagious disease of man and many animals, which is caused by the growth and specific action of a micro-organism, the bacillus of tuberculosis. No disease has received a greater amount of study and none deserves more, for its ravages are so great that not less than one-seventh of all deaths are due to this cause; and, if the number of cases in which a small focus has existed and become latent or cured are added, it is not unlikely that the favorite saying of a great German physician is true, that "sooner or later everybody has a little tuberculosis."

The favorite seat of tuberculosis is in the lungs, but any tissue or organ of the body may be affected. Pulmonary tuberculosis or phthisis is, however, so much more frequent that it has received the greatest attention, and has been the basis of most studies of the causes and nature of the disease. From the earliest times it has been known that the lungs of persons dead of phthisis contain yellow masses; these were called tubercles (small nodules), and from them the technical name tuberculosis is derived. From 1790 to 1820 Stark, Baillie, Boyle, and the immortal Laënnec contributed to more accurate knowledge regarding the earlier stages of these yellow masses. It was established that at the earliest stage gray or miliary tubercles will be found, and that these subsequently degenerate and become yellow. Gray tubercles may occur also in the membranes of the brain, in the pleura, pericardium, peritoneum, and in any of the solid organs; they may arise in the mucous surfaces, where they tend to degenerate with production of ulcerations.

Clearly as stages of tuberculosis can now be traced, the variety of the gross appearances presented made the pathology of this disease a ground for the bitterest conflicts, and not until the middle or later parts of the nineteenth century can anything like a settled view be said to have been established. This uncertainty and difference of opinion are largely due to the fact that associated and not necessarily specific changes in the affected organs frequently so mask or alter the appearances that it was only with the utmost difficulty that the characteristic were separated from the non-characteristic morbid changes. For example, in the lungs the growth of the tubercles may be unassociated with other changes, and the resulting condition is what is now called miliary tuberculosis; in another case the lung substance between the tubercle may be inflamed and solid, and the condition known as catarrhal or pneumonic phthisis results; while in still other cases nature's effort to cure the disease occasions an abundant growth of dense fibrous tissue, when the term "fibroid phthisis" is applied. The tendency in all parts of the body is for the tubercular masses to undergo cheesy change, and later to liquefy and form excavations. This is eminently true of the pulmonary forms.

*Causes of Tuberculosis.*—Two factors are to be considered —the individual susceptibility and the infection by the tubercle bacilli. *Susceptibility* to tuberculosis depends upon many causes. In the first place, animal families differ in this regard. The disease is rare among the cold-blooded animals, but common among many of the domesticated animals, particularly the ruminants. Of the greatest significance to man is the frequency of the disease in cattle, as has been shown at many large abattoirs and by the studies of veterinarians. Dogs, cats, and horses are less prone. The goat seems quite immune. Races of men differ largely in susceptibility in their natural state and under the influence of environment. In the U. S. the Negro seems specially susceptible.

The individual is affected unfavorably by heredity and by his surroundings, occupation, and the like. Heredity has always been looked upon, and justly, as a strong factor; but recent study indicates that in but very few cases is the disease itself transmitted directly from parent to offspring. There are a few undoubted cases on record, but these are certainly exceptional, and it seems unlikely that new investigations will show direct transmission to be frequent. The tendency to tuberculosis, the susceptibility, however, is regularly inherited, and especially from the maternal side. An individual with hereditary liability may increase this, or one without susceptibility may acquire it by the manner of life and surroundings. Any exposing occupation or ill-constructed residence, or other causes that deprave the system or occasion pulmonary troubles, bronchitis, and the like, make the individual prone to become infected. Certain occupations, such as mining, stone-cutting, grinding, hair-cutting or sewing, which expose the individual to the inhalation of dust, are notoriously liable to aid in the development of phthisis.

As a deduction from what has been said, and as experience proves, individuals strongly predisposed may escape the disease by the most careful attention to the care of health and the avoidance of the causes which specially increase susceptibility.

*The Bacillus of Tuberculosis.*—The history of the discovery of the infectiousness of tuberculosis is of very great interest. Villemin was the first to offer definite proof by showing that inoculation with tuberculous material produces the disease in the animal experimented upon. The final discovery of the bacillus itself was made by Koch and published in 1882. This is unquestionably one of the most brilliant contributions to human medicine and to science in general ever put forth. The bacillus (see BACTERIOLOGY) has been proved by all the tests regarded as decisive to be the specific cause of all forms of tuberculosis. Without this bacillus, tuberculosis can not arise.

*Modes of Infection.*—(1) As a rule, the bacillus enters the system by the inspired air, and in this way the disease is mainly contagious. The breath of phthisical patients does not contain the bacilli, but the sputa become dried on floors or the ground, and are then carried by the air to the lungs of susceptible individuals. Actual proof of the infectiousness of the dust in hospital wards or rooms where tubercular patients had lived was established by Cornet's experiments on guinea-pigs. (2) Intestinal tuberculosis is generally due to the swallowing of infected material. In the case of patients suffering with tuberculosis of the lungs, the sputa swallowed during sleep or at other times frequently causes tuberculosis of the bowels. The infection may, however, be conveyed by milk of tuberculous cows, by infected meat, or other food; and in particular the frequency of intestinal tuberculosis of children is attributable to this cause. (3) Some cases of tuberculosis result from direct inoculation, as in cases of tattooing, vaccination, or injuries to the hands of surgeons or dissectors. Another example is the tuberculosis of the genital organs, arising from sexual congress with an affected husband or wife. (4) Finally, direct transmission from the mother to her offspring during gestation, or from the father in procreation, is possible, but, in the human species at least, is very rare.

*Varieties and Seats of Tuberculosis.*—As has been said before, almost any structure of the body may be affected, and the appearances in the various situations vary widely in individual cases. Among the more common situations are the lungs, intestines, serous membranes, bones, and lymphatic glands. Since the discovery of the tubercle bacillus and the establishment of methods for its detection, a number of diseases have come to be recognized as tuberculous that were formerly not so regarded. Among these are scrofula (at least in many of its forms), certain bone diseases, lupus vulgaris, and other skin affections due to direct inoculation. *Scrofula* is of peculiar interest. In most cases this affects the lymphatic glands, which enlarge, caseate, and soften, discharging thick purulent material. The disease may remain local or may break into the blood-vessels with resulting general infection (general miliary tuberculosis). The glands affected are frequently those of the neck and those within the chest at the root of the lungs. In the former case the infection enters through the mucous membrane of the mouth, or nose, or through the lungs; in the latter through the lungs. It is to be noted that in many instances no local disease arises at the point of entrance of the bacilli, which simply pass through to the neighboring lymphatic glands, where they may lie dormant for a long time (latent tuberculosis), or occasion active disease of the glands. Many cases of general tuberculosis of obscure origin are traceable by careful search to such localized lesions of the glands or other parts which had remained latent before.

*Symptoms.*—These depend to the largest extent upon the organ or part involved, but there are certain general indications to be noted. The individual loses strength and flesh, he grows pale and worn in appearance, fever supervenes and becomes peculiarly irregular, coming on in the afternoon and subsiding in the morning; the patient perspires freely, and sometimes drenching night-sweats add seriously to his general weakness. Chills may be noted; and after a tedious illness, as a rule, the victim perishes of exhaustion and general intoxication. Individuals susceptible to the disease, especially to pulmonary tuberculosis, often present a characteristic appearance, in which the flattened chest, large bones, emaciated frame, straight black hair and dark eyes, and sallow complexion take a prominent part; but very often no doubt the appearances described as those of the "tuberculous diathesis" (or tendency) are in reality those of the beginning disease.

External tuberculosis, such as that of the skin (lupus), bones, and lymphatic glands, is, as a rule, less malignant than that of internal organs, and may be attended by few general symptoms.

*Curability.*—It is a widespread and not unnatural belief that tuberculosis is necessarily a fatal disease, but investigation proves the contrary. Very many persons become tuberculous and recover without having exhibited any decided symptoms, and in many more the disease is arrested before its ravages become extensive. Statistics of large series of *post-mortem* examinations, collected by various authorities, show that from 5 to 40 per cent. of all bodies examined show some evidence of past tuberculous disease which had become arrested. After, however, the disease has reached such extent that the symptoms are decided and the general health has materially suffered, the outlook is certainly grave. External tuberculosis is more hopeful than other forms.

*Treatment.*—Fresh air, change of climate, tonics, nutrients such as cod-liver oil, and the careful regulation of every detail of the life of the patient, constitute the reliable treatment. Special methods are useful according to the locality affected; and, in particular, surgical procedures are valuable in external tuberculosis. Specific remedies have been lauded by hundreds, but as yet none has been found. At the present day such antiseptics as creosote, guaiacol, and iodoform are in the ascendency. Koch, the discoverer of the bacillus of tuberculosis, introduced a hopeful method of treatment a few years ago, which consists in the introduction by hypodermatic injection of tuberculin, a derivative from the growth of bacillus itself. This was supposed to exercise antitoxic action, but the claims made for it (more by others than by Koch himself) have not been substantiated. In external tuberculosis it would seem to have done good in a number of reported instances; in internal tuberculosis it is neither reliable nor safe in the form in which it is now obtained and used. As a diagnostic agent, in the detection of tuberculosis in animals, it has served a most useful purpose. In every case of tuberculosis of animals in which the remedy is injected an elevation of the body temperature of from one to several degrees occurs, and this does not occur excepting in tuberculous animals. WILLIAM PEPPER.

**Tuberculosis** (of animals), also known as **Consumption:** an infectious disease, caused by the tubercle bacillus of Koch and characterized by the development in various organs and tissues of small dense nodules (tubercles) which are prone to undergo softening and cheesy degeneration. This disease is most common in cattle and hogs, but it may occur in other domesticated animals. It is caused, in most cases, by contaminated atmosphere, in which the germs of tuberculosis, having been expelled from the body of a diseased animal, have become dry and mixed with the air as dust. Tubercle bacilli inhaled may lodge on the mucous membrane of the air-passages, and where numerous, or in the case of especially susceptible animals when few, will set up a local irritation at the point of lodgment or will be carried through the lymph-channels to the lymph-spaces or glands, and will there cause an irritation that is followed by the development of a tubercle—the characteristic lesion of the disease. The tubercle is at first a very small grayish mass of spherical shape, and is made up of a dense collection of cells. As the disease progresses the tubercles grow and multiply; they become confluent, their centers soften, and cheesy change takes place, leaving them yellowish, semi-solid, or soft. In many cases of tuberculosis of cattle a strong fibrous membrane forms around the tuberculous areas, and the part inclosed becomes soft and pus-like. A lesion of this nature is usually described as a tubercular abscess.

Tuberculosis may also be contracted by eating infected food, and this means of transmission frequently operates when calves or pigs are fed upon the milk of tuberculous cows, or when pigs are fed the refuse from slaughter-houses. Milk from tuberculous cows is recognized as an occasional, if not a frequent, cause of tuberculosis in people who consume it, and many cases of human disease have been traced to this source. Heating milk to 160° F. for fifteen minutes is sufficient to destroy the tubercle bacilli and render milk from tuberculous cows a safe food. The extent to which the cow must be diseased in order to render her milk infectious is a subject that has received much attention, and it is now well established that the milk is always dangerous when the udder is tuberculous. It is frequently dangerous in very advanced, generalized cases, and some experiments indicate that it may be dangerous in a low percentage of cases in which the disease is not very advanced and is confined to organs at a distance from the udder. It may be, however, that more careful investigation in these last cases would have shown that the udder was in fact diseased, and the infectiousness of the milk thus accounted for. The flesh of tuberculous animals is regarded as dangerous to the health of the consumer only when the disease has reached the lymphatic glands between the muscles or is generalized in the viscera. In all cases both the meat and milk can be rendered innocuous by cooking.

Tuberculosis is spread among cattle chiefly by bringing healthy animals in intimate contact with diseased ones, as when they are members of the same herd. The disease spreads more rapidly in the winter, when the cattle are confined in the stable, than in the summer, when they are at liberty in the pasture. The prevalent impression that tuberculosis is frequently inherited is erroneous, and may be traced to the fact that many of the offspring of tuberculous bulls and cows develop tuberculosis. This is due, however, to exposure after birth, and to the fact that a predisposition to, or tendency toward, tuberculosis can be inherited, and this renders the young animal prone to contract the disease when it is exposed to it.

Tuberculosis of cattle is, in many of its forms and stages, a very difficult disease to recognize during life. This great difficulty in diagnosis has made the extermination of the disease, which is based upon the removal of sources of infection and the improvement of sanitary conditions, a matter of the greatest difficulty, for it is impossible by the ordinary methods to discover the tuberculous animals in a herd. The use of tuberculin or Koch's lymph as a diagnostic has become general, and has given very satisfactory results.

The tuberculin test, or the recognition of tuberculosis in the living animal by the use of tuberculin, is based upon the fact that when a small amount of tuberculin (0·2 c. c.) is injected beneath the skin of a tuberculous cow a reaction, or elevation of the temperatnre to the extent of distinct fever, is caused within from eight to sixteen hours, while in non-tuberculous animals no effect is produced. So far as known, this test is harmless to healthy animals, and has a curative tendency in many that are diseased. After tuberculosis has been recognized in this way, in a milch cow, even though the animal may appear to be in prime order, the milk should not be used in a raw condition, nor should the cow be allowed to associate with healthy animals.

LEONARD PEARSON.

**Tu'berose** [from Mod. Lat. specific name *tubero'sa* (in *Polyan'thes tuberosa*), liter., Lat. fem. adj., tuberous, deriv. of *tu'ber*, tuber]: the *Polyanthes tuberosa*, an amaryllidaceous plant, a native of Mexico, much cultivated in greenhouses, and in the open, for its beautiful and highly fragrant white flowers, which are extensively employed by perfumers. Some 24,000 lb. of tuberose flowers are yearly produced in the valley of the Var, in France, for perfumers' use. The common name is derived from the tuberous character of the plant, and is therefore *tuberose*, not *tube-rose*. The plant has "a solid pear-shaped tuber from the base of which proceed roots, and from the apex long, linear channeled leaves, and late in summer a stem 2 to 3 feet high, the upper part of which is crowded with short-pediceled flowers and the lower part bears a few short leaves. The flowers consist of a funnel-shaped slightly curved tube, with six nearly equal, spreading lobes often tinged with rose without and creamy white within."

Revised by L. H. BAILEY.

Double tuberose (*Polyanthes tuberosa*).

**Tubina'res** [in allusion to the character of the external nostrils]: an order of birds containing the albatrosses, petrels, and shearwaters, characterized by having the nostrils opening in a little, more or less complete tube, which forms a part of the beak. The bill is hooked, toes webbed, hind toe absent, or present as a single joint only. The wings are long, narrow, and pointed, the great length being due to the very elongate humerus, radius, and ulna. The order is usually divided into *Diomedeidæ*, albatrosses, *Procellariidæ*, petrels and shearwaters, and *Pelecanoidiidæ*, the diving petrels; but W. A. Forbes makes only two divisions, one *Oceanitidæ*, containing the genera *Garrodia*, *Oceanites*, *Pelagodroma*, and *Fregetta*, the other *Procellaridæ*, comprising all others.

F. A. LUCAS.

**Tü'bingen**: an old but interesting town of Germany, in Würtemberg; beautifully situated on the Neckar, 20 miles S. W. of Stuttgart (see map of German Empire, ref. 7-D). Its university, founded in 1477, has a botanical garden, a chemical laboratory, an observatory, and several fine museums and collections connected with it. Reuchlin and Melanchthon were among its first professors, and in the beginning of the nineteenth century it developed a new school of theology. The manufacture of surgical and physical instruments and chemicals is carried on, also milling, dyeing, and book-printing. Pop. (1890) 13,273.

**Tübingen School**: the common title of three groups of theological and exegetical writers connected with the University of Tübingen in Germany. (1) The old Tübingen school, founded by Gottlob Christian Storr (professor 1775–1805), and whose best-known members were the brothers Johann Friedrich and Karl Christian Flatt (professors 1792–1821 and 1804–1843, respectively), Ernest Gottlieb Bengel, grandson of the great Bengel (professor 1806–26), and Johann Christian Friedrich Steudel (professor 1815–37). This school based belief in the Bible upon the authority of Jesus. Its theology was the biblical supranaturalistic. Starting with the doctrine that the Bible was a revelation, it defended its position by an appeal to Scripture interpreted by a grammatical and historical exegesis in opposition to the current rationalism. (2) The modern or younger Tübingen school, founded by Ferdinand Christian Baur (professor 1826–60), and whose principal pupil was David Friedrich Strauss. It began with studies in the history of Christian doctrines, transforming the various systematical representations of the divine revelation into a simple historical evolution. It then subjected the documents of the Christian religion, the books of the New Testament, to a searching critical examination, attacking both their authenticity and their integrity. Finally, it undertook a reconstruction of the origin and development of Christianity, without admitting such ideas as revelation, inspiration, miracles, etc., as operating forces. Although Baur refused to acknowledge himself a pupil of Hegel, the fundamental principles of the school concerning the nature of religion and the progress of history were adopted from the philosophy of Hegel. (See R. W. Mackay, *The Tübingen School and its Antecedents*, London, 1863). (3) The Roman Catholic Tübingen school, founded by Johann Adam Möhler (professor 1828–35), which, although sincerely endeavoring to increase friendly relations between the Roman Catholic and Protestant communions, idealizes the Tridentine theology and somewhat caricatures the Protestant. See C. von Weizsäcker, *Lehrer und Unterricht an der evangelisch-theologischen Fakultät der Universität Tübingen von der Reformation bis zur Gegenwart beschrieben* (Tübingen, 1877).

Revised by S. M. JACKSON.

**Tubular Bridges**: See BRIDGES.

**Tubulariæ**: See HYDROIDA.

**Tuckahoe'**: the Indian name of a singular vegetable substance found under ground in the southern parts of the U. S., sometimes attaining the size, and having somewhat the appearance, of a loaf of bread, whence it is often called Indian loaf or Indian bread. Its methods of growth and reproduction are unknown. It has been thought by some observers to be a secondary product caused by the degeneration of the tissues of some flowering plant, the mass afterward becoming invaded by fungus mycelium. It was eaten by the Indians, and is said to be sometimes used, when boiled in milk, as a substitute for arrowroot.

Revised by CHARLES E. BESSEY.

**Tucker**, ABRAHAM: moralist; b. in London, Sept. 2, 1705; studied at Merton College, Oxford, and entered the Inner Temple, but retired to private life at Betchworth, near Dorking, where he died Nov. 20, 1774. After 1756 he devoted himself to the writing of *The Light of Nature Pursued* (7 vols., 1768–78), an unsystematic treatise of great originality on morals, metaphysics, and theology. It has been reprinted several times; standard edition by Sir Henry Mildmay (1805).

**Tucker**, GEORGE: author; b. in the Bermudas in 1775; emigrated about 1787 to Virginia, where he was educated under the superintendence of his relative, Judge St. George Tucker; graduated at William and Mary College 1797; became a lawyer; was a member of the Virginia Legislature; sat in Congress 1819–25, taking a high position as a debater and constitutional lawyer; was Professor of Moral Philosophy and Political Economy in the University of Virginia 1825–45, after which he lived in retirement, chiefly at Philadelphia. He was author of *Life of Thomas Jefferson* (2 vols., 1837); *The Theory of Money and Banks Investigated* (1839); *The Progress of the United States in Population and Wealth in Fifty Years, 1790–1840* (1843); *History of the United States to 1841* (4 vols., 1856–58); *Political Economy for the People* (1859); *Essays, Moral and Philosophical* (1860), and several other works; and contributed to numerous periodicals. D. at Sherwood, Albemarle co., Va., Apr. 10, 1861.

**Tucker**, NATHANIEL BEVERLEY: lawyer and author; son of St. George Tucker; b. at Matoax, Va., Sept. 6, 1784. He graduated at William and Mary College; was admitted to the bar, and was judge of the Missouri circuit court in 1815–30, and Professor of Law in William and Mary College from 1834 till his death, at Winchester, Va., Aug. 26, 1851. He published *Principles of Pleading* (1846); *George Balcombe* (1836); *Gertrude*; *The Science of Government*, and other works; but his most noteworthy book was *The Partisan Leader* (1836), an unfinished historical novel, the scene of which was laid in Virginia in 1849, thus forecasting the future by some dozen years. It was reprinted in 1861 as *A Key to the Disunion Conspiracy*, to prove that the project of secession had been long entertained in the Southern States. H. A. BEERS.

**Tucker**, ST. GEORGE, LL. D.: jurist; b. at Port Royal, Bermuda, June 29, 1752, but removed to Virginia in his early youth; graduated at William and Mary College 1772; studied law; was concerned in an expedition against Bermuda, where he aided in the capture of a fortification and of a large amount of stores 1776; was lieutenant-colonel at Yorktown, where he was severely wounded in the knee and rendered lame for life; married Mrs. Frances Bland Randolph, mother of John Randolph, 1778; became a member of the Virginia general court (legislature), professor at William and Mary College, commissioner to revise and digest the laws of Virginia, and a delegate to the convention at Annapolis, Md. (1786), which took the initiative in recommending the formation of a national constitution; was a judge of the State courts of Virginia nearly fifty years, judge of the court of appeals 1803–11, and of the U. S. district court of Eastern Virginia 1813–27, and was noted for wit, poetical talent, and legal attainments. D. at Edgewood, Nelson co., Va., in Nov., 1827. He was the author of *How far the Common Law of England is the Common Law of the United States*; *A Dissertation on Slavery, with a Proposal for its Gradual Abolition in Virginia* (Philadelphia, 1796); *Letter on the Alien and Sedition Laws* (1799); and edited *Blackstone's Commentaries, with Notes of Reference* (Philadelphia, 5 vols., 1803). See Lanman's *Biographical Annals.* Revised by F. STURGES ALLEN.

**Tucker**, SAMUEL: b. at Marblehead, Mass., Nov. 1, 1747; bred to the sea; was a captain sailing from Boston to London before the Revolution; commissioned a captain in the new American navy May 15, 1777; commanded the frigate Boston, in which he conveyed John Adams, minister to France, to his destination, Feb., 1778; took several prizes 1779; aided in the defense of Charleston, S. C., but became a prisoner at its capture, May, 1780; was exchanged June, 1781; took command of the Thorn, with which he made many prizes; received the thanks of Congress at the close of the war; settled at Bristol, Me., 1792; was for several years a member of the legislatures of Massachusetts and Maine, and in 1812 captured by stratagem a British vessel which had greatly annoyed the shipping of Bristol. D. at Bremen, Me., Mar. 10, 1833. His *Life* was published by John H. Sheppard in 1868.

**Tuckerman**, BAYARD: author; b. in New York, July 2, 1855. He graduated at Harvard in 1878, and has published *A History of English Prose Fiction* (1882): *Life of Lafayette* (1889); *Peter Stuyvesant* (1893); *William Jay and the Abolition of Slavery* (1893); and edited *The Diary of Philip Hone* (1889).

**Tuckerman**, EDWARD, M. A., LL. D.: botanist; b. in Boston, Mass., Dec. 7, 1817; educated in the Boston Latin School, Union College, and Harvard University; lecturer on history in Amherst College 1854–56; Professor of Botany there 1858–86. In 1868 he was elected to the National Academy of Sciences. His most important publications, many of which appeared in *The American Journal of Science and Arts* and the *Proceedings of the American Academy of Arts and Sciences*, relate to the lichens, viz.: *A Synopsis of the Lichens of New England, the other Northern States, and British America* (1848); *Genera Lichenum: an Arrangement of the North American Lichens* (1872); *A Synopsis of the North American Lichens*, part i. (1882); part ii. was published in a fragmentary state after his death (1888). In 1847 he began the publication of the *Lichenes Americæ Septentrionalis Exsiccati*, which reached 150 species (1855). D. at Amherst, Mar. 15, 1886. CHARLES E. BESSEY.

**Tuckerman**, HENRY THEODORE: author; b. in Boston, Mass., Apr. 20, 1813; studied in the public schools of that city; traveled in Europe in 1833 and 1837, and devoted himself to literature, criticism, and the study of art; settled in New York in 1845. Among his writings are *The Italian Sketch-book* (1835); *Isabel, or Sicily, a Pilgrimage* (1839); *Rambles and Reveries* (1841); *Thoughts on the Poets* (1846); *Artist Life*, being sketches of twenty-three American painters (1847); *Characteristics of Literature* (1849 and 1851); *The Optimist* (1850); *Life of Commodore Silas Talbot* (1851); *Poems* (1851); *A Month in England* (1853); *Memorial of Horatio Greenough* (1853); *Leaves from the Diary of a Dreamer* (1853); *Essays, Biographical and Critical* (1857); *Essay on Washington, with a Paper on the Portraits of Washington* (1859); *America and her Commentators* (1864); *A Sheaf of Verse* (1864); *The Criterion* (1866); *Papers about Paris* (1867); *The Book of American Artists* (1867); and *Life of John P. Kennedy* (1871). D. in New York, Dec. 17, 1871. Revised by H. A. BEERS.

**Tuckerman**, JOSEPH, D. D.: clergyman and philanthropist; b. in Boston, Mass., Jan. 18, 1778; graduated at Harvard 1798; was pastor of the Unitarian church at Chelsea, Mass., from Nov. 4, 1801, to Nov. 4, 1826; organized the Benevolent Fraternity of Churches for the support of a city mission called the Ministry at Large, to which he devoted himself and in which he was a pioneer; was the organizer of the first Seamen's Friend Society in the U. S. 1812, and visited England for the organization of charitable institutions. D. at Havana, Cuba, Apr. 20, 1840. He was the author of numerous sermons and *Reports*, of eleven tracts for seamen, of a *Prize Essay on the Wages paid to Females* (Philadelphia, 1830); *Gleams of Truth, or Scenes from Real Life* (1835); and *The Principles and Results of the Ministry at Large in Boston* (1838). The Tuckerman Institute in Liverpool commemorates his philanthropic labors in England, which were fully described by Miss Mary Carpenter in a *Memoir of Dr. Tuckerman* (London, 1849). Revised by J. W. CHADWICK.

**Tuckerman**, SAMUEL PARKMAN: organist and composer; b. in Boston, Mass., Feb. 11, 1819; received his first instruction from Charles Zeuner; from 1840 to 1849 was organist of St. Paul's church, Boston, going in the latter year to England to study the cathedral school of music. In 1853 took the Lambeth degree of Mus. Doc. and returned to Boston. He visited England again in 1856–60. He received the diploma of the St. Cecilia Academy, Rome, in 1852. For a short time he was organist of Trinity church, New York, succeeding Dr. Edward Hodges. D. at Newport, R. I., June 30, 1890. His compositions are entirely sacred and comprise anthems, services, and other church music; he also edited several collections of church music. D. E. HERVEY.

**Tuc'son**: city; capital of Pima co., Ariz.; on the Santa Cruz river, and the South. Pac. Railroad; 86 miles S. E. of Maricopa, and 121 S. E. of Phœnix (for location, see map of Arizona, ref. 14–N). It is in an agricultural, stock-raising, and mining region, and contains the University of Arizona, a public high school, public library, 2 national banks with combined capital of $100,000, 2 daily and 3 weekly newspapers, and works for the reduction of gold, silver, and copper ores. The city was the site of an Indian pueblo and was for several years the capital of the Territory. Pop. (1890) 5,150; (1900) 7,531. EDITOR OF "ARIZONA CITIZEN."

**Tucuman'**: an interior province of the Argentine Republic; bounded N. by Salta, S. E. by Santiago del Estero, and S. and W. by Catamarca. The authorities differ as to the area, but it is about 13,000 sq. miles. The surface is hilly, rising to mountains in the W., and the scenery is more varied and beautiful than that of any other province. The soil is very fertile, though requiring irrigation in parts; the climate is mild and salubrious. Though the smallest, Tucuman is the most thickly populated and one of the most prosperous of the Argentine provinces; it is called the garden of the republic. The most important industry is sugar-planting, which is protected by heavy import duties; most of the sugar and much of the rum consumed in the republic come from this province. Other products are wheat, maize, rice, tobacco, lumber, and fruits. The grazing industry is comparatively unimportant, and there are few mines, though the province is said to be rich in minerals. Pop. according to the census of May 10, 1895, was 215,693; it is rapidly increasing. Tucuman was the Tucma (region of cotton) of the Incas, who annexed it to their domains during the fifteenth century. The colonial government (*gobernación*) of Tucuman embraced, besides the modern province, most of Córdoba, Rioja, Catamarca, Santiago del Estero, Salta, and Jujuy: it was subject to the *audiencia* of Charcas (now Bolivia), attached to Peru until 1776, when it was transferred to the viceroyalty of La Plata. H. H. S.

**Tucuman**: a city; capital of the province of Tucuman, and the fifth town of the Argentine Republic in size and importance; beautifully situated on a plateau near the Sierra Aconquija, and a mile from the river Sali (see map of

South America, ref. 7-D). It is connected by railway with Rosario and Buenos Ayres, Jujuy, and other points, and controls most of the trade of the northern provinces. The town is surrounded by orange-groves, and there are nearly 300 sugar estates in the vicinity, with thirty central factories. It was founded in 1564 and removed to its present site in 1585. The streets are regular, but narrow; the principal square is shaded with orange-trees, and fronting it is the fine modern cathedral, with other public buildings. The town has a national college, libraries, large hospital, etc.; it is celebrated for its delightful climate. A congress of the Platine provinces (except Montevideo, Entre Rios, Corrientes, Santa Fé, and Paraguay) signed here the act of independence July 9, 1816; the building in which this congress met is carefully preserved in its original state. Pop. of the city (1895) 34,300. HERBERT H. SMITH.

**Tuda**: See DRAVIDIAN LANGUAGES and TODA.

**Tudawa**: See TODA.

**Tu'dor**: the family name of an English dynasty which occupied the throne from 1485 to 1603, when it became extinct upon the death of Queen Elizabeth. The family was descended from Owen ap Tudor, an obscure Welsh gentleman, who about 1423 married Catharine of France, widow of Henry V. of England. Their son, who was created Earl of Richmond, married Margaret, daughter and heiress of John Beaufort, Duke of Somerset, whose father was a son of John of Gaunt, Duke of Lancaster, but born out of wedlock. The Earl of Richmond was legitimated by act of Parliament, but was expressly excluded from the succession to the crown; but upon the failure of the real Lancastrian line, Henry, the second Earl of Richmond, was recognized by that party as their chief. He defeated Richard III. at the battle of Bosworth Field in 1485, and assumed the crown under the title of Henry VII., although without any legitimate right. He married Elizabeth, daughter of Edward IV., and thus united the pretensions of the rival houses of Lancaster and York. The sovereigns of the Tudor line were HENRY VII. (1485–1509), HENRY VIII. (1509–47), EDWARD VI. (1547–53), MARY (1553–58), and ELIZABETH (1558–1603), all of whom are treated under their respective names.

**Tudor**, WILLIAM: diplomat and editor; b. in Boston, Mass., Jan. 28, 1779; graduated at Harvard 1796; entered the counting-room of John Codman, an enterprising merchant, in whose employ he twice visited Europe (1800 and 1810); spent some time in literary pursuits at Paris, and traveled in Italy; went on a mercantile agency for the exportation of ice to the West Indies 1805; was one of the founders of the Boston Athenæum; was an active member of the Anthology Club, and editor of and a voluminous writer for its literary organ, *The Monthly Anthology* (10 vols., 1803–11); founded *The North American Review* May, 1815; conducted it as a bi-monthly, and wrote three-fourths of its contents until Dec., 1818, when it was changed to a quarterly and passed into other hands; published *Letters on the Eastern States* (1820), a volume of *Miscellanies* (1821), consisting of selections from his previous magazine articles, and a *Life of James Otis* (1823); was the originator of the Bunker Hill Monument (1823); was U. S. consul at Lima, Peru, 1823–27; became U. S. *chargé d'affaires* at Rio de Janeiro, Brazil, 1827, and wrote while there his last work, *Gebel Teir* (Boston, 1829), an ingenious allegory. D. at Rio de Janeiro, Mar. 9, 1830. Revised by H. A. BEERS.

**Tuesday** [M. Eng. *Tewesday* < O. Eng. *Tiwesdæg*; *Tiwes*, gen. of *Tiw* (See TYR), god of war + *dæg*, day; cf. Germ. *Dienstag*: Icel. *Týsdagr*]: the third day of the week. The name originated as a translation of the *Dies Martis* (liter., Mars's day) of the later Roman pagans.

**Tufa**: See LIMESTONE.

**Tufts**, COTTON, M. D.: physician; b. at Medford, Mass., May 30, 1734; graduated at Harvard 1749; became a physician at Weymouth; wrote the instructions to the representatives of Weymouth to oppose the Stamp Act 1765; married a daughter of Col. John Quincy; was a representative of Weymouth in the general court, State councilor and senator for many years, member of the convention for ratifying the Federal Constitution; was one of the founders of the American Academy of Arts and Sciences and of the Massachusetts Medical Society, of which he was president 1787–95. D. at Weymouth, Mass., Dec. 8, 1815.

**Tufts College**: a coeducational institution at Medford, Mass.; founded in 1852 on land given by Charles Tufts and through the munificence of several donors, among whom Sylvanus Packard gave the most. The college comprises four separate institutions, the College of Letters, the divinity school, Bromfield-Pearson (technical) school, and the medical school. Six courses of study are given in the College of Letters: (1) A course leading to the degree of A. B., equivalent to the regular classical course in New England colleges; (2) a second course, leading to the same degree, in which modern languages take the place of Greek as a condition of admission and during the course, with the option of beginning the study of Greek in the freshman year; (3) a course for the degree of Ph. B.; courses in (4) electrical, (5) civil, and (6) mechanical engineering. The divinity school, opened in 1867, fits students for the ministry in the Universalist denomination. The college buildings consist of a three-story building for recitations, etc., seven large dormitories, a library building, a beautiful stone chapel and a gymnasium, the gift of Mrs. Mary T. Goddard, a large natural history museum, the gift of Hon. P. T. Barnum, a divinity hall, the gift of Rev. Dr. A. A. Miner, a large brick building for the Bromfield-Pearson School, and a large structure for a chemical laboratory. The Bromfield-Pearson School was established in 1893, and the medical school the same year. The college is open to both sexes on equal terms in all its departments, and has an endowment fund of over $1,250,000, 110 professors and instructors, 800 students, and a library of 44,000 volumes. The first president (1854–61) was Rev. Dr. Hosea Ballou; the next was Rev. Dr. Alonzo A. Miner (1862–75), who was succeeded by Rev. Dr. Elmer H. Capen, the present (1901) incumbent.

**Tugaloo' River**, called also **Chattoo'ga**: a river which rises in Jackson co., N. C., and, flowing S., forms for some distance the boundary between Georgia and South Carolina, and then unites with the Keowee to form the Savannah river.

**Tuileries**, Fr. pron. twē̆l'ree' [= Fr.; cf. *tuilerie*, tile-kiln, deriv. of *tuile*, tile < O. Fr. *teule*: Ital. *tegola*: Span. *teja* < Lat. *tegula*; as loan-word in Germ. *ziegel*]: a famous palace formerly existing in Paris, on the right bank of the Seine. The ground was originally occupied by tile-works, whence the name of the palace, and was bought by Francis I. in 1518. In 1564 Catherine de' Medici began the erection of the buildings after the plans of Philibert Delorme, who was succeeded as master-architect by Jean Bullant. This, the original palace, which was subsequently much altered, but of which no exact drawing has been preserved, consisted of the central pavilion, and the adjoining galleries, but not in their later form. Under Louis XIV. the older parts of the palace were heightened, and the spherical dome of the Pavillon de l'Horloge was transformed into a quadrangular one. Thus the front façade was completed, and at the same time the garden, occupying an area of 56 acres between the palace and the Place de la Concorde, was laid out by Le Nôtre. After the erection of the palace of Versailles the Tuileries was seldom used by the French kings until Louis XVI. in 1789 was compelled to remove the royal residence hither, and after that time the palace was the scene of some of the most stirring spectacles of the history of France. Napoleon I., Louis XVIII., Charles X., Louis Philippe, and Napoleon III. resided here, and the palace was stormed and ransacked by the people Aug. 10, 1792, July 28, 1830, and Feb. 26, 1848. In May, 1871, it was finally destroyed by fire by the communists. The long galleries of the Louvre, ending in the Pavillon de Flore and the Pavillon de Marsan which flanked the Tuileries, connected the two palaces, and the pavilions named, are sometimes considered as a part of the Tuileries, but they remain and have been restored. The ruins were removed finally in 1883.

Revised by RUSSELL STURGIS.

**Tuke**, DANIEL HACK, M. D., F. R. C. P., LL. D.: alienist; b. at York, England, in 1827; studied medicine at St. Bartholomew's Hospital College, London; became a member of the Royal College of Surgeons in 1852 and a fellow in 1857; graduated M. D. at the University of Heidelberg in 1853; after visiting the principal asylums for the insane in Europe became assistant medical officer and subsequently visiting physician to the York Retreat for the Insane; in 1874 removed to London. He was coeditor of *The Journal of Mental Science* from 1878–92. With Dr. J. C. Bucknill he wrote a *Manual of Psychological Medicine* that has passed through several editions since its appearance in 1857. Among his more important works are *Insanity in Ancient and Modern Life* (London, 1878); *Chapters in the History of the Insane in the British Isles* (London, 1882); *Illustra-*

*tions of the Influence of the Mind upon the Body in Health and Disease* (London, 1884); *A Dictionary of Psychological Medicine* (London, 1892). D. in London, Mar. 5, 1895.
S. T. Armstrong.

**Tuke**, Henry: b. at York, England, in 1756; was for thirty-four years, from 1780, a minister and distinguished writer of the Society of Friends. He wrote *The Faith of the People called Quakers in Our Lord and Saviour Jesus Christ, set forth in various Extracts from their Writings* (1801; 3d ed., enlarged, 1812); *The Principles of Religion as Professed by the Society of Christians usually called Quakers, written for the Instruction of their Youth and for the Information of Strangers* (London, 1805; 12th ed. 1852), an authoritative manual, translated into German, French, Danish, and Spanish; *Biographical Notices of Members of the Society of Friends* (2 vols., 1813–15), and other writings collected in his *Works* (4 vols., 1815), which were edited, with a biographical sketch, by Lindley Murray. D. at York in 1814.

**Tula**: government of European Russia, bordering N. on the government of Moscow; area, 11,954 sq. miles. The surface is level or slightly undulating, the climate temperate, and the soil fertile. One-sixth of the surface is covered with forest; the rest is under tillage; around the capital are extensive iron and coal mines. Grain, hemp, flax, mustard, turnips, potatoes, tobacco, and hops are grown; sheep, cattle, and horses are raised. Breweries, distilleries, and manufactures of ironware are numerous. Pop. (1897) 1,431,322.

**Tula**: town of European Russia; capital of the government of Tula; on the Upa; 110 miles by rail S. of Moscow (see map of Russia, ref. 7–E). It is well built and has a fine cathedral, many other churches, a theater, several museums, several technical schools, and other educational institutions. Locks, tea-urns, cutlery, bells, muskets, pistols, sword-blades, etc., are made to perfection in large quantities. The imperial manufactory of arms employs many men and women. The manufactures of hats, silks, leather, platinum-ware, jewelry, and ironware are very important. Its niello-work is famous. Pop. (1897) 111,048.
Revised by M. W. Harrington.

**Tula**: a town of the state of Hidalgo, Mexico; on the Mexican Central Railway; at the junction of the Pachuca branch; 6,716 feet above the sea (see map of Mexico, ref. 7–G). It is supposed to be the ancient Toltec capital of Tollan, which, according to the Indian chronicles or legends, was founded in the seventh century. Extensive ruins about it have been studied by Charnay and others, and are frequently visited by tourists. (See Mexican Antiquities.) Some of them appear to indicate communal buildings like those of Arizona. The quaint church and cloister of San José date from 1553. Pop. about 5,000. H. H. S.

**Tulane University**: an institution in New Orleans, La., organized on its present basis in 1884, having formerly been called the University of Louisiana. It is intended for the higher education of the white youth of Louisiana, and includes the medical department, law department, College of Arts and Sciences, College of Technology, the university department of philosophy and science, and the H. Sophie Newcomb Memorial College for Women. The donations of the founder, Paul Tulane, at the time of his death amounted to $1,100,000. The medical department has since its foundation in 1834 matriculated 10,905 students and graduated 3,141 students. It has as its school of practical instruction the great Charity Hospital with its 700 beds and 6,000 patients annually. The law department teaches principally civil law, which forms the basis of Louisiana law. The line of demarkation between the university proper and the colleges is well defined and strictly observed. The courses of instruction are logical and progressive. The growth and expansion of the institution have been steady and rapid. The H. Sophie Newcomb Memorial College, resting upon a separate endowment of $500,000, donated to Tulane University by Mrs. Josephine Louise Newcomb, bids fair to become a rival of the best Northern colleges for women. The separate departments of the university are in different parts of the city in buildings of the best architectural character, and with the fullest literary, scientific, and mechanical equipment. In 1900 it had 77 instructors, 1,296 students, and 25,000 volumes in its libraries, and Edwin A. Alderman, LL. D., was president.

**Tulare**: city (founded in 1872); Tulare co., Cal.; on the South Pac. Railroad; 250 miles S. E. of San Francisco (for location, see map of California, ref. 9–E). It is in an agricultural and fruit-growing region, and contains 7 churches, public high school, grammar schools, public library (opened in 1878), 3 State banks with combined capital of $108,100, railway round-houses and machine-shops, artesian wells, and a daily and 2 weekly newspapers. Pop. (1880) 447; (1890) 2,697; (1900) 2,216. Editor of "Register."

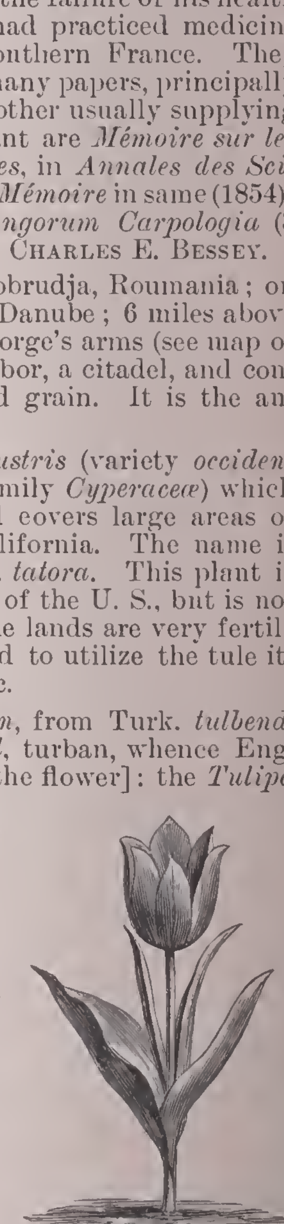
**Tulare** or **Tule Lake**: a shallow lake in Kings co., Cal.; once the largest lake in the State. It formerly had no outlet, but at high water its surplus flowed through a slough into San Joaquin river. It received Kern, Tulare, and King's rivers, and other streams. In 1872 it covered an area of 500 sq. miles; in 1895 its area was reduced to about 220 sq. miles. This result is attributed largely to the cutting of timber on the mountains, the tapping of the watercourses by which the lake was replenished, and to the use of the waters of tributaries for irrigation. Revised by I. C. Russell.

**Tulasne**, tü'laan', Louis René: botanist; b. near Tours, France, Sept. 12, 1815; d. at Hyères, Dec. 22, 1885. Charles Tulasne: botanist; b. near Tours, Sept. 5, 1816; d. at Hyères, Aug. 21, 1884. The brothers Tulasne, as they were called, were intimately associated in botanical work throughout their lives. The first botanical work of the elder was with Saint-Hilaire in the preparation of his *Flora of Brazil* (1825–33); from 1842 to 1864 he was upon the staff of the Jardin des Plantes (Paris), but upon the failure of his health he removed with his brother (who had practiced medicine from 1843 to 1864) to Hyères, in Southern France. They published jointly and individually many papers, principally relating to the fungi, the younger brother usually supplying the illustrations. The most important are *Mémoire sur les Ustilaginées comparées aux Urédinées*, in *Annales des Sciences Naturelles* (1847), and a second *Mémoire* in same (1854); *Fungi hypogæi* (1851); *Selecta Fungorum Carpologia* (3 vols., 1861–65). Charles E. Bessey.

**Tulcha**, tool'chaa: town of the Dobrudja, Roumania; on one of the arms of the delta of the Danube; 6 miles above the junction of the Sulina and St. George's arms (see map of Turkey, ref. 2–E). It has a good harbor, a citadel, and considerable trade in salt fish, wood, and grain. It is the ancient *Ægissus*. Pop. (1890) 17,250.

**Tu'le** [= Mex.]: the *Scirpus lacustris* (variety *occidentalis*), a large club-rush or sedge (family *Cyperaceæ*) which grows to a height of 8 to 10 feet and covers large areas of marshy ground in some parts of California. The name is also applied to the similar plant *S. tatora*. This plant is found throughout the western parts of the U. S., but is not elsewhere of as large a size. The tule lands are very fertile when drained. It has been proposed to utilize the tule itself in the fabrication of matting, etc.

**Tulip** [from O. Fr. *tulipe*, *tulipan*, from Turk. *tulbend*, *dulbend*, turban, from Pers. *dulband*, turban, whence Eng. *turban*; so called from the shape of the flower]: the *Tulipa gesneriana* and other species, liliaceous herbs from Central Asia, now everywhere cultivated for their beautiful flowers. Of this species fully 1,000 varieties have been catalogued, but there are hundreds of unnamed varieties. Conrad Gesner brought the tulip from Turkey to Augsburg in 1559. Haarlem, in Holland, is, and long has been, the principal seat of the production of tulip-bulbs for the European and American markets. During the seventeenth century the value of tulip-bulbs increased largely in Holland, and in some instances they were sold for 2,500 florins, and even, according to some writers, as high as 4,600 florins. The Duc van Thol or sweet-scented tulips (*Tulipa suaveolens*) are smaller and earlier than common tulips with acuminate perianth segments.


Early tulip, Duc van Thol.

Revised by L. H. Bailey.

**Tulip-tree**: the *Liriodendron tulipifera*, a beautiful and noble forest-tree of the U. S. belonging to the magnolia family. Its bark has active tonic powers, and its wood is valued in house-carpentry and carriage and furniture making. It is often incorrectly called poplar, and sometimes whitewood. It is a fine ornamental tree.

**Tull**, Jethro: agriculturist; b. in Oxfordshire, England, about 1680; received a good education; studied law; was admitted as a barrister and made the tour of Europe, after which he settled first on his paternal estate and afterward on Prosperous Farm in Berkshire, near Hungerford, and gave his attention to scientific agriculture; invented the drill-plow, and published a famous work entitled *New Horse-Hoeing Husbandry* (1733), which long enjoyed great authority in England. The essence of his system consisted in planting in rows and in pulverizing the soil around the plants, but he made the mistake of thinking manure unnecessary, and his own experiments consequently involved him in serious losses. Yet he so emphatically and truthfully expounded the importance of tillage that his work is generally considered to have marked an epoch in agriculture. D. Jan. 3, 1740. His work was edited by William Cobbett in 1822, with the addition of some scattered essays on similar subjects. Revised by L. H. Bailey.

**Tullaho′ma**: village (incorporated in 1851); Coffee co., Tenn.; on the Nashv., Chat. and St. L. Railway; 69 miles S. E. of Nashville, and 81 N. W. of Chattanooga (for location, see map of Tennessee, ref. 7–F). It is on the Cumberland Mountain plateau, contains 7 churches for white people and 3 for colored, the Woolwine School (building cost $30,000), public school, 2 national banks with combined capital of $100,000, and a semi-weekly newspaper, and has 3 lumber-mills, flour-mills, and a hub, spoke, and handle factory. Its altitude and accessibility have made it a popular health resort. Pop. (1880) 1,080; (1890) 2,439; (1900) 2,684.

Editor of "Guardian."

**Tulle**, tül: town; in the department of Corrèze, France; on the Corrèze; 61 miles by rail E. N. E. of Périgueux (see map of France, ref. 6–E). It is poorly built, but its paper-mills, sugar-refineries, tanneries, and wool-weaving factories are important, and its manufactures of arms employ between 1,500 and 3,000 men. The thin fabric called tulle takes its name from this place. Pop. (1891) 15,384; (1896) 17,374.

**Tullius**, Servius: See Servius Tullius.

**Tulloch**, John, D. D.: educator and author; b. near Tibbermuir, Perthshire, Scotland, June 1, 1823; educated at St. Andrews and Edinburgh; became in 1845 a minister of the Church of Scotland at Dundee; spent some time in Germany, familiarizing himself with speculative theology as there taught; became in 1849 parish minister of Kettins, Forfarshire, and in 1854 principal of St. Mary's College, St. Andrews, Primarius Professor of Theology, and in 1860 senior principal of the university. D. at Torquay, England, Feb. 13, 1886. He was the author of *Leaders of the Reformation* (Edinburgh, 1859); *English Puritanism and its Leaders* (1861); *Beginning Life* (London, 1862); *The Christ of the Gospels and the Christ of Modern Criticism—Lectures on Renan's Vie de Jésus* (1864); *Rational Theology and Christian Philosophy in England in the Seventeenth Century* (2 vols., Edinburgh, 1872); *Religion and Theology, a Sermon for the Time* (1875); a volume of Croall lectures on *The Christian Doctrine of Sin* (1876); *Pascal* (1878); *Modern Theories in Philosophy and Religion* (1884); *Movements in Religious Thought in Britain during the Nineteenth Century* (1885); and several volumes of sermons. In 1855 he entered the lists with 1,200 competitors and gained the second Burnett prize of £600 for an essay *On the Being and Attributes of God*, which was published under the title *Theism, the Witness of Reason and Nature to an All-wise and Beneficent Creator* (1855). He was confessedly one of the great leaders of liberal thought in Scotland; was a chaplain in ordinary to the Queen, and preached frequently before her at Balmoral, and in 1878 was elected moderator of the General Assembly. He visited the U. S. in 1874. See his memoir by Mrs. Oliphant (1888; 3d ed. 1889). Revised by S. M. Jackson.

**Tullus Hostil′ius**: according to Roman legends, the third King of Rome (672–640 B. C.). During his reign the combat between the Horatii and Curiatii took place, in consequence of which Alba acknowledged the supremacy of Rome. Subsequently the Albans meditated treason, and when Tullus discovered their plans he razed the city and transferred the inhabitants to Rome.

**Tully**: See Cicero.

**Tuman**, or **Mikiang**: See Korea.

**Túmbez**, toom′bā*th*: a town of the department of Piura, Peru; at the extreme northwestern end of the republic, near the entrance to the Gulf of Guayaquil and a little back from the coast. It is of very ancient origin, was conquered by the Incas in the fifteenth century, and was their principal frontier city in this direction. This was the first Peruvian city seen by the Spaniards, and here Pizarro landed and began his march of conquest. The place is now unimportant. Pop. about 2,000. H. H. S.

**Tumble-weeds**: the popular name of many species of herbaceous annual plants whose many branches curve upward so that the whole plant is globular in outline. When dead and dry they break off at the root and roll away before the wind, dropping their seeds here and there for many miles. They occur upon the prairies and great plains of North America, the pampas of South America, the steppes of Russia, and probably wherever similar conditions prevail. The most common tumble-weed of the prairies of the U. S. is *Amaranthus græcizans*, but upon the great plains *Cycloloma atriplicifolium* and *Corispermum hyssopifolium* occur also. About 1890 another tumble-weed (*Salsola kali tragus*) appeared upon the Dakota plains. It is a recently imported prickly weed, and is commonly known as the Russian thistle. Many common plants in dry soils become tumble-weeds, a dozen or more having been catalogued for the U. S. Charles E. Bessey.

**Tumors** [= Lat., liter., swellings, deriv. of *tume′re*, swell. Cf. Tuber]: in pathology, swellings abnormal to the body; but in the usual sense inflammatory swellings are excluded, and the term is limited to distinct and abnormal growths apparently causeless and without purpose. The structure of tumors is in all cases but a reproduction of normal tissue, more or less faithfully simulated. The structure of tumors differs from that of the tissues which they simulate, mainly in being of a less fully developed character, in being less regularly arranged, and in their tendency to undergo secondary degenerative changes. Tumors are in some cases characterized by malignancy, that is by a tendency to recur when removed and to spread throughout the system by portions being transferred from the original seat to other parts through the blood or lymphatic currents.

The classification of tumors may be based upon their shape, their structure, or their nature, whether malignant or benign. The most scientific is the structural classification, according to which there are fibrous, bony, fatty, lymphatic, cartilaginous, and other types, called respectively fibroma, osteoma, lipoma, lymphoma, chondroma, etc. In this manner practically every tissue and organ in the body has its counterpart in some tumor.

The malignant tumors are those which have always attracted the greatest attention. Of these there are two large groups—the *carcinomata*, or cancers, and the *sarcomata*. The former are composed of epithelial cells arranged for the most part somewhat after the manner of glands; the latter are composed of ill-developed connective tissue. The cancers grow where there is normally epithelium, as in the breast, stomach, or womb; the sarcomata, where there is mainly connective tissue, as about bones, in tendons, in the subcutaneous tissues, and the like.

The classification of tumors by their shape is the oldest and crudest. There are recognized in this classification polypoid, papillomatous, cystic, and other forms, but the nature of tumors taking the same shape may be widely different.

It has been one of the great difficulties in the work of pathologists to find a satisfactory explanation of the causation of tumors, and numerous theories have been advanced. Some held that the new growth depended upon a general blood disease or dyscrasia; others that local injury and irritation are the essential causes; others inclined to the view that some defective arrangement of tissue in fœtal life leads to subsequent abnormal outgrowths; and most recently the parasitic theory has gained ground. The last refers tumors to the action of micro-organisms. In the case of certain growths in the lower animals and perhaps in man this theory has been substantiated; but the question is still very undecided. Doubtless each of the theories conveys part of the truth.

While tumors are most dangerous in proportion to their malignant characters, a purely local and benign growth may at times be most dangerous from the pressure or other mechanical effects it exercises. William Pepper.

**Tunbridge**, or **Tonbridge**: town; in the county of Kent, England; on the Medway; 29 miles S. E. of London (see map of England, ref. 13–K). It is noted for its manufactures of toys in Tunbridge ware, a kind of mosaic made of vari-colored woods. It has an important grammar school, founded in 1553, with an endowment of £5,500 a year. Pop. (1891) 10,123.

**Tunbridge Wells**: town; in the county of Kent, England; 5 miles S. of Tunbridge (see map of England, ref. 12–K). It is celebrated for its chalybeate springs, and has been resorted to as a watering-place since the beginning of the seventeenth century. It has a fine common, commanding beautiful views. Pop. (1891) 27,895.

**Tundra** [from Russ. = barren moss-plain]: a type of treeless, moss-covered plain, bordering the Arctic Ocean in Siberia and North America. The tundra in typical localities is a moderately undulating, swampy country, covered with a dense carpet of mosses, lichens, and a great variety of small but exceedingly bright and beautiful flowering plants, with a few species of ferns and rushes. The monotonous surface is dotted with innumerable lakelets which are surrounded with rich verdure during the short summers, and is sometimes broken by mountains and hills rising as islands from the sea-like expanse. The tundra, like other peat-bogs, is formed by the growth of vegetation above and its partial decay and accumulation below. The preservation of the vegetable matter is due to the fact that below the depth of about a foot the peaty soil is always frozen. As the thickness of the vegetable layer increases by growth above, the surface of the continually frozen layer rises. Under existing climatic conditions there seems to be no limit to the thickness that the accumulation may attain. Large rivers flow through the tundras, and in their banks a depth of from 100 to 300 feet of ice and frozen soil is sometimes exposed. The bones of extinct animals are frequently found in these deposits, and in Siberia the carcasses of the hairy mammoth and woolly rhinoceros have been found entire. In Alaska, on the border of Bering Sea, the tundra has a breadth of about 100 miles, but it increases in width along the shore of the Arctic Ocean, and in Asia is of still greater extent. The entire area occupied by these frozen bogs can not be less than 300,000 or 400,000 sq. miles. ISRAEL C. RUSSELL.

**Tung'sten** [= Swed., *tung*, heavy + *sten*, stone, alluding to the high specific gravity of wolframite]: a rare metal related to molybdenum and uranium, whose atomic weight is 183·5 and symbol W. The chief sources are *wolframite*, a tungstate of iron and manganese $(Fe,Mn)O.WO_3$, which frequently accompanies native oxide of tin, and is found in Cornwall, England; Saxony; Bohemia; Wertschinsk, Russia; Limoges; Bolivia; Monroe and Trumbull, Conn.; and elsewhere; and *scheelite*, which is a tungstate of lime $(CaWO_4)$. Tungsten is prepared by calcining a mixture of $WO_3$ and carbon in a covered crucible, or by reducing $WO_3$ in a current of hydrogen, or, again, by the reduction of the chloride in the vapor of sodium. In order to obtain the pure metal the pure yellow-colored $WO_3$ is ignited in a platinum or porcelain tube to redness in a current of pure dry hydrogen. The powder thus prepared has a gray metallic luster, and has a specific gravity of 19·129. Metallic tungsten does not oxidize in air at ordinary temperatures, but it burns at a red heat, being converted into $WO_3$. When thrown into chlorine at a temperature of about 250° it combines with this element. By the action of aqua regia readily, or nitric acid slowly, it is converted into tungstic acid $(H_2WO_4)$, and when pulverulent it is oxidized and dissolved on boiling in a solution of the caustic alkalies or their carbonates. It forms a dioxide, $WO_2$, and a trioxide, $WO_3$. The latter, called tungstic anhydride, may be obtained as a straw-yellow, tasteless powder, insoluble in water or acids, but readily soluble in alkaline solutions by heating ammonic tungstate in open vessels. Tungstic acid, obtained as a yellow powder by adding hydrochloric acid in excess to a boiling solution of tungstic oxide in an alkali, forms acid and normal salts, generally of a complex nature, and yielding a white, sparingly soluble hydrate of tungstic acid, $H_2WO_4.H_2O$, when mixed in the cold with excess of hydrochloric acid. Metatungstic acid, $H_2W_4O_{13} + 7H_2O$, furnishes salts which are mostly soluble and crystallizable, and may be prepared by the action of tungstic acid on tungstates, or by removing part of the base by means of an acid. Tungsten yields several chlorides, oxychlorides, bromides, fluorides, sulphides, and phosphides; also silicotungstates and sulphotungstates. Its compounds are not poisonous. A class of compounds of $WO_3$, $WO_2$ and bases, called tungsten bronzes, are distinguished by their metallic luster and bright colors. They are used as bronze powder substitutes. A sodium compound, $Na_2O.W_2O_7 + WO_2$, has been made in the form of gold-like cubes, which conduct electricity like a metal.

Tungstate of sodium, prepared on a large scale in purifying certain tin ores, is used in place of sodium stannate as a mordant, and also to prevent muslin from suddenly igniting when brought in contact with fire, a little phosphoric acid or sodium phosphate being added to it sometimes, to prevent its decomposition. Tungsten alloys with iron in almost all proportions, making it excessively hard. Steel containing 9 to 10 per cent. of tungsten possesses unusual hardness, but it has not proved a commercial success. An alloy of iron and other metals with 4 per cent. of tungsten, called sideraphite, is said to be very ductile and malleable and not readily acted on by acids. Revised by R. A. ROBERTS.

**Tunguragua**, to͝on-goo-raa'gwaa: an interior province of Ecuador, surrounded by Pichincha, Oriente, Chimborazo, Bolivar, and Leon. Area, 1,686 sq. miles. It is in the Andine region and is crossed by the Eastern Cordillera. The Tunguragua volcano, from which it takes its name, is 16,690 feet high and is noted for its violent eruptions; it is one of the most imposing peaks of the Andes. Pop. of the province (1889), estimated, 103,000. Capital, Ambato. H. H. S.

**Tungu'ses**: a Mongolian tribe, inhabiting the regions of Siberia from the Yenisei eastward to the territory of the Chukchees and to Sakhalin; the Manchus are of Tungusian stock. The Tunguses have flat faces, olive complexion, no beards, straight black hair, and oblique eyes. They are nomads, and generally divided, according to the beast of burden which they principally employ, into reindeer, horse, and dog Tunguses. They are chiefly Shamanists, but Russian missionaries have labored with success among them. They number in Siberia 70,000, mostly in Transbaikalia and Yakutsk. Revised by M. W. HARRINGTON.

**Tunica'ta** [Mod. Lat., liter., neut. perf. partic. of *tunica're*, cover with a tunic, deriv. of *tu'nica*, tunic]: a group of marine animals of great interest to zoölogists on account of their relations to the VERTEBRATA (*q. v.*). Formerly they were regarded as molluscs, then transferred to the worms, and lastly, since 1867, associated with the vertebrates and usually, with these and a few other forms, constituting one of the great divisions of the animal kingdom, the branch or phylum CHORDATA (*q. v.*). The vertebrate affinities are best exhibited in the larvæ, which in general appear-

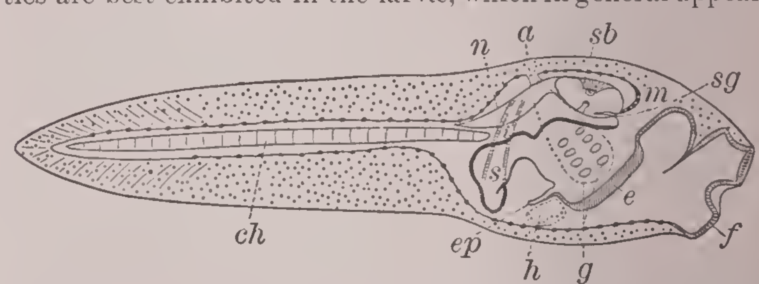



FIG. 1.—Tadpole larva of tunicate (based upon Seeliger), viewed as a transparent object: *a*, atrial opening; *ch*, notochord; *e*, endostyle; *ep*, epicardial process; *f*, fixing process; *g*, gill-openings into peribranchial chamber (dotted); *h*, heart; *i*, intestine; *m*, mouth; *n*, nervous cord; *s*, stomach; *sb*, sense vesicle; *sg*, subneural gland.

ance are tadpole-like. In the larva (Fig. 1) the dorsal mouth connects with a large pharynx, on either side of which are gill-slits through which the water used in respiration passes out to the exterior. On the ventral wall of the pharynx is a groove, the endostyle (so called because earlier regarded as a rod), the function of which seems to be to guide the food back to the opening of the œsophagus. The alimentary canal is folded on itself and opens in close proximity to the outlet of the gills. Below the pharynx and stomach is the heart; dorsal to them is the central nervous system. This has in front a vesicular enlargement in which are the sensory organs, visual and auditory in function. Behind, the body is prolonged into a tail, and in this is an axial structure, the notochord, which, like the structure with the same name in the vertebrates, arises from the entoderm. Gill-slits and notochord are peculiarly vertebrate structures. The tunicate tadpole resembles the vertebrates further in that the nervous system is not traversed by the alimentary canal, in the relative position of the various organs mentioned, and in other details. An important difference must be mentioned: in the true vertebrates the notochord extends forward far into the head; in the tunicates it is confined to the tail, a fact which has led to the name *Urochorda*, sometimes given to the group.

In the typical tunicate the larva, after a short free-swimming life, fastens itself to some solid support by means of a (varying) number of fixing processes on the anterior end of the body; and then begins the metamorphosis. The tail is absorbed and its various portions, including the notochord, degenerate. At the same time the body shortens and changes shape, so that the mouth and the opening through which the gills and the alimentary canal communicate with the exterior (atrial opening) are brought close together; the number of gill-slits increases; and the long nervous cord of the tadpole is contracted to a ganglionic mass situated between oral and atrial openings. The outside of the body soon becomes smooth, and all characters pointing toward the vertebrates are so thoroughly obliterated that no one not knowing the life-history would ever suspect the tunicates of being man's degenerate cousins.

The class of *Tunicata* exhibits considerable variety of form and range of structure, and is divided into three orders: (1) *Larvacea* or *Copelatæ*; (2) *Ascidiaceæ*; (3) *Thaliaceæ*.

In the first, *Copelatæ*, are included a few minute marine forms, belonging to three or four genera (*Appendicularia*, etc.) which may be defined as Ascidian tadpoles with adult characters. They retain the tail of the larva above described, this structure being folded forward on the ventral side of the body. They have but a single gill-slit on either side, and yet, with these apparent characters of immaturity, they are adults and undergo no further change.

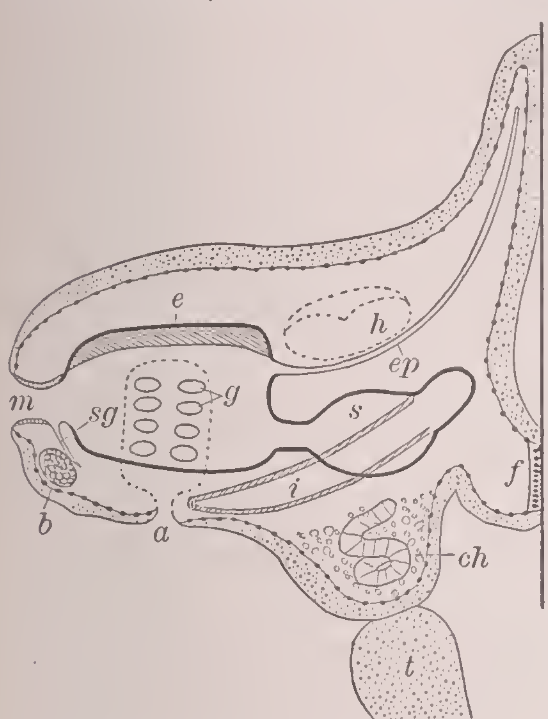



FIG. 2.—Diagram of young tunicate, with nearly adult characters: letters as before, except *b*, central ganglion; *ch*, degenerating notochord surrounded by remains of tail; *t*, cast-off cellulose sheath of tail.

The *Ascidiaceæ*, after passing through the tadpole stage, lose the tail and develop adult characters. The body, typically, becomes more or less globular, the gill-slits increase in number, and by the development of a fold in the body-wall, an atrial chamber is developed, into which the gills and vent empty. The external opening of this atrium is usually near the mouth, but in the *Pyrosomes* it is at the opposite end of the body. Three sub-orders of *Ascidiæ* are recognized. Two of these are fixed to some support during adult life, the third embraces free-swimming forms. The *Monascidiæ* are either solitary, or when they form colonies the new individuals arise from root-like stolons, and each number of the colony has its own atrium. In the second sub-order, the *Synascidiæ*, we find only colonial species, the individuals being covered by a common envelope or mantle, and arranged, usually in a star-like manner, around a common atrium. In the free-swimming *Luciæ* the individuals are colonial, the colonies taking the shape of a cylinder. The mouths are all turned to the exterior, and the atria empty into the central chamber of the colony. Here belong the *Pyrosomes* of tropical seas, celebrated for their phosphorescence. In the largest species the colony may reach a length of 15 inches.

The *Thaliaceæ* have barrel-shaped bodies, with the mouth at one end, the atrial opening at the other, and the similarity to a barrel is strengthened by the circular muscles which run round (incomplete rings in *Salpa*) the transparent body like hoops. The gill-slits also are less numerous than in the *Ascidiaceæ*, there being two rows in *Doliolum*, only two openings in *Salpa*. In these there is an alternation of generations, but only that of *Salpa* need be mentioned, it being especially interesting from the fact that it was the first instance known, and was discovered by the poet Chamisso. From each egg there develops a "solitary form" which is without sexual organs. In the body of this a stolon arises and becomes divided into distinct salps, each of which contains an egg. This second generation remains attached to each other through life, constituting the "chain form." The contained eggs undergo their development and give rise, in turn, to the solitary condition.

The literature of the *Tunicata* must be sought in special papers. In Korschelt and Heider's *Embryologie* is a summary of the development of *Tunicata* and a list of the most important papers on them. Little is known of the American species, excepting those of New England, for which see Verrill in *Report* of the U. S. Fish Commission for 1871–72 (1874). J. S. KINGSLEY.

**Tu'nis** (Fr. *Tunisie*): a French protectorate in North Africa; bounded E. by Tripoli and the Mediterranean, W. by Algeria, N. by the Mediterranean, and S. by the Sahara; area, 45,716 sq. miles. The coast to the E. of the Gulf of Tunis is low and sandy; to the W. it is rocky and bald, forming lofty promontories, among which Cape Blanc is the northernmost point of Africa. The interior is traversed by nearly parallel chains of the Great and Little Atlas, whose average height is between 4,000 and 5,000 feet, and which form several elevated plateaus of great extent. A number of shallow salt-marshes in the southeast are below the level of the sea. The climate is dry and hot, and the soil produces large crops of wheat, maize, dhurra, and barley; cotton, indigo, saffron, and tobacco are also cultivated. Olive and date plantations are very numerous and very remunerative, and all South European fruits grow abundantly. Oxen, sheep, mules, and camels are the common domestic animals, and they are all of good breed. Salt and lead are produced, though mining, like agriculture, is very carelessly carried on. Some branches of manufacture, such as woolen fabrics, especially the well-known red caps, dyed skins, morocco leather, and coral, are extensively developed. Pop. 1,500,000, chiefly Berbers and Arabs.

Tunis occupies nearly the territory of ancient Carthage. With Sicily it formed the granary of Rome. On the dissolution of the Roman empire it became a province of the Greek empire, from which it was conquered by the caliphs of Bagdad. From the twelfth century to the sixteenth it formed an independent state, and became the terror of all the nations around the Mediterranean on account of its piracy, which did not cease until near the middle of the nineteenth century. In 1574 the country became dependent on Turkey. Oct. 25, 1871, the bey obtained an imperial firman which made him virtually independent; but of this independence he was deprived by the French, who landed an army in the country in 1881, and, under form of a treaty signed May 12, 1882, reduced him to a state of vassalage. The French resident is called *chargé d'affaires*, and practically administers the government of the country under the direction of the French foreign office and by means of a staff of French judges and officials of all kinds. In 1900 there was a revenue of \$5,035,235 and an expenditure of \$5,015,725. Tunis has 883 miles of railway, of which 866 belong to the state. See TUNIS in the Appendix.

Revised by C. C. ADAMS.

**Tunis**: capital of the state of Tunis; near the Gulf of Tunis; surrounded by a double wall and defended by a citadel (see map of Africa, ref. 1–D). Its streets are narrow, unpaved, and filthy, but its houses, though only one story high and presenting no windows to the streets, are substantially built, and many are finely fitted up in Oriental style.

The bey's palace, Tunis.

Each house is erected in the form of a court, into the yard of which all the rooms open, and this yard is generally paved with marble and provided with a fountain, which is supplied with water from a large tank or cistern on the roof of the building. The palace of the bey and several of the mosques are fine edifices, and the bazaars are large and well stocked. Silk and woolen manufactures are extensively carried on; caps, shawls, burnooses, turbans, and mantles, soap, wax, olive oil, and leather are also manufactured and exported, and the transit trade between Europe and the interior of Africa is important. Pop. 135,000, of whom 20,000 are Europeans and 40,000 Jews. Revised by C. C. Adams.

**Tunja**, toon′*k*hăă: capital of the department of Boyacá, Colombia; near the sources of the river Sogamoso; 75 miles N. N. E. of Bogotá, and 9,164 feet above the sea (see map of South America, ref. 2–B). It was founded in 1538 on the site of Hunsa, the ancient capital of the northern Chibchas; during the colonial and revolutionary period it was important, but it is now somewhat decadent. Near by is the battle-field of Boyacá (*q. v.*). Pop. about 8,000. H. H. S.

**Tunkers**: See Dunkers.

**Tunkhan′nock**: borough; capital of Wyoming co., Pa.; on the Susquehanna river, and the Lehigh Valley and the Montrose railways; 28 miles S. by W. of Montrose, 32 miles N. by W. of Wilkesbarre (for location, see map of Pennsylvania, ref. 2–H). It is in an agricultural region, and has several planing-mills, iron-foundries, a national bank with capital of $100,000, and three weekly newspapers. Pop. (1880) 1,116; (1890) 1,253; (1900) 1,305.

**Tunnels and Tunneling** [from O. Fr. *tonnel*, tun, cask, pipe, tunnel for partridges (> Fr. *tonneau*, tun, cask), dimin. of *tonne*, tun, cask, pipe, from O. H. Germ. *tunna* > Germ. *tonne*]: Tunnels are subterranean passages constructed without removing the superincumbent earth. The construction of such subterranean passages is called tunneling. Similar works executed by excavating from the surface and refilling after the construction of the arches or other supports are properly "covered ways," although generally called tunnels, and are here included under that term. Mining tunnels which are not strictly through passages are called galleries, drifts, or adits.

The rock-hewn temples of Nubia and India and the tombs of Egypt, although constructed in the same manner, do not come under the definition of tunnels. Fergusson, however, says of the Turanian races, of which the Egyptians are the type, that "the existence of a tunnel is almost as certain an indication of their pre-existence as that of a tomb." The earliest tunnel known was made in Babylon to connect the royal palace with the temple of Belus on the opposite side of the Euphrates river. It was 15 feet wide, 12 feet high, and was arched with brick. There was a very ancient tunnel in Bœotia, said to have been made to drain Lake Copais; and in the sixth century B. C. a tunnel was built in the island of Samos which was 8 feet wide, 8 feet high, and 4,245 feet in length. Few tunnels for passage are found before those of the Etruscans, and after them the Roman works. These are numerous, though generally of small dimensions, made for drainage, for water-works, and some as highway tunnels. One of the latter class, built by Vespasian, carried the Flaminian Way through the range of the Apennines. The tunnel of Posilipo, 2,200 feet in length, on the road from Naples to Pozzuoli, was built about thirty-six years before the Christian era, and is still in use. The tunnel for the drainage of Lake Fucino (or Lake Celano), built about 52 A. D., was about $3\frac{1}{2}$ miles long. Numerous shafts were used in its construction, which extended over eleven years. Its modern reconstruction (see below) is one of the great works of the nineteenth century. In all these tunnels the rock was excavated with the chisel, gad, and pick, blasting being then unknown. In Egyptian quarries blocks are said to have been detached by cutting grooves around them with saws and tube-drills supplied with corundum or similar material. To these methods were added fires built in the face of the heading to heat the rock, which was then suddenly cooled, cracked, and disintegrated by the application of water. Drilling and blasting with gunpowder were first used in mining in 1613 in the Freiburg mines.

A tunnel is adopted for passage through a hill or mountain range when the cost of an open excavation is greater than that of a tunnel, including its protective masonry. This is usually the case when the depth of the cutting exceeds 50 or 60 feet. Tunnels are also built for the passage of rivers over which, for commercial or other reasons, bridges can not be placed; under populous cities where the surface can not be obstructed; and under lakes for procuring water-supplies.

Preliminary to the construction of a tunnel borings are necessary to ascertain the character of the ground to be passed through, and the depth at which water will be found. Upon the data thus obtained the exact situation of the tunnel is determined, and marked upon the ground with great precision and permanency. The small section of a tunnel limits the number of men that can work in it, and renders progress slow. For this reason access to it is sought at many points, where practicable, by means of shafts sunk from the surface to the level of the tunnel, from each of which two additional faces may be worked.

The operations of tunneling may vary according to the character of the ground. A "heading" is a small section which is carried in advance of the other workings, and facilitates their execution. In solid rock the work is slow, but very simple. In small tunnels (as single-track railway tunnels) a heading at the top of the section is enlarged to the full width of the tunnel, and the rest of the section, the "bench," is taken out by "bottoming." In the larger tunnels the same method may be followed, or a "bottom" heading is driven from which "break-ups" rise to the top, where a new heading is made and the work proceeds as before. If the rock be deficient in hardness and cohesion, temporary props of timber are used as the work proceeds, and walls and arches of masonry subsequently replace them. In blasting the holes are drilled by machine-drills operated by compressed air, water under pressure, or electricity, and the explosives used are generally some form of nitroglycerine. The charges are simultaneously fired by electricity. Ventilation is provided partly by the air used in the machine-drills, partly by fans or blowing-machines. Water, which sometimes accumulates in large quantity, is removed by pumps from the shafts, and by drains from the open ends of the tunnel when practicable. Tunnels in earth do


Fig. 1.—Timbering in soft ground.

not require the drill or explosive, but need support at every step. Sometimes, as in the English system, the entire section of the tunnel is excavated before the masonry is begun. When a section (10 to 18 feet in length) of top heading is completed, a bench is cut in the top on one side to receive the timbers that carry the roof. Into this a "crown bar" is rolled and a corresponding bench on the other side receives a second crown bar, all of large, round timber. Lagging boards support the ground between them. Chambers in the sides of the heading are cut down to the floor, in which props are placed to support the crown bars. The heading is widened and the operation repeated until the whole arch section is excavated. A transverse sill is placed under the props, and the excavation continued by similar methods to the bottom of the tunnel. At other times small drifts or headings are made at the sides in which the side walls are built, and the arch section is then excavated as before, or other small headings superimposed upon the side drifts permit the building of the arch in sections, after the completion of which the interior mass is excavated. By the Belgian system the central heading is carried down to the floor of the tunnel, the excavation for the arch is made, and the arch is built before the side walls; the "bench" on each side of the central heading is excavated in short lengths, and the side walls built up under the arch. In more difficult cases, where the ground is very soft, a shield is used. In its modern form this is a short tube of steel or iron plates closed by a diaphragm containing openings or doors. The rear portion of the tube incloses the end of the finished section, and leaves a space between it and the diaphragm in which a new short section of tunnel may be built. The material in front is excavated through the doors in the diaphragm, and the shield is pushed forward by hydraulic or other power.

The earliest tunnel for transportation in the commercial sense was that of Malpas on the Languedoc Canal (now Canal du Midi), in France, constructed by Riquet in 1666–76. It is 767 feet long, 22 feet wide, and 27 feet high. The next French tunnel, that of Rive de Gier on the Givors Canal, was built in 1770; that of Torcy on the Canal du Centre in 1787. The Tronquoy tunnel (St. Quentin Canal) was the first built in soft ground (sand), and the methods there followed are now known as the French or the German system. The tunnel of Riqueval, 3½ miles long, made in 1803 on the same canal, is the longest of the navigation tunnels, all of which are of good size. The Pouilly tunnel (1824) is over 2 miles in length. The Noireau tunnel, on a feeder of the St. Quentin Canal, is 5 feet wide and 7½ miles long. The French canal tunnels which are on the main lines of transportation are now operated by steam or electricity. On the Riqueval tunnel a train of twenty or thirty barges (300 tons each) is taken through by a steam tow-boat working on a chain laid in the bottom of the canal.

The earliest English tunnels were also on canals, but of much smaller section than those of France. The first in point of time is the Harecastle, by James Brindley, on the Trent and Mersey Canal in 1766–77, 8,640 feet long, 12 feet high, and only 9 feet wide, passing a boat 7 feet wide propelled by "leggers," men lying on their backs and pushing with their feet against the sides and roof. Fifty years later it was supplemented and superseded by another tunnel 13½ feet wide and 17½ feet high. Many other canal tunnels were built up to 1826, when the canal system of England was for the time completed.

The tunnel on the Union Canal, built 1818–21, was the first constructed in the U. S. It was 450 feet long, 20 feet high, and 18 feet wide. The first railway tunnel was on the Allegheny Portage Railroad, by Solomon Roberts, in 1831–33. The earliest in which shafts were used was the Black Rock tunnel in 1836–37, by W. H. Wilson. The introduction of railways about 1830 and their rapid extension required the construction of many tunnels, often, in the earlier days, to avoid grades now of everyday occurrence which were then deemed unworkable. Of the older English tunnels the Kilsby, by Robert Stephenson, 1¼ miles long, was of very difficult and expensive construction by reason of quicksands saturated with water. The Box tunnel, by Brunel, 1¾ miles in length, encountered great quantities of water. The brickwork lining of the Sydenham tunnel was pressed out of shape repeatedly by the swelling of the London clay in which it lies, and the final form required to resist this pressure is nearly circular, with the brickwork about 3 feet thick.

In more recent times, owing to the extension of railways, tunnels are of such common occurrence that although many of them are works of great length and difficult construction, it is impossible to refer to any but those of special interest. The three great rock tunnels of the world are the Mt. Cenis (Col de Fréjus), the St. Gothard, and the Arlberg, to which may be added in the U. S. the Hoosac tunnel, all, except the single shaft of the latter, built without shafts. To these will soon be added the Simplon tunnel—the longest of all.

The first in order of time, usually known as the *Mont Cenis* tunnel, is in fact the tunnel of the Col de Fréjus. The Col de Fréjus is a depression in the crest of the Cottian Alps, about 16 miles S. W. from the summit of the Mt. Cenis pass, and rising to a height of about 9,500 feet above the sea, about a mile above the culminating point of the excavation. The material traversed for about 6 miles from the southern entrance was calcareous schist, followed about 1,000 feet of gypsum and dolomitic rock, then about the same distance of refractory quartzite, and finally 1¼ miles

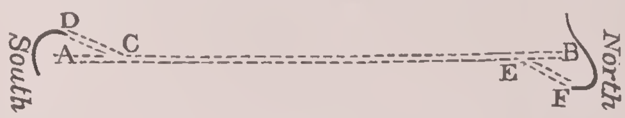



FIG. 2.

of anthraciferous formation. The excavations consist of a straight gallery, A B (Fig. 2), through the mountain, and the two junction galleries, C D and E F, to connect with the railway to Bardonecchia, in Piedmont, on the southern and Modane, in Savoy, on the northern side. The straight gallery, A B, is 38,173 feet in length, the junction galleries, C D and E F, nearly 2,500 and 1,500 feet, respectively. The termini at A and B are left open for ventilation and convenience of access. The length of tunnel traversed by trains is 42,158 feet, or less than 30 yards short of 8 miles. The junction curves were made not only to avoid short curves on the connecting railways, but to leave the mountain more nearly at right angles to its stratification, slight movements of the mountain slope across the line of the tunnel having already been observed. The southern entrance is 4,236 feet above sea-level. From this point the grade ascends 8 feet in 18,325 feet to a summit-level 1,082 feet long; thence it descends by a uniform grade of 115 feet to the mile to the northern terminus, 3,801·4 feet above the sea, or 434 feet lower than the southern entrance. The width of the tunnel is 26 feet, its height is 19·68 feet at one end, 18·68 feet at the other. The total quantity of rock excavated was nearly 1,000,000 cubic yards. The lining is of stone masonry, from 28 to 40 inches thick. About 16,000,000 bricks were employed for subsidiary purposes, about 15,000 tons of hydraulic lime were used, and some 1,200 tons of gunpowder for blasting. From the beginning of the works in 1857 until the invention of the machine-drill by one of its engineers in 1861, progress by hand-labor was very slow. After 1861 in the southern division and 1863 in the northern, drills driven by compressed air were used. The air not only operated the drill, but on its escape from the machine ventilated and by expansion cooled the gallery. In 1863 the rate of progress, average of both ends, was 7 feet a day; but as experience was gained and the machines perfected, the rate increased to 14¾ feet in the last year. The temperature near the center of the tunnel is constant at about 85° F. Upon breaking through the last partition of rock between the headings a strong current of air poured through from the N., and this, as might be expected from the difference of elevation of the two extremities, is said to maintain itself constantly, greatly facilitating the ventilation. As early as 1832 a peasant mountaineer suggested a tunnel under the Col de Fréjus. In 1845 engineers were employed to plan the work. One of them, Maus, a Belgian, invented a drilling-machine which was perfected later by Bartlett, Sommeiller, Grandis, and Grandoni. Colladon proposed the use of compressed air to work the drills and supply ventilation.

*The St. Gothard Tunnel.*—From remote ages until a very recent period most of the travel and a large proportion of the merchandise passing between Italy and her seaports on the one hand, and Switzerland, Northeastern France, Central and Western Germany, and Northern Europe on the other, were conveyed over Alpine passes having their northern termini in Switzerland. After the completion of the three great highways—the Simplon in 1806, the Splügen in 1822, and the St. Gothard in 1824, they monopolized most of this transit. On the completion of the Brenner Railway in 1867 and the opening of the Mt. Cenis tunnel in 1870, a large proportion of this traffic was intercepted, and the construction of a direct and independent railway across the Alps was felt to be of vital necessity to Northern Italy and Switzerland, and of great interest to all the Western and Central German states. The Simplon and the Splügen passes were studied and rejected, the former because it would be tributary to French interests rather than to those of Germany and Switzerland, the latter because the route lay along the Austrian frontier and was therefore exposed to control by a hostile force. The St. Gothard line was free from these objections, the only serious obstacle being the tunnel, 9 miles long, involving a great expenditure and a long delay. In Oct., 1869, a treaty was concluded between Italy and Switzerland by which the principal points relating to location, construction, and connections were determined, and in Oct., 1871, Germany also signed the treaty. The three contracting powers were to contribute 85,000,000 francs—45,000,000 by Italy, 20,000,000 by Germany, and 20,000,000 by Switzerland. In Aug., 1872, a contract was made by the company with Louis Favre, of Geneva, for the execution of the tunnel within eight years from the date of acceptance of the contract by the Swiss Government, at a fixed price per lineal meter, amounting for the whole to 48,000,000 francs. The line of the tunnel runs from Airolo N. about 5° W., passes under the Kastelhorn (9,915 feet high), the St. Anna glacier, the village of Andermatt, the river Reuss at the Devil's Bridge, and comes out at Göschenen. The station at Airolo is 3,756 feet (1,145 meters) above the sea. The grade ascends at the rate of 1 per 1,000 24,280 feet (7,400 meters) to the summit-level, 590 feet (180 meters) long, thence descends by a grade of about 5½ feet per 1,000 (·55 per cent.) to Göschenen. The total length of the tunnel is 9¼ miles. Although great difficulties were encountered in the execution of the St. Gothard tunnel, chiefly from the large quantities of water developed by the workings, the great advances in the art of tunneling since the completion of the Mont Cenis tunnel, and those made during the construction of this work enabled much more rapid progress to be made. The compressed air-drills were more perfect, as were also the installations for power from the torrents Reuss and Ticino, and the tunnel, begun in 1872, was completed in 1881. The excavated rock was removed and tools and materials brought in by a locomotive worked by compressed air instead of steam. Where the tunnel passed under the plain of Andermatt, 1,000 feet above, on a length of 200 feet, it passed through decomposed feldspar with alumina and gypsum, which not only swelled by absorbing water from the atmosphere, but was subjected to the immense pressure due to the height of the ground above. The masonry arches were twice crushed, and were finally made of cut granite 5 feet thick at the top and 10 feet at the sides. The difficulties of the company arose from its embarrassed pecuniary position, which was a consequence of the insufficient estimate and the excessive cost of the work, both due to the shortsightedness of the first chief engineer. In such a difficult country he had abandoned the bottom of the valley and placed his line high on the almost vertical flanks of the mountains inclosing the valley. His successor, Hellwag, suspended all work on the approaches and made a new study of the location. He kept the railway as nearly as possible in the bottom of the valley, and as in its upper portion the valley became too steep for the railway grade, elevation was gained by spiral tunnels, of which there are seven on the approaches north and south. The valleys of the Alps rise, as it were, by steps or terraces, facilitating and perhaps suggesting the use of spiral tunnels, which it is proposed to adopt also on the approaches of the Simplon tunnel.

*The Arlberg Tunnel.*—The province of Vorarlberg is separated from the rest of the Austrian Tyrol by the Arl Mountains, and was accessible therefrom only by a long detour outside of Austrian territory. To connect this province with the rest of the empire, and to make a more direct outlet for Austrian-Hungarian products to Switzerland and France, the Arlberg tunnel was constructed. After much discussion as to the location—eminent engineers advocating a rack railway with a shorter tunnel at a higher elevation—the location was fixed and the works begun in 1880. Its length is 6·38 miles. By reason of the improvements in the mechanical means of tunneling and carefully studied methods, the rate of progress was much more rapid than in the long tunnels which had preceded it, and it was opened in 1883. The estimated cost was less than 35,000,000 francs.

The rate of progress in the execution of these tunnels, although partly dependent upon the character of the rocks encountered, is chiefly interesting as indicating the progress in the implements and processes of the art of tunneling. At Mt. Cenis (Fréjus) the daily advance with machine-drills was at first, in the argillo-calcareous rock, 6 ft. 8 in. a day; in the coal-bearing sandstones 3 ft. 4 in. a day; in the Triassic quartzites superimposed upon the sandstones, 2 feet a day. The average advance in both ends was about 8 feet a day, but in the last year the advance in the schist exceeded 14 feet a day. In the St. Gothard tunnel more improved air-drills were used, and locomotives hauled the cars used in construction. The quantity of water encountered was enormous—the headings were generally a foot deep with water. The material varied greatly in character, some of it being quite soft. The average progress was 14½ feet a day. At the Arlberg tunnel everything was carried on in the most systematic manner. Trains removing excavated rock and bringing in tools and materials were run by a time-table. The heading, 9·2 feet wide and 7·5 feet high, was in the bottom of the tunnel instead of in the top, as at St. Gothard, break-ups 160 feet apart connecting it with the top heading. The most improved drills were used—at one end the Ferroux, a percussion drill operated by compressed air, at the other the Brandt, a revolving drill worked under great pressure by hydraulic power. About 1,760,000 lb. of dynamite was used. In this, as in all these tunnels, hydraulic power for compressing air and other purposes was obtained from the neighboring mountain torrents. The average rate of the advance was 27⅘ feet a day, being more than three times as much as at Mt. Cenis, and nearly twice that of the St. Gothard tunnel, which it more nearly resembles in the character of the strata pierced.

The following table shows at a glance the characteristics of these three great tunnels:

| NAME. | Begun. | Opened. | Time building. | Length, miles. | Ave. daily advance. |
|---|---|---|---|---|---|
| Mt. Cenis (Fréjus)...... | 1857 | 1871 | 13 yrs. | 7¼* | 8·0 ft. |
| St. Gothard............ | 1872 | 1881 | 9 yrs. 5 m. | 9¼ | 14·6 ft. |
| Arlberg................ | 1880 | 1884 | 3 yrs. 9 m. | 6½ | 27·8 ft. |

* Length of straight gallery. The actual length of tunnel operated is very nearly 8 miles.

The *Simplon* tunnel, which connects the valley of the upper Rhône, in Switzerland, with that of the Diveria, about 16 miles from Domo d'Ossola, in Italy, will be 12¼ miles in length—the longest of the Alpine tunnels. The contract for its construction was made in Sept., 1893. The plans have been carefully studied and some new features introduced. Instead of one tunnel for two railway tracks there will be two smaller tunnels, distant from each other 58 feet, each for a single line of rails. The two headings will be driven at the bottom simultaneously, with numerous cross-headings oblique to the line of the tunnels. Only one of the main headings will be enlarged to full dimensions; the other will await the demands of traffic for a second tunnel. The second heading will, however, be used during construction for the return of the construction cars empty or with materials for the work, while those loaded with the *débris* of the excavations will go out through the enlarged tunnel. Air will also be driven in through the second heading and in much larger quantities than in earlier works. The temperature in the middle of the tunnel, estimated to be 104° F., will be cooled to 90° F. by sprays of water combined with a vigorous ventilation. Seventeen hundred cubic feet of air per second are to be provided, 212 cubic feet having been found satisfactory at Arlberg, where, however, the temperature did not exceed 67° F., and the length of the tunnel was but little more than half that of the Simplon tunnel.

The *Hoosac* tunnel, on the line of the Fitchburg Railroad in Massachusetts, passes through the Hoosac Mountains, a southern extension of the Green Mountains of Vermont. Its length is a little more than 4¾ miles. It has one shaft 1,028 feet deep. Begun in 1856, it was seventeen years under construction, including several long suspensions due to discouragements and want of funds. The greater part of the rock penetrated is a micaceous schist of varying characteristics, some of it very hard. Progress was expedited in 1866 by the introduction of machine-drills worked by compressed air. Its cost, including interest, was about $11,000,000.

*Tunnel of Lake Fucino.*—The Lake Fucino or Celano lies in a mountain basin in the Apennines, having no natural outlet. It is about 50 miles E. of Rome and 2,200 feet above sea-level. Its area has varied with its level. In 1816, with a maximum depth of 75 feet, it covered 42,000 acres; in 1835, with a depth of 34 feet, but 33,000 acres were covered. To reclaim an area of fertile soil, to reduce the waters to a permanent level, and to improve the sanitary condition of the vicinity, a tunnel discharging into the river Liris (now Garigliano) was begun by the Emperor Claudius and completed eleven years later. Its length was about $3\frac{1}{2}$ miles, its cross-section variable, but nowhere less than 102 sq. feet, with a grade of 1 in 1,000. A large number of shafts, both vertical and inclined, were employed, and all the work was done with the chisel and similar tools. It fell into decay shortly after its completion. It was reconstructed by Prince Torlonia in 1854–76, at a cost for the entire drainage works of $4,800,000, in such manner as to drain the lake entirely. The new tunnel underlies and replaces the old one, and is 2,200 feet longer. It has a section of 215 sq. feet, and is lined throughout with masonry.

The *Severn* tunnel on the Great Western Railway of England passes under the Severn river at a point where the rise and fall of tide is about 50 feet. The length of the tunnel is about $4\frac{1}{4}$ miles ($2\frac{3}{4}$ miles between shafts on opposite sides of the river), and a drainage tunnel 7 feet square and $\frac{9}{10}$ths of a mile long leads from its lowest point to a pump-well 206 feet deep. It was constructed chiefly through the Permian sandstone on the one side and red marl on the other. Begun in 1873, it was not completed until 1885 owing to the very large irruptions of water. Twice the "big spring" was struck, discharging the second time over 30,000 gal. a minute, and in the same week an extraordinary tide overflowed the surrounding country and flowed down the shafts. After the arch was built the brickwork was crushed by the pressure of the water from the "big spring," which came from a very elevated source, and as a last resort the water was led away to a pump-well and permanent pumps established to pump it out. An interesting incident of this construction was the practical application of a method described in Jules Verne's story, *Twenty Thousand Leagues under the Sea.* When it became necessary, after the flooding of the works, to close an iron door in the tunnel 1,000 feet from the shaft, the head diver placed a Fleuss apparatus on his back and, without communication with the upper air, went into the tunnel to the door, which was rusted on its hinges, found a crowbar near by, and with much effort closed the door, and returned after having been about an hour and a half under the water. The attempt had previously been made in the ordinary diving-dress, but three strong men had been unable to drag after them a sufficient length of air-pipe to reach the point desired.

The *Mersey* tunnel connects Liverpool and Birkenhead. It is about a mile long, between large shafts containing elevators of great capacity, by which passengers between the two cities are brought from and taken to the surface. A drainage and ventilating tunnel under it was excavated at once to full size, in part by means of the Beaumont machine armed with rotary cutters, which cut away the rock to a fairly smooth, true cylindrical surface. The ventilation of the Mersey tunnel, which is superior to that of any other operated by steam, is accomplished by exhausting the foul air through the sub-tunnel by means of fans, fresh air being supplied to the main tunnel from the ends.

These two tunnels—the Mersey and the Severn—are literally "subaqueous," but, having been excavated through rock in the usual manner, they are not included in that class.

The Metropolitan and the Metropolitan District railways of London—the underground—are chiefly "covered ways," having been for the most part excavated from the surface and filled in and repaved after the construction of the arch. Three tunnels, however, aggregating about a mile in length, were made through very difficult ground. Built through the streets and under buildings in the most crowded parts of London, these works are models of ingenious and skillful construction, and are well worth study. The newer subways of London, as of Glasgow and elsewhere, are chiefly small tunnels in pairs built with shields and lined with iron segments. They are traversed by electric cars adapted to the size of the tunnel. This system of construction is well suited to the purpose for which it has there been used. By it the risk of disturbing buildings is reduced to a minimum.

The *Niagara* tunnel is the tail-race of the large water-power established on the New York side of the Niagara river to utilize a portion of the power of the falls. The buildings are erected near the river, above the falls and the rapids. Water is supplied to the turbines by a short open canal, and escapes from the wheel-pits into the tunnel, by which it is discharged into the river below the falls. The tunnel is 7,600 feet in length, 19 feet wide, and 21 feet high, with a

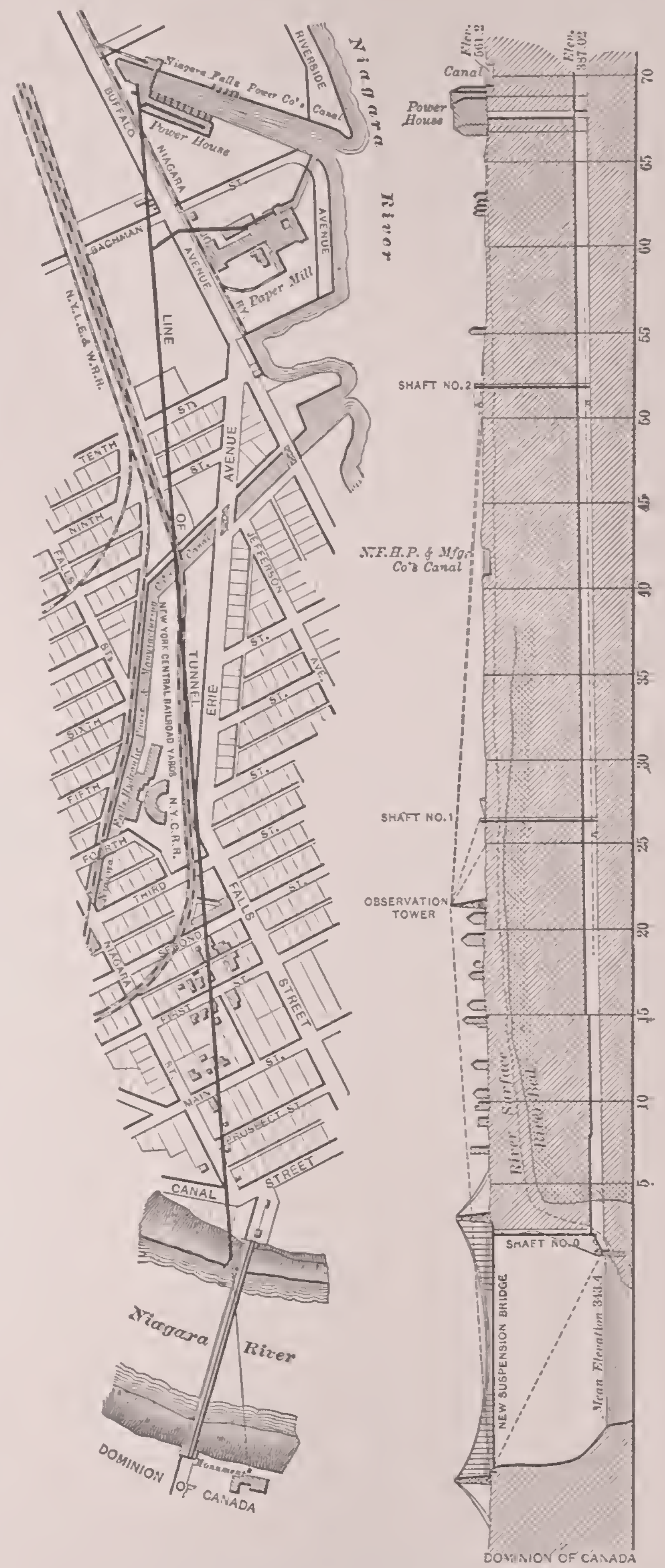



FIG. 3.—Niagara water-power tunnel, map and section.

sectional area of 365 sq. feet. At the upper end it is about 150 feet lower than the water surface in the river above; its discharge is about 200 feet below that level. Its capacity is about 7,300 cubic feet of water each second. See WATER-POWER.

The valley in which the city of Mexico lies has no natural outlet for its waters, and formerly the plain around the city was covered with water in rainy seasons, except the causeways communicating with the capital. In 1607 Enrique Martinez, a Dutch engineer in the employ of the Spanish Government, proposed and afterward constructed the tunnel of Huehuetoca (now the cut of Nochistongo) for the drainage of the valley. It was built in a very short space of time, though 4 miles long, and was arched throughout, but before the lining was completed and the bottom protected the walls were undermined in a great flood, and the tunnel fell in. The engineer was thrown into prison and kept there for three years. He was then released and ordered to make an open cutting in the place of his tunnel, in the execution of which he spent the remainder of his life. The construction of the cutting, however, extended over 120 years, and many lives were lost in its execution. The forced labor of the native Mexicans was so severe and the loss of life so great that it became a conspicuous cause of their hatred of Spanish rule. The excavation was not carried to the depth of the tunnel, and was of little use for the drainage of the valley. During the French occupation of Mexico plans were made for the drainage of the valley, and the project has been studied at various intervals since. In 1888 the plan was put in the way of execution. It consists chiefly of the tunnel of Tequixquiac, 6 miles in length, and 27 miles of large canal. The twenty-four shafts of the tunnel are from 75 to 325 feet in depth. The tunnel has a section of about 150 sq. feet, and a proposed discharging capacity of about 450 cubic feet a second. The works have been carried out by English contractors under the direction of Mexican engineers.

In the construction of the great trans-Alpine tunnels an indispensable condition was the proximity of sufficient water-power to supply the mechanical force needed in their construction. For the tunnels on the trans-Andean line, connecting Buenos Ayres with Santiago, the power obtained from waterfalls was transmitted to the sites 2 and 4 miles away by electricity. The summit tunnel on this line is over 3 miles long, constructed for single track only, at an elevation of 10,460 feet above the sea.

The new (Croton) aqueduct tunnel of New York city, about 14 feet wide and as many high, has a length of 33 miles. It was worked partly from shafts nearly a mile apart, and partly from faces where the grade of the tunnel came above the natural surface. It is chiefly, though not entirely, through rock of variable hardness, and passes under the Harlem river in a perfectly dry rock 306 feet below the surface. Portions under great head are lined with iron inside the brickwork. The work was generally not difficult, but one length of 110 feet occupied two years in its construction, and ranks with the most difficult works of the kind. The attempt was made to carry the conduit under the Harlem river in a tunnel 150 feet below the surface of the water. A pocket of very soft material was encountered, and to escape this, after several attempts to pass through it, the shafts were sunk over 150 feet lower.

The Howard Street tunnel, operated by the Baltimore and Ohio Railroad, lies under one of the principal streets of Baltimore. It has a length of 1·4 miles, of which about 1,200 feet was built as covered way. It passed through sand overlying clay, with a good deal of water in places. The side walls were first built in narrow drifts, the top was then taken out by the crown-bar system, and after the arch was turned the bench was removed. About 90 feet in length of side walls settled into the soft bottom and were pushed inward, deforming and rupturing the arch—all due to the want of an inverted arch between the walls. This portion was rebuilt, together with some other parts in which the crown of the arch had settled, the result probably of defective packing, and perhaps of other causes. The tunnel is lighted with electric (incandescent) lamps, and worked with electric engines capable of hauling the entire train, including the locomotive, the furnace doors and dampers of the latter being closed and steam shut off to avoid the escape of smoke and gases into the tunnel.

All mining drifts are really tunnels, but they will not be treated here except to mention the Sutro tunnel, 4½ miles in length, constructed to drain the lower levels of the Comstock mine, in Nevada, which it reaches at 2,000 feet below the surface of the ground. The principal difficulty encountered was the crushing of the sustaining timber, 16 inches square, by the swelling of the clay in which a part of the tunnel was excavated. It became necessary to cut off the protuberant clay and renew the timbers over and over again. The great heat in the extreme end of the tunnel also rendered the execution difficult, and required special precautions.

*Subaqueous Tunnels.*—The earliest and by far the most costly of these is the Thames tunnel, by Marc Isambart Brunel. Work upon a tunnel at this site (about 2 miles below London Bridge) was actually begun in 1807 by Trevethick, but after a shaft had been sunk the work was abandoned in the following year. The existing tunnel, 1,200 feet long, with two passages 14 feet wide and 16½ feet high, was commenced in 1825 and completed in 1843. It is now used by the East London Railway. The difficulties due to the influx of water and mud from the river were finally overcome by means of a shield invented by Brunel, which protected the whole face of the excavation, 38 feet wide and 22½ feet high. Although entirely different in form and in detail from the modern shields used in tunneling, Brunel's shield contained the principle upon which they are made, that of supporting the face and the perimeter of the excavation during the construction of short lengths of lining.

In 1868–69 the Tower subway under the Thames was constructed by W. H. Barlow, by the aid of a shield similar in principle to that of Brunel, though more nearly resembling the modern shield. This subway was circular, 8 feet in outside diameter, and was lined with ribbed cast-iron plates, the earliest of this kind of construction, now so much in vogue. It lies entirely in the firm London clay.

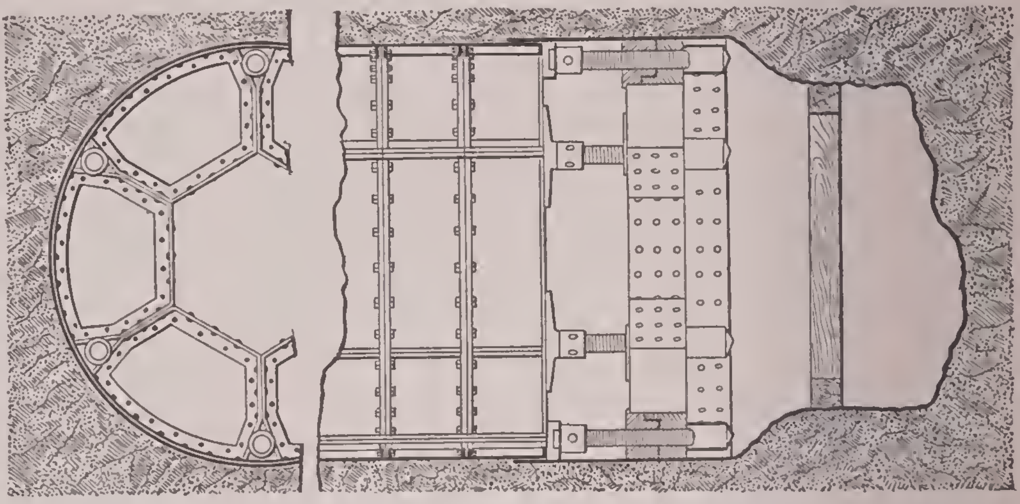


FIG. 4.—Shield and lining, Tower subway, London.

A pair of small tunnels, 10 feet in diameter, for the City and South London Railway, a rapid-transit line, were opened in 1889. They are carried under the Thames at a considerable depth by means of an improved shield, designed by Mr. Greathead, the chief engineer. They are lined with cast-iron plates, and coated on the outside with cement grout injected by air-pressure through holes in the cast-iron rings into the annular space around the tube left by the somewhat larger shield. These methods have been imitated, not only in subaqueous works, as in Glasgow and elsewhere, but for tunneling lengthwise under city streets, because of the small risk incurred of damage to overhead and adjoining property and buildings.

In America the first important subaqueous tunnels were those constructed for supplying water to the cities on the Great Lakes.

*The First Chicago Tunnel.*—The city of Chicago, Ill., which obtained its supply of water from the shore of Lake Michigan, about half a mile N. of the mouth of Chicago river, by means of works constructed in 1852, found that the lake at the point of supply was contaminated by the sewage of the city; and as the nearest, the purest, and the most abundant source was immediately in front of the city, it was decided to construct a tunnel under the bottom of the lake to a point 2 miles out. There is a land-shaft at the western and a lake-shaft at the eastern extremity. The latter is protected by a crib, or hollow pentagonal breakwater, from storms, vessels, and ice. This is 58 feet on each side and 40 feet high. The horizontal diameter of the tunnel is 5 feet, and the vertical 2 inches greater. The work was begun at the land-shaft on Mar. 17, 1864. The main tunnel proper was lined with two shells of brickwork, in all about 9 inches thick, including cement joints. The upper arch was built on a ribbed center of boiler iron, which diminished the open space inside of the tunnel only 4½ inches, and thus allowed the cars which conveyed away the earth to go up to the face of the excavation, usually kept from 10 to

20 feet ahead of the masonry. The excavation was generally through stiff blue clay, but with the irregularities of character peculiar to the drift. Sometimes sand-pockets, sometimes small bodies of quicksand, sometimes clay soft enough for a miner to run his arm into, and sometimes bowlders weighing several hundred pounds, were met. The greatest danger encountered was from inflammable and explosive gas. Early in the progress of the work several accidents occurred from this cause. Cavities containing gas were detected by sound, and bored into with a small auger. The gas was ignited as soon as it began to escape, and explosions were prevented.

The greatest progress made during any one week was 93 feet. Only once was a bowlder met so large as to require blasting. The ventilation of the tunnel was effected by means of tin pipes, through which the foul air was drawn out, and fresh air consequently drawn in through the main opening. The original estimate of the probable cost of the work was $307,552; the actual cost, including all preliminary and other expenses of whatever nature chargeable to the lake tunnel up to Apr., 1867, was $457,844.95. Later there was constructed another and larger tunnel from the same crib, parallel with the first, to the lake shore, and thence in a southwesterly direction about 4 miles farther to a point where new pumping-engines are in operation. Both tunnels have an estimated capacity of 150,000,000 U. S. gal. a day.

*The Second Chicago Tunnel.*—The enormous pollution by sewage of the lake water along the city's front and its extension into the lake nearly and at times quite as far as the 2-mile crib, as well as the rapid increase of the population and the consequent demand for a larger supply, determined the construction of another tunnel 8 feet in diameter, extending to a crib 4 miles from the shore. These works were begun in 1887. Difficulties occurred during the earlier construction from the pressure of a bed of plastic clay which was encountered in the roof of the tunnel at the same time that a water-bearing vein appeared at the bottom. A shield was built and put in place, but it was not strong enough. It was deformed by the pressure and finally abandoned. The mud and sand flowed in, and a conical hole or crater was formed over it in the lake bottom.

Two 6-foot tunnels were then substituted for the one of 8 feet diameter, and the line was diverted to pass around the place where the shield lay. Another shaft was sunk 2½ miles from shore, and work was carried on from it in both directions. Care was taken to keep the tunnel in the layer of hard clay, the soft clay being above and water-bearing sand below, and but little difficulty was experienced. The tunnel was completed to the 2½-mile crib on July, 1890, and to the 4-mile intake in Dec., 1892. At the shore end the tunnel is continued under the streets and blocks of the city 1¾ miles, to the pumping-station.

The Cleveland water-works tunnel under Lake Erie was built during 1869–74; length between shafts, 6,606 feet; diameter, 5 feet; depth of the shore shaft, 67 feet; of the lake shaft, 90 feet; both shafts are 8 feet in diameter. The crib is pentagonal, about 95 feet across and 61 feet high. Great difficulties were encountered. The first was the bursting in of the clay at 1,300 feet from the shaft, and the exposure of a seam through which gas, water, and quicksand poured in large quantities, and were stopped only by building a brick bulkhead across the tunnel. Before this could be done 300 feet of tunnel was filled with sand. It became necessary to abandon this portion and to move the line of the tunnel. This was done by changing its direction about 20° and continuing in this line until 40 feet from the original line, then proceeding parallel to the original line.

When about 4,000 feet from shore, at a point 600 feet back from the heading, the water suddenly poured in through innumerable cracks in the brickwork over a length of 150 feet. The lake shaft was then completed, and work was begun at the outer end of the tunnel. After progressing some 380 feet the same soft clay was encountered and flowed in so fast that the end of the tunnel was bricked up until other preparations could be made for continuing it. For this purpose a shield was made of boiler iron strengthened with two cast-iron rings 4 inches by 4 inches in section. It was 6 feet long and 6 ft. 5 in. in diameter. Two horizontal shelves were put in extending to within 2 feet of the rear end of the shield, the friction on these being found sufficient to prevent the soft clay from flowing in too fast. The brickwork was built within the rear end of the shield in rings 16 inches long. Cracks appeared at every cross-joint so long as the clay was soft, but it was necessary to use the shield for about 140 feet, after which the material was firmer. The shield was moved at first by screws, afterward by hydraulic presses of 135 tons capacity. The external pressure on the shield was about 4 tons to the square foot, and was too much for its strength. The cast-iron rings were broken and the shield flattened 5 inches. After leaving the soft clay the work progressed well until within 20 feet of the outer end of the shore section, when a mass of clay was blown into the tunnel with great force, followed by gas and water, and driving the men out of the tunnel. It was found that both tunnels were in communication and by means of increased pumping power both were soon emptied of water. The lake end, however, was full of gas, and being on an ascending grade it could only be blown out a few feet at a time. This, however, was done until it was clear. A few days later the connection was completed.

At 500 feet shoreward from the connection, near the large leak, transverse cracks were found; farther back the cracks were open and a portion of the masonry had settled 5 feet, breaking into short sections and going down bodily. The attempt was made to rebuild this portion, building up from the settled masonry, but cracks soon reappeared, and the cracked sections were cut off by bulkheads and a new tunnel built around them.

In 1871 it was proposed to construct a tunnel under the Detroit river to connect the Michigan Central Railway with the Great Western of Canada. A small drainage tunnel was driven as an experiment to a distance of 1,240 feet on the Michigan and more than 370 from the Canada shore. Great difficulties were encountered from the inflow of water and gas, the former under a head much greater than that due to the depth below the river. The cost far exceeded anticipations, and the work was finally abandoned.

In 1888 the Grand Trunk Railway undertook to make this connection at Sarnia, and after careful study and preparation a single-track circular tunnel, lined with cast-iron segments, was begun and successfully completed, not without difficulty, but without serious accident or delay. The material was soft blue drift clay with pockets of sand and gravel, and under this the stratum of gas-bearing sand. The work was done with shields, one on each side of the river, and a comparatively light pressure of air was kept up, chiefly to prevent the inflow of gas. The length is 6,000 feet, of which 2,290 feet is under the river. The water is 40 feet deep and the least cover over the tunnel is 15 feet. It was completed and opened for traffic in 1892.

The Liverpool water-works tunnel under the Mersey, finished in 1892, is chiefly remarkable by reason of the great cost, difficulty, and delay incurred in its earlier stages, for want of proper engineering advice, and its rapid execution when the means were properly adapted to the end in view. The tunnel is 10 feet in diameter, lined with cast-iron plates, and has been built with a shield through clay, silt, and sand, all soft and full of water. As the first shield was not adapted to its work, great delay and expense were incurred, and very little progress was made. When the work was taken over by the corporation of Liverpool the shield was strengthened and slightly modified to fit it for its work, and the tunnel, of which but 183 feet had been built in twenty-eight months, was completed in four and a half months, the total length being 810 feet.

The change in the shield consisted in raising a low bulkhead in the rear of the diaphragm and a few inches higher than its lower edge, forming thus an air-seal which prevented the inflow of water so long as the air-pressure was kept in excess of the pressure of water. This idea is said to have been introduced into Sir B. Baker's design for the Humber tunnel shield in 1870, a tunnel which was not made;* it was applied to the compartments of the Hudson tunnel shield, and by the hanging plates in the Blackwall shield. It was patented in Belgium in 1880.

The *Hudson River* tunnel, to connect Jersey City with New York and permit the entry of railway trains to the heart of the metropolis, was begun in 1880, after seven or eight years of litigation. It was proposed to construct two oval single-track tunnels of brick, but, money failing, one was suspended, and work upon the other continued at intervals as money could be obtained until 1886, completing some 1,800 feet of tunnel. This work was executed through the soft river silt by the use of compressed air, and by lining

* Sir John Fowler's plan for the Humber tunnel was to build it by means of caissons with compressed air, as in sinking bridge foundations.

the excavation with thin plates of iron or steel, forming an air-tight surface, by means of which the compressed air supported the pressures of the exterior silt for a short time, enabling the brickwork to be built in 10-foot lengths inside the plates. A "pilot" tube was also used, 6 feet in diameter, of heavier plates, which was driven 20 feet to 40 feet ahead of the main excavation, and from the rear portion of which the thin lining-plates were supported by radial shores. The face maintained itself well under a well-regulated air-pressure, neither too great nor too small, for the short time it was exposed. In 1889 a loan was placed in London, under the terms of which the method of construction was changed. A shield was introduced and the tunnel was made circular, 18 feet in diameter, and lined with cast iron, in flanged segments, weighing about 8,000 lb. to the running foot of the tunnel. The rate of progress, which under the former system had averaged about 3 feet a day and had never exceeded 5 feet, was increased to 10 feet; but many expenses had been incurred in constructing and erecting the shield, closing leaks from the river preparatory to the erection of the shield, etc., and after building about 2,000 feet, and when only about 1,700 feet of the north tunnel remained to be built, the loan was exhausted and operations were suspended.

When in 1889 construction by means of a shield was decided upon, it was required to erect the shield at the end of the finished tunnel, 2,000 feet from the shore. To accomplish this a chamber had to be constructed large enough to permit the shield to be put together, much larger than the former tunnel, and this by a method which had been discarded as dangerous. In the construction of this chamber a fall occurred and the river broke in. When the break was closed and the chamber finished mechanics could not be procured who would work in compressed air, and the shield was put together and riveted or bolted up by common labor. By the break and the means taken to close it the silt in proximity to the site was disturbed and softened, and much trouble arose from this cause, aggravated by the great weight of the shield. As the work progressed, however, the silt became more firm, and no further difficulty was experienced up to the abandonment of the work.

The Hudson tunnel was the first of large size in which compressed air was used. It had previously been employed by Hersent, in constructing a small connecting tunnel at the Antwerp dock works.

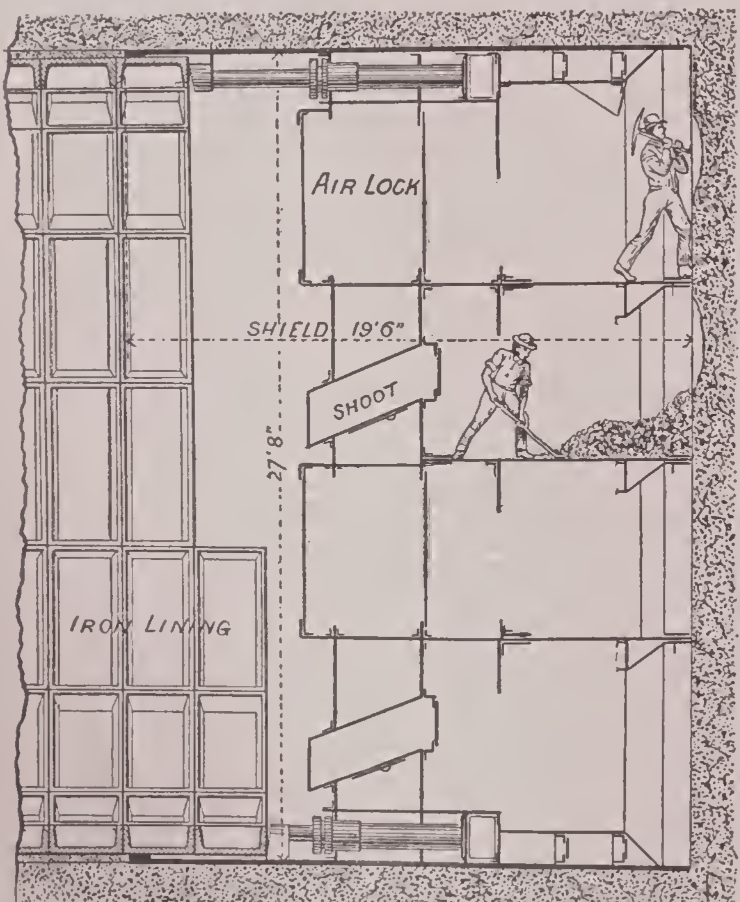



Fig. 5.—Section of shield, Blackwall tunnel, London.

The largest of the subaqueous tunnels is the Blackwall carriageway tunnel under the Thames, at London, which in 1895 was about half completed. The outside diameter of the iron-lined portion is 27 feet, and the cast-iron rings of the shell are 10 and 12 inches deep, making the interior diameter 25 feet, and for 821 feet 25 ft. 4 in. The whole length of iron-lined tunnel is 3,083 feet, of which 1,212 feet is under the water of the river, with in one place but 5 feet of cover (sand and gravel) over it; 1,382 feet at both ends is covered way, and 1,625 feet is open-walled trench. The entire length of the work is thus 6,090 feet.

The shield is a cylindrical shell 27 ft. 8 in. in diameter, and 19 ft. 6 in. long, with two diaphragms. The part in the rear of the first diaphragm is the tail of the shield. In front of this diaphragm is an inner skin or shell, strongly connected to the outer shell, from which it is distant 19 inches. The two skins are brought together to form the cutting edge. The space is divided horizontally by three platforms, forming four stages, from which the face of the work may be attacked. There are also three vertical partitions. The front part of the shield is thus divided into twelve compartments. Air-locks are formed in the space between the diaphragms, and in front of the front diaphragm, and some 6 feet back from the cutting edge, a vertical screen depends from the top of each compartment. The space between this hanging screen and the front diaphragm forms a safety-chamber for the men in case of a sudden irruption of water. The water will not rise in the inclosed space, being held back by the air, as in a diving-bell, and the men may keep their heads above water until relieved. The shield is pushed forward by hydraulic rams, placed in the annular space between the inner and outer shells, and they push against the cast-iron shell of the tunnel. Total pressure available, 2,800 tons. The material excavated is carried through the diaphragm by the shoots, which are also air-locks. The cast-iron segments forming the lining are erected inside the shield: the tail of the shield thus surrounds the last ring put in place. The segments are lifted into place by a hydraulic erector, such as was used in the Hudson tunnel. The air-locks in the shield are for exceptional occasions. A brick bulkhead across the tunnel contains large air-locks of the usual form.

No unexpected difficulties have been encountered (1895). Before reaching the river, while working without compressed air, the cutting edge of the shield at the bottom was damaged by contact with some hard body. A bottom heading was driven into the sand in front of the shield, timbered in the usual way, and a bed of concrete formed to fit the bottom of the shield, upon which it was slid forward until it reached the shaft, where the damage was repaired. In passing through the pure ballast (sand and gravel) the bottom of the river was first covered with a bed of clay 10 feet thick and 75 feet wide on each side. This to a large extent prevented the escape of the air, and also the run of the ballast. A similar plan is provided for the Hudson tunnel when work on it is resumed, there being but 7 or 8 feet of silt between the tunnel and the water in passing under the channel of North river, 62 feet deep. Additional quantities of air-pressure also were required at Blackwall when working in ballast to provide for that escaping to the river.

*The East River Gas Tunnel, New York.*—In view of the high price of real estate in New York, and the numerous objections to the establishment of gas-works in the heart of the city, the East River Gas Company established its works in Long Island City, and constructed a tunnel under the East river through which to convey its product to New York. The tunnel built in 1892–94 is circular, 10 ft. 2 in. in diameter, and 2,516 feet long. It passes under Blackwell's island and both channels of the river at a depth of 109 feet below high tide, and 41 feet under the deepest part of the river. The few borings made indicated that the tunnel would lie entirely in solid rock, but when the heading had advanced 360 feet from the New York shaft a stratum of decomposed rock was met, very soft, with streams of water between it and the adjoining hard rock. The water washed the soft material into the tunnel, forming large cavities overhead. At this juncture compressed air was introduced, and the soft stratum, 29 feet thick, was crossed by using steel roof-plates, after the manner of the first work on the Hudson tunnel, and lining with brickwork. About 80 feet beyond this section a large mass of soft black mud was encountered, and here a shield was introduced, and the lining was made of cast-iron segments, planed on all joints and placed to break joints. The brickwork which had been built across the preceding soft seam was not water-tight, and the iron lining was extended inside of it. About 380 feet of tunnel under the New York channel was lined with cast iron, and two seams, together 128 feet thick, under the Brooklyn channel were similarly protected. The rest of the tunnel was lined with brickwork.

*Special Cases in Tunneling.*—The tunnel of Braye-en-Laonnais, in France, passed through a clay containing pyrites and lignites, overlaid by water-bearing sand which dipped at one point into the tunnel. The compressed air (27 to 28 lb. to the square inch) which was required to pass this point drove back the water and oxidized the pyrites. The heat of oxidation was sufficient to ignite the lignites, the gas from which entered the tunnel and asphyxiated seventeen men. Wells were sunk from the surface to furnish outlets for the gas, and by a rapid ventilation, using a great volume of compressed air, the tunnel was rendered safe for the workmen until the sand was passed and the air was taken off. The water in the sand returned and extinguished the fire, but the water leaking through the arch was warm for six months afterward.

The tunnel of Père-Ternère, in the Pyrenees, lies in a schistose rock inclined about 35°, the layers of which are separated by thin layers of fine green clay, as slippery as soap when moist. The top heading, 6½ by 6½ feet, was completed, and for 180 feet from the Spanish end the bottom of the heading had been sunk below the level of the springing line of the arch. After a long-continued rain the layers cut by the excavation began to slip into the tunnel, crushing the heavy timbering. Work was suspended and the case was studied. The movement continued. Finally, the arch was built in short lengths, 6 feet thick at the portal, 4 feet at the inner end of the disturbance. When the arch was completed, the bench being undisturbed, the right side wall was built in pits excavated in short lengths under the arch. It was made 5½ to 7 feet thick. The attempt was then made to drift for the left side wall, but the ground began to move as soon as the strata were cut, and the method was abandoned. Narrow cross-cuts the whole width of the tunnel were then made, 80 feet apart, and in them the invert and left wall were completed. Intermediate cross-cuts were made and built in and this method was continued until the masonry was completed.

The Boston subway for rapid transit is built of vertical steel beams connected by concrete arches with vertical axes, convex on the outside, to take the pressure of the outside earth. Steel beams, with brick or concrete arches, also form the roof. The tunnel is to be used by electric cars. The use of iron is not to be recommended in tunnels used by locomotives operated with steam.

The use of "lock bars," steel needles, or "poling-boards" is an improvement upon the crown-bar method. Steel beams, 2 or 3 inches deep, rolled of a shape to lock together, replace the heavy timbers of the older system. They are drawn forward by screws or hydraulic jacks, by twos or threes, and supported at intervals by wooden frames the shape of the outside of the arch, one end resting on the completed brickwork. Grout may be injected behind them as they are drawn forward, but the space they leave is so small that the settlements therefrom may be neglected, except in special cases. A tunnel built in London by this method, with but 5 feet cover, has caused no appreciable settlement of the surface.

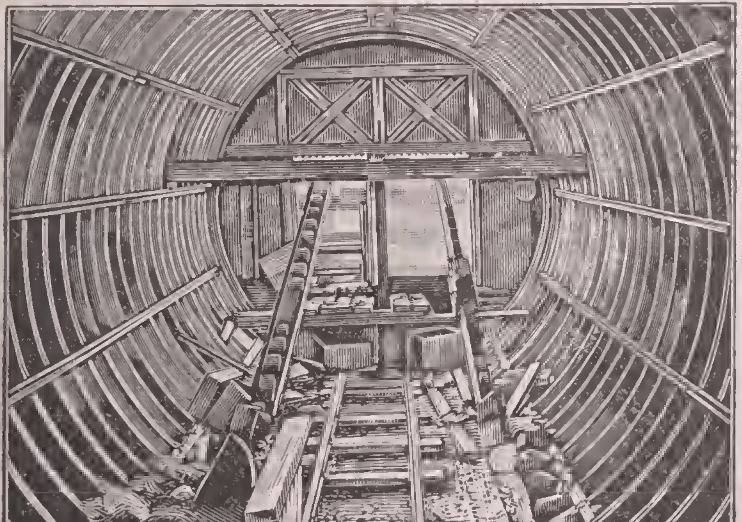


FIG. 6.—Glasgow Harbor tunnel, interior.

Where shields are used they must be adapted to the character of the excavation. The London and Glasgow subways are generally in clay, with very little water, and the men worked in front of the shields. This method was also used in the Mersey water-works tunnel, where the material was very soft and full of water. It was made practicable only by a very nice adjustment of the air-pressure, and there was a constant escape of air through the porous material. In the Hudson tunnel this method would not have been without risk, and the soft material was permitted to flow through the doors of the shield as it was pushed forward. The passage of air through the silt softened it and increased the risks of the work.

The boldest tunnel that has been projected is the Channel tunnel, designed to connect England with the continent of Europe, passing under the Straits of Dover, having a length between shafts of over 21 miles. The project was approved by such eminent engineers as Sir John Hawkshaw and Sir James Brunlees in England, and Thomé de Gamond and Alexandre Lavalley in France, but is for the present in suspense, powers to construct having been refused by Parliament at the suggestion of Gen. Sir Garnet (now Lord) Wolseley and other leading officers of the British army, as exposing their island to invasion from France.

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**Tunny** [dimin. of O. Fr. *ton, thon* < Lat. *thun'nus, thynnus* = Gr. *θύννος, θῦνος*, tunny; cf. *θύνειν*, to dart]: the largest member of the mackerel family (*Scombridæ*), known on the coast of the U. S. as the horse-mackerel. It is a heavily built fish, tapering rapidly to the pointed head and slender base of tail. The dorsal and anal fins, as in the mackerel, are followed by six to nine finlets; it reaches a length of 9 or 10 feet, and a weight of 1,000 lb. The tunny occurs on both sides of the Atlantic and ranges to Tasmania, and has been the object of extensive fisheries in the Mediterranean from time immemorial. See FISHERIES. F. A. LUCAS.

**Tunstall**: market-town of Staffordshire, England; in the parliamentary borough of Newcastle-under-Lyme (see map of England, ref. 8-G). It has several public buildings, including a town-hall (1884), market, and court-house, and has extensive manufactures of pottery, tiles, and iron. Pop. (1891) 15,730.

**Tunstall**, or **Tonstall**, CUTHBERT, D. D., LL. D.: b. at Hatchford, Yorkshire, about 1475; entered Baliol College, Oxford, about 1491; removed thence to Cambridge, where he was chosen fellow of King's Hall, now Trinity College; studied at Padua, where he took the degree of Doctor of Laws; became vicar-general to Archbishop Warham and rector of Harrow-on-the-Hill 1511, prebendary of Lincoln 1514, archdeacon of Chester 1515, and master of the rolls 1516; was sent 1516–17 to Brussels with Sir Thomas More as joint ambassador to Charles I. of Spain (afterward Charles V.), with whom they concluded two treaties; made there the acquaintance of Erasmus; became prebendary of York 1519, prebendary and dean of Salisbury 1521, Bishop of London Oct., 1522, Lord Privy Seal May, 1523, ambassador to Spain 1525; accompanied Wolsey to France July, 1527; was a plenipotentiary to negotiate the Peace of Cambray 1529; bought up Tyndale's New Testaments at Antwerp and burnt them in Cheapside 1529; became Bishop of Durham by papal bull Feb. 21, 1530; concurred in most of the ecclesiastical reforms of Henry VIII. and those of the first years of Edward VI., but was deprived of his bishopric and sent to the Tower on a charge of treason Oct., 1552; was restored by Mary, and conducted himself with great moderation during her reign, allowing no persecution within his diocese; was again deprived by order of Queen Elizabeth July, 1559, in consequence of having refused to take the oath of supremacy, and was committed to the custody of Dr. Parker, Archbishop of Canterbury. D. at Lambeth Palace, Nov. 18, 1559. He was described by Erasmus as "a man who outdid all his contemporaries in the learned languages"; was the inventor of a species of technical memory, and author of *In Laudem Matrimonii* (1518); *De Arte Supputandi* (London, 1522), one of the first books of arithmetic printed in England; *De Veritate Corporis et Sanguinis Domini Nostri Jesu Christi in Eucharistica, Libri II.* (Paris, 1554), being an elaborate defense of transubstantiation; *Compendium in X. Libros Ethicorum Aristotelis* (Paris, 1554); *Contra Impios Blasphematores Dei Prædestinationis Opus* (Antwerp, 1555); etc. Revised by S. M. Jackson.

**Tu'pac Ama'ru**: an Inca or chief of the Peruvian Indians; b. in Cuzco about 1544. He was the youngest son of Manco Inca, who after his final struggle with the Spaniards had retired to the Vilcabamba Mountains and kept up a semblance of sovereignty until his death. By the death of his elder brother, Tupac Amaru became the legitimate sovereign of Peru, and was so recognized by the Indians, though he was a mere boy; he avoided the Spaniards, but was not hostile to them. The viceroy, Toledo (*q. v.*), regarded him as a possible inciter of insurrection, and, under pretense that he had been involved in the murder of a priest, sent an expedition against him. He was captured, taken to Cuzco, and beheaded there about Dec., 1571. At the execution he prevented a revolt by using his authority over the Indians, and it is related that thousands of them came at night to do reverence to his head. Herbert H. Smith.

**Tupac Amaru II.** (called the last of the Incas): revolutionist; b. at Tinta, near Cuzco, in 1742. His real name was José Gabriel Condorcanqui, and he was descended from the ancient Incas; he was a man of education and some wealth, and, in accordance with the colonial custom, was the recognized chief of several Indian villages, subject to the viceroy. His Indian name was assumed in 1771. At that time the system of forced labor practically held the poorer Indians in a condition of slavery. After vainly seeking redress he headed a rebellion in Nov., 1780. The Indians, who universally regarded him as their Inca, flocked in thousands to his standard. At one time he had a force of 80,000, and held all the country between Cuzco and Lake Titicaca; even the Indians of New Granada and Paraguay were in secret sympathy with him, and a complete overthrow of Spanish power was threatened. But his army was undisciplined and almost without arms, and after a gallant struggle he was defeated and captured Mar., 1781. By sentence of the judge Areche he was torn to pieces by horses at Cuzco, after witnessing the torture and death of his wife and nearly all his relations, May 15, 1781. His brother Diego held out for some time longer, and was pardoned on condition of disbanding his forces, but was subsequently tortured and killed. In the effort to extirpate the whole Inca race, Tupac Amaru's son, a child of ten years, was spared, but was sent a prisoner to Spain; his fate is unknown, though a person claiming to be him appeared in South America in 1828, and was given a pension. Herbert H. Smith.

**Tupac Yupan'qui**, or **Tupac Inca Yupanqui**: the most renowned of the Inca sovereigns of Peru; succeeded Pachacutec Yupanqui about 1440. His reign was marked by a long series of successful wars, by which he annexed the coast region to the Gulf of Guayaquil, Northern Chili, Charcas, or Bolivia, etc. Tribes as far S. as Tucuman tendered submission to him, and it is said that he sent out an expedition on rafts which discovered the Chincha islands. D. at Cuzco about 1478. H. H. S.

**Tupaia**: See Tupaiidæ.

**Tupai'idæ** [Mod. Lat., named from *Tupa'ia*, the typical genus, from a native name]: a family of mammals of the order *Insectivora* and sub-order *Animalivora*, peculiar to the East Indies and neighboring islands. In form they resemble the squirrels; the head, however, runs out in a pointed snout; the pelage is soft and abundant; the hind legs are notably larger than the front ones, and all have five well-developed toes; the tail is long. The family embraces mammals about the size of squirrels; like the squirrels, the tupaias live chiefly in trees; their resemblance to the squirrels has obtained for them in certain places the same name, the native word "tupaia" being applied to the animal in question and to true squirrels as well. The species are most abundant in the islands of Sumatra, Borneo, and Java. They are generally grouped in two genera, *Tupaia* and *Ptilocercus*. They are truly insectivorous. Theodore Gill.

**Tu'pelo**: See Gum-tree.

**Tupelo**: town; capital of Lee co., Miss.; on the Old Town creek, and the Kan. City, Mem. and Birm. and the Mobile and O. railways; 45 miles S. by W. of Corinth, and 50 miles E. of Oxford (for location, see map of Mississippi, ref. 4–H). It is in an agricultural region, and contains 8 churches, 2 public-school buildings, about 40 artesian wells, foundry and machine-shops, cotton-compress, steam-gin, 2 mills, furniture and spoke factories, a national bank with capital of $50,000, a State bank with capital of $80,000, and 2 weekly newspapers. Pop. (1880) 1,008; (1890) 1,477; (1900) 2,118. Editor of "Journal."

**Tupís**, or **Tupys**, too-peez': a general name for numerous Indian tribes of Brazil. They form part of the great Tupí-Guarany race, which before the appearance of the whites occupied much of Brazil and Paraguay, as well as neighboring regions now included in Uruguay, the Argentine Republic, Bolivia, Peru, Venezuela, Colombia, and Guiana. Those of Paraguay were collectively called Guaranys, but they did not materially differ from the others. The Tupís were divided into a multitude of tribes which are known by different names, as Tupinambás, Tupiniquins, Caetés, etc. Nearly all of these were closely allied by language and customs; but they had no tribal connection, and were often at war with each other. They were scattered, generally along the coast and great rivers, frequently separated by tribes of other stocks. All were agriculturists and had fixed villages, but otherwise they were little advanced. They went naked, painting their bodies; the prisoners taken in war were sacrificed and eaten, at least by some tribes. Most of the Tupís received missionaries soon after the Conquest. Their tribal divisions have been lost, except in a few cases; but their descendants, mixed with Negro and white blood, form the bulk of the country population. Their language was adopted by the missionaries, and in modified form became the *lingoa geral*, long the common tongue in the interior of Brazil. It is still spoken on the upper Xingú and Tapajós. Herbert H. Smith.

**Tupper**, Sir Charles, D. C. L.: statesman; b. at Amherst, Nova Scotia, July 2, 1821; graduated as a physician at Edinburgh in 1843. He was appointed governor of Dalhousie College, Halifax, by act of Parliament in 1862; was president of the Canadian Medical Association from its formation in 1867 until 1870; and is a director of the London board of the Bank of British Columbia. He represented Cumberland in the Nova Scotia Assembly 1855–67; same constituency in the Parliament of Canada 1867–84 and 1887–88; was a member of the executive council and provincial secretary of Nova Scotia in 1857–60 and 1863–67; and prime minister of that province 1864–67. He was president of the Privy Council of Canada 1870–72; Minister of Inland Revenue 1872–73; Minister of Customs in 1873; Minister of Public Works 1878–79; Minister of Railways and Canals 1879–84; and Minister of Finance from Jan. 27, 1887, until May 24, 1888, when he was appointed high commissioner for Canada in London. He was a delegate to Great Britain on public business from Nova Scotia 1858 and 1865; from the Dominion Government relative to the Nova Scotia difficulty in 1868; was leader of the delegation from Nova Scotia to the union conference at Charlottetown in 1864, to that at Quebec the same year, and to the final colonial conference in London to complete the terms of union 1866–67. He was appointed executive commissioner for Canada at the International Exhibition at Antwerp in 1885; of the Colonial and Indian Exhibition, London, 1886, of which he was appointed royal commissioner by the Queen; and was one of the British plenipotentiaries to the fisheries conference at Washington in 1887. He received the honorary degree of D. C. L. from Cambridge in 1886; was knighted in 1879, and made a baronet in 1888. In Apr., 1896, he succeeded Sir Mackenzie Bowell as premier of Canada, but held office only until July, when the liberals came into power with Wilfrid Laurier as premier. Neil Macdonald.

**Tupper**, Sir Charles Hibbert, K. C. M. G.: cabinet minister; second son of Sir Charles Tupper; b. at Amherst, Nova Scotia, Aug. 3, 1855; educated at McGill and Harvard Universities, and admitted to the bar in 1878. He was first returned to the Dominion Parliament in 1882; re-elected in 1887 and 1891, and by acclamation after his appointment to office. He became a member of the Privy Council of Canada and was appointed Minister of Marine and Fisheries May 31, 1888; was appointed queen's counsel Aug. 2, 1890. He acted as British agent in the Bering Sea arbitration case between the Governments of the U. S. and Great Britain at Paris in 1893. He was gazetted K. C. M. G. in 1893. Neil Macdonald.

**Tupper**, Martin Farquhar: poet; b. in London, England, July 17, 1810; educated at the Charterhouse School and at Christ Church, Oxford, where he graduated 1831; studied law, and was called to the bar at Lincoln's Inn, but never practiced; published anonymously a volume of poems

(1832), and in 1838 issued the work by which he is best known, *Proverbial Philosophy* (second series, 1842; third, 1867). This had a prodigious circulation in England, and over 500,000 copies were sold in America. It was, notwithstanding, a very commonplace piece of work, and Tupper became a favorite butt for the ridicule of the critics and a proverb for platitude and inanity. He wrote other volumes of prose and verse: *Hactenus, a Budget of Lyrics*; *Ballads for the Time*; *Stephen Langton, or the Days of King John*; *Probabilities, an Aid to Faith*; *My Life as an Author* (1886). In 1851 and 1876 he visited the U. S., and in 1875 wrote a drama in honor of the centenary of American independence. D. at Albury, Surrey, Nov. 29, 1889.—His three daughters published in 1864 a volume, *Poems by Three Sisters*, and contributed to Dr. Roger's *Lyra Britannica*. Revised by H. A. BEERS.

**Túquerres**, too'ker-res: town of the department of Cauca, Colombia; near the frontier of Ecuador; on a high plateau of the Andes, 10,200 feet above sea-level. It covers a wide area, but is composed mainly of thatched huts; the climate is cold (mean, 55° F.). It has a considerable trade. Pop. about 8,000. The quiescent volcano of Túquerres, near here, rises to 13,350 feet, and is said to be composed almost entirely of sulphur. H. H. S.

**Tura'nian Languages**: See LANGUAGE.

**Turbella'ria** [Mod. Lat., double dimin. of Lat. *turbo*, a whirling, whirlpool, or *turba*, crowd, tumult]: a group of flat-worms, PLATHELMINTHES (*q. v.*), which are so called from the fact that the motile cilia covering the body create small vortices in the water. Unlike the other flatworms (Trematodes and Cestodes), only a few of the group are parasitic, but most of them lead free lives, either in the ocean or in fresh water, a few living in moist earth. The body is usually flat and oval in outline. A mouth is always present, but its position varies; it may be in front, median, or behind the middle of the ventral surface. The alimentary tract is in some a solid rod of digestive cells, in others a cavity occurs, but a vent is never found. The character of the alimentary tract is, with other features, used as a basis of classification. In the *Polycladea* the digestive organs are many-branched, the terminal branches reaching to almost all parts of the body. In the *Tricladea* there are but three primary branches to the digestive tract, one branch being anterior and median, the others paired and posterior. In the *Rhabdocœlida* the tract is straight and rod-like, and either solid or hollow. The nervous system consists of a central portion or brain, usually anterior in position, from which nerves arise; and in many there are eyes near the brain. There is no body cavity, but delicate excretory tubules run through the body, the external openings varying in different groups. Circulatory organs are absent. There are a few Rhabdocœla in which reproduction by transverse division occurs, but in most species the sexual method is the only way of perpetuation of the species. The sexual organs are quite complicated. Some forms develop directly into the adult, while others pass through a larval stage.

The *Turbellaria* are the most primitive of the flatworms, and from a triclad form the passage to the Trematodes is easily made. By many the *Turbellaria* are regarded as nearly allied to the Ctenophores. See Graff, *Monographie der Turbellarien* (*i. Rhabdocöliden*, 1882); *Organisation der Turbellaria Acœla* (1891); Lang, *Die Polycladen des Golfes von Neapel* (1884). J. S. KINGSLEY.

**Tur'bervile**, GEORGE: poet; b. at Whitchurch, Dorsetshire, England, about 1530; was educated at Winchester School and at New College, Oxford, where he obtained a fellowship 1561; studied law at one of the inns of court, London; accompanied Sir Thomas Randolph to Russia as his secretary, and wrote three poetical epistles descriptive of that country, which were printed in Hakluyt's *Voyages* along with Randolph's narrative. He published *Epitaphes, Epigrams, Songs, and Sonets* (1565; enlarged in the edition of 1570, and several times reprinted in the nineteenth century); *Heroycall Epistles of the learned Poet Publius Ovidius Naso, in Englishe Verse* (1569); *The Booke of Faulconrie, or Hawking* (1575); *The Noble Art of Venerie, or Hunting* (1576); *Tragical Tales, translated out of the Italian* (1576); and left a MS. translation of Tasso's *Jerusalem Delivered*, now in the Bodleian Library. D. about 1600. Revised by H. A. BEERS.

**Turbine** [= Fr. *turbine*, from Lat. *tur'bo*, *tur'binis*, anything that whirls around, wheel, top, whirlwind, deriv. of *turba're*, throw into confusion, disturb]: a water-wheel in which the water enters and leaves at all points around the circumference, acting both by its impulse and reaction. Turbines are usually horizontal wheels turning upon a vertical axis, but some forms are vertical and revolve upon a horizontal axis.

The reaction wheel (see BARKER'S MILL) was an early form of the turbine, although an inefficient one. The first

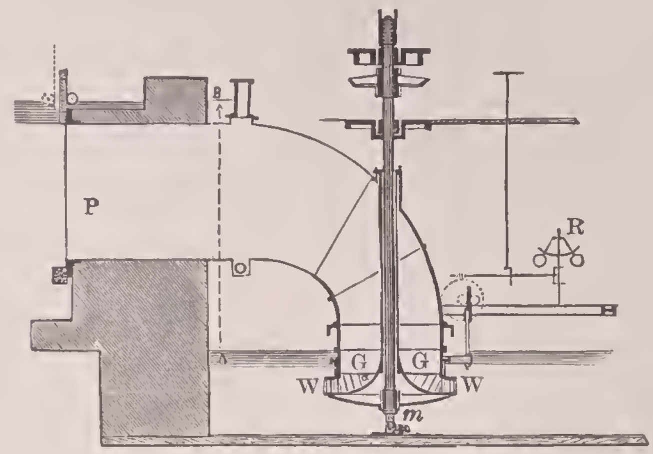


FIG. 1.

real turbine, however, was invented in France by Fourneyron, who received a prize of 6,000 francs for the design in 1833. A modification of this, called the Boyden turbine, has been extensively used in the U. S. Fig. 1 shows a vertical section of the Boyden turbine with its shaft and penstock. The water approaches the wheel by the curved penstock, P, is given a rotary motion by the fixed guide, G, through which it enters the wheel, W. Fig. 2 is an enlarged horizontal section showing the guides, G, and the vanes, W, the latter being rigidly attached to the wheel. Under the action of the impulse and reaction of the water the entire outer annulus, W W, which constitutes the wheel proper, revolves and carries with it the shaft by means of the connecting arms, *m*. At R is seen a governor for regulating the speed.

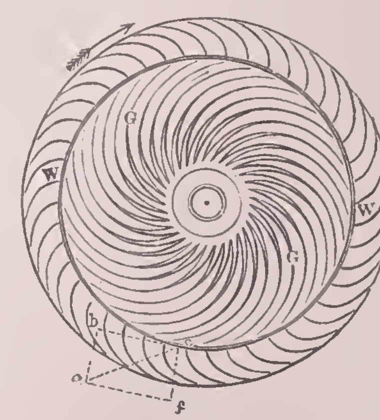

FIG. 2.

The theoretic work of a turbine is the product of the weight of water which passes through it, and the height of fall from the head-race to the tail-race; in Fig. 1 this fall is designated by A B. The work actually utilized, however, is usually only from 70 to 80 per cent. of the theoretic work, the remainder being lost in friction, foam, and leakage. For example, if a wheel discharge 8,000 lb. of water per second with a fall of 11 feet, the work per second is 88,000 foot-pounds, and the theoretic horse-power is 160; if the wheel have an efficiency of 75 per cent. there will be utilized 120 horse-powers. With very carefully constructed wheels efficiencies of 90 per cent. have been obtained.

The turbines of Fourneyron and of Boyden are called outward-flow wheels, as the water enters the wheel upon its inner circumference and is discharged upon the outer circumference. Another very common type is that of the inward-flow wheel, where the water enters upon the outer and is discharged at the inner circumference. Fig. 3 shows a horizontal section of such a wheel, in which, as before, G denotes the guide-spaces where the water enters and W the wheel-vanes. After leaving the wheel the water drops vertically down to the tail-race, having surrendered to the wheel the greater part of its energy.

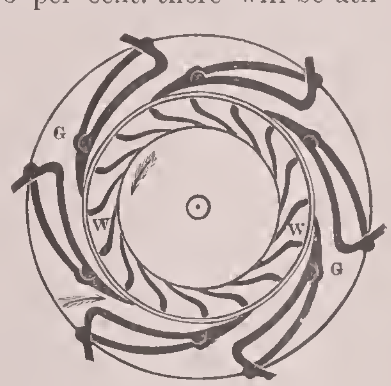


FIG. 3.

Turbines of inward and downward flow, having the wheel-vanes made as warped surfaces, are also very common. In these the water enters horizontally through fixed guides, but after entering the wheel the warped vanes give it also a downward direction. Fig. 4 shows a vertical section of one of these wheels, the arrows indicating the direction of motion of the water, while Fig. 5 shows a portion of a horizon-

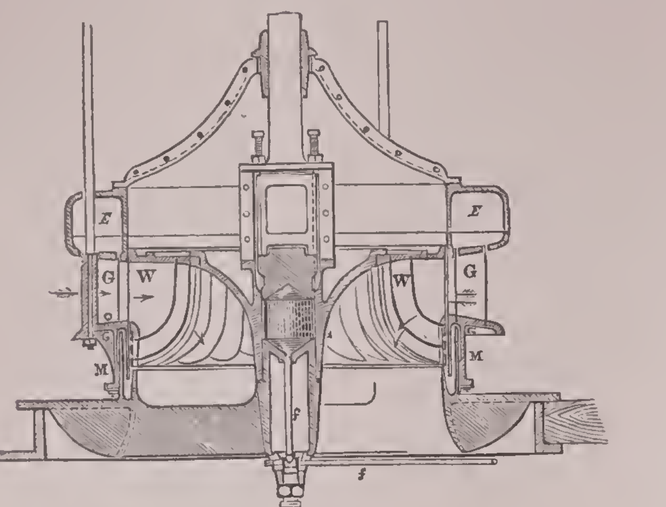

Fig. 4.

tal section through the guides and vanes. This compound motion of the water is not generally employed except for small wheels.

Another class of turbines is that of downward or parallel flow, in which the water moves downward without approaching or receding from the axis. Fig. 6 is an outline diagram showing the method of arrangement of such a turbine; the fixed guides are marked *a a*, while the moving wheel is designated by *b b*, the latter being attached to the revolving shaft, C. It is seen that this wheel is placed some distance above the tail-race and that a draft-tube, A, connects them. By this device the fall due to the total head can be utilized, provided that the wheel is not more than 30 feet above the tail-water, as the atmospheric pressure due to this distance is added to the static head actually above the wheel. Fig. 7 is an enlarged vertical section of one side of this wheel showing the positions of the guides and vanes, while Fig. 8 is a side view showing the edges of two of the guides with their corresponding vanes. This form of wheel is frequently called the Jonval turbine.

Fig. 5.

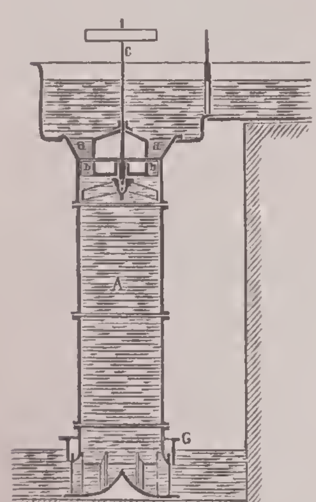

Fig. 6.

The regulation of the speed and power of a turbine is effected by a gate for shutting off the water, and also by a governor. The most common form of gate is an annular one which can be depressed around the entire circumference of the wheel. In Fig. 2 this annular gate fits into the annular space between the guides and vanes. In Fig. 4 the gate is marked by M, and at E, on the left-hand side, is seen one of the rods by which it is moved. In Fig. 3 each of the guide-openings has a gate which moves horizontally on a hinge. In the downward-flow turbine of Fig. 6 the gate is near the lower end of the draft-tube at G. In all cases, except that of Fig. 6, the efficiency of the turbine is materially less when the gate is partly closed than when it is fully opened, on account of the eddies and foam which result from the sudden change in cross-section.

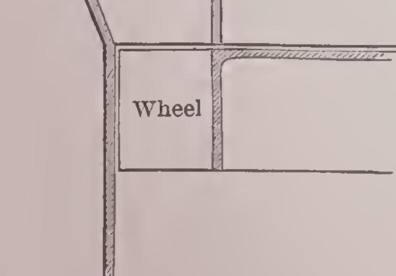


Fig. 7.

In an outward-flow turbine the discharge increases when from any cause the speed increases, while in an inward-flow turbine the discharge decreases if the speed increases. The first form hence requires a governor, and it is also frequently used for inward-flow wheels. Fig. 9 shows a governor of the centrifugal-ball type which is so connected with the main shaft and with the gate of the turbine that the latter is partially closed when the removal of a portion of the work causes an increase in speed. In the large Niagara turbines (see below) this method of control is so effective that the speed can not increase more than 4 per cent. when 25 per cent. of the work is suddenly taken off from the wheel.

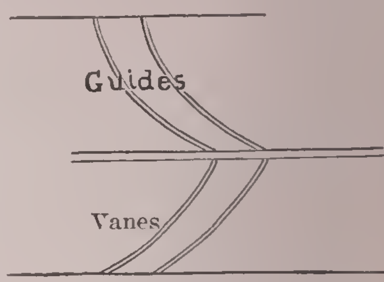


Fig. 8.

The weight of the turbine and shaft may be supported by a suspension box at the top of the shaft, as seen in Fig. 1, but a more common method is that of a wooden step at the bottom of the shaft, as shown in Fig. 4, where a pipe, *f*, is provided through which water is forced to prevent the heating of the bearing by friction. In Fig. 10 a form of step is shown where the shaft, *c*, revolves on a hemispherical seat, *b*, and lubrication is insured by oil which enters through the pipe, *h*, and passes out through *l*. In the large Niagara turbines there is a thrust-bearing at the top, but the weight of the wheel and shaft is supported, when in motion, by the upward pressure of the water on a disk in the upper part of the wheel-case.

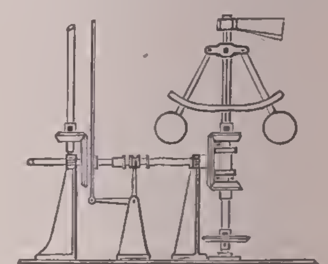

Fig. 9.

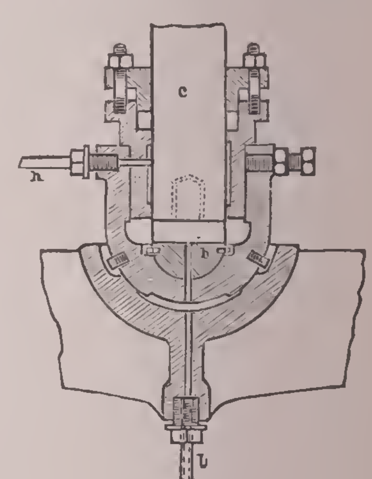

Fig. 10.

An impulse turbine is one in which the spaces between the vanes are not filled with water, and the velocity of the water when entering the wheel is that due to the head. A reaction turbine is one in which the spaces between the vanes are entirely filled with water, which at the same time is under a certain degree of static pressure; the velocity of the water when entering the wheel is then usually much less than that due to the head. Most turbines are built on the reaction principle, but when the gate is partially closed the spaces between the vanes are not filled and they become impulse turbines.

For every turbine there is a certain velocity, called the advantageous velocity, which gives the highest efficiency and power. This advantageous velocity can be ascertained by trial, or it may be approximately computed theoretically when the angles which the guides and vanes make with the direction of motion are known. These angles are controlling factors in the design of turbines, and they are materially different for the two classes of impulse and reaction turbines. A common method is to arrange these angles so that the advantageous velocity shall be that due to half the total head of water.

The large turbines installed in 1894 and 1895 by the Cataract Construction Company, for the utilization of a portion of the power of Niagara Falls, are the most powerful ever built. Three turbines have been erected, each of 5,000 horse-power, and the entire plant is intended to include ten such turbines. Each turbine consists of two outward-flow wheels attached to the same shaft. Fig. 11 shows a vertical section of the lower wheel, the other being $11\frac{1}{2}$ feet above it: the fixed guide spaces are marked G, while the wheel itself is marked W. The gate in this case, designated by E, is on the outside of the wheel. The water is brought to the turbine through a steel penstock, $7\frac{1}{2}$ feet in diameter, and the mean head is 136 feet. The wheel itself is 63 inches in diameter, and, as shown in the figure, it is divided into three stages by two horizontal partitions. The advantageous speed is 250 revolutions a minute, and the discharge about

13,800 cubic feet a minute. These wheels are of the reaction type, the spaces between the vanes being full of water for nearly all positions of the gate. They were designed by

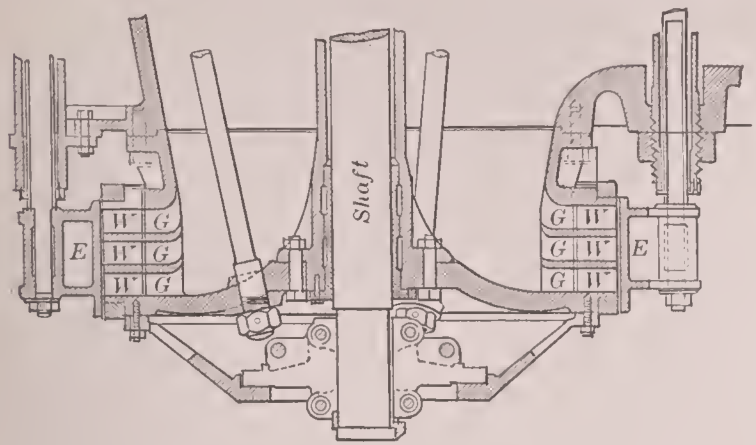


FIG. 11.

a Swiss firm, after an international competition in which engineers of five countries participated.

The theory of turbines is an extensive subject on which many volumes have been written. The fundamental principles of the theory are, first, that the water should enter the wheel without shock or foam; and, second, that it should leave the wheel with as small an absolute velocity as possible. The first requirement is fulfilled by giving proper angles to the guides and vanes at the circumference where the water enters; thus in Fig. 2, if $c\ e$ represent the absolute velocity of the entering water and $c\ b$ the velocity of the wheel, the line $c\ f$ will represent the velocity of the water relative to the wheel, and its direction will determine the entrance angle of the vanes. The second requirement is fulfilled by making the vanes cut the exit circumference at a small angle. As usually built the loss of energy in a turbine due to the absolute velocity of the escaping water is about 6 per cent. In axle friction about 3 per cent. is lost, while the resistance of friction to the water in passing through the wheel, together with foam and leakage, gives a loss of from 5 to 15 per cent. On account of their small size, cheapness, efficiency, and adaptability to both high and low heads, turbines are used more extensively than all other forms of hydraulic motors.

A very full descriptive and theoretical discussion of turbines is given in Meissner's *Die Hydraulik*, vol. ii. (Jena, 1878). See also Francis's *Lowell Hydraulic Experiments* (New York, 1884); Bodmer's *Hydraulic Motors, Turbines, and Water Pressure Engines* (London, 1889); and Merriman's *Treatise on Hydraulics* (New York, 1895). See HYDRAULICS and WATER-WHEELS. MANSFIELD MERRIMAN.

**Turbot**: a large flatfish, the *Psetta maxima*, of the North Sea and adjacent waters; highly esteemed as a food-fish. It is, next to the halibut, the largest flatfish of European waters, reaching a length of 3 feet and a weight of 30 or 40 lb. The general color is brown, with lighter shadings. The true turbot does not occur on the coasts of North America, but on the eastern side the name is bestowed on *Bothus maculatus* and in California on *Hypsopsetta maculata*. Both are medium-sized flounders of indifferent flavor, and both are common. See FISHERIES. F. A. LUCAS.

**Tur′didæ** [Mod. Lat., from *Turdus*, the typical genus, from Lat. *turdus*, thrush]: a family of birds containing the thrushes and allied forms. They are oscines with ten primaries, having a "booted" tarsus—i. e. the front covering of the tarsus entire for the greater part of its length; the young in their first plumage are more or less spotted. The robin and wood-thrush of the U. S. and the blackbird and song-thrush of Europe are typical thrushes. F. A. L.

**Turenne**, tü′ren′, HENRI DE LA TOUR D'AUVERGNE, Vicomte de: soldier; b. at Sedan, department of Ardennes, France, Sept. 11, 1611; a son of Henry, Duke of Bouillon, and Elizabeth, a sister of William I. of Nassau-Orange; was educated by his uncle, Maurice of Nassau, and entered the French army in 1630. During the Thirty Years' war he distinguished himself in subordinate positions in the campaigns in Germany and Italy; received an independent command in 1641; conquered Roussillon in 1642; was created a marshal of France in 1644, and contributed much to the conclusion of the Peace of Westphalia in 1648 by his successful campaigns in Germany and Flanders. In the wars of the Fronde he first sided with Condé, but having been defeated at Rethel in 1650 and driven out of France, he became reconciled with the court; was appointed commander-in-chief of the royal troops; defeated Condé at Gien, and nearly destroyed his army at the Faubourg St. Antoine in 1652, the Spaniards at Arras 1654, and Condé and the Spaniards in the Dunes 1658; and was made a marshal-general in 1660. In the war of the Spanish Netherlands (1667) he conquered Flanders in a brilliant campaign in which the king, Louis XIV., accompanied him, and in the war with Holland (1672) his fame reached its culmination by his conquest and devastation of the Palatinate in 1674 and the victories at Sinzheim (1674) and Türkheim (1675). He was preparing for a last and decisive encounter with Montecuculi, when he was killed by a cannon-ball during a reconnoissance near Sasbach, July 27, 1675. He is considered the greatest general France has produced, next to Napoleon. Turenne left *Mémoires*, comprising the period from 1643 to 1658, published by Grimoard in 2 vols. (1782). Deschamps, an officer of his staff, published some *Mémoires* in 1687 (new ed. 1756). His *Life* has been written by Ramsay (1733; trans. into English 1735), Raguenet (1738; new ed. 1877), Durny (5th ed. 1889), Hozier (1885). See also Neuber (Vienna, 1869), Roy (Paris, 1884), and Chappin (Brussels, 1888) for accounts of his military career. Revised by F. M. COLBY.

**Turf**: See HORSE-RACING.

**Turgénev**, toor-gā-nyef′: the name of several celebrated Russian authors. (1) ANDREĬ IVANOVICH, b. at Simbirsk in 1784; traveled in Germany, Italy, France, and Denmark to make investigations concerning the mediæval history of Russia, and published *Historiæ Russiæ Monumenta* (2 vols., St. Petersburg, 1841–42), and a *Supplementum* (1848). D. at Moscow, Dec. 15, 1845.—(2) His brother, NIKOLAĬ IVANOVICH, b. in 1790; studied at Göttingen; was, with Baron von Stein, placed at the head of the administration of those German countries which in 1813 were reconquered from France; studied subsequently the state of the serfs in Russia; was implicated in the conspiracy of 1825 and condemned to death, but escaped, and lived afterward in Paris. D. in Paris, Nov., 1871. He wrote *La Russie et les Russes* (3 vols., Paris, 1847).

**Turgénev**, IVAN SERGEEVICH: novelist; b. in the city of Orel, Russia, Oct. 28 (Nov. 9), 1818. He was partly brought up at home, but completed his education at Berlin (1838). In 1852 for his *Letter on Gogol*, although it had been passed by the Moscow censor, he was arrested and banished for two years to his estate. From 1863 to his death he lived abroad, chiefly at Baden Baden and Paris. Still he made frequent visits to Russia, and suffered not a little from homesickness in spite of the fact that he was on intimate terms with Flaubert and many others of the French writers of his day. In his ideas he was a *Zapadnik*, or admirer of Western Europe, for which, and for his residence in a foreign country, he was violently attacked by ardent Slavophils. Turgénev made his literary *début* with some verses (1841), but, though in the years that followed he wrote several pretty pieces, he does not rank high as a poet. His dramatic attempts, too, were failures. His earliest prose story, *Andreĭ Kolosov* (1843), did not attract great attention, but its successors were more fortunate. In 1847 appeared *Khor and Kalinych*, the first of his *Zapiski Okhotnika* (Tales of a Sportsman), which continued for four years and put him in the front rank of living authors. These were followed by other stories and sketches almost equally successful: in 1852 *Dimitri Rudin*, the first one long enough to be called a novel; in 1859 *Dvorianskoe Gnesdo* (A Nest of Noblemen, in some translations called Lisa); in 1862 *Nakanune* (On the Eve, in some translations Hélène); in 1862 *Ottsy i Deti* (Fathers and Sons), perhaps his masterpiece; in 1867 *Dym* (Smoke); in 1877 *Nov* (New, in some translations Virgin Soil), and many smaller pieces, the last of which, his exquisite *Poems in Prose*, came out only just before his death, which occurred at Bougival, near Paris, Aug. 22. (Sept. 3), 1883. As a writer Turgénev is characterized by his keen realistic insight into the weaknesses of mankind, always showing, however, a lurking sympathy and tenderness. His characters are marvelously vivid and true to life, while his appreciation of the beauties of nature is profound. None of his stories is long. They have perfect unity, cohesion, and in both substance and style the finish of a great artist. They have been translated into many languages, into French largely by the author himself. A new English edition (7 vols.) by Mrs. Constance Garnett is being published. A. C. COOLIDGE.

**Turgot**, tür'gō': ANNE ROBERT JACQUES, Baron de l'Aulne: statesman and economist; b. in Paris, May 10, 1727; was educated for the Church, but gave up the ecclesiastical career in 1751; studied law and national economy; became noted as a liberal thinker and an advocate of religious toleration, and wrote several essays for the *Encyclopédie*. Early in his career he entered into relations with the physiocrats Quesnay and Gournay, whose views were in some points identical with his own, and whose influence had an important effect upon his economic policy. In 1761 he was appointed intendant—that is, governor—of the province of Limousin. His administration was eminently successful, and although his reforms were crippled by his egotism of the privileged classes and the stupidity of the unprivileged, they proved beneficial. In 1774 Louis XVI. appointed him Comptroller-General of France—that is, Minister of Finance—and he immediately went to work to save, if possible, the state from bankruptcy. His ideas were essentially the same as those subsequently adopted and carried out by the Revolution, and the courtiers, the nobility, the clergy, etc., raised a veritable storm around him. For some time, however, the king supported him faithfully. In 1775 a scarcity of grain occurred, which almost grew into a famine. The artificial barriers between the provinces of the realm, which trammeled the free trade in grain in the interior, Turgot abolished; he compelled the Parliament to acknowledge the measure, and the riots of the mob, excited by secret emissaries of the courtiers, were speedily suppressed by military power. But at this point the king failed him. Although he said that he himself and Turgot were the only two who loved France truly, yet he suddenly dismissed him in May, 1776. Turgot retired into private life, occupying himself with scientific researches. D. in Paris, Mar. 20, 1781. His *Œuvres complètes*, containing his essay on usury, on the best method of taxation, and *Réflexions sur la Formation et la Distribution des Richesses*, etc., were published by Dupont de Nemours in 9 vols. (1808–11), and often reprinted. His *Life* was written by Condorcet (1786) and Tissot (1862). See also A. Neymarck, *Turgot et ses Doctrines*, 1885. He is the author of the famous line on Franklin—*Eripuit cœlo fulmen sceptrumque tyrannis.* Revised by F. M. COLBY.

**Tu'rin** (Ital. *Torino*; Lat. *Augus'ta Taurino'rum*): chief city of Piedmont, Northwest Italy; on the left bank of the Po; lat. 45° 4′ N., lon. 7° 42′ E.; elevation 784 feet above sea-level (see map of Italy, ref. 3–B). It is an industrial city, and makes silks, ribbons, lace, and bonnet-goods; also matches, leather, and tools. Its situation is picturesque. The town is so regularly laid out and built with so much uniformity as to be monotonous, but the constructions replacing the old ramparts and place of arms give some variety. The only building representing the architecture of the Middle Ages is the Madama Palace, a vast building flanked with towers, on Castello Place. The churches are very numerous, but not especially interesting. The city is especially rich in monuments raised in honor of celebrated Italians. The university is, next to that of Naples, the most frequented in Italy. Its library, now become national, has upward of 200,000 volumes and 3,000 MSS. The Egyptian museum of the Academy of Sciences is one of the best in the world, and the Academy of Fine Arts and the Royal Museum of Arms have fine collections. The climate of Turin is salubrious, but variable. The winter is cold and the spring inconstant. The mean annual temperature is 53°, and the mean annual rainfall 32 inches, with eighty-seven rainy days a year. It is the fourth city in size of Italy, is very modern in character, agreeable and full of business, rapidly growing, and affording charming sites for further expansion. Pop. of commune (1893) 335,900.

Turin owes its origin and name to a Celtic-Illyrian tribe, enemies of the Etruscans and faithful allies of Rome. Cæsar established the colony from which the city grew, calling it *Colonia Julia*, afterward changed by Augustus to *Colonia Augusta Taurinorum*. Lying near the border of Italy, it has undergone many vicissitudes and had many different masters. It was the political capital of the duchy of Savoy, and later of the kingdom of Sardinia from the Napoleonic occupation to 1861; and from 1861 to 1865 capital of the kingdom of Italy. With the removal of the capital to Florence, and then in 1871 to Rome, it received a brief check to its prosperity, since overcome. MARK W. HARRINGTON.

**Turkestan'**, or **Turkistan** [liter., country of the Turks; as *Turk* + Pers. *stan*, place, district, region]: a name of varying signification, political, linguistic, or geographic, but always centering about the great interior basins of Asia, generally those of the Tarim river, of Lake Balkash, and of the Sea of Aral. The name is passing into disuse as a general term, but is still employed to designate Chinese and Russian Turkestan.

By Chinese Turkestan, sometimes Eastern Turkestan, is meant by Western geographers the basin of the Tarim, comprising all the southern part of the immense district called *Kansuh-Sin-kiang* by the Chinese. It is mostly a desert, very sparsely occupied, except in the extreme west in the vicinity of Kashgar, was in the path of the migration of nations, and has often changed masters. It was formerly called Little Bokhara by Europeans, Mogolistan during the empire of the Khans of Jagatai, and Kashgaria during the ephemeral domination of Yakub Beg (1878). When recovered by the Chinese it was given the name already mentioned, and meaning the "New Frontier of Kansuh."

The Russian general government of Turkestan was formed in 1867, and later modified so that it now consists of the three provinces of Syr-Darya, Ferghana, and Samarkand. Area, 257,134 sq. miles; pop. (1890) 2,670,035, of whom about 930,000 are Kirghiz, 800,000 Sarts, 400,000 Uzbegs, 353,000 Tajiks, 23,000 Russians (not including troops), and 1,000 Germans, Poles, etc. The capital is TASHKEND (*q. v.*), in Syr-Darya. The next cities in importance are Samarkand and Khojend. Less than 5 per cent. of Russian Turkestan is cultivable, and less than 3 per cent. is actually cultivated. The population is chiefly nomadic and pastoral. MARK W. HARRINGTON.

**Turkey**: a gallinaceous bird, domesticated in many civilized countries, but confined to North America until after

The turkey.

its discovery by Columbus. It was found in the forests from the Isthmus of Darien to Canada when the country was first settled, being then abundant even in New England. See MELEAGRIDIDÆ and POULTRY.

**Turkey**, or more properly the **Ottoman Empire**: an empire comprising large portions of Europe, Asia, and Africa, and having its political center and capital at Constantinople, a city on the Thracian Bosphorus. Politically, geographically, ethnographically, and ecclesiastically, the Ottoman empire is an incongruous bundle of heterogeneous elements. Its territorial possessions may be grouped as direct and indirect. The direct are under the immediate authority of the sultan, whether governed by the common law of the empire or enjoying certain concessions and hence called privileged. To the latter class belong the communities of the Mirdites, Mt. Athos, Zeitoun in Asia Minor, the Lebanon, and Crete. The indirect are vassal provinces, nominally part of the Ottoman empire, but either administered by some foreign power or practically independent. These are Bosnia and Herzegovina, placed by the treaty of Berlin (1878) under the military occupation and civil administration of Austria-Hungary; Cyprus, by secret treaty of June 4, 1878, between Great Britain and Turkey, assigned to

VIENNA
BUDA
PESTH
AUSTRIA
HUNGARY
TRANSYLVANIA
GALICIA
MOLDAVIA
BESSARABIA
PODOLIA
KHERSON
ODESSA
ROUMANIA
WALLACHIA
BUCHAREST
SERVIA
BELGRADE
BOSNA SERAI
MONTENEGRO
BULGARIA
EAST ROUMELIA
ADRIANOPLE
CONSTANTINOPLE
SALONICA
MACEDONIA
THESSALY
EPIRUS
JANINA
GREECE
ATHENS
TRIPOLITZA
ASIA
BROUSSA
AIDIN
SMYRNA
KONIA
ADRIATIC SEA
IONIAN SEA
ITALY
BLACK SEA
MEDITERRANEAN SEA
CRETE OR CANDIA
Rhodes
CYPRUS
BARCA
Benghazi
GULF OF SIDRA
TRIPOLI
AFRICA
EGYPT
Siwah Oasis
Lesser Oasis
LIBYAN DESERT
ALEXANDRIA
CAIRO
Mouths of the Nile
Damietta
Port Said
Isthmus of Suez
Suez
RIVER NILE


TURKEY
AND
GREECE
East 35 from Greenwich
East 112 from Washington
Scale of Miles
50 100 150 200
DON COSSACK
ASTRAKHAN
RUSSIA
SEA OF AZOF
CRIMEA
CAUCASIA
CAUCASIAN PROVINCES
BLACK SEA
CASPIAN SEA
TREBIZOND
SIVAS
KARS
ERZROOM
ARMENIA
HARPOOT
DIARBEKIR
KURDISTAN
VAN
MOSUL
MESOPOTAMIA
AZERBAIJAN
GHILAN
IRAK AJEMEE
KERMANSHAH
LOORISTAN
KHOOZISTAN
IRAK ARABEE
ALEPPO
SYRIA
DAMASCUS
PALESTINE
GREAT SYRIAN DESERT
BADIEH EL ARAB
ALGWAF
ARABIA
ARABIA PETRÆA
NEDJED
EL ZEDEYR
EL HASSA OR EL HEJER
TURKESTAN
PERSIAN GULF
RED SEA
G. of Akaba
Ekaterinoslav
Alexandrovsk
Novo Tcherask
Taganrog
Rostov
Nakhitchevan
Berdiansk
Azov
Kertch
Kaffa
Anapa
Ekaterinodar
Stavropol
Georgievsk
Mosdok
Kizliar
Vladikaukas
Petrovsk
Derbend
Kouba
Shamaka
Baku
Tiflis
Kutais
Poti
Batum
Ardahan
Alexandropol
Erivan
Shoosha
Nakshivan
Bayazid
Lenkoran
Ardabil
Tabreez
Ooroomeyah
Erzroom
Trebizond
Amasia
Tokat
Sivas
Kaisarijeh
Nigdeh
Arabgir
Mush
Bitlis
Mardein
Orfa
Birejik
Aintab
Marash
Adana
Tarsus
Iscanderoon
Aleppo
Antakia
Rakka
Mosul
Nimroud
Kerkook
Suleimaniyah
Sinna
Hamadan
Kermanshah
Khorraimabad
Shooster
Susa
Samarrah
Tekrit
Anah
Hit
Bagdad
Kerbela
Babylon (Ruins)
Hilla
Sook-el-Shooyookh
Bassorah
Palmyra (Tadmor)
Homs
Hamah
Tripoli
Baalbec
Beyroot
Damascus
Mt. Hermon
Saida
Tyre
Acre
Jaffa
Jerusalem
Jericho
Dead Sea
Akaba
R. Euphrates
R. Tigris
R. Kour
R. Aras
River Volga
R. Don
R. Kouban
R. Terek
L. Sevan
Mt. Ararat
Mt. Elburz
Grane
Lyneh

Great Britain to be occupied and administered by her so long as Russia holds Batoum, Ardahan, and Kars; Tunis, occupied by France in 1881; Egypt, since 1882 under the military occupation and control of Great Britain; Bulgaria, created by the treaty of Berlin a tributary principality; Eastern Roumelia, by treaty of Berlin made an autonomous province subject to the sultan, but by revolution (1886) united to Bulgaria. See BOSNIA, CYPRUS, TUNIS, EGYPT, and BULGARIA. This article deals only with the direct possessions which constitute the empire.

*Turkey in Europe* occupies the central portion of the Balkan peninsula. It lies between 42° 50′ and 38° 56′ N. lat. and 19° 20′ and 29° 10′ E. lon. It is bounded N. by Montenegro, Bosnia, Servia, Bulgaria, and the Black Sea, E. by the Black Sea and Bosphorus, S. by Greece, the Ægean Sea, the Dardanelles, and Marmora, W. by the Adriatic and Ionian Seas. It includes also the island of Thasos. Area, 67,810 sq. miles. Its situation is advantageous, possessing an extensive coast-line with many harbors. On the W. are the Gulfs of Drino, Durazzo, Avlona, and Arta; on the S., of Salonica, Kassandra, Monte Santo, Rendina, Kavala, Lagos, Enos, and Saros. It terminates toward the S. E. in the commanding peninsula inclosed by the Black Sea, the Bosphorus, and Marmora. The general surface is broken and mountainous. The mountain system is complicated. Two main ranges, one the Messoro Dagh, which is a northern prolongation of the Pindus, and to which different names are applied, and the other, Despoto Dagh or Rhodope, emerge from the general confusion, proceed generally S. E., and divide the country into three sections of dissimilar shape but nearly equal area. These mountains sometimes attain a height of over 9,000 feet. The first section is Albania; the second, Macedonia, which comprises part of Thessaly; the third, Thrace. Albania is a mass of roughly parallel ranges, through which the rivers Boyana, Drin, Scoumbi, Loum, Voïoutza, Kalamas, and Arta force their way to the Adriatic and Ionian Seas. Here are also the large deep Lakes of Scutari, Ochrida, Janina, Prespa, and Kastoria. All this region is strategically commanded by the table-land of Janina, which is from 1,300 to 1,700 feet above the level of the sea. The ground is fertile only in a few localities, the climate rigorous and moist. Agriculture is in a most backward state, both from the poverty of the soil and from the aversion of the inhabitants to fixed pursuits. Oak, pine, box, and beech forests abound. In the second section, Macedonia, are the rivers Vistritza or Indji Kara Su and Vardar, emptying into the Gulf of Salonica, and the Strouma and Mesta or Kara Su, emptying into the Ægean. The Maritza, the largest river of Thrace, enters the Gulf of Enos. Macedonia and Thrace are fertile, but poorly cultivated. The forests have been almost destroyed. The climate corresponds with that of the same latitude and altitude in Southern Europe. Goats and sheep are exceedingly numerous, the latter furnishing the favorite food-supply. Buffaloes and even mules and asses are employed in cultivation rather than horses and oxen. Cattle and the live-stock generally are inferior. Great attention is paid to the bee and silkworm. Game is plentiful. The bear, wolf, stag, deer, and wild hog are found in Albania and Macedonia; the wolf and jackal in Thrace. Vultures, falcons, buzzards, hawks, and kites abound. Eagles are seen only in the mountains. Maize and the vine are extensively cultivated; also the fig, olive, and pomegranate in the south; wheat, rice, rye, barley, tobacco, cotton, hemp, and flax grow in the plains and low valleys; beans, peas, lentils, onions, cabbages, beets, and cucumbers are raised; the favorite fruit-tree is the plum. Rock-salt, copper, silver, and gold exist in certain localities, but mining is hardly undertaken. The numerous thermal and sulphurous springs are sometimes utilized for baths.

*Turkey in Asia* comprises the Sporades islands in the Ægean, Asia Minor, Crete, the vast basins of the Euphrates and Tigris, Syria, and the west coast of Arabia. Area, 686,370 sq. miles, or more than ten times that of the direct Ottoman possessions in Europe. This widespread territory, exclusive of Arabia, is included between 41° and 28° N. lat. and 25° and 48° E. lon. It is bounded N. by the Dardanelles, Marmora, Black Sea, and Russia, E. by Russia, Persia, and the Persian Gulf, S. by the Mediterranean and the Great Syrian Desert, W. by Africa, the Mediterranean, and Ægean. Turkish Arabia or El Hedjaz and Yemen is a strip of land nearly 1,000 miles long and of indefinite breadth, extending the entire length of Arabia along the Red Sea. Turkey in Asia comprises the many ancient kingdoms and provinces of Asia Minor, Judæa, Syria, Mesopotamia, and Assyria. It includes the modern political divisions of Anatolia, Karamania, Armenia, Kurdistan, El Djezireh, Irak Arabi, and Syria. Its coast is long, sinuous, and abounding in gulfs with natural harbors. Syria is indented by many tiny bays. For further details of that country, see SYRIA. Asia Minor has on the S. the Gulfs of Iscanderun or Alexandretta, Adalia, and Macri, between which project the headlands of Anemour and Khelidonia; on the W. the Bays of Symi, Kos, Mandelia, Scala Nova, Smyrna, and Edrimid, with the Capes Krio, Sancta Maria, Koraka, Karabournou, Baba, and Koum Kaleh, along which may still be seen the splendid ruins of the Dorian, Ionian, and Æolian Greek cities; in the Marmora, the Bays of Artaki and Panormo on either side of Cyzicus, and of Moudania and Ismid; in the Black Sea, innumerable bays, but none of large dimensions, the most notable being those of Sinope, Samsoun, and Trebizond, with the Capes Karpeh, Baba, Karembeh, Indjeh, Boztepeh, Tchalti, Yasoun, and Ieros. The mountain system is even more irregular than in European Turkey. From the great plateau of Armenia, which spreads in every direction around Ararat (17,212 feet), its central point, the Anti-Taurus Mountains extend W. and the Taurus Mountains S. W. across Kurdistan to the Gulf of Iscanderun. Thence the latter range sends the Amanus chain S. into Syria and the Argæus chain N. W. toward the Anti-Taurus and over Asia Minor to the shores of the Ægean. Many of the peaks are over 10,000 feet in height and are covered with snow almost throughout the year. In the Amanus Mountains are the famous Cilician and Syrian Gates, the only passes to the Euphrates and Syria. The Anti-Taurus joins the range of the Bithynian Olympus, from which irregular spurs diverge southward. In addition, isolated peaks and disconnected ranges dot the face of Asia Minor. The most important mountains are Kaz Dagh (*Ida*), dominating the Troad; Manisa Dagh (*Sipylus*), commanding Smyrna and Phrygia; Boz Dagh (*Tmolus*), above Sardis; Tashtali Dagh (*Chimaera*); Ershishi Dagh (*Argæus*), 13,200 feet, an extinct volcano, like Sipylus; Kershish Dagh (*Olympus*). Kurdistan is a wild, mountainous region, sloping southward to El Djezireh (*Mesopotamia*) and Irak Arabi, which form a succession of deserts and steppe lands broken by hills to the Persian Gulf. In Arabia the coast belt owned by Turkey is bordered on the E. by lofty mountain ranges, which collect moisture and thus render it more fertile than the rest of the peninsula. In Asia Minor, from its physical formation, there are few great rivers, and all are winding. The principal are Kizil Irmak (*Halys*), nowhere over 200 feet wide, but over 500 miles long, though the direct distance from its source to its mouth is less than 160 miles; Yeshil Irmak (*Isis*); Muhalitch Chaï (*Rhyndacus*); Khodja Chaï (*Granicus*); Mendereh Chaï (*Scamander*); Buyouk Mender Chaï (*Mæander*); Khodja Chaï (*Xanthus*); Keupri Su (*Eurymedon*); Seikhun Chaï (*Sarus*); Djehan Chaï (*Pyramus*); Tersus Su (*Cydnus*). The most important in the empire are the Euphrates, 1,750 miles, and Tigris, 1,000 miles. Both rise in the plateau of Armenia and finally unite as the Shatt-el-Arab, which empties into the Persian Gulf. The lower course of these rivers was anciently exceedingly fertile, highly cultivated, densely populated, a center of civilization, the seat of the Chaldæan and Babylonian empires. Assyria was W. of the Tigris. Lakes are numerous, some without known outlet, and very salt. The larger are Touz Tcholli, Igridi, Beishehr, and Ak Shehr, in the middle of Asia Minor; and Isnik and Aboullonia, near the Gulf of Moudania. Lake Van, in Armenia, 80 miles by 40, area 1,550 sq. miles, is an inland sea. In a territory so extensive as Turkey in Asia, drawn out through so many degrees of latitude, every kind of soil and climate and the greatest variety of mineral, vegetable, and animal products must exist. Asia Minor is rich in copper, iron, coal, petroleum, lead, meerschaum, and marble. Gold and silver are found in Kurdistan, bitumen and naphtha along the Tigris. The soil is generally fertile. Immense tracts are given up to pasturage. The plains of the interior are scantily wooded, but covered with wormwood, sage, and broom. Large forests, in which oak and fir predominate, spread inland from the Black Sea. Cypresses and junipers abound in the Taurus; plane-trees grow everywhere. Wild grape-vines grow freely in the lowlands and on the western coasts. The vineyards furnish excellent wines. Garden vegetables and fruits of all sorts are abundant. Hemp, flax, cotton, rice, tobacco, indigo, saffron, and madder grow plentifully. Armenia produces wheat, and has chestnut and oak forests. Kurdistan is largely woodland. In El Djezireh trees are rare, but the lilac, jasmine, and vine grow in profusion. In Irak Arabi every kind of palm is found. There the soil is very fertile, but, on account of poor irrigation, the yield of barley and rice is small, though tobacco and cotton succeed better. The melons reach an enormous size, often weighing over 100 lb. Through Turkey in Asia the ox is rare, the buffalo being preferred both as source of food and as beast of labor. The camel likewise supplants the horse, but the horses, mules, and asses are large and strong. The sheep is the most common domestic animal, but its flesh and wool are poor except in the region of Angora, which is justly celebrated for its goats, sheep, rabbits, and cats. The bee and silkworm are reared, especially in Kurdistan, El Djezireh, and Irak Arabi. Game abounds. Flocks of wild sheep live in the Taurus. Partridges swarm near the Dardanelles and swans on the Kutchouk Mender (*Caystrus*). The stork is the bird most frequently seen and most typical of the country. Carnivorous beasts are the bear, leopard, wolf, hyæna, and jackal. Lions are found in the swamps bordering the Tigris and Euphrates. Locusts infest El Djezireh. Despite the almost boundless resources of Turkey in Asia, commerce is little developed, manufactures have terribly decreased during the last century, and the country has grown steadily poorer. This is largely the fault of an improvident and feeble government. Yet the system of administration has somewhat improved, property and life have become less insecure, and injustice is less prevalent than at any other period since the foundation of the Ottoman empire. The real reason for decline must be found in economic causes. Home manufactures in both Europe and Asia, as the muslins of Mosul and the woolen stuffs of Macedonia, have been crowded out by the introduction of machine-made and cheaper European goods. The Oriental is unable to appropriate the inventions and methods of the European, and is invariably worsted in the competition. Moreover, lack of roads, due to governmental indifference and to Oriental lack of enterprise, has largely hindered development of resources. The enormous cost of transport of agricultural articles, generally bulky and often perishable, paralyzes their production at a distance from the coast.

*Turkey in Africa* comprises Tripoli and Benghazi or Barca. It is mainly included between the Mediterranean and the Great Desert, though touching Egypt on the E. and Tunis and Algeria on the W. Its inland boundaries are indefinite. Area, 308,500 sq. miles; according to Turkish estimate, 398,840 sq. miles. The Gulf of Sidra (*Syrtis Major*) partly separates Tripoli and Barca. Ras Sem (*Phycus*) and Ras Tourba (*Zephyrium*) are the most northern capes. There are few good harbors. A belt of fertile land borders the coast. Farther S. are sandy plains and ranges of rocky mountains. The rivers are small, and, like the wells and watering-places, are often dry. Water is deficient, but wherever it is found the fruits, vegetables, and cereals are excellent and abundant, especially the date, olive, lemon, orange, mulberry, tobacco, wheat, and barley. Most of the inhabitants live in tents, and are nomads. Their flocks and herds and agriculture in a primitive way furnish their principal support. The population consists of Moors, Arabs, Kabyles, Ottomans, Negroes, Jews, and Europeans. The latter, mainly Maltese, and the Jews are the traders. The climate is healthful and not disagreeable, notwithstanding the heat. The temperature in winter rarely descends below 50° F., and in summer is ordinarily maintained at from 85° to 95°; when the wind blows from the desert, at from 104° to 113°. Tripoli, being less remote than the other Barbary states, is traversed by the chief caravan routes from the interior to Northern Africa. The caravans bring ostrich-feathers, gold-dust, ivory, dye-woods, skins, and cereals, and carry back cloth, silk, arms, iron, sugar, drugs, glass, coffee, dry-goods, and manufactured articles of all kinds. Barca includes ancient *Cyrenaica*, the remains of whose cities lie along the coast. See TRIPOLI.

*Constitution and Government.*—The Ottoman empire is an absolute monarchy. Succession is hereditary in the family of Osman, vested since 1617 in the person of its oldest male member. The ruler is the sultan or *padishah*. His person is inviolable; he is irresponsible. This absolutism is modified by essential conditions of the Mussulman faith and by certain customs which have the force of laws. Since the conquest of Egypt (1517) by Selim I. the sultan is caliph or spiritual head, not only of his own Mussulman subjects, but of the entire Mussulman world. He is represented in temporal affairs by the grand vizier, first appointed in 1327, and in spiritual affairs since 1523 by the Sheik-ul-Islam. (See MUFTI.) The state ministers are hardly more than state secretaries. Their departments at present are war; marine; interior; foreign affairs; justice and worship; finances, mines, forests, and civil list; *evcaf* (property of mosques and philanthropic institutions); public works; commerce, and agriculture; public instruction; artillery; presidency of the council of state. There is also the divan, a deliberative body; the council of state, charged with the elaboration of laws; and the senate, whose functions are honorary. The government is often styled the Porte, or Sublime Porte. A constitution, proclaimed by Abd-ul-Hamid II. (Dec., 1876), guaranteed equal rights to all subjects, and applied to them without distinction the name Ottoman, heretofore reserved to the Mussulmans. It conferred the privileges enjoyed in the most civilized countries, and instituted a representative chamber. Save for a brief season this constitution has been inoperative. Political legislation is called *kanoun*, and is based on the codes of Mohammed II. and Suleïman I. The civil and religious legislation is that of the *sheriat*, or sacred law of Islam. The *hatti sherif* (1839) and *hatti humayoun* (1856), imperial rescripts of Sultan Abd-ul Medjid, proclaimed general reforms whereby non-Mussulman subjects were to be raised to full equality with Mussulmans. But the intolerance and inertia of the dominant race have rendered these rescripts generally a dead letter in almost all their provisions, such as acceptance of Christian testimony in trials, right of Christians to bear arms, and eligibility to all offices. Foreigners are not amenable to Ottoman law, but by virtue of the so-called capitulations are tried in their own courts. The slaves are the only legally subordinate class. There is no aristocracy. Manumitted slaves and persons of the humblest origin often attain the highest positions. For administrative purposes the empire was divided in 1868 into vilayets (governments), administered by a vali (governor-general), named by the sultan, and assisted by an administrative council. The vilayet is subdivided into sandjaks (provinces); the sandjak into casas (districts); the casa into nahiehs (communes). The name, number, and size of the vilayets is often changed. According to the last apportionment (1889) there are seven vilayets in Europe—Adrianople, Salonica, Kossova, Monastir, Janina, Scutari in Albania, Constantinople with the two sandjaks of Bigha (Dardanelles) and Ismid in Asia; twenty-four vilayets in Asia—Hudavendighiar, Aïdin, Archipelago, Crete, Konieh, Adana, Angora, Kastamuni, Sivas, Trebizond, Erzeroum, Van, Bitlis, Diarbekir, Mamuret-ul-Aziz, Dersim, Aleppo, Lebanon, Syria, Mosul, Mesopotamia, Bassora, Hedjaz, Yemen; two vilayets in Africa—Tripoli and Benghazi.

*Army and Navy.*—Military service is incumbent on every Mussulman subject twenty years of age—three years in the infantry or four in the cavalry or artillery (after five months of active service one may purchase exemption for the remainder of the period); then three or two years in the *shtiad* (reserve), eight in the *redif* (landwehr), six in the *mustafiz* (landsturm). In the navy—five in active service, three in the reserve, four in the landwehr. Non-Mussulmans pay the *haratch* (tax) of about 30 piasters and are not liable. The army is organized in seven *ordus* (corps d'armée), each commanded by a *mushir* (marshal). The headquarters are at Constantinople, Adrianople, Monastir, Erzinghian, Damascus, Bagdad, and Sanaa. There are also three separate divisions, one each in Tripoli, the Hedjaz, and Crete. An ordu consists of divisions, brigades, regiments, battalions, and companies. There are sixty-six *nizam* (regular) infantry and forty-two cavalry regiments. The artillery is in a state of disorganization or attempted organization. The cannon are largely Krupp guns. The infantry are supposed to be armed with Mauser magazine-rifles, though few have been delivered to the troops. It is the endeavor to follow the German system in organization and tactics. No accurate statement exists or can be made of the number of soldiers. The real effective on either peace or war footing differs largely from the nominal force and the cadres are never full. The Government believes the army to number 250,000 in time of peace, and claims ability in case of war to put over 1,000,000 men into the field. Probably not half as many could be raised or officered and equipped. The large number constantly under arms during past years has been a main cause of the decrease in the Mussulman population and of its increasing poverty, as compared with the non-Mussulmans. The Ottoman soldier is docile, patient, enduring, abstemious, content with little, and when behind fortifications almost unconquerable. But, since the foundation of the empire, he has seldom been victorious against Christians in the open field, except when far superior in number. On paper the navy is formidable—forty-one ironclads, almost all obtained in Great Britain, and 131 other vessels of all sorts; also sixteen in process of construction; nominally manned by 977 officers, 30,000 sailors, and 9,650 marines. Yet most of the ships are so superseded or unseaworthy, the crews are so incompetent and so deficient in discipline and experience, and the commanders so generally incapable, that the Ottoman navy hardly counts as a fighting power. Nevertheless in 1877–78 the fleet did excellent service in the transport of troops. See ARMY and SHIPS OF WAR.

*Finance, Money, Weights and Measures.*—In 1854 the empire contracted its first foreign loan; this was succeeded at short intervals by others, until in May, 1875, the total debt was 5,023,860,500 francs, or about $1,000,000,000. Hardly more than half of this enormous sum had been received by the Government. In Oct., 1875, the Government, unable to pay the interest due, announced that during the next five years half the interest would be paid in cash and half in new bonds. The following year it declared that no further payment would be made till internal affairs became more settled. Until 1881 no part of the interest or sinking fund was paid. Then delegates of the foreign bondholders met at Constantinople and effected an arrangement which the Government embodied in the formal decree of Dec., 1881. The various loans, except bonds of the Roumelian Railway, were consolidated and grouped. A commission of delegates was authorized to administer the excise revenues of the empire entirely separate from all other revenue. The acknowledged debt is now over $600,000,000. In this is not included $155,364,000 due Russia as war indemnity, of which $1,539,991.20 is to be paid annually without interest, and also $1,539,991.20 as indemnity to Russian subjects. This payment is guaranteed by the revenues of the vilayet of Konieh. The revenue for 1889–90 was estimated by the budget committee as about $81,400,000, and the expenditure as about $94,160,000. Though the court and palace expenses have been reduced by the present sultan, they must still be very large. Any estimate as to their amount is mere conjecture. The piaster (4·4 cents) is the unit of value. Forty paras make one piaster; 100 piasters make one lira or Turkish pound. Paper money (*kaïmeh*) and copper are withdrawn from general circulation. Notes of the Imperial Ottoman Bank circulate at par. Common coins are pieces of 1, 2, 5 (beshlik), 10 (onlik), and 20 (*medjidieh*) piasters; gold coins are ¼, ½, 1, 2½, and 5 liras. The metallic currency (with exception of gold) is of different issues and alloys, and fluctuates in value. The decimal system of weights and measures was introduced in 1882 and declared obligatory in 1892, but the old names, as of oke and arshine, were retained, and much confusion has resulted.

*Commerce.*—A tax of 8 per cent. *ad valorem* is levied on all imports, except articles for embassies, consulates, schools, and churches, which are admitted free. The introduction of salt and tobacco is prohibited, they being Government monopolies. There is an export customs duty of 1 per cent. on native goods sent abroad, and of 8 per cent. between the different provinces of the empire. The repeated efforts of the empire to reform the customs tariff in its own interest have always encountered the determined opposition of the foreign powers.

| YEARS. | Imports. | Exports. |
|---|---|---|
| 1889–90 | $92,582,688 | $66,758,692 |
| 1890–91 | 100,822,876 | 56,480,468 |
| 1891–92 | 108,037,336 | 67,528,220 |

The value of the imports (1891–92) was: From Great Britain, $44,884,972; Austria-Hungary, $20,227,592; France, $13,294,028; Russia, $8,223,556; U. S., $142,780. The chief imports were linen goods, piqué, sugar, woolen and cotton goods, cereals, cotton thread, medicines and dyes, coffee, rice, duck-cloth, petroleum, skins, animals, iron, cloths, cashmere, butter and cheese, manufactured iron, paper, timber, made clothing, dry goods, silk, bags—·576 being manufactured articles, ·03 animals, ·132 raw materials, and ·262 food articles. The value of the exports (1891–92) was: To Great Britain, $30,197,288; France, $19,830,800; Austria-Hungary, $5,422,888; Russia, $1,114,564; U. S., $1,024,364. The chief exports were cereals, raisins, raw silk, opium, mohair, nuts, coffee, wool, skins, figs, cotton, drugs and dyestuffs, minerals, animals, vegetables, dates, olive oil, carpets, seeds, sesame, fish—·089 being manufactured articles, ·024 animals, ·308 raw materials, and ·579 food articles.

*Shipping and Navigation, Internal Communications.*—The merchant marine consisted in 1900 of 2,205 sailing vessels, of 141,055 tons, and of 177 steamers, of 55,983 gross tons. In 1897–98 altogether 173,739 vessels, of 34,653,457 tons, entered or cleared from Ottoman ports—from Constantinople alone 14,931 vessels of 10,348,269 tons. The mails are largely in the hands of foreigners. Great Britain, France, Germany, Austria-Hungary, and Russia have their own post-offices at Constantinople and in most of the seaboard cities. The Government has made many fruitless attempts to close these foreign offices and to bring the entire postal department under its own control. The number of Ottoman offices in 1889–90 was 1,442; receipts, 4,190,842 francs; expenses, 1,641,633 francs. Through the Ottoman mails passed 9,403,000 domestic letters and 48,000 postal cards, and 3,649,000 foreign letters and 66,000 postal cards; also 559,000 foreign letters and 12,000 postal cards going to foreign countries. Telegraphs: Length of wires, 31,969 miles; receipts (1888–89), 51,615,526 piasters; expenses, 17,669,044 piasters. Railways (Oct., 1899): 1,240 miles in Europe and 1,713 in Asia Minor. The gross receipts in 1899 were $6,333,036.84. See TURKEY in the Appendix.

*Population.*—No other country presents such variety of races and creeds; nowhere is it more difficult to obtain trustworthy statistics. Equally trustworthy authorities differ by 5,000,000 or 6,000,000 in their estimate of the number of the inhabitants. No reliable census has ever been taken. Mussulmans and non-Mussulmans are alike interested in avoiding enumeration, the former to escape conscription, the latter to escape the *haratch*, or capitation tax. The great majority of the subjects may be classed in seven main racial groups: Turkish, including the Ottomans, Yurouks, and Turcomans; Græco-Latin, including Greeks, Moldo-Wallachians, and Albanians; Slavic, including Bulgarians, Servians, and Kossacks; Georgian, including Circassians and Lazes; Hindu, represented by the gypsies; Persian, including Armenians and Kurds; Semitic, comprising Arabs, Jews, Chaldæans, Druses, Syrians, and Maronites. The population of the empire is estimated at about 40,000,000; that of Turkey in Europe, which is more accurately known, is about 4,780,000. In Europe the Ottomans, Albanians, and Greeks must be of nearly equal numbers, each about 1,300,000. The majority of the Albanians are Mussulmans. The Christian Albanians in the north, called Ghegs, are Roman Catholics, and use the Latin alphabet; those of the south, called Tosks, are members of the Greek Church, and use the Greek alphabet. Their dialects are very different, and they hate each other cordially. Macedonia is inhabited principally by Greeks, Bulgarians, Ottomans, Albanians, Moldo-Wallachians, and Servians. Thrace is peopled by a mixed multitude of Ottomans, Greeks, Bulgarians, Jews, Armenians, gypsies, Circassians, by members of other subject races, and foreigners. The Greeks predominate along the coast, not only in Europe and the islands, but in Asia, where they devote themselves to navigation, and, together with the Jews, Armenians, and foreigners, are the tradesmen and bankers. In Asia Minor there are about 9,000,000 Ottomans, double all the other inhabitants of that peninsula put together. The Yurouks are nomadic, and the Turcomans pastoral. Since the conquest of the Caucasus by Russia there has been a large immigration of Tartars and Circassians. The Armenians are scattered everywhere, though many still remain in their ancient country, Armenia. Northern and Central Kurdistan are occupied by 1,000,000 Kurds, ostensibly Mussulmans. They are a fierce people, never entirely subjugated in their mountain fastnesses, a perpetual trouble to their nominal masters, the Ottomans. Their neighbors, the Armenians, have always suffered greatly at their hands, as in the outrages of 1894–96. The 4,000,000 or 5,000,000 of Arabs in Syria, Irak Arabi, and Turkish Arabia are of two classes, sedentary and nomadic. The latter, the Bedouins, by far the more numerous, are the typical Arabs. Though of the same faith as the Ottomans, they are their inveterate foes, and, as far as possible, defy their authority. In case of war, the Porte can count upon only the 10,000,000 or 11,000,000 of Ottomans, on a possible million of Circassians, Tartars, Yurouks, Turcomans, Lazes, and Zebecks, and perhaps on the assistance of the Kurds and Albanians. The remaining 15,000,000 or 16,000,000 members of subject and non-Moslem races controlled by force are secretly hostile or at best indifferent. Pop. of different towns (estimated in 1889): In Albania—Scutari 36,000, Janina 20,000; in Macedonia—Salonica 122,000, Monastir 50,000; in Thrace—Constantinople 900,000, Adrianople 70,886; in Asia Minor—Smyrna 225,000, Broussa 75,000, Manisa 50,000, Kaisairieh 45,000, Trebizond 45,000, Adana 45,000, Konieh 40,795, Sivas 39,368, Angora 37,000, Marash 35,000, Kastambol 33,000; in Armenia—Erzeroum 60,000, Erzinghian 30,000, Van 30,000; in Kurdistan—Mosul 57,000, Kharpout 35,000, Diarbekir 25,000; in Irak Arabi—Bagdad 180,000; in Syria—see SYRIA; in Arabia—Mecca 80,000, Medina 80,000, Sanaa 50,000; in Africa—Tripoli 30,000.

*Religion and Education.*—The state religion is Islam or MOHAMMEDANISM (*q. v.*), but other religions have always been tolerated and have enjoyed a certain degree of protection and freedom. Since the capture of Constantinople (1453) the Porte has preferred to deal with its non-Mussulman subjects as members of different religious communities rather than of distinct nationalities. So the religious chief of each church or sect is regarded by the Government as the civil head and representative of his coreligionists; its church organization has become to each subject people not only a religious institution, but a national center and the preserver of its national existence and language. The principal religious communities thus officially recognized by the Porte are: The Eastern Orthodox or GREEK CHURCH (*q. v.*), with its Œcumenical Patriarch of Constantinople and its Patriarchs of Antioch, Jerusalem, and Alexandria; the Armenian or Gregorian Church, the oldest national church in existence, with its Patriarchs of Constantinople, Sis, and Jerusalem; the Protestant Armenian community, with an official representative or *vekil*; the Jewish community, with a *khakham bashi* or grand rabbi. There are, moreover, a number of less prominent or less numerous religious groups, all recognized and represented. Education has made marked progress since about 1850, specially in the vicinity of the capital and large towns. This advance is due to the efforts of the Government, to the awakened sentiment of the people, and to the Protestant and Roman Catholic missionaries, whose work is largely educational. Formerly Mussulman education was entirely in the hands of the ulema and derived from the school attached to the mosque; that of the Christians was limited to such rudimentary branches as were taught in the school invariably connected with each Greek or Armenian Church. The imperial school of medicine, founded in 1826 by the Government, has been followed by a large number of colleges and of other high institutions, military, naval, polytechnic, etc., and of primary and secondary establishments. The subject nationalities have vied in founding many of various grades for their own children.

*History.*—The Ottomans are a Turkish tribe, originally from Khorassan. Numbering only 400 families, they were led by their chief, Ertogroul, into Asia Minor in 1231. The Seljuk sultan, Alaëddin I., grateful for aid chivalrously afforded him in battle, bestowed on Ertogroul some pasture-lands on the river Sangarius E. of the Bithynian Olympus. This insignificant territory, a few square miles in extent, was the nucleus of the Ottoman empire. There Ertogroul and his followers, hitherto pagans, embraced Islam. The sword played no part in their conversion, and their descendants have continued faithful and zealous Mussulmans. On the dissolution of the Seljuk empire, Othman, son of Ertogroul, was proclaimed *padishahi ali Othman*, Sultan or Emperor of the Ottomans, and his followers have ever since been called from his name Ottoman or Osmanli. His first official act was the erection of a mosque. His possessions slowly increased. At that time Asia Minor was broken up into twelve principal states, one of which consisted of the possessions of Othman, and into many minor fragments. The whole presented a ready field of conquest to whichever power was stronger or more ably governed than the rest. In Europe the Byzantine empire, which still held territories in Asia Minor, had never recovered from its conquest by the Latin crusaders, and the entire Balkan peninsula was divided between jealous and antagonistic petty states. Yet the rapid growth of the Ottoman empire was not due primarily to favoring circumstances, but to the pre-eminent abilities of its early sultans as warriors, statesmen, and organizers, and to the sober and austere virtues of their followers. The first seven sultans, OTHMAN I., ORKHAN, MURAD I., BAYAZID I., MOHAMMED I., MURAD II., and MOHAMMED II. (*qq. v.*), possessed the qualities requisite to the founding of states. Broussa was besieged and made the capital (1325). A code was formulated, the JANISSARIES (*q. v.*) and *sipahis* (cavalry) organized, money coined, and red adopted as the national color before 1330. Tzympe, the first Ottoman acquisition in Europe, was captured (1359); then Adrianople (1365). Gradually Asia Minor and the Balkan states were subdued. The frightful defeat of Bayazid I. at Angora by Tamerlane (1402), and the consequent eleven years' interregnum, threatened the very existence of the empire. Yet when Mohammed II. succeeded (1451), it had already become more strong and compact than before. The Seljuks, as fast as they were subdued, fused with the Ottomans. So did vast numbers of Christians, who became Moslems in the conquered European states. No distinction was made between the born Moslem and the convert. All, the original Ottoman, the Seljuk, and the convert from Judaism or Christianity, were considered equally Ottoman. The majority of grand viziers from 1359 to 1895 have been of Christian or Jewish origin. Duration was assured the empire by the capture of Constantinople (1453), which was at once made the capital. Under MOHAMMED II., BAYAZID II., SELIM I., and SULEÏMAN I. (*qq. v.*) the empire steadily expanded, reaching its acme in the reign of the latter. The unsuccessful siege of Vienna (1529) and of Malta (1565) were its first real checks. Then Europe learned that the Ottomans were not invincible. Their empire in the sixteenth century was the most powerful in the world. It comprised all the European, Asiatic, and African countries situated on the Mediterranean, except Morocco, Spain, France, and Italy; all the coasts of the Black Sea, and nearly all of the Red Sea; Hungary and all the kingdoms S. of the lower Danube. Its possessions extended from 47° 30′ to 12° N. lat., and from 3° W. lon. to 48° 30′ E. lon. Austria and Venice paid tribute; the European powers rivaled each other in congratulating the Ottomans on every victory and in seeking their good will and favor. Yet already the empire was beginning its slow, apparently intermittent, but constant and inevitable decline. Prominent causes of this decline were the gradual abandonment of direct government by the sovereign, and his customary withdrawal into seclusion; the consequent increasing influence of the HAREM (*q. v.*) in political and military affairs, and the demoralization of the janissaries, the Ottoman right arm in war; the progress made by the hostile Christian states in wealth and civilization, while the Ottomans deteriorated, or at best stood still; the fact that the last twenty-four sovereigns, with the exception of Murad IV., Mahmud II., and Abd-ul Hamid II., have each been inferior in ability to any one of the first ten sultans; above all, because the Ottoman empire from the first has resembled an armed camp, because it has always consumed and never produced, because it has lived on the countries which it conquered without conferring any benefits upon them. After the decline began, subsequent fruitless conquests, as of Cyprus (1570), Erivan (1635), and Crete (1669), and infrequent victories only varied the monotony of such irreparable disasters as Lepanto (1571), St. Gothard (1664), Vienna (1683), Zenta (1697), Peterwardein (1716), Belgrade (1717), Tcheshmeh (1770), Ismaïl (1790), Navarino (1827), and Plevna (1878). The whole humiliating history is best indicated by the successive treaties of Sivatorok (1606), when the empire first receded; Carlovitch (1699), by which it was first dismembered; Passarovitch (1718), Kaïnardji (1774), Jassy (1792), Adrianople (1829), resulting in the first recognition of the independence of a hitherto subject people; San Stefano (1878), when Turkey submitted to the loss of several provinces; and Berlin (see BERLIN CONGRESS), when the last treaty was practically ratified by Europe. Even the treaties least unfavorable, Falksen (1711), Belgrade (1730), Bucharest (1812), and Paris (1856), after the Crimean war, contained no permanent or real advantage for the Ottomans. (See TREATIES.) The term "sick man of the East," commonly attributed to the Czar Nicolas, was used in reference to Turkey after the treaty of Carlovitch (1699). The empire is now protected by its relative weakness, which inspires no suspicion or dread, by the mutual jealousies of the European states, and by the antagonisms of its subject non-Mussulman races against each other, which prevent their union. See TURKEY, HISTORY OF, in the Appendix. See also ABD-UL AZIZ, ABD-UL HAMID, ABD-UL MEDJID, MAHMUD, MOHAMMED, MURAD, MUSTAPHA, OTHMAN, SELIM, and SULEÏMAN.

See Baker, *Turkey in Europe* (London, 1877); Clark, *Races of European Turkey* (New York, 1879); Georgiades, *La Turquie actuelle* (Paris, 1892); Mrs. Blunt, *People of Turkey* (London, 1878); Tozer, *Highlands of Turkey* (2 vols., London, 1869), *Islands of the Ægean* (Oxford, 1890), and *Turkish Armenia and Eastern Asia Minor* (London,

1881); Sterrett, *Epigraphical Journey to Asia Minor* (Boston, 1888) and *Wolfe Expedition to Asia Minor* (Boston, 1888); Cuinet, *La Turquie d'Asie* (Paris, 1891); Geary, *Asiatic Turkey* (London, 1879); Davis, *Asiatic Turkey* (London, 1878); Macdonald, *Land of Ararat* (London, 1893); Dwight, *Turkish Life in War Time* (New York, 1881); Warner, *In the Levant* (2 vols., London, 1892); Texier, *Asie Mineure* (Paris, 1862); d'Ohsson, *Tableau Général de l'Empire Ottoman* (3 vols., Paris, 1787); Creasy, *History of the Ottoman Turks* (London, 1882); Freeman, *Ottoman Power in Europe* (London, 1877); de la Jonquière, *L'Histoire de l'Empire Ottoman* (Paris, 1881); Jouannin, *La Turquie* (Paris); von Hammer, *L'Empire Ottoman* (trans., Paris, 1844); Grosvenor's *Constantinople* (1895); and H. C. Thomson, *The Outgoing Turk* (1897). E. A. GROSVENOR.

**Turkey-buzzard**: the *Cathartes aura*, the commonest of American vultures, resembling a turkey in size and appearance. It is 2½ feet in length and 6 feet in spread of wing; the general color is blackish, lighter on the wing coverts; head and upper part of neck bare and reddish. It ranges throughout the greater part of the U. S., except the most northern and eastern portions, and thence southward over nearly all of South America. It feeds on carrion and is remarkable for its sustained sailing flight. It must not be confounded with the smaller black vulture, or carrion crow, *Catharista atrata*. See also CATHARTIDÆ. F. A. LUCAS.

**Turkey Red**: See DYEING.

**Turkey-stone**, or **Turkey Oil-stone**: a siliceous rock of very fine grain used for sharpening cutting-tools; so-called because obtained from Asia Minor. See HONE.

**Turkish Language**: the most important member of the Ural-Altaic or Ugro-Tartaric family of languages. It is spoken by the Osmanli or Ottoman Turks, regnant since 1453 in the Eastern Roman or Byzantine empire. There are really two Turkish languages: (1) That of the common people, a virtually unmixed language, spoken in its greatest purity by the Turkoman nomads, and practically covering the vast territory lying between the Danube and the western confines of China; and (2) the elevated language used in official life and in the higher flights of both prose and poetry. This elevated language has borrowed freely from both Arabic and Persian. All terms relating to religion, theology, politics, and law have been taken from the Arabic, while Persian literature, and the fact that the Turks first accepted Islam at the hands of the Persians, have caused another host of Persian words to be incorporated into Turkish. In order, therefore, to understand the elevated language, one must know well both Arabic and Persian. But it is with especial reference to the language of the common people, the practically unmixed language, that this article would give information, since its structure is fully preserved in the elevated language.

Originally, Turkish was written in an alphabet of its own, but this was abandoned long ago for the Arabic alphabet, to which were added several Persian letters, thus raising the number to thirty-three, or, if lam-élif be counted in, to thirty-four. Most of these letters have one form when they stand alone, another form at the beginning, another in the middle, and still another at the end of a word. The alphabet is therefore virtually a fourfold one. The names, order, and value of these letters are as follows, it being noted that the right-hand column gives the nationality of the words in which the several letters are used.

| Order. | Name. | Value. | In Turkish, Arabic, or Persian words. |
|---|---|---|---|
| 1 | élif | a e *i ü u* | t. a. p. |
| 2 | bé | b | t. a. p. |
| 3 | pé | p | t. –. p. |
| 4 | té | t | t. a. p. |
| 5 | sé (té) | s (Gr. $\theta$) Eng. th | –. a. –. |
| 6 | jim | Eng. j | t. a. p. |
| 7 | chim | Eng. ch (church) | t. –. p. |
| 8 | ha | h (aspirated) | –. a. –. |
| 9 | khĭ | German ch | t. a. p. |
| 10 | dal | d | t. a. p. |
| 11 | zel (zal) | z | –. a. –. |
| 12 | rĭ (ra) | r | t. a. p. |
| 13 | zé (za) | z | t. a. p. |
| 14 | zhé | French j | –. –. p. |
| 15 | sin | s | t. a. p. |
| 16 | shin | sh | t. a. p. |
| 17 | sad | sharp s | t. a. p. |
| 18 | dad | z dh | –. a. –. |
| 19 | tĭ (ta) | d t | t. a. p. |
| 20 | zi (za) | hard z | –. a. –. |
| 21 | ayn | no equivalent (breathing) | –. a. –. |
| 22 | ghayn | hard g = gh | t. a. p. |
| 23 | fé | f | t. a. p. |
| 24 | kâf | palatal k | t. a. p. |
| 25 | kef (kyef) | k g n | t. a. p. |
| 26 | gyef-i 'adjemi | y | t. –. p. |
| 27 | saghyr noon | ñ (ng) | t. –. –. |
| 28 | lam | l | t. a. p. |
| 29 | mim | m | t. a. p. |
| 30 | noon | n | t. a. p. |
| 31 | vav | v w | t. a. p. |
| 32 | hé | h (t) | t. a. p. |
| 33 | yé | y | t. a. p. |
| 34 | lam-élif | la | t. a. p. |

All of these letters are consonants, though élif, vav, hé, and yé are sometimes used as vowels. The vowels are indicated by seven vowel-signs or diacritical marks, which need not be explained here; these signs, however, are rarely employed, except in the case of a rare or foreign word. This fact adds immensely to the difficulty of learning to read Turkish. In fact, one can not read with ease until one knows and speaks the language. Turkish writing is therefore a kind of stenography. The Turks write from right to left, so that what with us is the end of a volume is with them the beginning. The numerals alone are written from left to right. They have no capital letters and make but little use of punctuation. The accent is usually on the last syllable of a word.

The Turkish language is in some respects the most remarkable of known tongues. It is conspicuous for the pronounced agglutinative character of its grammatical forms, for its law of vowel harmony, for the absolute regularity of its one declension and one conjugation, and for the extreme simplicity and transparency of its syntactical construction. Max Müller has said that "if a college of the most distinguished scholars had met for the purpose of constructing a language, nothing more regular or symmetrical could have come from their hands than we have here in this living tongue"; and again, "but no such society could have devised what the mind of man produced, left to itself in the steppes of Tartary, and guided only by its innate laws, or by an instinctive power as wonderful as any within the realm of nature."

Turkish illustrates most wonderfully the agglutinative stage of language. Under *agglutination* is meant the simple appending of fixed particles to a fixed root in order to modify in various ways the meaning of the root. Primitive languages made free use of agglutination, as may still be seen in Sanskrit, Greek, and Latin. The familiar *-mi*, *-si*, *-ti*, in

| Sanskrit, | Greek, | Latin, |
|---|---|---|
| *as-mi* | *ἐσ-μί (ἐμ-μί)* | *es-um* |
| *asi* | *ἐσ-σί* | *es* |
| *as-ti* | *ἐσ-τί* | *es-t* |

are illustrations of it. In modern languages, however, the tendency has been to reject agglutination and to obscure its particles or suffixes. Only the initiated can trace it, say, in English (slay*eth*, kill*ed*), which is as conspicuous for the neglect of agglutination as Turkish is for its employment. To illustrate agglutination in Turkish, take the fixed particles *lar*, *yñ*, *dan*, which are the signs for the plural, for the possessive pronoun of the second person singular, and for the ablative case. Now take the word *at*, which means *horse*, append thereto these agglutinative particles in the order given above, and there results a word *at-lar-yñ-dan* (*atlaryñdan* = from thy horses). In what follows illustrations of agglutination will abound. These agglutinative particles are called *post*positions in contradistinction from *pre*positions. The Turkish makes no use of any kind of *pre*position.

The second instance cited above to show the remarkable character of Turkish is the law of vowel harmony. In all the languages of the Turkic class the root is never obscured, but remains virtually unalterable, no matter what or how many syllables (postpositions) are added to the end of the root to modify its meaning. The vowels of such modifying syllables are not fixed, but are regulated by a law of euphony, which requires the vowels of the postpositions to harmonize with the vowel immediately preceding the postposition. That is, if the root vowel be hard (a, o, u, y) or soft (e, i, ö, ü), the vowel of the postposition must be hard or soft to correspond therewith. Thus, for instance, the ending of the genitive singular may be either (1) *-yñ*, (2) *-uñ*, (3) *-iñ*, (4) *-üñ*, according as the end vowel of the word is (1) *a* or *y*, (2) *o* or *u*, (3) *e* or *i*, (4) *ö* or *ü*. In like manner the ending of the aor. act. 1st pers. sing. may be (1) *-dym*, (2) *-dum*, (3) *-dim*, (4) *-düm*, according as the end syllable of the verb-stem be (1) *a* or *y*, (2) *o* or *u*, (3) *e* or *i*, (4) *ö* or *ü*. Let the following serve as illustrations of the law of vowel harmony:

(1) *at*, horse.
*at-yñ*, of the horse.
*bak* = see, *bak-dym*, I saw.
(2) *dost*, friend.
*dost-uñ*, of the friend.
*boz* = spoil, *boz-dum*, I spoiled.
(3) *ev*, house.
*ev-iñ*, of the house.
*gel* = come, *gel-dim*, I came.
(4) *göz*, eye.
*göz-üñ*, of the eye.
*büz* = draw together, *büz-düm*, I drew together.

In a similar manner a number of postpositions have either the vowels *a* or *e* according as hard or soft vowels precede. Thus the ablative plural of (1) is *at-lar-dan*, but of (3) is *ev-ler-den*, while the negative of (1) is *bak-ma-dym* (I did not see), but of (3) is *gel-me-dim* (I did not come).

There is no definite article in Turkish, and no gender other than natural gender. Strictly speaking, there is no declension of the noun, the case-endings being really agglutinative suffixes or postpositions, which are appended to the unchanged stem (which is seen in the nominative and vocative cases), and thus form what we are accustomed to call the genitive, dative, locative, accusative, and ablative cases.

There is but one such declension, and one noun is here inflected, but as the vowels of the postpositions vary according to the law of vowel harmony, eight different nouns would have to be inflected to illustrate the declension fully.

*Sing.*

| | |
|---|---|
| Nom. | *Adam*, the man. |
| Gen. | *Adam-yñ*, of the man. |
| Dat. | *Adam-a*, to the man. |
| Loc. | *Adam-da*, at (by) the man. |
| Acc. | *Adam-y*, the man. |
| Abl. | *Adam-dan*, from the man. |
| Voc. | *Adam*, man. |

*Plur.*

| | |
|---|---|
| Nom. | *Adam-lar*, the men. |
| Gen. | *Adam-lar-yñ*, of the men. |
| Dat. | *Adam-lar-a*, to the men. |
| Loc. | *Adam-lar-da*, at (by) the men. |
| Acc. | *Adam-lar-y*, the men. |
| Abl. | *Adam-lar-dan*, from the men. |
| Voc. | *Adam-lar*, men. |

As in English, the adjective is indeclinable and stands before its noun. So *böyük bagh*, the large garden; *böyük baghyñ*, of the large garden; *böyük baghlar*, the large gardens; *böyük baghlardan*, from the large gardens. As in German, French, Italian, etc., the numeral *one* (*bir*) is used for the indefinite article, as *bir kara tash*, a black stone. The comparative and superlative are formed by placing *daha* and *en* respectively before the positive, as

| | | |
|---|---|---|
| *kütchük*, | *daha kütchük*, | *en kütchük*. |
| small, | smaller, | smallest. |

But when two things are compared the simple ablative case with the positive of the adjective expresses the comparison, as *at eshekden eyi dir*, a horse is better than a donkey. A superlative peculiar to Turkish is in common use, viz., if the adjective begins with a consonant, then the first two letters of the adjective plus some consonant serve to make a superlative prefix, as *kuru*, dry: *kup kuru*, very dry; *yash*, wet: *yam yash*, very wet; *bosh*, empty: *bom bosh*, quite empty; *mavi*, blue: *mas mavi*, very blue; *sary*, yellow: *sap sary*, quite yellow.

The verb, however, is the chief glory of Turkish; it is the most complete and most transparent in existence. Here, too, law reigns supreme, so that after one has mastered a complete conjugation, no further difficulties are encountered, as there are no irregularities or exceptions. The root is always seen in the second person singular of the imperative, and it remains unchanged throughout, except that final *t* or *k* is changed under certain circumstances to *d* or *gh*. But that, too, is law. The verb not only has moods and tenses sufficient for expressing every shade of doubt, conjecture, hope, and supposition, but new verbal roots are created by adding to the original verb-stem certain postpositions which modify the original meaning of the verb-stem and create other moods that are inflected regularly. In this way a negative, a reflexive, a reciprocal, an interrogative, a causal, a necessitative, an impossible, and a conditional mood are created.

Mere description can give no idea of the glory of the Turkish verb. Max Müller gives a list of thirty-six present infinitives (to which belong just as many imperatives), but a still more astonishing list of present tenses might be furnished. In the verb *atmak*, to throw, for instance, there is a positive present in both the active and the passive voices (*at-arym*, I throw, *at-yl-yrym*, I am thrown); a negative present in both voices (*at-ma-m*, I do not throw, *at-yl-ma-m*, I am not thrown); an impossible present (*at-ama-m*, I can not throw, *at-yl-ama-m*, I can not be thrown), and so on through a positive, a negative, and an impossible reciprocal present: a positive, a negative, and an impossible reflexive present; a positive, a negative, and an impossible causative present; a positive, a negative, and an impossible reciprocal causative present; a positive, a negative, and an impossible reflexive causative present, etc., with a reciprocal interrogative, a reflexive interrogative, an interrogative causative, a conditional, a necessitative, an optative, and a dubitative present, each with its positive, negative, impossible, reflexive, reciprocal, causative, and other forms in both moods to the number of over 300. The same refinement runs through the other tenses, the aoristic imperfect, past habitual, pluperfect, future, and past future in most of the moods. Space utterly forbids anything like even a synopsis of the present tenses.

For a discussion of the various dialects belonging to the Turkic class of languages, see Max Müller, *Lectures on the Science of Language* (London, 1875). For a good short account of Turkish literature, see Lane-Poole, *The Story of Turkey*. For a more extended study of Turkish literature, see Redhouse, *History, System, and Varieties of Turkish Poetry* (Leipzig, 1879), and von Hammer-Purgstall, *Geschichte der Osmanischen Dichtkunst* (4 vols., Pesth, 1836–38). The chief grammars of Turkish in English are by Wells, *A Practical Grammar of the Turkish Language* (London, 1880); Redhouse, *A Simplified Grammar of the Turkish Language* (London, 1884); Tarring, *A Practical Elementary Turkish Grammar* (London, 1886). The best dictionary is still Redhouse's *Turkish and English Dictionary* (London, 1884–87).

J. R. S. Sterrett.

**Turkistan**: See Turkestan.

**Tur'komans**: certain tribes of Turkish tongue scattered through Transcaspia, Turkestan, Persia, Khorassan, Western China, and Turkey in Asia. Their language is very similar to Osmanli Turkish, but physically they are much modified by Iranian intermixture. They are all zealous Sunnite Mohammedans, and are pastoral and nomadic.

**Turks**: in the broad sense, a race with definite and well-marked ethnic and linguistic characters which has played an important part in the history of Central Asia and Eastern Europe, and is now found scattered over a territory stretching from Yakutsk to Northern India and westward to the Mediterranean and Lithuania. It occupies but a part of this great territory, has extensively intermingled with Aryan and Mongol races, and comprises many different tribes divided into three general groups. The first or Oriental comprises the Yakuts, the Tartars of the Altai and of other parts of Siberia, and the Turks of China, otherwise called Daldes, Taranchi, Kashgarians, etc. The central group comprises the Kirghiz, the Uzbegs, the Tartars of Astrakhan, Lithuania, and the Crimea, and the Bashkirs with their Turko-Finnish mixtures. The western group includes the Turkomans, the Tartars of the Caucasus, the Tauridians of the Black Sea littoral, certain Turco-Iranians of Persia, and the Osmanli Turks, generally called Turks *par excellence*, though perhaps the most distant from the pure Turkish characters by extensive Aryan intermixture. The purest types are believed to be in the Crimea and among the Turkomans of Khiva. Some of the tribes, like the Jats of

India, have lost their language though preserving other characters. More than twenty dialects are known which fall into groups corresponding fairly with the grouping of races already mentioned. The most of the Turkish races are Mohammedan and employ the Arabic alphabet, with some modifications; a few formerly used the Sogdianian or Syrian, and some now the Russian, Greek, or Armenian. They were originally nomads, are generally courageous and warlike, haters of tillage, and eaters of flesh. See Vambéry's works, especially his *Das Türkenvolk* (1885), which is a complete monograph. MARK W. HARRINGTON.

**Turks Islands**: a group of small islands (Grand Turk, Salt Cay, and some uninhabited islets); physically, the south-easternmost of the Bahama group, but politically, with the neighboring Caicos islands, attached to the British colony of Jamaica. All are low, and Grand Turk, the largest, is only 7 miles long by 1½ miles wide. Several lagoons furnish an excellent quality of salt, and about 1,500,000 bush. are annually exported to the U. S. and British America. Total population of the Turks and Caicos islands (1891), 4,745, nearly all engaged in the salt industry. H. H. S.

**Turlupins**: See BRETHREN AND SISTERS OF THE FREE SPIRIT.

**Tur'meric**: the root of *Curcuma longa* (family *Zingiberaceæ*), a native of the East Indies and Cochin-China. It contains a volatile oil, a yellow coloring-matter (*curcumin*), starch, cellulose, gum, and a brownish dye. The root of *Canna speciosa*, a plant occurring in West Africa, also possesses the same physical and chemical properties. Turmeric is used in the dyeing of silk and wool, and is employed in pharmacy for coloring ointments, etc. The tincture of turmeric, or unsized paper stained with the aqueous or alcoholic solution (turmeric paper), is used in chemical operations as a test for the alkalies and for boric acid, which impart a reddish-brown color to the paper.

**Turnbull**, ROBERT, D. D.: clergyman and author: b. at Whiteburn, Scotland, Sept. 10, 1809; graduated at Glasgow University; was for some years a Baptist preacher in England and Scotland; in 1833 removed to the U. S., preaching at Danbury, Conn., 1833, at Detroit, Mich., 1835, at Hartford, Conn., 1837, at Boston, Mass., 1839; from 1845 to 1869 was pastor at the First Baptist church at Hartford, subsequently preached in several places, and was secretary of the Connecticut Baptist State convention; author of *Olympia Morata* (1842); *The Genius of Scotland* (New York, 1847); *The Genius of Italy* (1849); *Pulpit Orators of France and Switzerland* (1848); *Theophany, or the Manifestation of God in Christ* (Hartford, 1851): *Christ in History, or the Central Power* (Boston, 1856); and *Life Pictures* (New York, 1857); translated Vinet's *Vital Christianity* (1846); edited Sir William Hamilton's *Discussions on Philosophy and Literature* (New York, 1855); and for two years was joint editor of the *Christian Review*. D. at Hartford, Conn., Nov. 20, 1877.

**Turnbull**, ROBERT JAMES: political writer; b. at New Smyrna, Fla., in Jan., 1775, son of an English physician who married a Greek lady of Smyrna, and obtained, in connection with Lord Hillsborough, a grant from the British Government in 1772 for settling a Greek colony in Florida, but forfeited his rights by adhesion to the Revolutionary cause, and settled at Charleston, S. C. Robert was educated in England, studied law in Charleston and Philadelphia, and practiced at Charleston until 1810, when he devoted himself to the care of his residence on his large plantation; became a leader of the nullification party; was prominent in the free-trade conventions at Columbia and Charleston 1831, 1832, and at the South Carolina nullification convention of Nov., 1832, which adopted from his pen an address to the people. D. in Charleston, June 15, 1833. A fine monument was erected to his memory by his political associates. Author of *A Visit to the Philadelphia Prison* (London, 1797; trans. Paris, 1800) and *The Tribunal of Dernier Ressort* (1830); wrote much on politics for the Charleston *Mercury* 1827, and a collection of his articles from that paper, republished under the title of *The Crisis*, became the text-book of the nullification party.

**Turnbull**, WILLIAM: civil engineer; b. in Philadelphia, Pa., Oct. 9, 1800; graduated at the U. S. Military Academy July, 1819, when commissioned second lieutenant of artillery, but served on topographical duty until 1831, in which year he was transferred to the corps of topographical engineers with rank of captain; major 1838; was chief topographical engineer in construction of the Potomac aqueduct 1832–43. This work, the piers of which are founded by coffer-dams on rock (covered by sometimes 20 feet of mud), from 30 to 40 feet below the water-surface, was one of the earliest of important works of American engineering—the earliest of its type. He was in charge of improvement of lake harbors 1844–46. In the war with Mexico he served as chief topographical engineer of Gen. Scott's army, from Vera Cruz to the city of Mexico, gaining the brevet of lieutenant-colonel for gallantry at Contreras and Churubusco, and colonel for Chapultepec. In 1848–49 he superintended the construction of the New Orleans custom-house; engaged in the study of the question of bridging the Susquehanna at Havre de Grâce, and of the expediency of an additional canal around the Falls of the Ohio 1852; on lighthouse duty and in charge of the improvement of Cape Fear river, North Carolina, at the time of his death, at Wilmington, N. C., Dec. 9, 1857.—His son, CHARLES NESBIT, b. in Washington, D. C., Aug. 14, 1832, graduated at the U. S. Military Academy in 1854, and attained a captaincy in the corps of topographical engineers in 1862; was chief engineer of Gen. Sheridan's cavalry corps; also of the Eighth Army-corps; breveted colonel; resigned Dec. 31, 1865, and engaged in business in Boston, where he died Dec. 2, 1874.

**Turnbull**, WILLIAM BARCLAY: antiquarian; b. in Edinburgh, Scotland, in 1811; was called to the bar of Scotland 1832, to that of England 1856; was for several years secretary to the Scottish Society of Antiquaries; founded the Abbotsford Club 1833; was its secretary until 1841; edited for it many old MSS. and reprints of rare early publications, and was appointed, although a Roman Catholic, by Sir John Romilly in 1859 calenderer of the foreign correspondence at the state paper office, which post he resigned in 1861 in consequence of dissatisfaction with his method of presenting the religious transactions of the reigns of Edward VI. and Mary in the *Calendar* issued in February of that year. Among his other publications were *Legendæ Catholicæ* (1840); Audin's *Life of Luther* (2 vols. 8vo, 1854); *The Poetical Works of Rev. Robert Southwell* (1856); *The Poetical Works of William Drummond of Hawthornden* (1856); and *The Complete Works of Rev. Richard Crashaw* (1858); *An Account of the Monastic Treasures confiscated at the Dissolution of the Various Houses in England* (1836); *The Miscellany of the Abbotsford Club* (1837); and *The Chronicles of Scotland* (3 vols., 1857–58), the latter forming part of the Rolls Series. D. Apr. 22, 1863.

**Turnbull's Blue** (*Ferrous ferricyanide*): a kind of Prussian blue, which when dry is of a blue color with a reddish luster. It is precipitated when potassium ferricyanide is added to a solution of a ferrous salt; formula, $Fe_5(CN)_{12} + xH_2O$.

**Turnèbe**, tür'nāb', ADRIEN (*Turnebus*): classical scholar; b. at Andelys, in Normandy, France, in 1512; called to the chair of Greek in the University of Paris in 1547, where Scaliger was for a short time one of his pupils; director of the royal printing establishment 1552–56. D. June 12, 1565. Turnèbe is one of the greatest of French Hellenists, distinguished alike for his erudition and his critical genius. He printed the *editio princeps* of Philo, Synesius, Demetrius Triclinius's scholia to Sophocles with a valuable preface; edited Æschylus, Aristotle's *Ethics*, Cicero's *De legibus*; wrote commentaries to Varro's *De Lingua Latina*, and to Horace; and published admirable translations of Arrian, Oppian, Theophrastus, and of several treatises of Plutarch. See his *Opera* (3 vols. fol., 1600). Most of his critical emendations, covering a wide field of classical authors, are collected in his justly famous *Adversaria*, thirty books. A. G.

**Turner** (now **West Chicago**): village; Du Page co., Ill.; on the Burlington Route, the Chi. and N. W., and the Elgin, Jol. and East. railways; 30 miles W. of Chicago (for location, see map of Illinois, ref. 2–F). It is a manufacturing place, with rolling-mills, railway, machine, and carpenter shops, sash, door, and blind factories, creamery, pump-factory, office-furniture factory; and has 5 churches, 2 public-school buildings, a private bank, electric lights, and a monthly and 2 weekly periodicals. Pop. (1880) 1,001; (1890) 1,506; (1900) 1,877.

**Turner**, CHARLES TENNYSON: poet; b. at Somersby, Lincolnshire, July 4, 1808; third son of Dr. George Clayton Tennyson; educated at Louth Grammar School and Trinity College, Cambridge (1828–32), where he did admirable work in the classics, obtaining a Bell scholarship; became vicar of Grasby (Oct., 1835), where he passed the greater part of his life, beloved as pastor and highly esteemed for his good works; married (May 24, 1836) Louisa Sellwood, youngest sister of Lady Tennyson; assumed by royal license the name of Turner (1835), having inherited the Grasby living and Caistor house of his great-uncle, Rev. Samuel Turner. Besides *Poems by Two Brothers* (1827), which contained the juvenile verses of Charles and Alfred Tennyson, his works are *Sonnets and Fugitive Pieces* (1830); *Sonnets* (1864); *Small Tableaux* (1868); *Sonnets, Lyrics, and Translations* (1873); *Collected Sonnets, Old and New* (1880). D. at Cheltenham, Apr. 25, 1879. EUGENE PARSONS.

**Turner**, CHARLES YARDLEY: genre and landscape painter; b. in Baltimore, Md., Nov. 25, 1850; pupil of the National Academy and of the Art Students' League in New York, and of Jean Paul Laurens, Munkacsy, and Bonnat in Paris; National Academician 1886; second Hallgarten prize, National Academy, 1884; honorable mention, Paris Exposition, 1889; member of the American Water-color Society. Studio in New York. W. A. C.

**Turner**, JOSEPH MALLORD WILLIAM: landscape-painter; b. in London, Apr. 23, 1775. He was the son of a hairdresser, and entered the schools of the Royal Academy in 1789; studied perspective with Thomas Malton, and architectural drawing with Girtin, and drew from nature in pencil and water-color. He was elected a Royal Academician in 1802, and soon afterward traveled in France, Italy, and Switzerland. In 1807 he began his *Liber Studiorum*; in 1819 visited Italy, to which country he returned in 1829 and 1840. He had a most successful artistic career, and received many honors. D. at Chelsea, London, Dec. 19, 1851. He left his pictures to the nation, the National Gallery in London thus acquiring over a hundred finished works. His work was enthusiastically championed by John Ruskin, who wrote eloquently about his methods and his faithful study of nature, and exalted him at the expense of Claude Lorraine, who was considered the greatest of all landscape-painters at the time when Turner began to be known. Ruskin's criticism, while sincere and earnest, is pernicious in its effects, and has had much to do with preventing the development of an intelligent appreciation of art in England. Turner was undoubtedly a man of great talent and singularly gifted as a colorist, his chief claim to rank high as an artist depending indeed on the fine color quality of many of his works, much more than upon any real truth to nature. In his later work he paid little attention to form, and occupied himself almost entirely in working out elaborate color schemes, for which almost any subject served his purpose.

In the National Gallery, in London, in Room VI., are a large number of oil-paintings by Turner, most of them coming from his bequest to the nation. Among these are *Calais Pier* (1803); *The Garden of the Hesperides* (1806); *Crossing the Brook* (1813); *Apuleia in Search of Apuleius* (1814); *Rome from the Vatican* (1819); *The Bay of Baiæ*, called also *Apollo and the Sibyl* (1822); *Dido building the Fleet* (1828); *Ulysses deriding Polyphemus* (1830); *The Fighting Téméraire* (1839); *Bacchus and Ariadne* (1840); *The Burial of Wilkie at Sea* (1842). In Room IV. are the two pictures, *Snow Storm, Steamer Signalling* (1842), and *Rain, Steam, and Speed on the Great Western Railway*, of about the same epoch, together with a number of water-color drawings, some of great importance. In Room III. are several large pictures, including two celebrated ones of *Venice* and *Lake Avernus*. In Room IX. are *The Sun rising in a Mist* and *Dido building Carthage*, which two pictures Turner left to the nation with the express proviso that they should be hung beside the two large pictures by Claude Lorraine, *Landscape with Figures* and *The Embarkation of the Queen of Sheba*. In the basement of the building is a very large collection of drawings, all framed and arranged like books upon shelves. Some of these are of great value.

Many of Turner's most important works are in private hands, generally in Great Britain, and a few are in the South Kensington Museum. In New York, the *Scene on the French Coast* (1831) and *Staffa* (1832) are in the Lenox Library; *Norham Castle* and the *Fountain of Indolence* are in the collection of Mrs. W. H. Vanderbilt; and the *Slave Ship* is owned by Thornton Lathrop, Boston.

Turner produced some remarkable engravings, the chief of which are the set known as *Liber Studiorum*. Eighty or more plates were prepared for this publication, of which seventy-one were published. Their general character is that of an etching in line, very carefully and skillfully made, as the framework of the composition, the plate being then mezzotinted; but some few of the plates were engraved in different ways. Five or six pure mezzotints of great beauty also exist. Engravings after Turner's pictures and water-color drawings were made in great numbers, on a large and also on a very small scale. Among the important series of prints may be named the *England and Wales*, the *Yorkshire Series*, the *Harbours of England*, and the illustrations to Rogers's *Italy* (1830) and *Poems* (1834). See the *Lives* by Thornbury (1862), Hamerton (1878), and Monkhouse (1879).
WILLIAM A. COFFIN.

**Turner**, SAMUEL HULBEART, D. D.: clergyman and author; b. in Philadelphia, Pa., Jan. 23, 1790; graduated at the University of Pennsylvania 1807; was ordained deacon in the Protestant Episcopal Church 1811, and priest in 1814; was pastor of a church at Chestertown, Md., 1812–17; was elected Professor of Historic Theology in the General Episcopal Seminary, New York, Oct. 8, 1818; removed with that institution to New Haven, Conn., 1820, and returned with it in 1821 to New York, where it was combined with the New York Diocesan Seminary under the title of the General Theological Seminary, in which he was Professor of Biblical Learning and Interpretation of Scripture from Dec. 19, 1821, to his death, and also Professor of the Hebrew Language and Literature in Columbia College from 1831. He was the author of *Notes on the Epistle to the Romans* (New York, 1824); *Companion to the Book of Genesis* (1841); *Biographical Notices of Distinguished Jewish Rabbis* (1847); *Parallel References Illustrative of the New Testament* (1848); *Essay on our Lord's Discourse at Capernaum* (1851); *Thoughts on the Origin, Character, and Interpretation of Scripture Prophecy* (1852); *Teachings of the Master* (1858); *Spiritual Things compared with Spiritual* (1859); *The Gospels according to the Ammonian Sections and the Tables of Eusebius* (1861); an *Autobiography* (1862); and several volumes of sermons. He translated Jahn's *Introduction to the Old Testament* (1827), in which he was aided by Dr. W. R. Whittingham, and Planck's *Introduction to Sacred Philology and Interpretation* (1834); edited in Greek and English, with analytical and exegetical commentaries, the Epistles to the Hebrews (1852), to the Romans (1853), and to the Ephesians (1856). D. in New York, Dec. 21, 1861.
Revised by S. M. JACKSON.

**Turner**, SHARON: historian; b. in London, England, Sept. 24, 1768; became a successful attorney in London, but retired from the practice of his profession in 1829, and devoted the remainder of his life to literary pursuits, receiving a pension of £300 from the crown. D. in London, Feb. 13, 1847. The most valuable of his writings was the *History of the Anglo-Saxons* (4 vols., 1799–1805: 7th ed., 3 vols., 1853), which was long the standard authority. Besides other works in verse and prose, he also wrote *A History of England from the Norman Conquest to the Death of Elizabeth* (1814–23) and *The Sacred History of the World* (3 vols., 1832; 8th ed. 1848).

**Turner**, WILLIAM, M. D.: physician, clergyman, and naturalist; b. at Morpeth, Northumberland, England, about 1515; educated at Pembroke Hall, Cambridge, where he obtained a fellowship about 1531; studied medicine, botany, and theology; took orders in the Church of England; was imprisoned for preaching the doctrines of the Reformation; proceeded on his release to the Continent, and studied natural history at Zurich and Bologna; returned to England on the accession of Edward VI.; became physician to the Protector Somerset; prebendary of York 1550, dean of Wells 1550, and canon of Windsor; resided in Germany during the reign of Mary; was twice deprived of his deanery, and twice restored, 1553 and 1560, and at one time had a seat in Parliament. He was the author of *The Huntyng and Fyndyng out of the Romish Fox, by Witt. Wraughton* (Basel, 1543); *Avium præcipuarum, quarum apud Plinium et Aristotelem mentio fit, Historia* (Cologne, 1544); *The Rescuynge of the Romish Fox, etc., by Wuittyam Wraghton* (Winchester, 1545); *The New Herball* (book i., London, 1551; i. and ii., Cologne, 1562; i., ii., and iii., 1568), the first scientific work on botany by an English writer. He published a collation of the English Bible with the Hebrew, Latin, and Greek, and wrote the account of British fishes in his friend Johann Gesner's *Historia Animalium*. D. in London, July 7, 1568. Revised by S. M. JACKSON.

**Turner**, Sir WILLIAM, F. R. C. S., D. Sc., LL. D., D. C. L., F. R. S.: anatomist and naturalist; b. in Lancaster, England, in 1832; studied medicine in St. Bartholomew's Hospital, London, graduating M. B. in 1857; became a member of the Royal College of Surgeons, England, in 1853, and a fellow in 1893; was prosector in anatomy in the University of Edinburgh in 1854; and was elected Professor of Anatomy in that body in 1867. He has been coeditor of the *Journal of Anatomy and Physiology* 1866–94. Among his more important works are *An Introduction to Human Anatomy* (Edinburgh, 1875); *Lectures on the Comparative Anatomy of the Placenta* (Edinburgh, 1876); and *Atlas of Human Anatomy and Physiology*. S. T. ARMSTRONG.

**Turner,** WILLIAM WADDEN: philologist; b. in London, Oct. 23, 1810; removed to the U. S. 1818; was apprenticed to a printer in New York 1829; became distinguished for his attainments in modern and Oriental languages; was successively librarian to the University of New York and instructor in Hebrew in Union Theological Seminary 1842–52; assisted Dr. Isaac Nordheimer in the preparation of his Hebrew manuals; contributed to Bartlett's *Dictionary of Americanisms* (1848); translated von Raumer's *America and the Americans* (New York, 1845), and the greater part of Freund's *Latin-German Lexicon* for Prof. E. A. Andrews; superintended the publication of Dr. Stephen R. Rigg's *Dakota Grammar and Dictionary*, and other linguistic works issued by the Smithsonian Institution; contributed to Ludewig's *Literature of American Aboriginal Languages* (1858), to the *Transactions* of the American Ethnological and Oriental societies, *Iconographic Encyclopædia*, the *Bibliotheca Sacra*, and other periodicals. He was for several years recording secretary of the National Institute for the Promotion of Science, and librarian of the U. S. patent office from 1852 to his death, in Washington, D. C., Nov. 29, 1859.

**Turner's Falls**: village; Montague town, Franklin co., Mass.; on the Connecticut river, and the N. Y., N. H. and Hart. and the Fitchburg railways; 3 miles N. E. of Greenfield, the county-seat (for location, see map of Massachusetts, ref. 1–E). A canal 3 miles long here cuts off a long bend in the river, and three falls provide an enormous water-power, which is utilized by extensive manufactories. The village has a public library, a national bank with capital of $200,000, a savings-bank, a weekly and a monthly periodical, one of the largest cutlery-works in the world, 3 paper-mills, cotton-factory, foundry and machine-shops, and leather-factory. Pop. (1890) of town, 6,296; (1900) of town, 6,150.
EDITOR OF "REPORTER."

**Turnhout**, toorn'howt: town; province of Antwerp, Belgium; 25 miles E. of the city of Antwerp (see map of Holland and Belgium, ref. 8–F). It has large paper-mills, tanneries, dye-houses, and manufactures of cotton, flax, hemp, and lace. It was formerly a strong fortress, and in 1597 Maurice of Nassau, supported by a corps of English troops, engaged the Spaniards here, routed them, and captured the fortress. Pop. (1891) 18,747.

**Turning**: See LATHE.

**Turnip** [M. Eng. *turnep*; (perhaps) *turn*, implying something round + *nepe*, turnip < O. Eng. *nǣpe*, from Lat. *nāpus*, a kind of turnip]: a biennial plant, abundant throughout the temperate zone, having a swollen fleshy root of great value as food both for man and more especially for cattle. It is of the same genus (*Brassica*) as mustard, and of the species *B. rapa*. It is found growing wild as a weed in Europe and Northern Asia, and is largely cultivated both as a field and as a garden crop, sometimes reaching 20 or 25 lb. Turnips, when grown in gardens, may be sown early; when raised in the field, they are sown much later, and thrive best in moist cloudy weather. Though turnip-culture is of comparatively recent origin in Great Britain, it has already taken rank there as a most important field-crop, being fed to sheep in the fields, inclosed within hurdles or movable fences. Though an agreeable article of diet for man, it has never assumed great importance in that respect, owing to the enormous proportion of water, 87 to 92 per cent., in its composition. The ruta-baga or Swedish turnip is closely allied to it, but is held by some botanists to be specifically distinct, *B. campestris*. Revised by L. H. BAILEY.

**Turnip-fly**: any one of several insects destructive to turnips. The most common is the small chrysomelian beetle called also turnip-flea (*Altica* or *Haltica nemorum*), from its prodigious leaping powers, a species having an oval body and wide head, long and strong hind legs, large black wings with two yellowish stripes, and claws notched and hooked to enable it to keep firm hold of the cruciferous vegetables which constitute its food. It eats the leaves of the turnip as soon as they appear above ground in the spring, and lays its eggs on the under side of the leaves later in the season. The larvæ thus bred upon the plant are often extremely destructive to the turnip-root, in which they burrow. Other species are the *H. striolata*, or wavy-striped flea-beetle of the U. S.; the *Pontia oleracea*, potherb or white butterfly; and the *Anthyomia radicum*, a dipterous insect of the family *Muscidæ*, of the same genus as the cabbage-fly and the beet-fly, and especially abundant and noxious in Great Britain, where the latter is considered as the turnip-fly proper. Revised by F. A. LUCAS.

**Turnpike**, or **Turnpike Road**: a road, especially a highway, upon which turnpikes or toll-gates are established, and which are kept in repair by the tolls or fees collected from those who use the road.

In England the roads constituting the main lines of communication are, or formerly were for many years, chiefly turnpikes. Each parish, or township, or other particular district, is liable for the maintenance of all highways passing through its lands; but still many such roads are kept in repair, and were formerly built, under the authority of local acts of Parliament which vested their management for a certain number of years in trustees or commissioners who were empowered to erect toll-gates and levy tolls on those passing through as a means of raising a fund for defraying expenses of labor or improvement. The collection of such tolls, however, does not supersede other means for the maintenance of the roads. The turnpikes of England do not generally fall within the operation of the highway acts, and their construction and management are regulated primarily by the local acts relative to each particular trust, which (though temporary) were, until about the middle of the nineteenth century, continued by the legislature from time to time, as they were about to expire; and, secondly, are regulated by certain general acts, applicable (with very few exceptions) to all turnpike roads throughout the kingdom, that is, to all roads maintained by tolls and placed under the management of trustees or commissioners for a limited period of time. There were at one time in England many thousands of these turnpike trusts. In 1864 they numbered over 1,000, but in 1879 were reduced to a little over 200 by expiration of the trusts in accordance with the provisions of the Annual Turnpike Continuance Acts.

The first authorization in England for the erection of toll-gates was in 1346 under Edward III., and from that time the system spread throughout all England, Scotland, and Ireland, being regulated in each country by special laws. The first general turnpike act was that of 13 Geo. III., ch. 64, since which time numerous others have been passed, the effect of which has been to do away with turnpikes to a large extent, and place the roads and their maintenance under the charge of the county officers. The most important, as well as the earliest, of the general acts systematizing the turnpike laws now in force is that of 3 Geo. IV., ch. 126.

In Scotland there were formerly two main classes of roads, statute-labor roads and turnpike roads. The statute-labor roads were intended for local communication, and were maintained by personal services of tenants, cotters, etc., the services being later commutable to a money payment. Turnpike roads constituted the main lines of communication, and were maintained by tolls. These roads in Scotland, like those in England, were maintained by virtue of special acts, many of which were passed from time to time; but in 1878 an act was passed putting all the roads in each county under one system of management, abolishing statute labor, money commutation, and tolls, and substituting a rate upon land and heritages for the maintenance of the roads. This act was at first permissive, but became compulsory on June 1, 1883. Turnpike roads have also been abolished in Ireland.

England's various systems of maintaining roads were practically copied in her colonies. Thus in the U. S. many of the highroads for local communication in rural districts are maintained by the statute-labor system; in others they are maintained by some form of tax, usually a land tax. Where statute labor exists a provision is usually made for commutation into a money payment. Turnpike roads in the U. S. are constructed and maintained by corporations created either under general statutes or by special charters. The legislation of the several States upon this subject varies widely, but in general such corporations (which have practically the same general rights and duties as the commissioners or persons holding the turnpike trusts in England) stand in a position similar to railroad companies in regard to the exercise of the right of eminent domain, being considered so far public that they are authorized to take lands necessary for their own use, upon making adequate compensation to the owners thereof, and even to appropriate existing highways when necessary to carry into effect the rights and privileges granted by their charters. They are also given power to lay and collect tolls, and to erect gates to insure their payment, the rates of tolls, the distance between the gates, and various other details being frequently regulated by their charter. Owing to the importance of the franchise granted in bestowing a right to make and maintain a turnpike road, and the ease with which the rights of the parties concerned may be violated either by the turnpike company or the public, as the case may be, the rights and duties of the turnpike company and of the public are very strictly prescribed by the statutes or charters under which the turnpike companies or trusts are created. Turnpike roads are becoming less numerous, their construction and maintenance being assumed by, or imposed upon, municipal corporations.

Sometimes roads are constructed so that by taking a circuitous route a person traveling upon a turnpike may avoid passing through the toll-gates, and so avoid the payment of toll. These circuitous routes were called *shunpikes*, and they may be erected when public necessity demands it, but the laws are stringent against their being made with the intent and effect of depriving the turnpike company of its legal tolls.

In return for their franchises it is the duty of the turnpike companies to keep the road-bed and its appurtenances in good repair, and in such condition and manner as the statutes prescribe, at least so long as they do not surrender their charter by ceasing to demand payment of tolls. For a failure to comply with this requirement they may be held liable in an action for damages by a person injured through their negligence, and also to an action for such penalties or annullment of their charter as the law provides for. As concerns its use, a turnpike is in every respect a public highway, free to all, except that the legal toll must be paid as a condition of use; and the rules of law concerning the encroachment upon highways apply equally to turnpikes.

F. STURGES ALLEN.

**Turnsol**: another name for LITMUS (*q. v.*). See also ARCHIL.

**Turnspit**: a kind of dog, formerly employed for turning the spit upon which meat is roasted. The turnspit is a very intelligent dog, with a long body, short and often crooked legs, long and pendent ears, and a very large head. It has a dash of greyhound blood. Two or more dogs were kept, to relieve each other at the task, the dog standing in a kind of treadmill, his weight giving motion to the spit. The breed is apparently very old, as similar dogs are figured on the monuments of ancient Egypt.

**Turnstone** [so called from its habit of overturning stones in search of food]: the *Strepsilas interpres*, a wading bird of the family *Hæmatopodidæ*, allied to the plovers, and common on the shores of the U. S. and in nearly all parts of the world. On the Pacific coast is found *S. melanopus*, the black turnstone.

**Turpentine** [from O. Fr. *turbentine* < Lat. *terebin'thina*, *terbin'tina* (sc. *res'ina*, gum), turpentine, liter., fem. of *terebin'thinus*, of the terebinth or turpentine-tree, deriv. of *terebin'thus*. See TEREBINTH]: any one of certain vegetable oleo-resins which exude from coniferous trees, also the resin obtained from the *Pistacia terebinthus*. They are obtained by making an excavation, having a capacity of about 3 pints, in the trunk of the tree, in which the exuded juice accumulates, which is collected, washed with warm water, and purified by straining through straw filters. The several varieties of turpentine are viscid solutions of resin in a volatile oil. American turpentine is chiefly procured from the *Pinus palustris* and the *Pinus tæda*, the principal supply coming from North and South Carolina and Georgia. French and German turpentines greatly resemble the American in most of their properties. Venice turpentine, which is obtained from the *Tarax europæa*, is a ropy, slightly greenish liquid having a rather unpleasant odor and taste. Canada turpentine is produced from the *Abies balsamea* (see BALSAM, CANADA), growing in Canada and the northern part of Maine. The remaining varieties of turpentine are the Strassburg, the Hungarian, and the Chian, which differ somewhat in their properties, but are in most respects very similar compounds. The turpentines as a class form yellowish viscid liquids, possessing a strong aromatic odor, and a bitter, pungent taste, and are very inflammable. They consist of a volatile oil (or oils) and *colophony* (*rosin*). Upon distilling the crude product with water the volatile oil is separated, a brittle residue of rosin remaining.

*Oil of turpentine* (*spirits of turpentine*) ($C_{10}H_{16}$) is obtained by the distillation of crude turpentine, the different varieties of the crude product yielding oils that differ from one another. They all form colorless, mobile liquids of a peculiar disagreeable odor, are insoluble in water, but dissolve in alcohol, in ether, and in carbon disulphide. The oils of turpentine are solvents of many resins and oils, of caoutchouc, and of iodine, sulphur, and phosphorus. The chief differences exhibited by the various varieties are in specific gravity, boiling-point, and optical rotatory power. The ordinary turpentine oil of commerce has a specific gravity of 0·864 and a boiling-point of 320° F. French oil of turpentine consists essentially of a hydrocarbon termed *terebenthene* ($C_{10}H_{16}$), of specific gravity ·8767 at zero centigrade, and boiling-point of 321° F. (*Riban*). *Australene* is an analogous hydrocarbon obtained from the American oil. The oils of turpentine on standing slowly absorb oxygen, a portion of which is converted into ozone. Chlorine, bromine, and iodine are dissolved by them, disengagement of heat and combustion often occurring. Under the influence of heat and of acids turpentine oils assume various isomeric states; when heated to 464° F., *isoterebenethene* and *metaterebenethene* are formed; by the action of sulphuric acid *terebene* and *colophene* are produced. Two other isomers, *camphilene* and *terebilene*, have been prepared by treating artificial camphor with quicklime. Artificial camphors are the results of the combination of hydrochloric acid with oil of turpentine, so far two hydrochlorates, $C_{10}H_{16}.HCl$ and $C_{10}H_{16}.2HCl$, having been obtained. The former, which is termed *hydrochlorate of camphene*, crystallizes in white prisms, which have an aromatic smell and taste greatly resembling that of ordinary camphor; the latter compound possesses the characteristic odor of the oil of thyme. (See THYME, OIL OF.) A numerous variety of seeds and fruits yield by distillation oils isomeric or polymeric with those of turpentine. These have received the generic name of *camphenes* or *terebenes*. Turpentine is sometimes applied externally in medicine in the shapes of salves and plasters; it is also taken internally in the form of pills. The oils of turpentine are extensively used in the preparation of varnishes, and to some extent in medicine as stimulants, diuretics, and anthelmintics. Revised by IRA REMSEN.

**Turpentine-tree**: See TEREBINTH.

**Turpeth**, or **Turbith** [*turpeth* is viâ O. Fr. from Pers.; *turbith* = Fr. from Pers. *turbid*, a cathartic; *turbad*, a purgative root]: a medicinal cathartic root (that of the *Ipomæa turpethum*) from India and Australia. Spirgatis found in it a substance he called *turpethine*, $C_{34}H_{56}O_{16}$, a yellowish resin which possessed purgative properties. It seems to be a glucoside.

**Turpeth-mineral**, also **Turbith-mineral**: an ancient name of what is now known as the basic sulphate of mercuric oxide, $Hg_3SO_6$. It is obtained by boiling with water the neutral mercuric sulphate, $HgSO_4$. It is a lemon-yellow powder, which is very slightly soluble in cold water. It was formerly used in medicine. Notwithstanding its name it is not a mineral substance, but is wholly artificial.

**Turpil'ius**, SEXTUS: a Roman comic poet contemporary with Terence, but outliving him by many years, dying at Sinuessa, 103 B. C. Like Terence he cultivated the *Fabula Palliata*, and six of the thirteen play-titles known to us agree with titles of Menander. In diction he falls far below the purity of Terence, to whom he is ranked next in merit in the canon of Volcatius Sedigitus. The *Fragments*, 215 verses, are given in Ribbeck's *Com. Rom. Frag.*, pp. 85–111. M. WARREN.

**Turpin**, Fr. pron. tür'păn', or **Tylpi'nus**: archbishop of Rheims (d. Sept. 2, 800); the reputed author of a Latin chronicle relating the campaigns of Charlemagne against the Saracens in Spain. The book was declared authentic by Pope Calixtus II. in 1122, translated into French in 1206, printed in 1566 in Frankfort, and edited by Ciampi (Florence, 1822) and Reiffenberg (Brussels, 1836). The first part of the book was evidently written simply in order to encourage pilgrimages to St. Jago di Compostella, and the rest bears the character of a romance written principally for the purpose of entertainment. Many interior features indicate that the work was produced in the twelfth century, perhaps by Pope Calixtus II. himself. See Ciampi, *De Vita Caroli Magni et Rolandi Historia. J. Turpino vulgo tributa* (Florence, 1822), and Gaston Paris, *De Pseudo-Turpino* (Paris, 1865). Revised by S. M. JACKSON.

**Turpin**, EDMUND HART: organist and composer; b. at Nottingham, England, May 4, 1835; studied entirely in London; in 1859 he became organist at St. George's, Bloomsbury; is honorary secretary of the College of Organists; and has edited the London *Musical Standard* since 1880. He has conducted various societies and orchestras, and has composed a large quantity of church music of excellent character, with two cantatas—*A Song of Faith* (1867) and *Jerusalem*—several masses, a *Stabat Mater*, and many songs and organ pieces. D. E. HERVEY.

**Turquoise**, or **Turquois** [from Fr. *turquoise*, Turkish (adjec. femini., turquoise, deriv. of *Turc*, Turk; named (as also *Turkey-stone*, as it was called in the sixteenth century) from Turkey, because derived from the East]: an aluminium hydrous phosphate, owing its blue color to a small amount of copper, always opaque and amorphous, and occurring in small seams in igneous and volcanic rocks. It has long been a favorite gem-stone from its peculiar delicate light-blue color; when greenish in tint it is much less prized. The principal localities for turquoise are at Nichapur, Persia, and in the Sinai Desert in Egypt. The stones from the latter are more liable to change color. Since 1890 very fine gems have been obtained in New Mexico, near Los Cerrillos, where extensive mines have been reopened that were worked by the ancient Mexicans. A single stone from these mines has been sold for $4,000, and the product is one of much commercial importance. Turquoise occasionally loses its color and turns greenish, especially when exposed to fatty acids, as in washing with soap water. A natural imitation, known as *bone turquoise* or *odontolite*, is fossil bone similarly colored by copper. It is easily distinguished by its microscopic structure. GEORGE F. KUNZ.

**Turretin**, Fr. pron. tür'tăn', or **Turreti'ni**, FRANÇOIS: theologian; b. at Geneva, Oct. 17, 1623; studied theology in his native city, in Holland, and in France under Spanheim, Morus, and Diodati; was appointed pastor at Geneva in 1647; removed to Leyden in 1650: returned to Geneva as Professor of Theology in 1653. Died there Sept. 28, 1687. His principal work is *Institutio Theologiæ Elencticæ* (Geneva, 1679–85; n. e. Edinburgh, 1847–48, 2 vols.), a standard treatise on the lines of the strictest Calvinism. His complete works were published in 4 vols., 1688. See his *Life* in Latin, by B. Pictet (Geneva, 1688).—His son, JEAN ALPHONSE TURRETIN, b. at Geneva, Aug. 13, 1671; studied theology; visited Holland, England, and France, and was appointed Professor of Ecclesiastical History in 1697 at Geneva, and of Systematic Theology in 1734. D. at Geneva, May 1, 1737. His complete works were published in 5 vols. in 1775, and contain *Pyrrhonismus Pontificius*, against Bossuet's *Histoire des Variations, Historia Ecclesiasticæ Compendium ad annum 1700, Cogitationes et Dissertationes Theologicæ* (2 vols., 1737), etc. In his theology he tried to mitigate and modify the severe Calvinism, and practically he exerted himself much in order to promote a union between the Lutheran and the Reformed Churches. It was mainly due to him that the rule requiring every German pastor to subscribe to the Helvetian *consensus* was withdrawn; and when Frederick I. of Prussia asked the opinion of the German ministry concerning the union, it was Turretin who drew up the answer which makes a happy distinction between fundamental and non-fundamental differences, reducing the differences between the two great Protestant churches to the latter kind. See his *A Discourse concerning the Fundamental Articles in Religion*, which appeared in an English translation (London, 1720). The work was attacked by the Jesuit François de Pierre (Lyons, 1728), who urged that the Reformed churches, with such an explanation, had no further reason for remaining outside the Roman Church. See E. de Budé, *François et Alphonse Turretini* (2 vols., Lausanne, 1880). Revised by S. M. JACKSON.

**Turrets** [M. Eng. *touret*, from O. Fr. *tourette*, dimin. of *tour*, tower < Lat. *tur'ris*, tower]: in military usage, towers of metal, often revolving, designed both to protect the guns and gunners contained in them, and to afford these a suitable position for offensive operations. Since the civil war in the U. S. they have become a recognized element in land and naval warfare. A patent was issued to Theodore R. Timby, of New York, in 1843, for "a revolving metallic tower, and for a revolving tower for a floating battery to be propelled by steam." This wholly original idea of a revolving battery found its earliest practical expression in the turrets of the monitors. (See MONITOR and SHIPS OF WAR.) For each of the monitors built by Ericsson and his associates the inventor received a royalty. The great military value of the revolving battery once fully demonstrated by the crucial test of war, it was soon adopted by other nations, not only for naval purposes, but also for defensive works on land. "Revolving turrets," observes a high English authority, "if of adequate strength, are the best of all methods of protecting ordnance for coast-defense. They combine the security given by shields with more than the lateral range afforded by the barbette system, and the ease with which they can be turned gives special facilities for firing at moving objects, or for screening the gun-ports from an enemy's fire while loading the guns. The gunners are fully protected."

The Gruson turret (see Fig. 1) has the ellipsoidal form

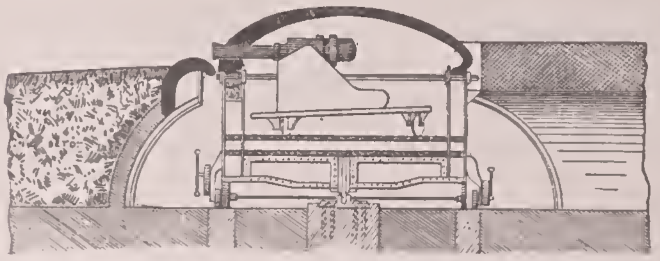

FIG. 1.—The Gruson, a modification of the Timby turret.

in order to deflect a shot striking it. The turret is cast of chilled iron in separate pieces, which when put together are mutually supporting. They are comparatively cheap. Germany, Russia, Holland, Italy, Austria, and Belgium have adopted this type of defensive works. A two-gun turret is generally considered as equivalent to an open battery of six or eight guns.

*The Dover Turret (England).*—The Dover turret (Fig. 2), placed on the outer end of the pier at Dover, England, consists of a live ring and rollers of steel running on a path of steel laid on a massive cylinder of masonry. On

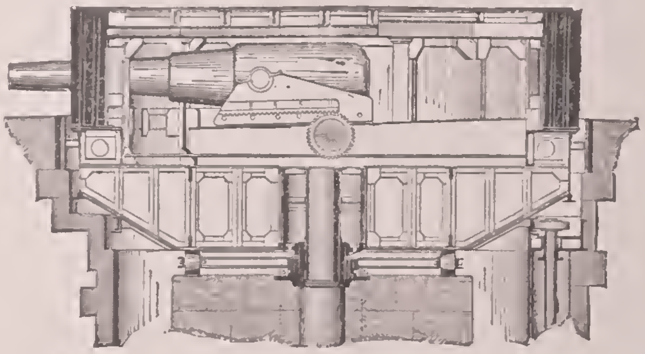

FIG. 2.—Another modification of the Timby turret.

this live ring runs an iron framework weighing about 240 tons. The framework contains the gun-chamber, which is protected by three thicknesses of 7-inch armor, with two intermediate thicknesses of 2-inch plates and 6 inches of wood, weighing together about 460 tons. The weight of guns, carriages, and slides, added to the above makes a total running weight of about 895 tons. This throws upon each of the thirty-two rollers of the live ring a pressure due to about 28 tons. The outside diameter of turret is 37 feet; inside, 32 feet; interior height of gun-chamber, 8 ft. 8 in.; height of turret-armor, 9 feet; armament, two 80-ton guns. The turret is turned by a pinion, the vertical shaft shown, working into a large ring, with steel trundles secured to the framework, the power being given by a set of main engines capable of working up to 300 horse-power, and auxiliary engines of 45 or 50 horse-power. All engines and boilers are in the lower part of the battery, about 30 feet below the guns. The magazines are nearly at the same level as the engines. S. B. LUCE.

**Turret-ships**: See SHIPS OF WAR.

**Turtle**: See TESTUDINATA.

**Turtle**, or **Turtle-dove** [*turtle* is O. Eng. *turtle*, from Lat. *tur'tur* (probably a name imitative of its cooing)]: any one of several small pigeons, especially those of the genus

*Turtur.* The *T. auritus*, or common European turtle, is a migratory bird, famed for its gentleness, its strong conjugal affection, and its loud but pleasant cooing note. The turtle or mourning dove of the U. S. is the *Zenaidura macroura*, whose gentle and mournful note is well known. It is 13 inches in total length, and has a remarkably long tail. Pigeons of the genus *Æna* are also reckoned as turtles. There are perhaps twenty species of turtle-dove. That mentioned in the Bible is *Turtur risorius*, an abundant Eastern species often kept in cages. Revised by F. A. LUCAS.

**Turtle-fishery**: the taking of turtles for commercial purposes. While turtles are used for food wherever they are sufficiently large or abundant, few species are the object of regular pursuit. Among marine species the green turtles (*Chelonia midas* and *virgata*) are taken for their flesh and the hawk's-bills (*Eretmochelys imbricata* and *squamata*) for their shells; the loggerhead (*Thalassochelys caretta*) is also taken, but forms indifferent or poor food. The diamond-back, or terrapin (*Malaclemmys palustris*) of the southeastern parts of the U. S. and the large species of *Emydidæ*, usually called sliders, are much sought for, as are also the soft-shelled turtles (*Trionychidæ*) of the southern parts of the U. S. and Mississippi valley. The Indians of the Amazon systematically hunt turtles for their flesh and eggs, the latter used for making oil, and the Japanese consume numbers of a species of *Trionyx* (*T. japonicus*). Marine turtles are taken on most suitable sandy shores in tropical or warm regions. The island of Ascension is an old and famous locality, as are the Bahamas and the Gulf of Mexico very generally, and the fishing extends as far N. as North Carolina, few, save stragglers, going beyond. The turtles are taken on land by watching on the nights when they come ashore to deposit their eggs, and quickly turning them on their backs. In the water they are sometimes caught by the primitive plan of diving and grasping the front of the shell with one hand and the hind part with the other, giving the animal such a twist that his struggles bring him to the surface. Another method much in vogue is to use a spear with a small round point, which is fastened to a line, though detachable from the shaft, the creatures being speared when asleep, or pursued when the conditions are favorable, as, for example, in smooth or shallow water. Nets are also employed to some extent. The turtles are usually kept until wanted for shipping in inclosures termed crawls, and travel very well if simply laid on their backs in a damp cool place. Fresh-water turtles are caught in nets and in traps on the principle of a lobster-pot, one end being attached to a stake and kept above water in order that the turtle may not drown. They are also scooped up in dredges or taken in the fall and winter after they have entered the mud to hibernate by probing for them with an iron rod. Turtle-culture has been practiced to some extent both in the U. S. and Japan, a suitable body of water being fenced in and, in necessary places, covered with netting to prevent crows and other enemies from destroying the eggs and young. These inclosures are perhaps more used in the U. S. for the keeping and feeding of small individuals until they reach a marketable age than for raising turtles from the eggs. In the States of the Eastern coast of the U. S. in 1890 there were taken 476,630 lb. of terrapin, worth $70,141, and 1,287,256 lb. of turtle, valued at $40,550, besides 1,153 lb. of tortoise-shell, amounting to $2,884, and turtle eggs to the extent of $994, the total, including the product of the Pacific States, reaching $119,569. Florida claims the largest catch of the sea-turtles and Virginia leads in the number of terrapin caught, although Maryland's product stands first in value, owing to the large proportion of the valuable diamond-backs in her waters. F. A. LUCAS.

**Tusa'yan Indians**: See CLIFF-DWELLINGS, PUEBLO INDIANS, and SHOSHONEAN INDIANS.

**Tuscaloo'sa**: city; capital of Tuscaloosa co., Ala.; on the Black Warrior river, and the Ala. Gt. South. Railroad; 55 miles S. W. of Birmingham, 75 miles N. N. W. of Selma (for location, see map of Alabama, ref. 4–B). It is in a cotton-growing and coal-mining region, was formerly the State capital, and is noted for its educational institutions, which include the University of Alabama (post-office, University), University High School, Central Female College, Tuscaloosa Female College, and the Institute for Training Colored Ministers (Presbyterian). It is also the seat of the Alabama Insane Hospital. There are 2 national banks with combined capital of $160,000, a private bank, and 2 daily and 3 weekly newspapers. Pop. (1890) 4,215; (1900) 5,094.

**Tuscan Order**: an order of architecture still simpler than the Roman Doric. (See ORDERS OF ARCHITECTURE and DORIC ORDER.) Its origin is probably to be found in the imitation of Greek designs by the Etrurians and other inhabitants of Italy before the time of the Roman domination. The Roman builders took this, with other features of Etruscan architecture, into use before importing Greek forms more directly. It may well be that the Roman Doric so called was a more decorated form of Tuscan. R. S.

**Tus'cany** [from Lat. *Tusca'nus*, Tuscan, Etruscan, deriv. of *Tusci*, another name for *Etru'sci*, Tuscans, Etruscans]: a compartimento of Italy, comprising the eight provinces of Arezzo, Florence, Grosseto, Leghorn, Lucca, Massa-Carrara, Pisa, and Sienna; now not recognized as a legal division. Area, 9,304 sq. miles. Pop. (1893) 2,296,011. It was formerly an independent grand duchy of Italy. Its territory corresponded nearly to that of the ancient Etruria, and after the fall of the Roman empire it formed at first part of the kingdom of the Goths, then of the kingdom of the Longobards, and then of the empire of Charlemagne. He gave it a somewhat more independent position, erecting it into a marquisate, and giving it away as a military fief. Guelph VI. sold his fief in 1160 to the German emperor Frederick I.; but as the connection with the German empire was somewhat loose from the very beginning, Tuscany was soon broken up into a number of independent republics, of which Florence, Pisa, and Sienna were the most important. Florence conquered Pisa and the greatest part of the Tuscan territory, but was conquered itself in 1532 by Charles V., who appointed Alessandro de' Medici Duke of Florence. In 1569 Cosmo I. united the whole of Tuscany into a grand duchy, and from that time to 1737, when it became extinct, the Medici family ruled the country, and made it one of the most prosperous and civilized in Europe. In 1737 it fell to Francis, Duke of Lorraine, who had married Maria Theresa and later became Emperor of Germany, and with exception of a few years, during which Napoleon first made it a part of the kingdom of Etruria, and then annexed it to France, it was ruled by the house of Lorraine until Aug. 16, 1859, when by an almost unanimous vote of the people it annexed itself to the kingdom of Sardinia. In 1861, by a similar process, it was annexed to the kingdom of Italy. From that time until 1871 Florence was the capital of the kingdom. Revised by M. W. HARRINGTON.

**Tuscaro'ra** or **Tuskarora Indians**: See IROQUOIAN INDIANS.

**Tuscia**: See ETRURIA.

**Tusco'la**: city (founded in 1856); capital of Douglass co., Ill.; on the Chi. and E. Ill., the Ill. Cent., and the Ind., Decatur and W. railways; 150 miles S. of Chicago, and 150 miles E. of St. Louis (for location, see map of Illinois, ref. 6–F). It is in an agricultural region and the broom-corn belt of Illinois; contains several churches, 2 public-school buildings, a national bank with capital of $60,000, a private bank, and 3 weekly newspapers; and is the largest broom-corn shipping-place in the U. S. Pop. (1880) 1,457; (1890) 1,897; (1900) 2,569. EDITOR OF "REVIEW."

**Tusculum**: See FRASCATI.

**Tuscum'bia**: city; capital of Colbert co., Ala.; on the Tennessee river, and the Memphis and Charleston, the Louisv. and Nashv., and the Birmingham, Sheffield and Tenn. River railways; 125 miles N. W. of Birmingham, 175 miles N. W. of Montgomery, the State capital (for location, see map of Alabama, ref. 1–B). It is in an agricultural region, and contains a public school, several private schools, the Deshler Female Institute (chartered in 1870), an excellent spring-water supply, Baptist, Methodist Episcopal, Presbyterian, Protestant Episcopal, and Roman Catholic churches, a State bank with capital of $25,000, flour and feed mill, plow-factory, and a weekly newspaper. Pop. (1880) 1,369; (1890) 2,491; (1900) 2,348. EDITOR OF "NORTH ALABAMIAN."

**Tushita** [Sanskr., satisfaction or joy]: the heaven of "the perfectly contented ones"; the fourth of the six Buddhist devalokas or celestial spheres or abodes of the gods. Here dwell the Boddhisattvas, or beings whose essence has become intelligence, and who have only once more to pass through human existence before attaining to Buddhaship. Here dwelt Gautama, and it was from this heaven that he descended in the form of a white elephant to be born for the last time. Here also dwells Maitreya, the coming Buddha of the present age. In Tushita life lasts 4,000 years, but twenty-four hours are there equal to 400 years on earth.

**Tuske'gee**: town; capital of Macon co., Ala.; on the Tuskegee Railroad; 40 miles N. by E. of Montgomery, 135 miles S. W. of Atlanta, Ga. (for location, see map of Alabama, ref. 5–E). It is in a cotton-growing region, is an attractive winter resort, and contains 2 cottonseed-oil mills, an incorporated bank with capital of $50,000, a private bank, and a weekly newspaper. It is widely noted for its educational institutions, which comprise the Alabama Military Institute, the Alabama Conference Female College, the Alabama Normal School, school for colored people, and the Tuskegee Normal and Industrial Institute. The latter was founded in 1881 by Booker T. Washington, a graduate of the Hampton Normal and Industrial Institute, and in 1894 had 48 professors and instructors, all colored, 915 students, 1,810 acres of ground, and 31 buildings valued at $200,000. The institution is exclusively for colored youth, is thoroughly equipped for advanced normal and industrial education, and nearly if not all of the work of laying out the grounds, erecting the buildings, and constructing the operating plants, was done by the students. From its opening till the 1894 commencement the institute received from all sources $421,-955, and the students paid in labor $187,612, put over 500 acres under cultivation, and made over 500,000 bricks. Mr. Washington has been principal of the institute from its organization. Pop. of town (1890) 1,803; (1900) 2,170.

**Tusser**, Thomas: successively a musician, schoolmaster, serving man, husbandman, grazier, and poet; b. at Rivenhall, Essex, England, about 1515; educated at Eton and at Cambridge. D. in London about Apr., 1580. He was the author of *Five Hundred Points of Good Husbandry, united to as many of Good Housewifery, etc.* (1573), in verse, with a metrical autobiography. His book is chiefly valuable for its picture of the manners and domestic life of English farmers. Revised by H. A. Beers.

**Tutmes**: See Thothmes.

**Tuttle**, Daniel Sylvester, D. D.: bishop; b. at Windham, Greene co., N. Y., Jan. 26, 1837; graduated at Columbia College in 1857; studied theology in the General Theological Seminary in New York; entered holy orders, and in 1866 was elected Bishop of Montana, having jurisdiction in Idaho and Utah; was consecrated in 1867, his election to the missionary episcopate having taken place before he was of canonical age to be made a bishop. After nearly twenty years service in the far West he was chosen to succeed Dr. Charles Franklin Robertson as Bishop of Missouri. He has published missionary reports, episcopal addresses, sermons, and pastorals. Revised by W. S. Perry.

**Tuttle**, Herbert, A. M., L. H. D.: historian; b. at Bennington, Vt., Nov. 29, 1846; A. B., University of Vermont, 1869; after graduation engaged for several years in journalism at Boston, afterward at Paris and Berlin, where he continued studies in history and public law; lecturer on international law, University of Michigan, 1879; received appointment to Cornell University 1881, where he held for a time the chair of politics and international law, and afterward became Professor of Modern European History. He was the author of *German Political Leaders* (New York and London, 1876); *History of Prussia to the Accession of Frederick the Great* (1884); *History of Prussia under Frederick the Great* (2 vols., New York, 1888); and many articles in magazines and reviews. D. at Binghamton, N. Y., June 21, 1894. C. H. Thurber.

**Tuttle**, Joseph Farrand, D. D., LL. D.: clergyman and educator; b. at Bloomfield, N. J., Mar. 12, 1818; educated at Marietta College and Lane Theological Seminary; tutor in Marietta College 1843–44; pastor of the Presbyterian churches at Delaware, O., 1845–47, and at Rockaway, N. J., 1847–62; president of Wabash College 1862–92. Besides contributing frequently to several reviews, Dr. Tuttle has published a large number of important historical sermons, addresses, and pamphlets: *Life of William Tuttle*; *Way Lost and Found*; *Self-reliance*; *Revolutionary Fathers of Morris County, N. J.*; *The Western States of the Great Valley*; *Presbyterianism on the Frontiers*; *Our Half Century*; *The General Assembly's Jubilee*; and *Sixtieth Anniversary of Lane*. C. K. Hoyt.

**Tutuila**: See the Appendix.

**Tux'pan**: a town and port in the northern part of the state of Vera Cruz, Mexico; on the Tuxpan, 7 miles above its mouth (see map of Mexico, ref. 7–H). Vessels anchor in the roadstead, the bar only admitting small craft. Coasting steamers touch here regularly, and there is a thriving trade in cabinet woods, dyewoods, honey, rubber, hides, etc. Tuxpan dates from before the Conquest and is connected with the legends of the Toltecs. Pop. 9,000. H. H. S.

**Tver**, tvãr, or **Twer**: government of European Russia; bounded S. by the government of Moscow; area, 25,225 sq. miles. The ground is elevated, but the surface level, covered with forests, and dotted with small lakes; the Volga and several of its affluents rise here. The climate is somewhat severe, and the soil is not very fertile. Rye and oats are produced, sufficient for home consumption; flax and hemp are cultivated. Cattle are neither numerous nor good, but the fisheries are remunerative. Pop. (1897) 1,812,559.

**Tver**: town of Russia, government of Tver; at the confluence of the Tvertsa and Volga, which latter here becomes navigable for steamers (see map of Russia, ref. 6–E). The town contains an imperial palace, a cathedral, a college, various schools, and barracks, and, situated as it is on the highway from Moscow to St. Petersburg, its trade is considerable. Nails and cotton goods are extensively manufactured. There are several chalybeate springs in the vicinity. Pop. (1897) 53,477.

**Twachtman**, John Henry: landscape-painter; b. in Cincinnati, O., Aug. 4, 1853; pupil of F. Duveneck and of the Munich Academy; member of the Society of American Artists 1879; Webb prize, 1888. His work may be properly classed as of the impressionist school, and is remarkable for luminousness and atmospheric quality. W. A. C.

**Twatu'tia**: the capital of Formosa (*q. v.*).

**Tweed**: next to the Tay the largest river of Scotland. It rises in the southwest corner of Peeblesshire, at an elevation of 1,500 feet above the sea, flows northeastward, eastward, and again northeastward, and enters the North Sea at Berwick after a course of 97 miles. It is tidal for 10 miles and forms a part of the border with England for 18½ miles.

**Tweed**, William Marcy: politician; b. in New York city, Apr. 3, 1823, of Scotch descent; the son of a poor chairmaker; when twenty-eight years old went into partnership with his brother in the chairmaking business; soon became prominent in local politics, and in 1853 was elected to Congress. For many years he was a member of the Tammany Society, of which he was chosen grand sachem in 1869, holding the office till 1871. From his appointment as deputy street commissioner in 1863 may be said to date the foundation of the famous Tammany Ring, of which he was the chief spirit. He became at once the virtual head of the department of streets, afterward the department of public works, and by extending enormously the expenditures for public improvements acquired vast political influence and began to accumulate a fortune. His position as president of the board of supervisors enabled him to increase the city's pay-roll to unprecedented dimensions, giving sinecure positions to an army of political friends. The ring gradually grew in power and influence till 1868, and at the opening of 1869 found itself master of nearly every department of the State government. In 1868 the ring's greatest scheme of robbery, the building of a new county court-house, was planned. The work was begun under the stipulation that the cost should not exceed $250,000. Before 1871 over $8,000,000 was pretended to have been expended on it and it was still unfinished. When by the charter of 1870 the power of auditing accounts was taken from the board of supervisors and vested in certain city offices then filled by Tweed and his friends, all restraints on the system of plundering by fraudulent bills was removed. Such bills, amounting to $6,000,000, were passed by the board of audit at its first and only meeting. Of this amount over $1,000,000 was traced to Tweed's private pocket. A secret account of the money thus paid was kept in the auditor's office under the title "County Liabilities." During the winter of 1870–71 a clerk employed in the auditor's office copied by stealth the items in this account and gave them to his patron, James O'Brien, an opponent of the Tammany Society. O'Brien subsequently gave the figures to *The New York Times*, and that journal published them in July, 1871. The excitement created thereby started an investigation which through the earnest efforts of Samuel J. Tilden and others resulted in the exposure of the frauds and the complete overthrow of the ring in the elections of Nov., 1871. Tweed was tried for grand larceny and forgery, and sentenced on Nov. 22, 1872, to twelve years' imprisonment in the penitentiary and to pay a heavy fine. On Dec. 4, 1875, he escaped and fled to Spain, where he was captured and returned to the city Nov., 1876. Tweed was married in 1844 and had eight children. D. in Ludlow Street jail, New York, Apr. 12, 1878. See Bryce's *American Commonwealth.* Revised by F. M. COLBY.

**Tweedmouth**, LORD: See MARJORIBANKS, EDWARD.

**Twelve Tables, Law of the**: See ROMAN LAW.

**Twer**: See TVER.

**Twesten**, AUGUST DETLEV CHRISTIAN, D. D.: theologian; b. at Glückstadt, Germany, Apr. 11, 1789; studied at Kiel and Berlin; Professor of Philosophy and Theology at Kiel from 1814; called to Berlin in 1835 to fill the theological chair of the great Schleiermacher, which position he occupied till his death Jan. 8, 1876, retaining his vigor and faithfully attending to his academic duties to the last. He was also member of the Oberkirchenrath of the Evangelical Church of Prussia from 1850 till 1874. He was a pupil and admirer of Schleiermacher, but more positive and orthodox. As a teacher and writer he was remarkably clear and accurate. He wrote *Die Logik* (Schleswig, 1825); *Vorlesungen über die Dogmatik der evangelisch-lutherischen Kirche nach dem Compendium des Herrn Dr. W. M. L. de Wett* (vol. i., Hamburg, 1826; 4th ed. 1838; vol. ii., part i., 1837, unfinished); *Matthias Flacius Illyricus* (Berlin, 1844); *Erinnerung an Frdr. Dan. Ernst Schleiermacher* (1869); and an introduction to Schleiermacher's *Ethik*, which he edited (1841). See his *Life*, by C. F. G. Heinrici (Berlin, 1889). Revised by S. M. JACKSON.

**Twichell**, JOSEPH HOPKINS: clergyman; b. at Southington, Conn.; graduated at Yale College 1859; studied for the ministry at Union Theological Seminary and Andover Theological Seminary; was chaplain of a regiment in the civil war (1861–64); became minister of the Asylum Hill Congregational church, Hartford, Conn., in 1865. He has published a *Life of John Winthrop* (New York, 1891) and edited *Some Puritan Love Letters*, correspondence of John and Margaret Winthrop (New York, 1893). G. P. F.

**Twick′enham**: town; in Middlesex, England; on the Thames, opposite Richmond; 11 miles S. W. of London (see map of England, ref. 12–J). It has powder and oil mills, and contains many fine villas and summer residences. It was the home of Pope, who is remembered there by his grotto and a monument in the parish church. Among the other curiosities of the place are the Orleans House, where Louis Philippe lived while a refugee in England, and Strawberry Hill, the seat of Walpole. Twickenham is connected with Richmond by a handsome bridge. In 1894 a new lock, weir, and footbridge was opened. Pop. (1891) 16,026.

**Twiggs**, DAVID EMANUEL: soldier; b. in Richmond co., Ga., 1790; appointed captain in 1812, major 1814, and served throughout the war with Great Britain; was retained in the peace organization of the army in 1815 as captain, major May 14, 1825, lieutenant-colonel 1831, colonel June, 1836. In the war with Mexico he was promoted brigadier-general and breveted major-general. In Feb., 1861, being in command of the department of Texas, he surrendered his army to Gen. McCulloch of the Confederate service, together with all the Government stores, munitions, and material to the value of $1,500.000, for which he was dismissed from the service of the U. S. Mar. 1. He was soon after appointed a major-general in the Confederate army. D. at Augusta, Ga., Sept. 15, 1862.

**Twilight** [*twi-* (< O. Eng. *twi-*, *twā*, two) + *light* (< O. Eng. *lēoht*, light); cf. Germ. *zwielicht*, twilight]: the glow in the morning and evening sky caused by the reflection of the light of the sun by the atmosphere after sunset and before sunrise. This very familiar phenomenon offers many interesting features to the observer who carefully watches it immediately after sunset under a clear, unobstructed sky. He can see what is equivalent to the shadow of the earth cast upon the sky. Suppose the observation to begin five minutes after sunset. Then if one could in a moment ascend to the height of half a mile above the earth he should again catch a view of the setting sun. All that portion of the atmosphere above this point is therefore in full sunlight, while that below it is illuminated by the reflection from other portions. Ten minutes after sunset the line of demarkation will have risen to a height of 2 or 3 miles; all below that limit will be in the shadow of the earth. Now, looking toward the E., the shadow will be distinctly seen, the portion of the atmosphere near the horizon being in comparative darkness, while at the height of a few degrees will be seen the edge of the illuminated portion shining by the red light of the setting sun. As the sun sinks farther and farther below the horizon, the illuminated part will be seen to shrink away toward the W. Then no part of the air overhead is illuminated by direct sunlight; to see the sun one would have to ascend above the limits of the atmosphere. Yet later the only illuminated portions of the atmosphere to which sight can extend are near the western horizon. The sun is then so far below the horizon that only the most distant parts of the atmosphere visible are illumined by its direct rays. Twilight is found to end entirely when the sun is between 15° and 18° below the horizon. The amount of depression varies with the place and the season, and has not been reduced to any satisfactory law. One conclusion from the observations of twilight is that the atmosphere ceases to reflect the rays of the sun at a height of about 45 miles. Did any part of the air higher than this reflect any light it would be visible when the sun was more than 18° below the horizon, and thus there would be a longer twilight than we actually have. S. NEWCOMB.

**Twillingate**: a port of entry; on the two Twillingate islands, off the northeast coast of Newfoundland, 190 miles by steamer from St. John's; lat. 49° 42′ N., lon. 54° 44′ W. The town is the capital of Twillingate and Fogo district. The name is apparently a corruption of Toulinguet, a cape in Brittany, near Brest. Pop. 2,800. M. W. H.

**Twills**: See TEXTILE-DESIGNING.

**Twining**, KINSLEY, D. D.: clergyman and editor; b. at West Point, N. Y., July 18, 1832; graduated at Yale College 1853, and at Yale Theological School 1856. He was pastor of Congregational churches at Hinsdale, Mass., 1857–63, at Cambridgeport, Mass., 1867–72, at Providence, R. I., 1872–76. In 1880 he became literary editor of *The Independent*, New York. G. P. F.

**Twining**, WILLIAM JOHNSON: soldier; b. in Indiana, Aug. 2, 1839; appointed a cadet from that State to the Military Academy at West Point, and was graduated in 1863, the fourth in a class of twenty-five. He was then appointed first lieutenant of engineers, and served in the civil war as assistant engineer of the department of the Cumberland and as chief engineer of the department of the Ohio, and was engaged in the invasion of Georgia, in the operations against Gen. Hood's army in Tennessee, in the battles of Franklin and Nashville, in the movement to the mouth of Cape Fear river, and in the operations in North Carolina in Feb., Mar., and Apr., 1865. Captain of engineers Dec. 28, 1868; major of engineers Oct. 16, 1877. He was breveted major and lieutenant-colonel of volunteers for gallant and meritorious services. After the civil war he served as Assistant Professor of Engineering at West Point 1865–67, as chief engineer of the department of Dakota, as commissioner for the survey of the U. S. boundary-line along the 49th parallel 1872–76, and as commissioner of the District of Columbia 1878–82. D. in Washington, D. C., Mar. 5, 1882.

**Twiss**, Sir TRAVERS, F. R. S., D. C. L.: political and legal writer; b. in Westminster, Mar. 19, 1809; graduated at Oxford University: public examiner at Oxford in classics and mathematics 1835–39; called to the bar at Lincoln's Inn 1840; afterward admitted as advocate at Doctors' Commons; Professor of Political Economy at Oxford 1842–47, and afterward served in various other collegiate and public offices; created queen's counsel and bencher at Lincoln's Inn; made advocate-general 1867: knighted in 1867. He retired from his professorship of Civil Law at Oxford, and gave up the office of advocate-general in 1872, after which time he devoted himself chiefly to literary work. He drew up in 1884 for the King of Belgium a constitution for the Congo Free State. D. Jan. 15, 1897. He was a man of remarkably wide attainments, and a brilliant but somewhat unreliable scholar. He published *Niebuhr's History of Rome Epitomized*; *Livy's History* (editor); *The Oregon Question Examined in Respect to Facts and the Law of Nations* (in which he treats it as of little present weight); *View of the Progress of Political Economy in Europe since the Sixteenth Century*; *The Law of Nations considered as Independent Political Communities*; *Monumenta Juridica: the Black Book of the Admiralty* (editor); Henry de Bracton's *De Legibus et Consuetudinibus Angliæ* (editor; London, 1878–83); *Belligerent Right on the High Seas* (London, 1884). F. STURGES ALLEN.

# APPENDIX.

**Soulé**, Caroline Augusta (*White*): b. in Albany, N. Y., Sept. 3, 1824; graduated at Albany Female Academy in 1841; was on the staff of the Boston *Ladies' Repository* 1855–63, and for eleven years edited and published in New York city *The Guiding Star*, a Sunday-school periodical; was ordained as a minister of the Universalist Church, and became its first foreign missionary in 1879; afterward became pastor of a congregation in Glasgow, Scotland. She is the author of *Home Life* (1855); *The Pet of the Settlement* (1859); and *Wine or Water* (1861).

**Sousa**, John Philip: conductor and composer; b. in Washington, D. C., in 1854, of a Spanish father and a German mother; began the study of music very early, and attracted attention while still a boy by his violin-playing. He became an orchestral leader at eighteen years of age, and when twenty-six was appointed leader of the U. S. Marine Band, holding the position for twelve years, in which he made the band famous. He resigned in 1892 to form a band of his own, with which he has since traveled all over the U. S. He is a famous composer of marches, and has also composed four operas, viz., *Angela*, *El Capitan*, *The Bride Elect*, and *The Charlatan*. D. E. Hervey.

**South African Republic**: In 1897 there were 198 gold mines, capitalized at $363,863,750. Twenty-eight mines, with a capital of about $50,000,000, paid $14,750,000 in dividends, or nearly 30 per cent.: 64 mines were producing gold, but paying no dividends, and some could not pay dividends without a reduction in working expenses; 106 mines were being opened up.

The gold output in 1897 was $58,306,600, and in 1898 $81,203,150, the republic leading the world in these years in gold production. Nine-tenths of the yield was obtained from a strip of land 30 miles long and 1 to 2 miles wide, being about half of the gold-bearing area of the Witwatersrand (white water slope) that extends 25 miles to the E. and 30 miles to the W. of Johannesburg. The reefs have been found to a depth of 2,500 feet, and the structure of the country seems to show that they continue to a great depth. Estimates by experts of the probable yield of this area accord fairly well. The estimate of Messrs. Hatch and Chalmers embraces the whole Rand to the 5,000 feet level, from which they figure that about $3,500,000,000 may be obtained. Mr. G. F. Becker, of the U. S. Geological Survey, says: "I have found no grounds for regarding this as an overestimate, and I know no one familiar with the deposits who thinks it exaggerated."

For an account of the Transvaal war of 1899–1900, and the events leading up to it, growing out of the grievances of the large foreign mining population against the Boer Government, chiefly in regard to taxation and citizenship, see the article Africa. C. C. Adams.

**South Carolina College**: an institution of learning in Columbia, S. C.; chartered by the General Assembly in 1801, and opened in 1805. The Confederate Government took possession of the buildings of the institution in 1863, and used them as a hospital until the close of the civil war. After an amendment of the charter the school was reopened in 1866 as the University of South Carolina, but in consequence of political conditions it was again closed in 1877. Another amendment of the charter, in 1878, divided the university into two branches—South Carolina College, in Columbia, and Claflin College, in Orangeburg. In 1880 the Columbia branch became South Carolina College of Agriculture and Mechanics, but in 1882 the previous name was resumed and the number of professors increased. The charter experienced two more amendments, in 1887 and 1890, the first considerably enlarging the scope of the college, providing for 19 professors, 1 assistant professor, and 7 instructors and tutors; the second discontinuing six courses and reducing its scope to four courses—classical, literary, scientific, and law. Two courses had been previously discontinued. Normal courses were added, and a professorship in Pedagogics was established in 1894. The college is coeducational. F. C. Woodward is president.

**South, University of the**: an institution of learning in Sewanee, Tenn., founded in 1857 in the interests of the Church and of Christian education. A charter was soon afterward obtained from the Legislature, and a domain of nearly 10,000 acres of land was secured for the university site. About $500,000 had been subscribed toward an endowment and the corner-stone of the central building had been laid when the civil war interrupted all operations. At the close of the war little remained except the university land, but through the untiring efforts of Bishop Charles Todd Quintard, of Tennessee, the project for a university was revived, and in 1868 the institution was put into operation on a moderate scale. Since that time there has been a rapid development. The university has now a teaching staff of 62 members and an attendance of 518. Its eight buildings stand in the middle of the extensive grounds, portions of which are leased for building lots. The university embraces colleges in theology, medicine, pharmacy, and law. Courses are also offered in engineering, finance, and economy. In its grammar school the university gives preparation for the college. B. Lawton Wiggins, M. A., is vice-chancellor.

**Spain, History of**: The death of Alfonso XII. in 1885, and the accession in 1886 of his posthumous son, Alfonso XIII., failed to disturb the political conditions. The Carlists, indeed, have been uneasy at certain crises, and the adherents of a republic are not unimportant. Nevertheless, affairs have been in the hands alternately of the Liberals, led by Sagasta, and the Conservatives, led by Cánovas until his assassination by an anarchist in 1897.

Spain has in fact had her share of anarchism; she has suffered from labor trouble, and her finances have been on the verge of collapse. Externally, the chief recent event is the loss of the Spanish colonial empire, incident to the American-Spanish war of 1898. Edmund K. Alden.

**Spanish Law**: The present laws of Spain are the result of a modification and coalescence of the Roman law and the laws of the Visigoths with ingrafted portions of the canon and feudal laws. With the conquest by the Romans, Spain became a province of the Roman empire and subject to the Roman law; and this law, with the modifications arising from the necessities of its administration, continued to be the law of the land until the conquest of the country by the Visigoths, which took place early in the fifth century. The Visigothic ruler, Euric, upon his conquest of Spain, had the "customs of the Goths" embodied in a code, which was amended and published by his successor, Alaric II., as the *Breviarium Alaricanum*, under the superintendence of civil and ecclesiastical lawyers, and this code is mainly based upon what is known as the Theodosian code. The codes of Euric and Alaric seem to have furnished the basis for the code known as the *Fuero juzgo*, which became the general law of Spain probably about the seventh century.

The *Fuero juzgo* is divided into 12 books containing 54 titles and 559 distinct laws. The first book treats of the nature of law and of the instrumentalities for enacting and enforcing it; the second book of judges, their powers and attributes, modes of conducting sittings, written and oral testimony, and the solemnities required in the execution of last wills and testaments. The third book treats of marriage, conjugal infidelity, etc.; the fourth of the law of descent and the rights of inheritance, the rights and duties of guardians and orphans, etc. The fifth book treats of the established rules of the Church, ecclesiastical property, donations as well as exchanges, deposits, loans for a consideration, debts, pledges, and manumissions. The subsequent books treat of criminal matters and some subjects of special legislation, such as the rights and duties of physicians, foreign merchants, etc.

This code continued to be the general law of Christian Spain during the subsequent dominion of the Arabs, but it was modified and supplemented by the code known as the *Fuero viejo*, which was promulgated about the end of the tenth century. The *Fuero viejo* is divided into five books, which contain the ancient and general usages and customs of the nation, treating of the king's prerogatives, the rights of vassals, rules of single combat, laws relating to tenants and dependents of the nobility, penal laws, the administration of justice, contracts, the acquiring of property, successions to estates, partitions, disinheritance, legitimacy of children, etc. This work is much less comprehensive than the preceding act, the *Fuero juzgo*, and it is now practically obsolete, being seldom cited except to establish some historical fact.

In the twelfth and thirteenth centuries the Roman law became a subject of zealous study, and led to the promulgation of the code known as the *Sietes partidas*, preceded by the *Fuero real*, both of which introduced modifications based upon the Roman law. The *Fuero real* was imperfect in its analysis and arrangement, and seems to have been intended rather as a guide to the administration of the law than as a full and exact exposition of the jurisprudence of the country.

Such an exposition, however, is made in the *Sietes partidas*, which, although published about the middle of the thirteenth century, appears not to have been promulgated as the law of the land until 1348, in the reign of Alfonso XI. This code embodies the substance of the actual laws of Spain today. It is divided into seven parts (*partidas*), of which the first treats of the nature, origin, and object of laws, usages and customs, and religious matters. The first *partida* is essentially a digest of the canon law, and gives exorbitant powers to the pope and clergy. The second *partida* treats of the prerogatives and duties of the crown and the duties of the people toward the sovereign. The third *partida* treats of judicial proceedings, responsibilities of judges, lawyers, and public functionaries, and is copied almost exclusively from the Roman law. The fourth *partida* treats of the subject of marriage, and the marriage relation, feudal laws, and vassals. The fifth *partida* treats of the obligations of contracts of merchants, partnerships, security, mortgages, etc., and is largely copied verbatim from the Roman law. The sixth *partida* treats of wills and heirs, estates and the administration of them, guardianships, tutorships, etc. The seventh and last *partida* treats of the criminal laws.

After the expulsion of the Arabs from Spain, although the *Fuero juzgo* and the *Sietes partidas* still remained the law, generally speaking, the law in particular respects was modified. Among others, two important laws were enacted, entitled *Las ordenanzas reales*, *Ordenamiento real*, or *Ordenamiento de Montalvo*, which is a compilation made by the order of Ferdinand and Isabella in the year 1484, and the *Leyes de Toro*. The former is divided into eight books, and contains the most important royal edicts and ordinances subsequent to the publication of the *Sietes partidas*. The *Leyes de Toro* is a code of eighty-three laws published in the cortez of Toro in 1505 as supplemental to the *Ordenamiento de Montalvo*.

These various codes and laws supplementing each other, but none of them making a complete statement of the law of the land, produced a state of great confusion, which was partially remedied by the publication of a general code, called the *Nueva recopilacion*, in the reign of Philip II., and the publication of the *Novisima recopilacion* in the year 1805. The general legislation of Spain at the present time, therefore, is found in the *Fuero juzgo*, the *Fuero real*, the *Sietes partidas*, and the *Novisima recopilacion*, which is the latest and highest authority. The specific provisions of the Spanish law in general follow very closely the Roman law. See ROMAN LAW.

The development of the system of Spanish jurisprudence differs from that of England and America in the important particular that there is no judicial legislation, or (as it is sometimes called) judge-made law, in Spain. None of its tribunals render decisions which are considered as authoritative precedents, and hence there is no such record or records of adjudications as those which are so useful and conclusive in England and the English-speaking countries where the common law prevails. The different codes of the kingdom, often enriched by the commentaries of learned jurists relying chiefly on the doctrines of the Roman law, are the only authorities ever quoted in the courts of justice, and where these are insufficient, or doubts arise as to the proper interpretation of the law, the subject is referred to the monarch. This mode of administering justice is doubtless one of the reasons why the law of Spain abounds in codes and so few treatises have been published treating of detached portions of the law.

*Spanish Colonial Legislation.*—The Spanish codes were found ill adapted for the purpose of colonial government, so that many of the laws of the Spanish colonies were newly devised to meet the exigencies of the occasion. They were enacted in Spain for the government of the country, and forwarded under various titles, such as *cedulas*, *decretos*, *resoluciones*, *ordenamientos*, *pragmaticos*, etc., which laws variously emanated from the superior tribunals, officers having authority to impose them, and from the king himself. The actual administration of the government of the colonies was given to agents appointed and removable by the sovereign; and the colonies were regarded as royal monopolies, the administration of which belonged exclusively to the monarch. These different orders and decrees became in course of time so numerous that it was frequently uncertain as to what laws were actually in force in the colonies, and to remedy this a collection was made of the colonial laws, which was completed in 1680, in the reign of Charles II., commonly known as the *Recopilacion de Indias*. This work, or code, however, is a mere digest of the royal orders, etc., issued from time to time for the better government of the American colonies, and is practically an enumeration of exceptions to the general and common law of Spain. It was provided in general that where the *Recopilacion de Indias* had no provision affecting a subject the laws of Castile should be observed, so that the civil law of Spain became likewise the civil law of her colonies. It was, however, also provided by a general decree that no law enacted for Spain should be obligatory in America unless accompanied by a *cedula* to that effect, emanating from the council of the Indies. Later the colonial law was again revised in order to include the gradual changes which had been introduced, and a new code was published in 1792.

The revolution in Spain which followed the French invasion gave rise to a new form of government, which arose under the direction of the Cortes, whose decrees were held obligatory in Mexico whenever expressly declared so to be or when there promulgated. After the re-establishment of the monarchy in Spain the Spanish sovereigns continued to enact laws for the American colonies, until in 1820 a republican government was again established, since which time further codification of the laws previously existing has taken place. The civil law of the American colonies of Spain is therefore, with some few exceptions, hardly dissimilar to that of Spain.

See Schmidt's *The Civil Law of Spain and Mexico*; Johnston's *Law of Spain*; and general Spanish histories.

F. STURGES ALLEN.

**Spartel, Cape**: the northwestern point of Morocco on the south side of the entrance to the Strait of Gibraltar. It rises 1,040 feet above the sea, and is conspicuous for the lighthouse near its point, which was erected and is supported by the civilized nations that are interested in Atlantic-Mediterranean commerce. The cape yields the best grapes in Morocco.

**Speer**, WILLIAM, D. D.: missionary; b. in New Alexandria, Pa., Apr. 24, 1822; graduated at Kenyon College, Ohio, in 1840; studied medicine under his father in Pittsburg, Pa., and divinity at the Presbyterian Theological Seminary in Allegheny; was licensed to preach in 1846; with two colleagues established the first Presbyterian mission in Canton, China; was the first preacher in their own tongue to the Chinese in California in 1852; founded a Chinese school, established a dispensary, and built a mission-house; organized the first Christian Chinese church in America; founded *The Oriental*, a Chinese-English religious and secular paper devoted to the interests of immigrants; became corresponding secretary of the Presbyterian board of education at Philadelphia in 1865; traveled in Japan and China 1876–77. He is the author of *China and the United States* (1870); *The Great Revival of 1800* (1872); and *God's Rule for Christian Living* (1875).

**Spence**, Henry Donald Maurice, D. D.: Church of England clergyman; dean of Gloucester; b. in London in 1836; graduated B. A. at Cambridge 1865; was Professor of English Literature and Modern Languages and Hebrew lecturer at St. David's College, Lampeter, 1865–70; rector in Gloucester 1870–77; principal of Gloucester College 1875–77; vicar and rural dean of St. Pancras, London, 1877–86; dean of Gloucester 1886. Besides contributing to Bishop Ellicott's and Dr. Schaff's commentaries, he edited *The Pulpit Commentary* (London and New York, 1880, *sqq.*) and *The Teaching of the Twelve Apostles* (1884); *Dreamland and History—the History of the Norman Dukes* (1890); *The Cloister Life in the Days of Cœur de Lion* (1892); *Voices and Silences* (1894); *Gloucester Cathedral* (1897); *The Church of England: a History for the People* (1897–99, 4 vols.). S. M. J.

**Stall**, Sylvanus: clergyman; b. in Elizaville, N. Y., Oct. 18, 1847; after studying at Union Theological Seminary, graduated at Pennsylvania College, Gettysburg, in 1872, and at the theological seminary there in 1874; was ordained in the Hartwick Lutheran synod in 1874, and has held pastorates at Cobleskill, N. Y., Martin's Creek, Pa., and Lancaster, Pa., 1874–87; retired in 1887 to devote his time to *Stall's Lutheran Year-book*, which he founded in 1884; has been statistical secretary of the Lutheran general synod since 1885. He has published *A Pastor's Record* (1876); *Handbook to Lutheran Hymns* (1879); *How to Pay Church Debts and How to Keep Churches Out of Debt* (1880); and *Methods of Church Work* (1887).

**Stanton**, Oscar Fitzalan: naval officer; b. in Sag Harbor, N. Y., July 18, 1834; graduated at the Naval Academy 1855; became master 1855, lieutenant 1856, lieutenant-commander 1862, having served in the Paraguay expedition, on the coast of Africa, and in the Pacific squadron: was with the West India and the Gulf blockading squadrons 1862–64, on ordnance duty at New York 1865, and on duty at the Naval Academy 1867; was advanced to commander 1867, and was with the North Atlantic squadron and on special service 1867–69; commanded the receiving-ship at Portsmouth, N. H., 1871; served with the Asiatic squadron 1872–74; became captain 1879; was on duty at the naval asylum at Philadelphia 1881–84, then commanded the flag-ship Tennessee on the North Atlantic station; was advanced to commodore 1893, rear-admiral 1894, and retired the same year.

**Starr**, Frederick, Ph. D.: anthropologist and author: b. in Auburn, N. Y., Sept. 2, 1859; prepared for college in the Auburn high school; B. S., Lafayette College, 1882; M. S. and Ph. D., Lafayette College, 1885; teacher of science, Wyman Institute, Upper Alton, Ill., 1882–83; teacher of science and history, Central State Normal School, Lockhaven, Pa., 1883–84; Professor of Biological Sciences, Coe College, Cedar Rapids, Ia., 1884–87; in charge of geology and associated sciences, Chautauqua University, 1885–88; curator of ethnology, American Museum of Natural History, N. Y., 1889–91; Associate Professor of Anthropology, University of Chicago, since 1892. Author of *On the Hills*; *Ancient Pictures for Little Moderns*; *Some First Steps in Human Progress*; *American Indians*; and many papers in periodicals and scientific transactions. Lecturer on anthropological subjects; traveler and explorer in Mexico.
C. H. Thurber.

**Stavenhagen**, Bernhard: pianist; b. in Greiz, Germany, Nov. 24, 1862; pupil in Berlin, and (1885) of Liszt in Weimar, with whom he remained until the latter's death in 1886. He is a renowned pianist all over Europe, and made a visit to the U. S. in 1896. He has received many court decorations and orders from the reigning sovereigns in Europe. Since 1898 he has resided in Munich.

**Stearns**, John William, LL. D.: educator; b. in Sturbridge, Mass.; A. B., Harvard, 1860; A. M., Harvard, 1864; LL. D., University of Chicago, 1874; tutor in Latin, University of Chicago, 1865–67, and Professor of Latin there 1867; director of the National Normal School, Argentine Republic, 1874–78; president of Whitewater Normal School (Wisconsin) 1878–85; Professor of the Science and Art of Teaching, University of Wisconsin, 1885–88; Professor of Philosophy and Pedagogy there since 1888, and director of its School of Education since 1897. He is editor of the *Wisconsin Journal of Education.*

**Stejneger**, stī-nee'ger, Leonhard, Ph. D.: naturalist; b. in Bergen, Norway, Oct. 30, 1851; educated at the university in Christiania, where he received the degree of Ph. D. in 1871. In 1881 he settled in Washington, and in 1882 visited the Commander islands for the purpose of studying their natural history and to make collections for the U. S. National Museum. He returned a year later, bringing with him numerous skulls and bones of the northern sea-cow, an extinct mammal, and then worked up the material collected by him. The installation of the ornithological portion of the exhibit of the U. S. National Museum at the Cotton Centennial Exposition, held in New Orleans in 1885, was prepared by him, in which year he was also made assistant curator of birds in the U. S. National Museum. This office he held until 1889, when he was made curator of reptiles and batrachians, which place he has since held. Again in 1895 he visited the Commander islands under the auspices of the U. S. Fish Commission, and in 1896 he was detailed as a member of the fur-seal commission to visit the Pribiloff, Commander, and Kurile islands. Dr. Stejneger prepared the greater portion of the volume on birds for the *Standard Natural History*, and besides numerous papers in the *Proceedings* of the U. S. National Museum, under the serial title of *Contributions to the Natural History of Commander Islands*, he is the author of the following monographs: *Results of Ornithological Explorations in the Commander Islands and in Kamtschatka* (Washington, 1885); *Directions for Collecting Reptiles and Batrachians* (1891); and *The Poisonous Snakes of North America* (1893).
Marcus Benjamin.

**Stembel**, Roger Nelson: naval officer; b. in Middletown, Md., Dec. 27, 1810. He became midshipman 1832, was on duty at the New York naval school 1834–38, and became passed midshipman in the latter year; was advanced to lieutenant 1843; served in the Coast Survey, on the Brazil station, and on the East India station 1847–59; at the beginning of the civil war he was engaged in fitting out river gunboats at Cincinnati; serving in the Mississippi river flotilla, he took part in the successful engagements at Lucas Bend, Fort Henry, Island No. 10, and Fort Pillow 1861–62; in action with the rams at Fort Pillow, his vessel was sunk and he was severely wounded, after which he was assigned to special duty at Philadelphia and Pittsburg until 1865; was promoted to captain 1866, cruised in the Mediterranean 1866–67; was made commodore 1870; was appointed commander-in-chief of the Pacific squadron 1872, was retired in the same year, and was advanced to rear-admiral on the retired list 1874. D. Nov. 20, 1900.

**Stephen**, Sir Herbert, Bart., K. C. S. I., LL. M.: English lawyer and law-writer; b. in London, June 25, 1857, the son of Sir James Fitzjames Stephen, the famous criminal lawyer, law-writer, and judge; was educated at Rugby and at Trinity College, Cambridge; read law and was called to the bar in 1881, when he entered upon the practice of his profession; was made clerk of assize for the northern circuit in 1889. He has published *The Law Relating to Actions for Malicious Prosecutions*, and other minor legal works.

**Stereor'nithes**: a name given by Florentino Ameghino to a group of extinct gigantic birds, whose remains are found in the Tertiary of Patagonia. They are mostly comprised in the family Phororhachidæ (*q. v.*).

**Sternberg**, Constantine: pianist; b. in St. Petersburg, July 9, 1852; studied in Germany. In 1871 he was appointed conductor of the Strelitz Hofopera, and in 1876 court pianist. He traveled all over Europe in concert tours, and finally went to the U. S., settling first in Philadelphia and later in Atlanta, Ga., where he is director of a music school. He has composed many pieces for the pianoforte which are often heard in the concert-room.

**Sternberg**, George Miller, M. D., LL. D.: surgeon; b. in Otsego co., N. Y., June 8, 1838. He graduated at the College of Physicians and Surgeons of Columbia University in 1860, and on the breaking out of the civil war was appointed as assistant surgeon in the U. S. army, and has since been advanced through the various grades of the medical service until May 30, 1893, when he was made surgeon-general with the rank of brigadier-general. While stationed in Baltimore, he devoted much attention to bacteriology, and he was a fellow by courtesy of the Johns Hopkins University 1881–85. Besides many assignments on important Government boards, he was appointed especially to make (1887–89) investigations in Brazil, Mexico, and Cuba, relative to the ætiology and prevention of yellow fever. He was director of the Hoagland laboratory in Brooklyn, N. Y., from its inception in 1890 until his appointment to the surgeon-generalship. The degree of LL. D. was conferred upon him by the University of Michigan in 1894, and by Brown in 1897. He is a member of many scientific and medical societies, holding honorary membership in the Academies of Medicine in Rome and Rio Janeiro, and in the Epidemiological Society of London. In 1887 he was president of the American Public Health Association, which society, in 1885, awarded him the Lomb prize of $500 for an essay on disinfectants, and in 1897 he was made president of the American Medical Association. He has written 125 papers, in addition to which he has published 29 single works, including *Photomicrographs and How to Make Them* (Boston, 1883); *Malaria and Malarial Diseases* (New York, 1884); *Disinfectants and Individual Prophylaxis against Infectious Diseases*, Lomb prize essay (Concord, N. H., 1886); *Report on the Etiology and Prevention of Yellow Fever* (Washington, 1890); *A Manual of Bacteriology* (New York, 1892); *Protective Inoculations in Infectious Diseases* (Concord, N. H., 1893); *Immunity, Protective Inoculations in Infectious Diseases, and Serumtherapy* (New York, 1895); and *Researches Relating to the Specific Infectious Agent of Smallpox and the Production of Artificial Immunity from this Disease* (Chicago, 1896).

MARCUS BENJAMIN.

**Stetson, John B., University**: an institution of learning in De Land, Fla.; non-sectarian; chartered in 1887. It has an endowment of $201,500, five buildings, a library of nearly 9,000 volumes, chemical, physical, biological, and bacteriological laboratories, a museum containing numerous mineralogical, geological, and marine biological specimens, and a collection of Florida birds. Work is done in the following departments: Collegiate, academic, normal, commercial, music. Instruction is also given in art. The college has two courses, the classical and the scientific, leading, respectively, to the degrees of A. B. and S. B. After the freshman year a liberal range of electives is permitted. The university is active in university extension work, and offers correspondence courses. In 1898 it was affiliated with the University of Chicago. There are three scholarships which pay all expenses. In the academic work a distinctive feature is instruction in philosophy, political economy and political science, and constitutional law. Seven professors, 2 acting professors, and 23 instructors and assistants compose (1899) the faculty. The attendance in all departments is 375. John F. Forbes, A. M., Ph. D., is president.

**Stevens**, JAMES GRAY: lawyer and legal writer; b. in Edinburgh, Feb. 25, 1822, receiving his education in the Edinburgh schools and university; went to New Brunswick in 1840, and was called to the bar in 1847, since which time he has practiced his profession at St. Stephens, New Brunswick; was a member of the New Brunswick Assembly 1861–64 and 1866–67, when he was made queen's counsel and appointed county court judge. He is a popular public speaker and active in agricultural and educational affairs. He has published *An Analytical Digest of the Decisions of the Supreme Courts of N. B. from 1825 to 1873 inclusive* (1873), and *from 1873 to 1887* (1887); *Indictable Offenses and Summary Convictions* (1880). F. STURGES ALLEN.

**Stoddard**, WILLIAM OSBORN: author; b. in Homer, N. Y., Sept. 24, 1835; graduated at the University of Rochester in 1858; edited the Chicago *Daily Ledger* for a short time, and was for three years editor of the *Central Illinois Gazette*, vigorously opposing slavery; was a private secretary to President Lincoln 1861–64, and U. S. marshal for Arkansas 1864–66; has secured patents for improvements in desiccating processes and in machinery, and invented a center-locking printer's chase. He has published *Royal Decrees of Scanderoon* (1869); *Verses of Many Days* (1875); *Dismissed* (1878); *The Heart of It* (1880); *Dab Kinzer* (1881); *The Quartet* (1882); *Esau Hardery* (1882); *Talking Leaves* (1882); *Wrecked?* (1883); *The Life of Abraham Lincoln* (1884); *The Volcano Under the City*, depicting the draft riots of 1863 in New York city (1887); *Inside the White House in War Times* (1890); and *Men of Business* (1893).

**Stoeckel**, GUSTAV J.: musician; the first Professor of Music in Yale University; b. in Bavaria, Nov. 9, 1819, and went to the U. S. in 1848 with letters of introduction to members of the Yale faculty; began his connection with Yale in 1852 as instructor of music and college organist. In 1864 he received the degree of doctor of music, and, the Battell professorship of music having been founded, he was appointed to the position in 1890. Besides his work in the college, he has directed many concerts and musical enterprises in New Haven, produced several oratorios, compiled a number of music-books, composed four operas, several overtures, many anthems, orchestral pieces, and small works. The breaking down of his health compelled him to retire in 1894, and he was succeeded by Horatio W. Parker.

D. E. HERVEY.

**Stokes**, HENRY NEWLIN, Ph. D.: chemist; b. in Moorestown, N. J., Oct. 24, 1859; graduated at Haverford College in 1878, and then entered the Johns Hopkins University, where he spent six years as a fellow, studying chemistry under Ira Remsen and biology under Henry M. Martin, and received the degree of Ph. D. in 1884 for a thesis on *Phthalic Sulphinide*. From 1885 to 1892 he was a student in chemistry at the University of Munich and at the Polytechnikum in Zurich. On his return to the U. S. he became assistant chemist in the U. S. Geological Survey, which place he held until 1892, when he became assistant professor in the University of Chicago in charge of general and inorganic chemistry. This appointment he resigned in 1893 and returned to the U. S. Geological Survey as assistant chemist, which place he still holds. Dr. Stokes is a member of the American Chemical Society, and also of similar organizations in Germany and France. He has been very active in chemical investigation, especially in the field of inorganic chemistry. The results of his researches have been published mainly in the *American Chemical Journal* and have been on oxy- and amido-oxy-pyridines; on esters of silicic acid; on amides of phosphimic acid; on metaphosphimic acids; and on chloronitrides of phosphorus, which constitute a remarkable and unique series of inorganic polymers.

MARCUS BENJAMIN.

**Stone**, FREDERICK DAWSON, Lit. D.: librarian; b. in Philadelphia, Pa., Apr. 8, 1841; was educated in private schools, and entered his father's silk-importing house as an accountant; enlisted in the Union army at the outbreak of the civil war, and took part in the Gettysburg campaign; became a member of the council of the Historical Society of Pennsylvania, and librarian of that association in 1876, holding the post until his death; was recognized as an authority on the colonial history of the U. S.; received the degree of Lit. D. from the University of Pennsylvania; was for several years editor of the *Pennsylvania Magazine of History*. His works include *The Founding of Pennsylvania*; *The Struggle for the Delaware*; *Pennsylvania and the Federal Constitution*, in collaboration with John B. McMaster (1888); *The Battle of Brandywine*, a monograph; and *A Plea for the Study of Genealogy*, an address. D. in Philadelphia, Aug. 12, 1897.

**Storage Batteries**: batteries of voltaic cells for the storage of electric energy. Voltaic cells may be conveniently divided into two classes: primary and secondary cells. The primary cell, which consists of two chemically different metals, such as zinc and copper, plunged in an electrolyte, gives an electric current whenever the two metals are brought into metallic contact. This current, the energy of which is obtained by the combination of one of the metals with the acid radical of the electrolyte, will continue to flow until the supply of metal and electrolyte is exhausted. The products of the reaction must then be removed and fresh material supplied before the cell can be brought into activity again. In the secondary cell the necessary difference between the two metals is brought about by the direct action of the current flowing through the cell. The current employed for this purpose, which is called the charging current, has a portion of its energy transformed into potential energy of chemical combination, in which form it may be said to be stored—whence the term storage battery. After the charging process has gone on for a sufficient length of time the cell may be taken out of the circuit, its terminals may be metallically connected, and it may thus be made to give current just as any primary cell would do. This current, which is called the discharging current, flows in the opposite direction from the charging current. The amount of energy which may be obtained from it can never exceed the total energy stored in the cell by the action of the charging current, but under the best conditions it may approach very near to the latter in amount.

There are numerous combinations of metals and electrolytes from which action such as this can be obtained, but in order that a storage battery shall be of practical use it is necessary that charging may take place over and over again without serious deterioration in the capacity or performance of the cell. The combination of materials which most completely fulfills this condition, as has been pointed out in the article ACCUMULATOR (*q. v.*), consists of two plates of lead submerged in dilute sulphuric acid. If the electric current be sent through such a cell the metal plate from which the current enters the electrolyte will be oxidized, and the other where the current leaves the liquid to enter the metal will be converted into spongy lead.

Of the two original processes of making secondary cells described in the article just cited, that of Planté (1860), which consisted in oxidation of the surface of the positive plate and the production of spongy lead on the surface of the negative plate by long-continued action of the voltaic current, was for many years almost completely supplanted by the later process of Faure (1878). The latter process, which was independently discovered by Metzger, consisted in applying oxides of lead, chiefly red lead and litharge respectively, to the surfaces of the plates in order to shorten the operation of formation by the action of the current. There has since been a reaction, and in the manufacture of storage batteries, which has grown to be an important industry, modifications of both processes are extensively employed.

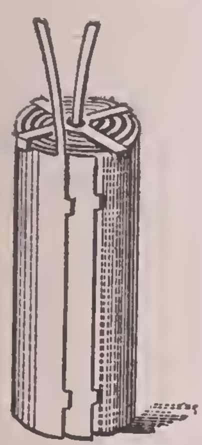

FIG. 1.

Planté, in order to secure a very large surface and low resistance, rolled two sheets of lead side by side, as shown in Fig. 1. These sheets, which were kept apart by means of flexible strips of vulcanite, formed respectively the positive and the negative element of the cell. The roll was submerged in a cylindrical jar of dilute sulphuric acid.

The Planté process is modified in modern commercial practice in several ways. The plates are sometimes built up of bundles of corrugated ribbons of lead, as shown in Fig. 2. Sometimes they are folded back and forth with a frame or grid of lead or alloy, a device due to Sorley (Fig. 3). Such ribbons are sometimes coiled into flat spirals and forced into circular holes in a solid plate. In other cells the grid is grooved or slit in a variety of ways to increase

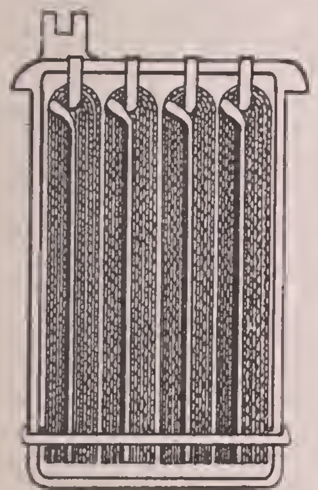

FIG. 2.

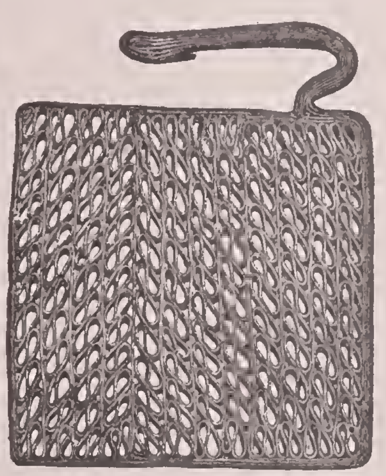

FIG. 3.

the surface. Another important modification consists in submerging the plates, constructed in any of the ways described above, in a solution which attacks the lead and greatly hastens the subsequent formative action of the current.

The modern development of the process of Faure or Metzger consists essentially in constructing the grid, which is cast of lead or of some alloy of lead, in such a form as to hold as large a quantity as possible of the oxides applied in the form of pasté. Great difficulty has been experienced from the loosening of this active material in the process of charge and discharge through which the battery has to go alternately in the course of its existence, and a large number of ingenious forms have been given to the grid for the purpose of holding the paste securely in place. The grid is sometimes cast in a form similar to that shown in cross-section in Fig. 4, with deep recesses on each side to hold the paste. Another plan is to cast the grid in halves, which are placed face to face, leaving pockets beveled inward for the active material (Fig. 5). A highly developed example of this type is the *Correns* grid shown in Fig. 6. This consists of a double latticework, beveled within the network, the halves placed as shown in the figure so that the openings on opposite sides do not coincide. The entire space between the two lattices is filled with the active material, which in the case of the positive plate is minium, and for the negative litharge.

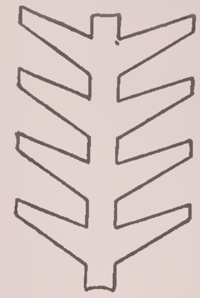

FIG. 4.

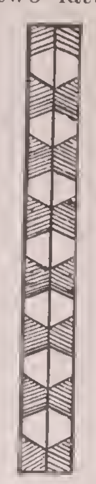

FIG. 5.

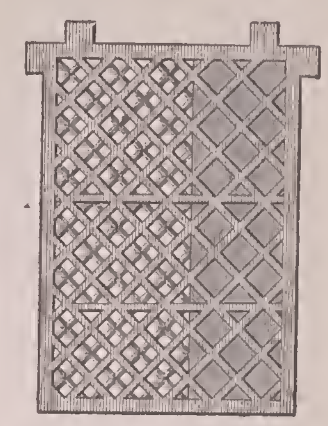

FIG. 6.

A very serviceable home-made grid, which has been found to render excellent service, is made by splitting ordinary lead pipe, about 1 cm. in outer diameter, and mounting the sections one above another, as shown in Fig. 7. The interstices are filled with litharge for the negative and with red lead for the positive plates, and the formation is accomplished by means of the electric current in the usual manner. The sections are held in place by casting a frame of lead around them in such a manner as to give support to the ends of the pipe.

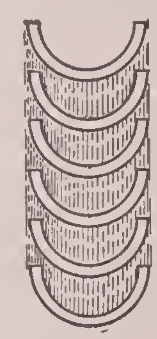

FIG. 7.

It would greatly exceed the limits of this article were mention to be made of even the most important of the numerous variations that have been introduced into the construction of storage batteries. In some cells porous partitions are placed between the plates to hold the active material in position; in others the oxides are placed in a porous dish of non-conducting material. Other salts of lead have been used instead of the oxides before formation; various salts have been dissolved in the electrolyte to increase the conductivity or modify the reactions; other metals than lead and likewise non-metallic substances have been used for the grids.

Whatever form be given to the storage battery, the final result produced by the charging current and the change which the battery undergoes during the process of discharging is much the same. The discharging current gradually undoes the work which the charging current has done in the process of forming the battery, reducing the oxide on the surface of the positive plates, and oxidizing the spongy lead of the negative plates. The result is a falling off in

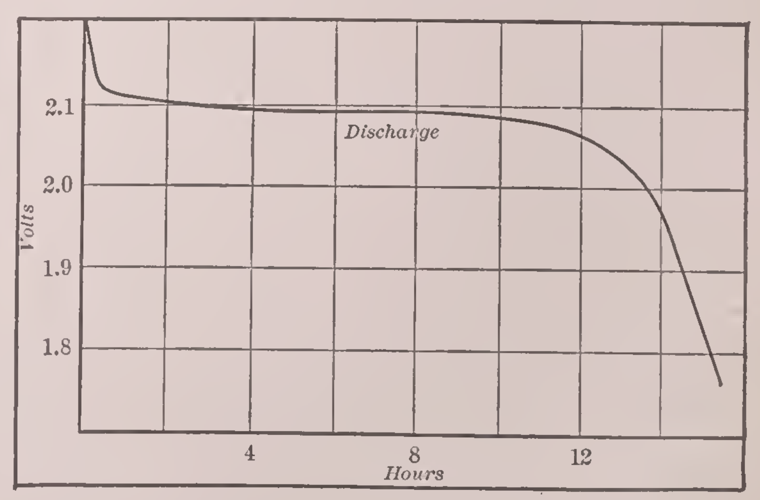


FIG. 8.

electromotive force, slow at first, then after a certain period much more rapid. The character of this change as it occurs in a normal discharge of a battery is shown in Fig. 8. When the point is reached where the curve of electromotive force begins to bend suddenly downward the discharge must be interrupted, otherwise a new set of reactions begin to take place as the result of electrolysis within the cell which are not to be readily undone by the subsequent action of the charging current. The further use of the battery without recharging is then likely to do it permanent damage, and perhaps to ruin it. The approach of this danger-line is indicated in a number of ways. The voltameter, which at the beginning of discharge should have indicated a potential difference for each cell of about 2·1 volts, will have fallen to about 1·9 volts. The density of the acid, which is at its maximum when the battery is fully charged, falls off during discharge, and a suitable hydrometer merged in it can therefore be made to indicate the degree of depletion of the cells and the approach of the condition of complete discharge.

If the circuit be opened before the critical point is reached and a charging current be sent through the cell from an outside source, these processes are all reversed: reoxidation of the positive plate occurs, together with a reduction of the surface of the negative plate to its normal condition of spongy lead, and after an amount of energy slightly greater than that which has been taken from the cell has been expended, the cell will have returned virtually to its original condition. That there must be loss of energy in this cycle of operations is obvious, and this must manifest itself primarily through the development of heat both during charge and discharge.

The chemistry of the secondary cell of a storage battery is in reality much more complicated than would be inferred from the foregoing statements. Much attention has been given to this subject, especially by Ayrton, by Frankland, and by Gladstone and Tribe, who have pointed out—what is indeed recognized by every student of the subject—that there are formed in the electrolytical processes which go on in the cell a variety of oxides and hydrates of lead, as well as of basic sulphates of that metal, and that the changes which occur in charging and discharging do not supplement each other completely throughout to such an extent as to bring the cell back to precisely its original condition. The existence of these irreversed reactions leads to depreciation of the battery, and it is an important part of the art of operating such batteries to keep this depreciation at a minimum.

The principal function of the storage battery is to supplement the work of dynamo-electric machines. Batteries do this in various interesting ways. The character of the work to be done by a station for the distribution of electric light or power, for example, is very unequally distributed throughout the twenty-four hours. In a lighting station the times of chief demand will be during the early morning and the early evening, and there will be times during the day and between midnight and early morning when the load will be so light that engines can be kept running only at a loss. A storage battery the electromotive force of which equals that of the generators of such a station can be made to carry these light loads without the assistance of the engines, thus enabling the latter to be taken out of service altogether for several hours of each day. The demand for energy during the busy hours of the day at such a station is, moreover, so greatly in excess of the average load that it becomes necessary to build engines and generators oftentimes of more than double the size necessary to carry the average load. This may be avoided by the use of a storage battery put on in addition to the engines and generators during these hours. If the capacity of the battery at its maximum discharge rate is equal to the capacity of the generators, it makes it possible to reduce the size of the latter to that adapted to the average instead of to the maximum load.

In order that the battery shall be able to do work in these two ways, (1) by taking the place of engines and dynamos during the comparatively idle hours of midnight and midday, and (2) by supplementing them during the early hours of the morning and evening, it is necessary that it shall be charged between times, and it will be found that there are certain periods during which the load, while considerable, falls below the average, and that the generators can be employed in charging the battery during these hours of light load to great advantage. The result of this application of the storage battery is that, instead of having machines of double the size necessary for the average load, running at full load for a few hours only, and running at light loads uneconomically during the remainder of the day, it becomes possible to operate smaller engines for a portion of the day at full load, which is the most economical condition, and to stop them altogether during the remainder of the day. The economy and convenience of such an arrangement are very great.

Fig. 9 represents graphically the changes of load which might be expected to occur in such a station as that just described. The diagram shows the part of the load taken

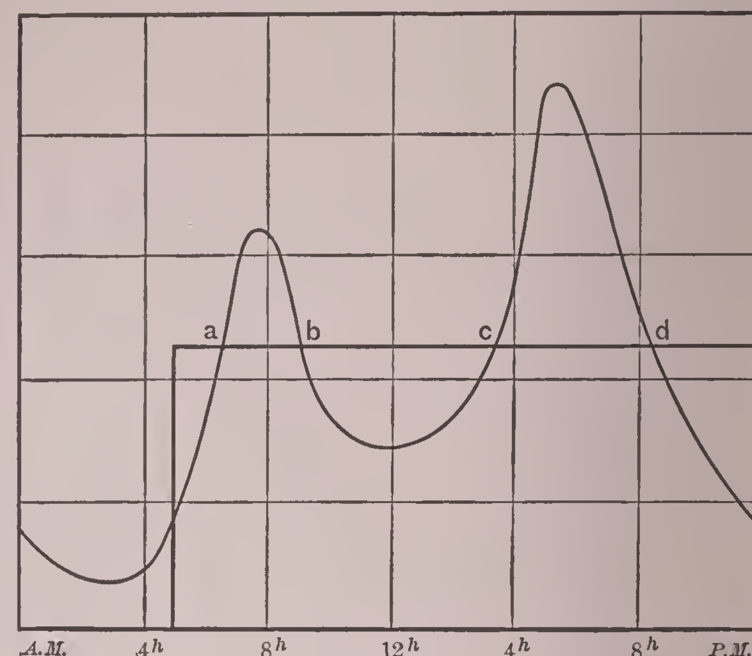


FIG. 9.

by the engines and that which is taken by the battery in the course of twenty-four hours. From midnight until 5 A. M. the engines are shut down and the battery carries the light night load. After five o'clock the engines carry the now rapidly increasing load and charge the batteries until, soon after six, the load-line crosses the horizontal line which indicates the full capacity of the engines at *a*. The batteries then help the engines with the "peak" of the load until the curve crosses the engine load-line again, soon after nine o'clock, at *b*. The engines then charge the batteries and carry the load until 3 P. M. (*c*), and in turn are supplemented by the batteries until nearly 9 P. M. (*d*). From this time until midnight, when the engines are shut down, the batteries are being charged. In stations for the distribution of power a similar state of affairs usually exists, and the function of the battery is similar to that just described.

Another very important use to which such batteries have been put consists in equalizing the sudden fluctuations of load that occur on electric railroads where a small number of cars are employed. The first application of this kind was to a suburban railroad in Zurich, Switzerland, where 270 cells of storage battery were connected in parallel circuit with the generator. Owing to the heavy grades encountered by the cars on this road, the fluctuations and the demand for current are very sudden and through a great range. Fig. 10 shows the demands on the power station of

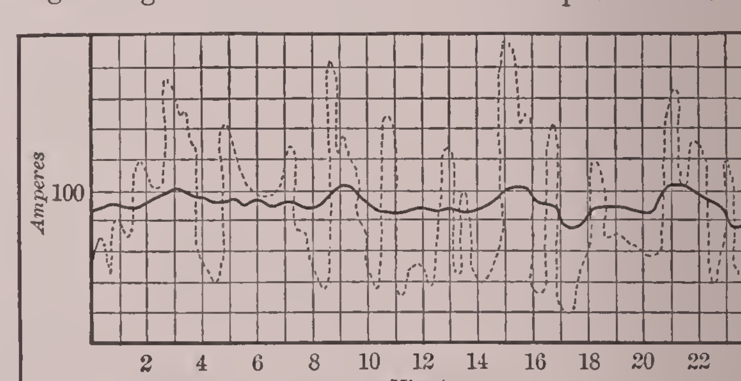


FIG. 10.

this road for current during an interval of twenty-four minutes. The battery is so arranged that whenever the load exceeds a certain normal value—namely, about 100 ampères—the surplus current will come from the battery. During such intervals of time as the demand for current falls below 100 ampères the battery is charged by the generator. The black line in this diagram shows the current demanded from the generators; the shaded areas above and below that line show the intervals during which the battery is receiving current and is delivering current to the line. As a regulator or equalizer used in this or in some similar manner the storage battery fills a very important place.

Still another way in which the storage battery has been utilized consists in locating it in a sub-station at some distant point where from time to time power is needed. To carry the current for power-distribution to such a distant station would require lines the weight of copper in which would be sufficient to furnish capacity for the maximum current ever demanded. By the installation of a storage battery in the sub-station, however, smaller currents can be transmitted to the new center of distribution over correspondingly smaller wires, and when the time of heavy demand comes the battery may be used to aid in supplying it. The saving in copper thus effected has been found an item of very great economical importance.

These are the most important uses to which storage batteries have thus far been put, if we measure importance by the number of cells or by the tons of lead thus employed. The minor applications are, however, very numerous. For electrically driven boats and launches the storage battery may be said to be the only available source of current. Electrically driven motor vehicles have to depend upon the same source. There are many instances where it has been found advantageous to place storage batteries on street cars instead of obtaining current from feed-wires along the track or from the rails of the road. The modern practice in this respect has, however, in most instances tended toward the installation of the batteries in stations and toward the feeding of the motors on the cars by means of the trolley or some substitute for that device.

It would be impossible to enumerate in this article the almost infinite variety of applications to the arts which have been made of the storage battery. There is scarcely a technical process in which at the present day electricity does not play some part, and in a large majority of cases the most convenient source of electricity for these varied purposes is the accumulator.

See, further, Planté, *The Storage of Electrical Energy* (trans. by Elwell, London, 1887); Tommasi, *Les Piles Électriques*; Benjamin, *The Voltaic Cell*; Gladstone and Tribe, *Chemistry of Secondary Batteries*; Loppé, *Les Accumulateurs Électriques*; Treadwell, *The Storage Battery*; also Ayrton, *Journal of the Institution of Electrical Engineers*, vol. xix., and memoirs by various authors in the London *Electrician*, *Transactions of the American Institute of Electrical Engineers*, etc. E. L. Nichols.

**Strachey**, John St. Loe: English lawyer and journalist; b. in 1860; received his college education at Baliol College, Oxford, where he graduated first class in history; then took up the study of law and was called to the bar, but since 1884 has given his entire time to journalism; was editor of the *Cornhill Magazine* 1896–97; is now (1899) joint editor and joint proprietor of *The Spectator*. He is best known, aside from his general writings for periodicals and newspapers, by his book entitled *From Grave to Gay*. F. Sturges Allen.

**Strack**, Hermann Leberecht, D. D.: Protestant German theologian; b. in Berlin, May 6, 1848; studied there and in Leipzig; became a teacher in a Berlin gymnasium 1872–73; in 1877 professor extraordinary in the Berlin University. He is eminent as a biblical and Talmudic scholar, and is much interested in the conversion of the Jews to Christianity. Among his numerous independent publications may be mentioned *Prolegomena Critica in Vetus Testamentum Hebraicum* (Leipzig, 1873); *Prophetarum posteriorum codex Babylonicus Petropolitanus* (1876); *Hebräische Grammatik* (Carlsruhe, 1883; 6th ed. Berlin, 1896); *Einleitung in das Alte Testament* (Nördlingen, 1883; 5th ed. Munich, 1898); *Einleitung in den Talmud* (Leipzig, 1887; 2d ed. 1894); *Das Blutaberglaube in der Menschheit, Blutmorde und Blutritus* (Munich, 1891); *Grammatik des biblischen Aramäisch* (Leipzig, 1896; 2d ed. 1897). With K. Siegfried, he issued *Lehrbuch der neuhebräischen Sprache und Litteratur* (Carlsruhe, 1884); with Zöckler, he co-operated upon the *Kurzgefassten Kommentar zu den Schriften des Alten und Neuen Testaments* (Nördlingen u. Munich, 1886, *sqq.*; 14 parts). In 1883 he founded and has since conducted the Berlin Institutum Judaicum, and, as the organ of the Mission to the Jews, in 1885, *Nathanael, Zeitschrift für die Arbeit der evangelischen Kirche an Israel*. He has published, with notes and vocabularies, the Mishna tracts *Sayings of the Fathers* (Karlsruhe, 1882; 2d ed. Berlin, 1888); *Day of Atonement* (Berlin, 1888); *Idolatry* (1888); *Sabbath* (Leipzig, 1890). S. M. J.

**Stranahan**, James Samuel Thomas: b. in Peterboro, Madison co., N. Y., Apr. 25, 1808; attended a district school for a few terms, then studied in an academy; taught school for a year, and afterward became a surveyor. He went to the Northwest in 1827 for the purpose of trading with the Indians, but failed, and returning entered the wool business in Albany, N. Y. In 1832 he established the town of Florence, N. Y., and in 1838 he was elected Assemblyman for that town. In 1840 he moved to Newark, N. J., and became a railroad contractor, taking part of his pay in stocks, thus acquiring a large interest in several profitable roads. In 1844 he settled in Brooklyn, N. Y., because of his interest in the Atlantic Docks there, an enterprise then only beginning, and from which no dividend was declared until 1870. In connection with the construction of these docks, which are 2 miles in length, 200 acres of land were reclaimed from tide-water, warehouses were built with a frontage of a mile, and the dwellings on the reclaimed land accommodate 15,000 inhabitants. Mr. Stranahan was also a large owner of the Union Ferry Company and prominent in its management. He became an alderman in 1848, and in 1850 was nominated for mayor, but not elected. In 1854 he was elected to Congress. In 1858 he was a police commissioner under the metropolitan system, which embraced the two cities New York and Brooklyn. The institution of this system nearly led to rioting, in the prevention of which he was largely instrumental. He was a delegate to the Chicago convention in 1860, and voted for the nomination of Abraham Lincoln. During the civil war he was active in raising funds in connection with the women's relief committee, of which his wife was president. Under the act of 1860 providing for the making of a park Mr. Stranahan became a park commissioner, and he remained at the head of the commission twenty-two years, during which time he virtually controlled its action in the expenditure of nearly $9,000,000. He was also prominent in the movement that led to the building of the Brooklyn bridge, and through this and the park was popularly called "the wizard," "the magician," and "Brooklyn's first citizen." On June 6, 1891, a bronze statue of Mr. Stranahan was unveiled at one of the entrances to Prospect Park. The last public work in which he engaged was the consolidation of New York, Kings, Queens, and Richmond Counties into the present city of New York. He was a member of the first commission that considered the project, and a strong advocate of consolidation. D. in Saratoga, N. Y., Sept. 3, 1898.

**Strathcona and Mount Royal**, Sir Donald Alexander Smith, Lord: b. in Archieston, Scotland, in 1820; entered the service of the Hudson Bay Company in 1838, and was promoted until he became resident governor and chief commissioner of the company in Canada. In 1870 he entered the Legislature and the House of Commons, but resigned his seat in the Legislature four years later. He remained in the House until 1880, and entered again in 1887, remaining until 1896, when he retired from Canadian political life on his appointment to represent the Dominion in London as high commissioner. In 1897 he was raised to the peerage as Baron Strathcona and Mount Royal. He received the degree of LL. D. from Cambridge University in 1887, and from Yale University in 1892.

**Strong**, George Templeton: musician; b. in New York city, May 26, 1856; studied music as an amateur, in both the practical and theoretical branches, and became an expert oboe-player; began to compose about 1883, and since then has produced a large number of works for orchestra, piano, and voices. These are all marked by high purpose, fine musicianship, fluent melodies, and clever construction. Of late years he has lived mainly abroad. He composes only as an amateur. D. E. Hervey.

**Strong**, Sir Samuel Henry: chief justice of Canada; b. in Poole, Dorsetshire, England, Aug. 13, 1825; was taken by his father to Canada in 1836, and received his education in Quebec; studied law in Bytown, and was called to the bar in 1849 in Toronto, where he entered upon the practice of his profession; he early achieved distinction in equity practice and in 1856 was appointed a member of the commission for the consolidation of the statutes of Canada and Upper Canada; was elected bencher of the Law Society of Upper Canada in 1860, and created queen's counsel in 1863; was appointed vice-chancellor of the court of chancery in 1869, in 1874 was appointed to the court of error and appeal of Ontario, and in the following year made puisne judge of the Supreme Court of Canada, then newly created; became chief justice of this court in 1892, and was knighted in 1893. He has filled many high positions of public trust, including the office of deputy governor and that of privy councilor in the judicial committee of her Majesty's most honorable privy council of the British Empire League.

F. STURGES ALLEN.

**Strong**, WILLIAM L.: b. in Loudonville, Richland co., O., Mar. 22, 1827; was employed in a store in Ohio till 1853, when he moved to New York, where he acquired wealth as a dry-goods merchant. In 1895 he was selected as candidate for the mayoralty of New York by the independent voters represented by a body known as the "committee of seventy," and was elected. D. Nov. 2, 1900.

**Stuart-Wortley**, CHARLES B., M. A.: English lawyer and statesman; b. in Eserick Park, York, Sept. 15, 1851; attended school at Rugby, and afterward at Baliol College, Oxford, where he received his master of arts degree in 1879; was called to the bar in 1876, and practiced on the north-eastern circuit until 1885, when he was made Under-Secretary of State for the Home Department under Lord Salisbury; served in this office until 1892; was made a member of the chairman's panel for standing committees in 1895, and also in the same year was appointed as ecclesiastical commissioner and commissioner of church estates; was a Conservative member of Parliament for Sheffield 1880–85, and for the Hallam division of Sheffield 1885–99.

F. STURGES ALLEN.

**Sturgis**, JULIAN: English lawyer and author; b. in America, Oct. 21, 1848; was taken to England when seven months old and educated at Eton and at Baliol College, Oxford; studied law and was called to the bar, becoming a British subject; traveled in the Levant in 1878, and visited the armies of Turkey and Russia then before Constantinople, and in 1880 spent some time in traveling in America. He has devoted most of his time to literary pursuits, and has published *John-a-Dreams*; *Dick's Wandering*; *John Maidment*; *My Friends and I*; *Comedy of a Country House*; *A Master of Fortune*: *After Twenty Years*; *The Folly of Pen Harrington*; *Count Julian, a Tragedy*; *Nadesha* and *Ivanhoe* (libretti); *Little Comedies*; *A Book of Song*. F. STURGES ALLEN.

**Sulte**, BENJAMIN: author; b. in Three Rivers, province of Quebec, Sept. 17, 1841; graduated at the Military School, Quebec, and was in active service with the volunteers in 1865–66. He began to write for the newspapers as early as 1860. Among his published works are *Les Laurentiennes* (1870); *Histoire des Trois-Rivières* (1870); *Melanges d'Histoire et de Littérature* (1876); *Le Coin de Feu* (1877); *Chronique Trifluvienne* (1879); *Les Chants Nouveaux* (1880); *La Poésie Française au Canada* (1881); *Histoire des Canadiens-Français* (1882–84); *Histoire de St. François-du-Lac* (1886); *Pages d'Histoire du Canada* (1891); *Causons du Pays et de la Colonisation* (1891).

**Support of Land**: in law, the support of the land of one owner which is afforded by the adjacent or neighboring land in its natural condition, or such support as will prevent its falling into an excavation made in the underlying land, the first being called *lateral support*, and the second *subjacent support*. Every owner of real estate has a right in the nature of an easement to have his land supported in its natural condition by the resistance or support of the land of the adjacent owners; and if excavation be made by the owner of adjacent lands, he must so make his excavation as not to deprive the adjacent owner of the natural support necessary to retain the adjacent owner's land in its natural position; and if excavation be made in such a manner that the adjacent land falls into the excavation, he is liable in damages to the owner of the land injured by the excavation. This right of support may, by prescription or easement, also include the right to the support of any buildings or erections which are upon the land in the same condition in which they existed before the excavation.

The right of subjacent support arises usually in the case of persons having a right to mine under the surface of another's land, as where a lessee has a right to mine coal under land over which buildings have been erected or over which a railroad is operated, or where a miner has a location at the apex of a lode and may follow it in a downward course, even though it may enter the land of an adjacent owner. In either of these cases, and in other analogous cases, the owner of the adjacent land has a right to have the surface of his land supported in its natural condition, and the excavating miner is liable for damages occasioned by the settling or sinking of land caused by his excavation.

Generally speaking, the right of support does not extend to the support of the land where the lateral pressure has been increased by the erection of structures or buildings upon the land; but every owner has a right to assume that the land will be permitted to remain in its natural state, and an action for damages arises for any violation of this right independent of the question of negligence. As respects the support of buildings upon the adjacent land, in the absence of an easement, or the like, the excavating owner is held only to reasonable care, it usually being held that he is only required to give reasonable notice to the owner of the building of his intention to excavate the adjoining land, in order to enable the owner to take the necessary measures for the preservation of his own property. After giving such notice, however, the excavating owner is bound only to reasonable and ordinary care in the prosecution of the work. If the buildings erected upon the adjoining premises, however, shall have been erected for more than twenty years to the knowledge of the adjacent owner, the right of easement of support in the adjacent wall may arise in the owner of the buildings so supported.

The measure of damages in an action for removing the support of land to which another is entitled is the amount required to restore the property to its former condition with as good means of lateral support. Special damages must be pleaded.

See EASEMENT and PRESCRIPTION. See Wade's *American Mining Law*; Lindley's *Treatise on American Law Relating to Mines and Mineral Lands* (1897); Walmsley's *Mining Laws of the World* (1804); Stephen's *Law of Support and Subsidence* (London, 1890); Washburn's *Treatise on the American Law of Easements and Servitudes*.

F. STURGES ALLEN.

**Surette**, THOMAS WHITNEY: musician; b. in Concord, Mass., and studied in Boston under Prof. J. K. Paine, of Harvard University, and during his student period composed the opera *Priscilla, or the Pilgrim's Proxy*. He established himself as a teacher of the piano and theory in Boston, remaining there eight years, and then began lecturing on musical topics in various cities, and in Sept., 1894, made his home in Baltimore. He has composed another opera, entitled *Cascabel*, a cantata on Keats's poem *The Eve of St. Agnes*, a sacred cantata, and some church music. D. E. HERVEY.

**Surveyors and Surveys**: The position of a surveyor as respects his legal relation to his employer or client is covered by the general rules and regulations controlling the rights of persons employed in any other professional capacity. An implied contract exists that he is qualified to practice his profession and make a survey which shall be accurate and reliable, and he is responsible to the party for whom the survey is made for such damages as shall arise directly to the person relying lawfully upon it by reason of any inaccuracy or mistakes made in the survey and attributable to the surveyor's negligence or the lack of proper knowledge of his profession. In the giving of evidence in a question or proceeding at law a surveyor acts as an expert witness, and his reasonable skill in his profession must be proved, as in the case of any other expert testimony, and when so proved surveys made by him personally or under his personal supervision are admissible as evidence.

A map or survey made by a person who can not appear to prove the survey may be admissible if it be proved that it was made by a person having adequate knowledge of the art of surveying, as in the case of certain ancient surveys which have been in existence for a long period of time and are admissible as ancient documents under the law of evidence. See EVIDENCE and EXPERT TESTIMONY.

F. STURGES ALLEN.

**Sutro**, ROSE and OTTILIE: pianists; sisters, daughters of Otto Sutro, of Baltimore, Md., where they were born, and received their first instruction from their mother, herself an accomplished pianist. In 1888 they went to Berlin in company with Mrs. Sutro, and remained there studying until 1893 in the Royal High School of Music, receiving the official diploma of the Royal Academy of Arts. In 1893 they played in Paris, and in 1894 in London, and in Oct., 1894, they went to New York. Since then they have played frequently in various cities of the U. S., with annual visits to Europe. They always play together on two pianos, and their ensemble playing is so exact that it is impossible to distinguish between them. D. E. HERVEY.

**Sweden, History of**: The friction between the two neighboring Scandinavian countries has been referred to under NORWAY. One notable movement in recent years is the so-called Gothenburg system for regulating the liquor traffic. The position of Sweden has kept it out of the complications of Continental politics; its leanings, however, are toward the Triple Alliance. EDMUND K. ALDEN.

**Swete**, HENRY BARCLAY, D. D.: Church of England clergyman; b. in Bristol, England, Mar. 14, 1835; graduated B.A. at Cambridge 1859; was fellow 1858–71, and tutor of Gonville and Caius College 1872–75; divinity lecturer in the university 1875–77; rector of Ashdon, Essex, 1877–90; Professor of Pastoral Theology, King's College, London, 1882–90: since 1890 has been Regius Professor of Divinity at Cambridge. Of his works may be mentioned *On the History of the Doctrine of the Procession of the Holy Spirit, from the Apostolic Age to the Death of Charlemagne* (Cambridge, 1876); an edition of the commentary on the Pauline Epistles by Theodore of Mopsuestia (1880–82, 2 vols.); but chiefly his *The Old Testament in Greek according to the Septuagint, edited for the Syndics of the University Press* (1887–94, 3 vols.; 2d ed. 1895–98); *The Psalms in Greek according to the Septuagint, with the Canticles* (1889; 2d ed. 1896); *Fragments of the Apocryphal Gospel of St. Peter* (1893); *Apostles' Creed and Primitive Christianity* (1894); *Church Services and Service-books before the Reformation* (1896); *The Gospel according to St. Mark*, Greek text with notes (1898). S. M. J.

**Switzerland**: On June 1, 1898, a system of remarkably cheap travel on all the railroads of the country was inaugurated. First, second, and third class tickets are sold, which give the purchaser, whose photograph is attached to the ticket, the privilege of riding as much as he desires over the entire railroad system and also on the lake steamers during the time of the validity of the ticket. The price varies according to the time limit of the ticket, which is issued for periods from fifteen days to one year. The Swiss have increased their exports of dyed and raw yarns, which are now distributed to 22 countries, marking a decided advance in the spinning industry. The chief characteristic of Swiss industry is that the country does not aspire to produce a large amount of cheap stuffs, but rather to gain reputation for excellence and fineness of manufactures. Textile and metal industries lead. In textiles, cotton manufactures hold the first place, followed by embroidery and silk manufactures. Cottons employ 1,800,000 spindles, chiefly in the cantons of Zurich, Glarus, St. Gallen, and Appenzell. They are usually noted for fineness of texture and excellence of dyes and prints. Embroideries are exported to the average value of $18,000,000. The silk industry has declined somewhat, owing to American competition. Woolen and linen manufactures are less developed. The most prominent metal industries are the manufacture of watches and clocks, jewelry, music-boxes, and machinery. Watch-making has been passing through a severe crisis, owing to over-production and American competition. About 3,000,000 watches, however, are produced annually, mostly cheap grades, and five-sixths of the product is exported. Manufactures of chocolate, preserved fruits, straw braid, chemicals, dyes, wood-engravings, leather, and scientific instruments have more or less importance in the export trade, while manufactures of flour, beer, glass, china, artistic metal products, etc., are not largely produced, and are mainly consumed at home. The exports to the U. S. in 1900 were valued at $17,393,268, of which laces and embroideries, silk and silk goods, clocks and watches, cheese, and aniline colors were the chief items. In 1900 the imports from the U. S. were valued at $250,477, raw cotton, petroleum, raw tobacco, preserved meat, and cereals heading the list. C. C. ADAMS.

**Synchronograph**: an apparatus for the rapid transmission of telegraphic signals by means of the alternating current. This instrument depends upon the principle that an alternating-current circuit may be made and broken without the production of a spark, provided the interruption occurs at the instant when the current is changing sign, at which time there is no current flowing in the line. This statement does not hold strictly true of circuits of large capacity, but it is approximately true of all ordinary telegraphic lines. In order that the interruptions of the circuit used in signaling may occur at the proper instants, they are made automatically by the following device: A metallic disk or drum is mounted on the shaft of the alternating generator which supplies the circuit, or is driven synchronously with the same, or is geared in some known and exact ratio with the shaft of the alternator. The current used in signaling enters this disk from an adjustable brush bearing upon its periphery, and the interruptions of the circuit are made by means of a previously perforated tape similar to that used in other systems of machine telegraphy. This tape, which travels with the revolving disk, passes under the brush, which is thus lifted from contact during a portion of the time, and which is allowed to make contact as it drops into each successive perforation. To bring the make and break thus automatically produced at the precise instant of time when the current is changing sign, the brush is adjusted backward and forward until all appearance of sparking ceases. This is found to be a simple matter, which can be performed in a moment. The lengths of the gaps in the tape are made to correspond with the angular portion of the periphery of the disk, which measures a single alternation of the current, so that when the brush is adjusted for one interruption all the subsequent ones come into the proper place. Slipping of the tape is followed by sparking and calls for readjustment of the brush.

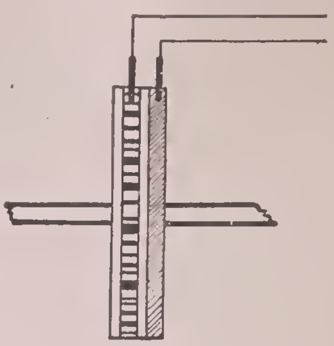

FIG. 1.

To get the requisite variety of signals for use in the telegraphic code, positive loops of the alternating current may be interrupted to indicate dots and negative loops to indicate dashes, or a positive and a negative which would correspond to the ordinary continental code (Fig. 2). Current may be carried out of the revolving disk by means of a second brush, as shown in Fig. 1, or a single brush may be used and the current may be carried out through the shaft. The circuit may be supplied directly from the alternator, or the voltage of the machine may be modified to suit the conditions of the line by the interposition of a transformer. In the latter case the arrangement would be that shown in Fig. 3, where L and L′ are the line wires, A is the alternator, T the transformer, and D the synchronous drum. It is also possible, by means of a number of independent generators arranged in multiple, to send several messages over the same line simultaneously. These may be distinguished from each other by using different frequences in the different circuits.

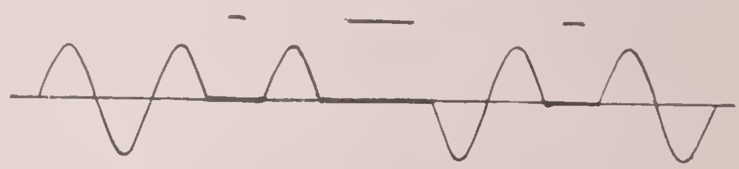

FIG. 2.

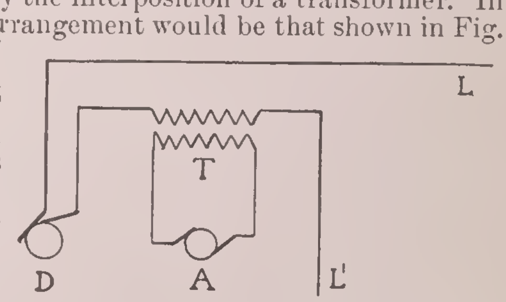


FIG. 3.

Since all interruptions of the circuit occur at the instants of time when no current is flowing, high potentials may be utilized for signaling without fear of injurious sparking.

The apparatus just described may be used with many of the forms of telegraphic receiver already employed in machine telegraphy. The ordinary Wheatstone receiver or the chemical receivers of Bain and of Delaney are suitable for this purpose. Experiments made under the auspices of the British Government showed that with the ordinary receiving instruments on their lines a notable increase in speed could be obtained. In various experimental trials the inventors of the synchronograph, Messrs. Crehore and Squier, have found it practicable to send from three to four thousand words a minute. In signaling through submarine cables the synchronograph used in connection with the ordinary commercial receivers is found to increase largely the speed of transmission without diminution in the sharpness of the indications at the receiving end of the cable. In order to reach the highest possible speed of signaling, the inventors propose to use the synchronograph in connection with a receiver based upon the principle of their photochronograph, in which a beam of light passes through a pair of crossed Nicol prisms (N' and N'', Fig. 4), and between these through a tube of carbon bisulphide (C) in the magnetic field. The field, which is caused by the current in the signaling circuit, rises and falls with each alternation and disappears altogether at each change of sign. At each alternation of current the magnetic field turns the plane of polarization of the beam of light within the carbon bisul-

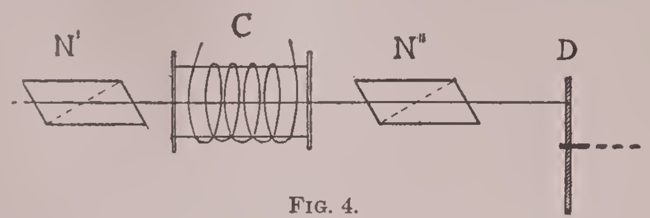


FIG. 4.

phide and permits it thus to pass momentarily through the second Nicol and to reach the sensitized surface of the revolving disk D, on which the photographic record is to be made. The record, therefore, when no signals are made, consists of successive equidistant spots of light on a dark ground, as shown at the extreme left and right in Fig. 5. The dots and dashes of the code, which are made, as has already been explained, by the suppression of one or of two


FIG. 5.

successive single alternations respectively, are signalized by the omission of the corresponding light spots from the series. The appearance of record of the word *telegraph* is shown in the middle of Fig. 5.

This form of receiver, which has the advantage of complete freedom from inertia, is not limited in the speed of its operation, as the ordinary commercial receivers used in telegraphy must be. The very high speeds at which it is capable of working have been demonstrated in its use in the determination of the velocity of the flight of projectiles and in similar experiments. (See, further, CHRONOPHOTOGRAPHY.) For details concerning the synchronograph, the reader is referred to *Transactions of the American Institute of Electrical Engineers*, vol. xiv., p. 93; also *Tests of the Synchronograph on the Telegraph Lines of the British Government*; *A Report to the Postmaster-General of the United States*; *Journal of the Franklin Institute*, vol. cxlv. (1898). E. L. NICHOLS.

**Szumowska**, shoo-mov'skaa, ANTOINETTE: pianist; b. in Lublin, Poland, Feb. 22, 1868, the daughter of a Polish professor who was banished to Siberia. After his return from exile he settled in Warsaw, where his daughter studied under local teachers. Later she went to Paris and worked for five years with Paderewski. Then she began a career as a concert pianist, and aroused great approbation in Paris and London. In 1890 she went to New York, and made a concert tour of the U. S., and a few years later was married to the Boston violinist Timothee Adamowski, with whom and his brother, a violoncellist, she has continued her professional career. D. E. HERVEY.

**Taft**, WILLIAM H.: jurist; b. in Cincinnati, O., Sept. 15, 1857; was graduated at Yale in 1878, and at the law school of Cincinnati College in 1880. He was law reporter on the *Cincinnati Commercial*, 1880–81; assistant prosecutor Hamilton County, 1881–82; collector of internal revenue, first district Ohio, 1882; judge of the Superior Court of Ohio 1887–90; Solicitor-General of the U. S. 1890–92; and U. S. judge, sixth circuit, 1892–1900. In Mar., 1900, he was appointed by President McKinley president of the commission to organize and establish civil government in the Philippines, and on July 4, 1901, became Civil Governor of the islands (appointed June 22).

**Tait**, ARTHUR FITZWILLIAM: artist; b. near Liverpool, England, Aug. 5, 1819; studied painting at the Royal Institution, Manchester; chiefly relied upon self-instruction; removed to the U. S. in 1850, and soon became celebrated for his pictures of animal life, many of his productions having been lithographed or engraved; became a member of the National Academy in 1858; studied and sketched much in the Adirondacks, where a number of his hunting scenes are laid. His paintings include *A Duck and Her Young*; *Ruffled Grouse*; *Woodcock-Shooting*; *Snowed In*; *Halt on the Carry*; *Racquette Lake*; *There's a Good Time Coming*; *The Portage*; *Jack in Office*; *Thoroughbreds*; *Startled*; *A Mother's Solicitude*; and *Quail and Young*.

**Tait**, JOHN ROBINSON: artist and author; b. in Cincinnati, O., Jan. 14, 1834; graduated at Bethany College, Va., 1852, immediately afterward traveling for several years in Europe, devoting himself to literature and painting; studied and worked in Düsseldorf 1859–71; was awarded first-class medals at the Cincinnati Industrial Exhibition 1871–72; visited Europe again in 1873, working and studying in the Tyrol and in Munich; returned to the U. S. in 1871, and has resided in Baltimore since 1876; designed the art hall of the second Cincinnati Exposition. His principal publications are *Dolce Far Niente* (1859), and *European Life, Legend, and Landscape* (1860), and he has written a comedy in German called *Ein aufrichtiger Heirathsgesuch*. Among his paintings are *Siebengebirge*; *Lake of Wallenstadt*; *Meyringen*; *Lake of Four Cantons*; *A Norwegian Waterfall*; *Solitude*; *A Rainy Day*; *Under the Willows*; *Vesper Hour*; *A Tyrolean Cottage*; *Noon*; *Crossing the Brook*; and *Landscape and Cattle*.

**Tait**, Sir MELBOURNE, D. C. L.: jurist; b. in Melbourne, Quebec, 1842; educated at St. Francis College, Richmond, Quebec, and in 1859 began to study law in Montreal, graduating with the degree of B. C. L. from McGill University in 1862; was admitted to the bar of the province of Quebec in 1863; practiced law a short time in Melbourne, and then removed to Montreal; after a period of very successful practice at the bar he was, in 1882, appointed queen's counsel, in 1887 was appointed judge of the Superior Court, and in 1894 was made acting chief justice for the Montreal division. F. STURGES ALLEN.

**Tarr**, RALPH STOCKMAN, B. S.: educator; b. in Gloucester, Mass., Jan. 15, 1864; B. S., Lawrence Scientific School, Harvard University, 1891; assistant U. S. fish commissioner, 1883–84; assistant, Texas Geological Survey, 1889–90; assistant, U. S. Geological Survey, 1888 and 1891–92; Assistant Professor of Geology, Cornell University, 1892–96; Professor of Dynamic Geology and Physical Geography, same, since 1896. He is author of *Economic Geology of the United States*; *Elementary Geology*; *Elementary Physical Geography*; *First Book of Physical Geography*; and numerous articles in scientific and educational magazines. C. H. THURBER.

**Tax Laws**: Taxes, or the burdens or charges imposed by law upon persons and property for public purposes, are levied and collected by laws passed under the authority of the state for the support of the government and the meeting of the public needs. The power of passing laws for the purpose of levying taxes is inherent in all governments, and is limited only by the provisions embodied in the expressed constitution, which itself is revocable by the people of the state.

*Restrictions upon the Taxing Power in the U. S.*—In the U. S. the only direct limitation contained in the Constitution is that no tax or duty shall be laid on articles exported from another State. There are other provisions for the equitable and just distribution and collection of taxes—such as that capitation or direct taxes shall be paid in proportion to the Federal enumeration upon which representation in Congress is based; that duties, imposts, and excises shall be uniform throughout the U. S.; and that no preference shall be given by any regulation of commerce or revenue to the ports of any one State over those of another. These latter, however, are rules describing rather the mode in which taxes shall be regulated than limitations upon the tax power. Direct taxes are the only ones which require to be laid in proportion to the representation of States in Congress, all other taxes being assessable without apportionment; but all taxes must be levied in accordance with the rule of uniformity.

There are no direct limitations upon the power of the States of the U. S. to levy taxes except those which provide that no State may, without the consent of Congress, lay imposts or duties on imports or exports except such as may be necessary for the proper execution of their inspection laws.

The clause of the U. S. Constitution which vests the control of interstate commerce in the Federal Government in effect prohibits the several States from any exercise of the power of taxation which in effect regulates or restricts such commerce. A further restriction upon the taxing power of a State arises out of the provision of the Federal Constitution that no State shall pass any law impairing the obligation of a contract, so that, as a result of this, exemptions from taxation which are granted upon conditions that are accepted, and other stipulations with reference to taxation embodied in the charters of corporations which are contracts, can not be modified by subsequent legislation. This limitation, however, does not deprive the State of the right to a reasonable regulation of the use and operation of the rights and privileges which have become vested; nor is it a violation of the constitutional provision to change the method of taxation.

All taxes to be valid must be based upon notice given to the taxpayer, affording him a reasonable opportunity to be heard and dispute the propriety and justice of the tax levied upon him; and any statute which makes assessments without such notice, or attempts to validate void assessments without providing for such notice by reassessment or otherwise, is unconstitutional and void. There is no definite time or place when and where the taxpayer shall be entitled to be heard, except that they must be such as are reasonable under the circumstances; and it is sufficient if he is afforded an opportunity to be in an action brought for the collection of the tax.

Most of the States of the U. S. provide in their constitutions that taxes shall be equal and uniform, conforming to the construction of the clause of the Federal Constitution which forbids any State to deny any person within its jurisdiction the equal protection of the law. This restriction requires that all property of the same description shall be uniformly taxed, and that taxes shall be so levied as to give to all within the limits of the district in which the tax is levied equal benefits therefrom, and so that they shall bear with equal burden upon all of those upon whom the tax is levied. Approximate equality in taxation, however, being all that is obtainable, is construed to be in conformity with this rule. A State tax, therefore, must be imposed equally upon all parts of the State, and a county tax equally upon all parts of the county, etc. In order to secure equality and uniformity, property must be taxed according to its value, which must not be arbitrary or artificial, nor estimated by arbitrary or artificial rules.

*Delegation of Taxing Power.*—The power of taxation is entirely legislative; and if this power be in any part delegated or intrusted to a judicial or other body, the action of such body in imposing a tax is quasi-legislative. Executive officers have power to enforce tax laws, but they may not vary them by adding or taking away from the amount levied, or the nature of the property levied upon, or in any other way. The Legislature may regulate the method of imposition and collection of taxes, and may change them at any time before the taxes have been paid; and in the absence of constitutional restrictions, may pass retrospective legislation which will be valid provided it does not avoid the obligation of contracts or divest persons of their property without due process of law.

The power of levying taxes can not be delegated to the judiciary or to the executive or administrative branch of the Government, nor to individuals or corporations. The control of the details as to the levying and collection of the taxes, however, may be delegated, or the power to determine the existence of a fact or state of facts upon which the effect of law shall depend. The conferring of the power to tax upon counties and States and other municipalities to such an extent as may be necessary to the proper conduct of the local government is not a delegation of the power to tax, but the action of such municipality in levying a tax constitutes an exercise of the taxing power by the State itself.

*Relinquishment of the Right of Taxation.*—A State or municipal government may relinquish its right of taxation by an act constituting a contract based upon a sufficient consideration, and such relinquishment may be for a limited or unlimited period, and when such relinquishment has once been made, the revocation of it is void as against the provision of the Federal Constitution which prohibits legislation avoiding the obligation of a contract.

*Purpose of Taxation.*—All taxes must be imposed with the intention of raising revenue for public purposes. What constitutes a public purpose within the meaning of the law is a matter which must be judicially settled, the common purposes being construction and maintenance of highways and bridges intended for public accommodation; roads and highways and public improvements in the nature of highways; the construction of harbors, piers, breakwaters, etc.; the draining and reclaiming of swamps and overflowed lands; the manufacture of gas; the supply of water; the maintenance of a fire department; the protection of the public health; the regulation of market-houses; the maintenance of schools, poorhouses, hospitals, etc.

It has been held that taxes levied for private manufacturing enterprises, or to aid individuals in rebuilding districts destroyed by fire, or for the purpose of furnishing amusement to the public, are not for public purposes within the meaning of the law. A tax must also be levied and expended in such a way as to inure to the benefit of the district or locality taxed, although a tax is not rendered void by the fact that an indirect benefit may accrue to a locality other than the one upon which the tax is levied.

*The Levy and Assessment of Taxes.*—A tax may not be levied except within the jurisdiction of the State or Government imposing the tax, either actually or constructively. Land can be taxed only within the actual limits of the taxing State or Government, and a tax levied elsewhere is void and does not affect the liability of the owner upon the assessment rightly made. Personal property, as a general rule, is construed to be situated at the owner's domicile, and there to be taxable; but the State may, and often does, tax such property at the place where it is actually situated. The levying of a tax consists in the legislative act by which the tax is imposed; but the term is also used to denote the levying upon the property which is an incident of the collection of the tax. There should be a record of the levy of taxes, which should contain a record of every essential proceeding in a written and permanent form, such record being usually the only evidence to show that the tax was duly levied. It must show that the necessary statutory requirements have been complied with, and that the methods of levying and collecting the tax imposed by statute or legislation have been substantially followed. The absence, however, from the record of any fact or proceeding essential to the valid levying of a tax is not conclusive evidence that the tax was wrongly levied, but raises a presumption which must be disproved by further evidence.

The time and methods at which assessments for purposes of general taxation are required to be made are expressly prescribed by statute, and the requirements of the statute must be strictly followed. In some of the States provision is made for the correction of errors or irregularities by boards of equalization or review, usually consisting of county commissioners or supervisors. These boards can act only when specially authorized and within the strict limits of the authority conferred upon them. Their duties usually consist in adjusting and equalizing the valuation of property in the several tax districts, to the end of making an equitable apportionment of the burden of taxes upon each district. They ordinarily can increase or decrease the valuation of a district for this purpose, but, except when expressly authorized, can not change individual assessments or the valuation placed upon particular classes of property.

*Tax Liens.*—The lien of a tax upon property is wholly statutory, and its priority to other liens is determined entirely by the express provisions of the statutes, and does not arise by implication. A municipal government has no power to create a lien for its taxes unless expressly authorized to do so by the State Legislature; and a lien imposed in pursuance of authority so conferred has only such priority as may be provided for in the State law.

In the absence of statutory provision as to when a tax becomes a lien upon real estate, it is generally held that it becomes a lien at the time when a certain fixed sum is made payable as a tax against the property specified. A tax lien is generally discharged either by abandonment of its right on the part of the taxing power, by the statute of limitations, by the repeal of the statute providing for levying of the tax, or by payment or tender of the amount due to the proper officer. For a treatment of the subject of tax sales, municipal taxes, tax titles, taxation of corporations, etc., see MUNICIPAL ASSESSMENTS, TAX SALES, CORPORATIONS, FOREIGN CORPORATIONS, etc. See also Cooley's *Treatise on the Law of Taxation, including the Law of Local Assessments.*

F. STURGES ALLEN.

**Tax Title**: a title by which land is held by virtue of purchase at a tax sale. Such a title, if valid, is superior to all other titles and claims upon the land so purchased, and it may be acquired by the owner himself by his purchasing the land at the tax sale. Such titles are usually subject to grave uncertainty as to their validity, by reason of the fact that the sales must be made, and the title vested in the purchaser, in substantial compliance with the laws providing for tax sales, and the fact that these sales are usually administered by officers without special training fitting them for the conduct of such technical proceedings. See TAX LAWS. F. STURGES ALLEN.

**Taylor**, CHARLES FAYETTE: surgeon; b. in Williston, Me., Apr. 25, 1827; graduated at the medical department of the University of Vermont in 1856; made a specialty of orthopædic surgery; founded the New York Orthopædic Dispensary and Hospital in 1866, and was surgeon there until 1876; was appointed consulting orthopædic surgeon to St. Luke's Hospital in 1867. He invented apparatus for use in correcting deformities and for developing muscles by exercise, for which he received medals at the Vienna and Philadelphia International Exhibitions in 1873 and 1876. He was a corresponding member of the Vienna Royal Society of Physicians. He wrote many important medical papers and books, among the latter being *Theory and Practice of the Movement Cure* (Philadelphia, 1861); *Spinal Irritation, or Causes of Backache in American Women* (New York, 1864); *Mechanical Treatment of Angular Curvature of the Spine* (New York, 1864; German translation, Berlin, 1873); *Infantile Paralysis and its Attendant Deformities* (Philadelphia, 1867); *Mechanical Treatment of Disease of the Hip-joint* (New York and Berlin, 1873); and *Sensation and Pain* (New York, 1881). D. in Los Angeles, Cal., Jan. 25, 1899.

**Taylor**, HENRY CLAY: naval officer; b. in the District of Columbia, May 4, 1845; graduated at the Naval Academy; was commissioned ensign May 28, 1863, and was attached to the Shenandoah, of the North Atlantic blockading squadron. He was on special service in 1864 and 1865; was commissioned master Nov. 10, 1865; lieutenant Nov. 10, 1866; lieutenant-commander Mar. 12, 1868, serving in the meantime on the Iroquois, the Rhode Island, and the Susquehanna. He was stationed at the Naval Academy 1869–71; was executive officer of the Saranac, flag-ship of the Pacific squadron, until 1874, and was in command of the Coast Survey steamer Hassler for the next three years. He was then at the Hydrographic Office a year, was ordered to the navy-yard at Washington in 1879, and commanded the training-ship Saratoga 1881–84, receiving his commission as commander Dec. 16, 1879. He served on special duty in 1884 and 1885, was a member of the board of inspectors for the next two years, and was granted leave of absence in 1888. In 1890 he was put in command of the Alliance, of the Asiatic squadron, was granted leave of absence in 1891, and in 1893 was made president of the Naval War College. He was commissioned captain Apr. 16, 1894, and in 1896 was ordered to command the Indiana. He was engaged in the blockade of the Cuban ports during the war with Spain, and took part in the battle of July 3, 1898, off Santiago.

**Taylor**, JAMES MORFORD, LL. D.: educator; b. in Holmdel, N. J., Sept. 15, 1843; prepared for college at South Windham, Conn., and grammar school of Madison (now Colgate) University; A. B., Madison University, 1867, and A. M. 1869; LL. D., William Jewell College, 1891; studied theology at Hamilton Theological Seminary 1868–69; instructor in mathematics in Madison University 18€7–69; principal of academy and Professor of Mathematics, Madison University, 1869–73; Professor of Mathematics in Madison University since 1873. He is author of *Elements of Calculus* (1884); *College Algebra* (1889); *Academic Algebra* (1893); *Differential and Integral Calculus* (1898).

C. H. THURBER.

**Taylor**, SAMUEL COLERIDGE: musician; b. in London, England, Aug. 15, 1875. His father was a native African of Sierra Leone and his mother an Englishwoman. He began to study music when six years old, taking up the violin, and also becoming a chorister, first in St. George's church, and then in St. Mary Magdalene church, where he still sings alto. In 1890 he entered the Royal College of Music, and won a composition scholarship in 1893. After graduation he was appointed Professor of the Violin at the Corydon Conservatory of Music and conductor of the orchestra there. His compositions are already many and remarkable. They include a symphony in A minor; a nonet for piano, strings, and wind; a quintet for clarinet and strings; a ballade in A minor for orchestra; a ballade in D minor for violin and orchestra; a string quartet in D minor; a number of songs; an operetta, *Dream Lovers*; separate pieces for orchestra, piano, violin, and other instruments; a cantata, *Hiawatha's Wedding Feast*; and considerable church music. Mr. Taylor has the color, features, hair, and most of the physical characteristics of the Negro race, but has also remarkable mental development. D. E. HERVEY.

**Taylor**, Sir THOMAS WARDLAW, K. B. M. A.: lawyer and judge; b. in Auchtermuchty, in Fife, Scotland, Mar. 25, 1833; was educated privately and at Edinburgh University, subsequent to which he studied law and was called to the bar in Upper Canada in 1858; was made queen's counsel in 1881. He held the office of master in chancery 1872–83, of puisne judge of the court of queen's bench of Manitoba 1883–87, and he has been chief justice of Manitoba since 1887. He was appointed administrator of the government of the province of Manitoba in 1890, and again in 1893. He is best known for his researches in equity jurisprudence, and has published *The Chancery Statutes and Orders*; *Commentaries on Equity Jurisprudence* (1875); *Investigation of Titles to Estates in Fee Simple* (2d ed. 1873).

F. STURGES ALLEN.

**Telegraphy without Wires**: An illustration of telegraphy without wires, or "wireless telegraphy," is afforded by any method of signaling that does not require the use of a connecting wire; for example, signaling by means of flags, whistles, or search-lights. The use of the term is generally restricted, however, to cases in which *electrical* methods are employed. At least one method of telegraphing without wires was devised, and to some extent experimentally tested, as early as 1855; but no satisfactory results were obtained until more than thirty years later. In 1884 an extensive series of experiments on the subject was begun, under the direction of W. H. Preece, by the British postal authorities. These experiments, which are still in progress, led to the adoption of wireless telegraphy for temporary commercial service at several different points in the British Isles, and in one instance the system has been in regular use, over a distance of about 3 miles, for several years. Renewed interest in the subject has been aroused since the year 1895 by experiments upon wireless telegraphy by means of electric waves. This method has been successfully employed for distances as great as 100 miles, and is now frequently used in cases where the conditions are such as to make communication by ordinary methods impracticable. The three principal methods of telegraphing without wires are briefly described below.

*Methods Depending on Conduction by the Earth.*—Two terminals or electrodes are buried in the earth at the sending station, being placed at a considerable distance apart. A strong current, so arranged that it can be conveniently interrupted, is caused to flow through the earth from one terminal to the other. It is found that this current does not flow in the straight line joining the electrodes, but spreads out as shown in Fig. 1. In the diagram the electrodes are supposed to be at A and B; the arrows represent the direction of the current flowing between them. The presence of a current in the moist earth can be detected, even at a great distance from A B, by means of a second pair of electrodes, C D, between which is placed some sensitive indicator of current, such as a galvanometer or telephone. To send signals from A B to C D the current between A and B is "made" and "broken" in accordance with any convenient code, such as the Morse code used in ordinary telegraphy. Instead of burying the electrodes A and B in the ground they may be submerged in the water of a lake or of the sea; in this case, also, the current will distribute itself in the manner indicated in Fig. 1. The method has been employed in this form in communicating between an island and the mainland without the use of a submarine cable.

The distance to which signals can be sent in this way depends upon the distance between the electrodes, the character of the soil, and the strength of the current used. For the best results the distance between A and B, and also that between the receiving electrodes C and D, should be as great as possible—say several miles. This system of signaling is subject to considerable disturbance on account of variable earth-currents due to electric railways, telegraph circuits, etc., as well as earth-currents due to unexplained causes. For this reason it has never been extensively used.

*Methods Depending on Electro-magnetic Induction.*—In the case of two circuits not far apart the sudden starting or stopping of a current in one circuit develops an induced current in the other; in fact, an induced current will be developed by the mere change in intensity of a current in a neighboring circuit. (See ELECTRICITY.) The humming

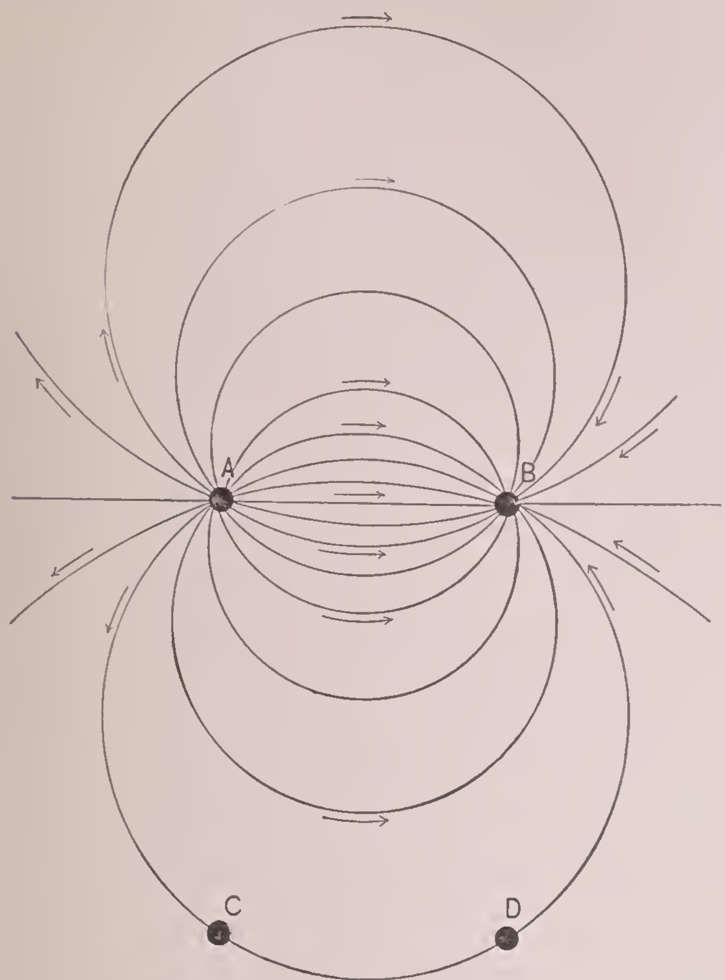


FIG. 1.

sound frequently heard in a telephone is usually due to induction from neighboring circuits, and special precautions are often necessary to prevent disturbance from this cause. All phenomena of this kind are, in a sense, illustrations of wireless telegraphy by means of electro-magnetic induction.

To utilize the phenomena of induction in practical signaling two complete circuits are required, one at the transmitting station and another at the receiving station. Signals are sent by making and breaking the current in the first circuit, and are received by any instrument that is sufficiently sensitive to indicate the induced currents produced in the second. In most cases a telephone is used for this purpose. The transmitting circuit generally consists of an overhead wire suspended at a considerable distance above the ground and having an earth return. The receiving circuit is similar to the transmitting circuit, and is placed parallel to it. Since the mutual inductive action of the two circuits is largely influenced by the area inclosed by each, the overhead wires are not only made long, but are also placed as high above the ground as circumstances will permit. In one instance, where this system of telegraphy was used in communicating between an island and the mainland, the wires were placed at the top of a bluff several hundred feet above the sea, while the return circuit was through the water.

The method above described has been used for commercial signaling in a large number of instances. It has been found especially useful as a means of obtaining temporary telegraphic communication at times when the ordinary connections were interrupted. Messages have been successfully transmitted in this way to distances slightly in excess of 10 miles. The system is in regular operation between Lavernock and the island of Flat Holm, near Bristol, England, the distance between the two stations being 3·3 miles. Attempts to signal by this method between England and Ireland have proved unsuccessful.

Inductive methods have frequently been used in signaling to and from a moving train. In this case the induction occurs between a telegraph line running parallel to the track and a wire stretched along the top of one of the cars. The principle of the method is the same as that explained above.

It is possible to increase the distance to which signals can be sent by giving suitable proportions to the sending and receiving circuits. Thus, when an alternating current is used, there is a certain relation between the self-induction and capacity of the receiving circuit which makes it respond most readily. When this condition is reached the two circuits are said to be in unison, or in "syntony." The extensive experiments that are in progress on this modification of the method are beyond the scope of this article.

*Methods Depending on the Use of Electric Waves.*—Telegraphy by means of electric waves is a more recent development than either of the two methods already mentioned, most of the experimental work on this subject having been done since the year 1895. In fact, electric waves have been known experimentally only since 1886, although their existence was predicted from theoretical considerations twenty-five years earlier. The discovery of these waves is due to Heinrich Hertz, who was also the first to investigate their properties and to determine their velocity. For this reason they are often referred to as Hertz waves. See HERTZIAN WAVES, in the Appendix.

To utilize electric waves in wireless telegraphy some form of apparatus is required at the sending station by which such waves may be developed in great intensity, while at the receiving station some instrument must be used which enables the presence of the waves to be detected. The apparatus used to develop the waves is called the "oscillator." It consists essentially of two insulated conductors, usually spherical in form, mounted side by side with a space of about half an inch or less between the adjacent surfaces. Sparks are caused to pass between the two by means of a Holtz machine or induction coil. The latter is usually the more convenient. If the sparks are truly disruptive—i. e. if they occur with great suddenness, and not as the result of a comparatively gradual breaking down of the intervening dielectric—the discharge will be *oscillatory.* (See ELECTRICITY.) To insure this condition the conductors are sometimes separated by an insulating oil instead of air; this has the additional advantage of preventing the surfaces from corroding. The violent surging back and forth of the charge on the two conductors gives rise to electrical disturbances in the surrounding ether which spread out in all directions. These disturbances constitute electric waves. Each spark gives rise to a succession of waves; in the forms of apparatus usually employed from four to ten waves are probably developed by each spark. The waves produced in this way travel with the same velocity as that of light; in fact, so far as is now known, they differ from waves of light in no respect except that of wave-length. The waves used for wireless telegraphy have a wave-length that is usually not less than 50 cm., and is in many cases as great as 200 meters.

Fig. 2 shows a diagram of a transmitter of the form above described. The two spheres $O_1$ $O_2$ form the oscillator. Connection is made with the secondary of an induction coil either directly or through the two air-gaps at $S_1$ $S_2$. A key (K) is placed in the primary circuit, and the coil is provided with some form of automatic interrupter (not shown in the figure). On pressing the key the coil is thrown into action, sparks pass between $O_1$ and $O_2$, and electric waves are sent out from the oscillator as long as the key is depressed. To send signals the key is operated in the same manner as in ordinary telegraphy.

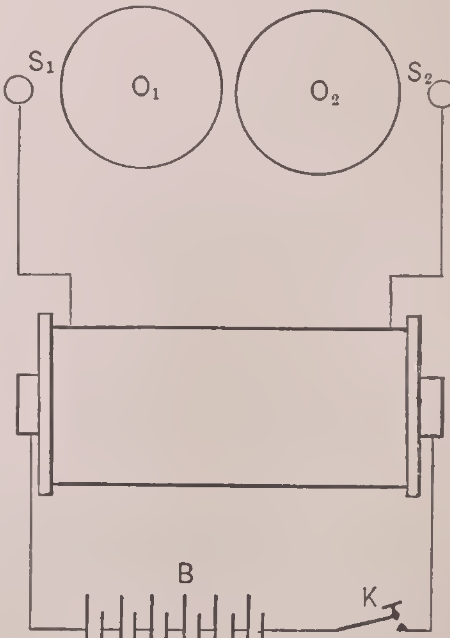


FIG. 2.

A simple form of instrument by which the electric waves may be detected at the receiving station is shown diagrammatically in Fig. 3. The essential feature of this instrument is the "coherer," C, which consists of a tube containing two terminals, $t_1$ and $t_2$, separated by metal filings. These filings lie loosely in the space between the two terminals, and on account of the succession of poor contacts between adjacent bits of metal the electrical resistance of the coherer is several thousand ohms. The coherer is connected in series with a battery, B, and an electric bell, S. Owing to the high resistance, the current developed under normal conditions is insufficient to operate the bell. The effect of electric waves falling upon such a coherer is to reduce its resistance to only a few ohms; this causes an increase in current, and the bell rings. Upon slightly jarring the tube the resistance returns to its original high value.

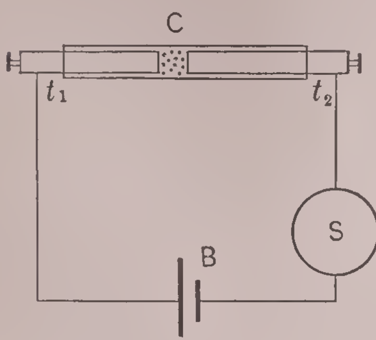


Fig. 3.

The exact manner in which the electric waves produce this effect is not known; but it is thought that they shake the filings into better contact, or perhaps cause little sparks to pass, which partly weld the filings together. This explanation of the effect, which is due to Lodge, has given rise to the name coherer. Filings of any metal may be used, but the metals differ widely in sensitiveness and certainty of action. In some cases mixtures of different metals have been used, and one experimenter has recommended that the filings be placed in a partial vacuum. A form of coherer that is often used has terminals of silver at a distance apart of about 1 mm. or less, the intervening space being loosely filled with nickel filings mixed with a trace of mercury. Opinion regarding the most satisfactory form of coherer is, however, still divided.

For distances exceeding a quarter of a mile greater sensitiveness is necessary than is attainable with the form of apparatus shown in Fig. 3. A very considerable gain is obtained by substituting for the electric bell a sensitive high-resistance relay, R (see Fig. 4). A small decrease in the resistance of the coherer, such as would be produced by waves of small intensity, is sufficient to cause the armature of the relay to move. This closes the circuit of a second battery, $B_2$, which operates the telegraph sounder, or Morse recorder, S. To restore the high resistance of the coherer and put it in condition to respond to the next signal some slight mechanical vibration is necessary. This may be obtained by an electrical vibrator operated by the same relay, R, or by some form of apparatus that will shake the coherer continuously. The jar produced by the sounder is often sufficient for this purpose.

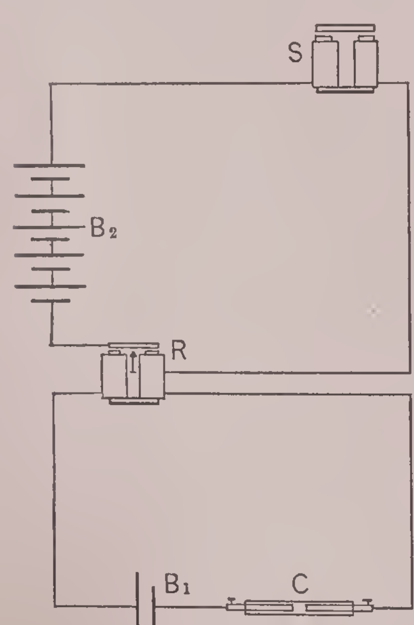


Fig. 4.

The sensitiveness may be still further increased by attaching a wire to one terminal of the coherer and carrying it as high as possible in the air, the other terminal being connected to the earth. This wire serves to collect the electric waves and carry the disturbance to the coherer. When signals are to be transmitted over great distances it is customary to connect one sphere of the oscillator to the earth also, and the other to an insulated wire extending high in the air. The length of this vertical wire is the chief factor in determining the wave-length of the electric waves developed. The vertical wires at the transmitting and receiving stations are usually made of the same length, and in many cases have been as high as 150 feet.

Telegraphy by means of electric waves is only to a slight extent affected by the presence of ordinary obstructions, such as buildings of stone or wood, lying between the two stations. In general, all substances that are not electrical conductors are "transparent" to these waves in the same sense that glass is transparent to light-waves. Metals, on the other hand, are opaque, and do not permit the waves to pass. The same is true, to less extent, with water and moist earth. A coherer on the interior of a completely closed metal inclosure will not be affected by electric waves developed on the outside. But a metal screen placed between the oscillator and the coherer is not sufficient to destroy the effect, since the great wave-length of the electric waves enables them to bend around an obstruction; in this respect they behave like waves of sound. This property of electric waves makes it possible to signal between points on opposite sides of a mountain, or between two points so far apart that the curvature of the earth makes it impossible to see one station from the other.

As already mentioned, the waves developed by the oscillator proceed from it in all directions. The signals sent by it can therefore be received by any coherer of sufficient sensitiveness in its neighborhood. In some instances this is evidently a disadvantage. Attempts have been made to remedy the difficulty by concentrating the electric waves and reflecting them in the desired direction by metallic mirrors, in much the same way that light-waves are concentrated in a searchlight. This has proved effective for distances of 2 or 3 miles, but at the present writing it has not been successful at greater distances. Another source of annoyance is due to the fact that the receiving instrument will respond to electric waves from any source within its range. The signals received from one transmitting station are therefore likely to be interfered with by those from another station in the same neighborhood. Attempts to remove this difficulty have not yet proved successful.

The discovery of the coherer is due to Branly, in France, and to Lodge, in England. The first extensive experiments on telegraphy by means of electric waves were undertaken by Guglielmo Marconi, and were in part carried on with the co-operation of the British postal authorities. Extended experiments have also been made in other countries, in some cases with Government aid; but the development of the subject is chiefly due to Marconi. Messages have been successfully transmitted for experimental purposes over distances of about 100 miles, and in a number of instances the system has been used practically for distances of 40 miles and less. Communication has been maintained, for example, between Alum Bay and Bournemouth, England (a distance of 18 miles), for two years, and across the British Channel between Folkestone and Boulogne (a distance of 32 miles) for a year. Wireless telegraphy is also in use between the Goodwin lightship and the South Foreland lighthouse (a distance of 12 miles) and has been found satisfactory even in the roughest weather. In 1899 the system was adopted by the British navy for communication between war-vessels; in the tests made during the naval manœuvres of that year messages were sent over distances of about 70 miles. It is for cases such as this, where communication by ordinary methods is difficult, that telegraphy without wires seems most promising.

Ernest Merritt.

**Telephone Law**: The laws governing the rights and duties of telephone companies and users and subscribers of public telephones are much the same as those applicable to telegraph companies. In a general sense, the term *telephone* includes all instruments or apparatus which transmit sounds beyond the limits within which they are ordinarily audible; but it is specifically and usually used to designate a device or mechanical contrivance for transmitting the sound of the human voice beyond the ordinary limits of audibility, especially by the use of electrical apparatus. The term *telegraph* has in a number of instances been construed to embrace within its meaning those instruments specifically called telephones; and in the absence of special conditions or provisions rendering such an application improper, or evidently without the intent of a statute, it would be held to apply to telephones as well as to what is commonly understood by the term telegraph. Thus in England the statute passed in 1869 regulating the transmission of telegraphic messages and telegrams, and placing it under the control of the Postmaster-General, has been held to apply to the transmission of messages by telephone, although the telephone was not invented in 1869, and was not contemplated in the act when passed.

Telephone companies when so conducted as to be open to the public in general are held to be public carriers in the same sense and to the same effect as telegraph companies, and a telephone company which receives the benefits of the right of eminent domain or other public privileges thereby assumes the character of a public carrier, and becomes obligated to permit the use of its line by the public in general under proper and reasonable regulations. Such a company is held to come within the conditions and description of a person or company engaged in a business affected with a public interest, and as such is subject to the regulation of the State. The statutes now generally prescribe that telephone companies shall provide service for all who apply, according to reasonable rules and regulations, for service as subscribers; but prior to such statutory provision it was held that such companies were bound to furnish to the public in general such facilities as were consistent with their rights and privileges under the patents or licenses under which they were doing business. The company may not discriminate against particular individuals or classes of individuals; and any contract or provision between a company and the owner of a patent used by it which stipulates that such discrimination shall be made is either wholly void or void as to such stipulation if the contract be separable in its nature.

A subscriber of a telephone company must conform to the reasonable rules and regulations of the company, and has no right to allow a telephone to be used for any other purpose than that for which his subscription is made or which may be reasonably incidental thereto. Thus the proprietor of a hotel may be enjoined from permitting his guests to use the hotel instrument for their private business, such as the calling of a carriage, a messenger, making of appointments, and the like.

It has been held that where a telephone company maintains a line with public stations operated by itself in different towns and cities it must maintain a reasonable messenger service for the purpose of notifying persons within a reasonable distance when they are wanted, and that it is liable for the negligence of its messengers, notwithstanding it may have a regulation to the contrary.

It is as yet undecided to what extent a conversation over the telephone shall be considered at law a conversation between persons in each other's presence. The decision of the question seems to depend upon the unmistakable identification of the voice of the person talking; and the legal recognition of such conversation has been carried in the State of New York to the extent of making an affidavit taken and sworn to over the telephone the basis for an attachment proceeding, although the law provides that such proceeding shall be based on an affidavit sworn to before a notary public or other qualified officer.

The maximum rates which a telephone company may charge may be fixed by legislative authority at a reasonable amount without violation of the constitution either of any State or of the U. S., and the control over rates is not taken away from the State authorities by the fact that the lines of the telephone company extend into the territory of another State; but the State can not exercise its authority over interstate messages or business in contravention of the Constitution of the U. S. See INTERSTATE COMMERCE.

On the subject of the inadmissibility of telephone messages as evidence, see vol. xxiv. of the *Weekly Law Bulletin*, p. 245; on the subject of telephone rates and discriminations, see INTERSTATE COMMERCE, and vol. xxiii. of the *Law Reports Annotated*, p. 177; see also vol. xxxv. of *American and English Corporation Cases*; Croswell's *Treatise on Law Relating to Electricity* (1895); *American Electrical Cases*; and Thompson's *Law of Electricity* (1891).

F. STURGES ALLEN.

**Tennessee Centennial and International Exposition**: an exposition held in Nashville, Tenn., May 1 to Oct. 30, 1897.

*Origin.*—A desire on the part of the citizens of Tennessee to celebrate the one hundredth anniversary of the admission of their State into the Federal Union by an exposition that would show to the world their patriotism, and at the same time promote their industrial, commercial, and educational progress, was suggested in 1881 at the time of the celebration of the centennial of the founding of Nashville. During the autumn and winter of 1893 the idea began to take shape, and at a convention called for that purpose on June 10, 1894, a preliminary organization was effected. Subscriptions were invited, and on July 8, 1895, the sum of $62,635 having been subscribed, and the city of Nashville having agreed to take $100,000 worth of stock, the preliminary officers resigned and a corporation of the stockholders was formed. Subsequently the citizens of Nashville and her two leading railways subscribed and paid in over $600,000, while in response to aid asked for of Congress, $130,000 was appropriated by that body—$30,000 for the erection of a building, and $100,000 for a complete exemplification of the workings of the national Government.

*Officers of the Fair.*—President, John W. Thomas; vice-presidents, V. L. Kirkman, W. A. Henderson, and John Overton, Jr.; secretary, Charles E. Currey; director-general, E. C. Lewis; director of affairs, W. L. Dudley; chief clerk, W. H. Bruce; commissioner-general, A. W. Wills; chairman of the finance committee, S. J. Keith; general counsel, S. A. Champion; auditor, Frank Goodman; treasurer, W. P. Tanner; and bookkeeper, C. T. Berry.

*Location.*—The site chosen for the exposition was the Old West Side Park, to which adjacent property was added, making a tract of 200 acres, and was a little more than 2 miles from the Public Square, and directly N. of Vanderbilt University. The grounds were made attractive with shade-trees, and thousands of evergreens, plants, shrubs, and blooming flowers were planted in the blue grass of the sward. Delightful drives and walks and the two lakes of Watauga and Katherine made the Centennial City, as it was called, a place of remarkable beauty.

*Buildings.*—There were perhaps a hundred structures of all kinds on the grounds, the largest of which, except the Fine Arts and History buildings, were constructed of heavy framework, the exterior being finished in staff, making them uniformly white. A brief description of the more important buildings is herewith given:

*Agriculture Building.*—This was 685 feet long by 175 feet wide, and was in the Renaissance style of architecture. It had a central dome rising to a height of 100 feet, while six minor domes balanced and lent an indescribable charm to the whole. The four entrances led under triumphal arches which were embellished with carving and surmounted by statuary. The domes were partly constructed of opaque glass, through which poured a flood of light on the exhibits.

*Auditorium.*—This was Colonial in design and Ionic in treatment. It had a square tower 140 feet high. The airy porticoes facing the points of the compass gave the building a shape resembling a short cross, except for the colonnades extending from the main entrance around in each direction to the end porticoes. Above the colonnades were pleasant balconies. Inside was the organ made by Messrs. Hook and Hastings, which was the largest organ ever brought South.

*Children's Building.*—This was built with money raised by the children of Tennessee. It was of a chaste design, and the interior was arranged to show the school system of the State. Only such exhibits were admitted as would amuse and instruct the young. A set of chimes in the tower was also procured with the fund raised by the children.

*Commerce Building.*—This was 591 feet long and 256 feet wide. The style of architecture was based on the Corinthian and Ionic orders of the Græco-Roman. The central pavilion was two stories in height, the second story forming a gallery on each side 141 by 160 feet, overlooking the nave, and reached by four broad stairways, one at each end of the four corners. Over the the central pavilion a dome rose to the height of 175 feet. Over the eastern portico was a bronze statue of Mercury of heroic mould, and the pediment beneath contained the seal of Tennessee.

*Educational Building.*—This was 144 feet long by 144 feet wide and 30 feet high, and was in the Renaissance style of architecture. The front elevation was uniform on the four sides, with an entrance from each. In addition to the exhibits of the educational institutions, this building also contained the articles pertaining to hygiene.

*Fine Arts Building.*—This was an exact reproduction of the Parthenon that stood on the Acropolis in Athens, in stone, brick, and iron. The sculptures on the pediments, metopes, and frieze were in imitation of the original, and were in moulded staff. Its fifty-eight fluted columns and every detail possible were true to the original in design and coloring. There was a large door at each end opening upon the double-columned porticoes, but no windows, light being obtained through the glass roof and incandescent lamps. The architect was Mr. William C. Smith.

*History Building.*—This was an adaptation of the Erechtheum that stood on the Acropolis near the Parthenon. Rooms on wings having the same projections and occupying the same area as the main porch in the original were used on the north and south sides of the building, giving it the form of a Greek cross. The building contained about 4,200 sq. feet, divided into five compartments. Aside from the exhibits of history and antiquities, there were displays by the Confederate Veterans, the Grand Army of the Republic, the Colonial Dames and the Daughters of the American Revolution, and a general miscellaneous exhibit. The architect was Mr. William C. Smith.

*Machinery Building.*—This was 375 feet long by 138 feet wide. The design of this structure was classic and was an adaptation of the Parthenon in part, and also of the Propylæum, the latter being used to suggest the main entrance and the former the side entrance. Utility and beauty were most harmoniously combined in the design for this building, and no steam was admitted, the boilers and engines being in a separate building some distance away.

*Minerals and Forestry Building.*—This was 526 feet long and 126 feet wide. It was of the Roman-Doric order of architecture, and had three main entrances, each marked by imposing porticoes, with six columns each, which gave the building a distinctive character. The columns guarding the entrances were crowned by sculptured gables in high relief and in beautifully appropriate designs. An annex, 162 feet long by 62 feet wide, was necessary to display the collected material. The total floor-space was 76,888 sq. feet.

*Negro Building.*—This was constructed with funds raised among the Negroes of the South, and had for its chief purpose to show exhibits of work done by Negroes in all walks of life, and illustrated the progress of that race in America from the old plantation days to the present.

*Transportation Building.*—This was 400 feet long and 125 feet wide. By the artistic grouping of the Muses and proportioning a very pleasing effect was obtained without the use of a single column. The sculpture and relief work illustrated the development of the art of carrying, from the old creaking cart to the lightning express. Railroad tracks ran through the building, and the doors at the north end were of sufficient size for the admission of engines and trains.

*U. S. Government Building.*—This was 350 feet long and 120 feet wide, and was in the form of a Greek cross, surmounted by a dome 50 feet high closely resembling that on the National Library in Washington. The display by the Government was designed to illustrate the internal operations of the various departments of the national service. It was designed in the supervising architect's office of the Treasury Department.

*Woman's Building.*—This was 160 feet long by 65 feet wide, and was modeled somewhat after the Hermitage, the home of Andrew Jackson. Eight massive columns held the roof above the portico, and higher still was an observatory surrounded by columns and highly ornamented, crowning the whole. Within the doors a rotunda extended through the two stories with a grand staircase leading up from the rear, passing a magnificent window of stained glass. The architect of this building was Mrs. Sara Ward-Conley.

*Other Buildings.*—These included special State buildings of Alabama, Georgia, Illinois, Kentucky, New York, and Texas; also of Mexico; and there were local buildings, as those of Cincinnati, Knoxville, and Memphis, the latter resembling the great Pyramid of Cheops. Nor should mention of the reproduction of the famous Rialto bridge of Venice, and the colossal statue of Pallas Athene, by Miss Enid Yandell, be omitted.

*Amusement Features.*—These were gathered in the northwestern portion of the grounds and were called Vanity Fair. The "Streets of Cairo," a Chinese village, and an "old plantation" were the ethnological shows. A cyclorama of the battle of Gettysburg was of historic interest; and a Colorado gold mine was attractive. A giant seesaw and the chutes were largely visited, while the palace of illusions and mirror maze, Night and Morning, Edison's mirage, and the phantom swing had many admirers. The wild animal arena was the menagerie feature. Besides the foregoing there were several vaudeville entertainments that were run in conjunction with restaurant privileges, notably the "Old Vienna," built to represent the walls of that city.

*Opening Exercises.*—These were conducted in the Auditorium and included an opening prayer by Bishop Thomas F. Gailor, followed by an address by President John W. Thomas, on behalf of the exposition, and then by addresses by Hon. Robert L. Taylor, Governor of Tennessee; Hon. D. L. Snodgrass, chief justice of the Supreme Court of Tennessee; Hon. John Thompson, Speaker of the Tennessee Senate; Hon. Morgan Fitzpatrick, Speaker of the Tennessee Legislature; Mayor McCarthy, of Nashville; and Major E. C. Lewis, director-general of the exposition. The machinery was then started by the touching of a button by President McKinley in the White House, and, amid the booming of cannon and other demonstrations, President Thomas pronounced the exposition open to the world. Several of the buildings were then opened with formal exercises.

*Exhibits and Awards.*—A jury of awards of 46 persons was selected, with Hon. Gardiner G. Hubbard as chairman, which examined 1,945 exhibits, and awarded 45 gold, 206 silver, and 338 bronze medals, and 179 certificates of merit, also 9 certificates of grateful recognition, and 1 certificate of honorable recognition.

*Attendance.*—The total attendance was 1,786,714 persons, of which 5,040 was prior to June 1, and 2,602 was after Nov. 1. The total paid attendance during the life of the exposition was 1,166,692. As in other expositions, each day was devoted to some special object, and of these the more important were June 11, McKinley and Ohio Day, with a total attendance of 25,212 persons, of which 20,792 were paid; June 23, Confederate Veterans' Day, with an attendance of 28,342, of which 24,407 were paid; June 24, Confederate Veterans' Day, with an attendance of 26,599, of which 22,657 were paid; Sept. 11, Nashville Day, with an attendance of 41,558, of which 38,963 were paid; Oct. 8, Nebraska Day (so called owing to the presence of William J. Bryan), with an attendance of 35,062, of which 30,829 were paid; Oct. 21, Director-General's Day, with an attendance of 33,449, of which 29,957 were paid; Oct. 23, Public Schools Day, with an attendance of 29,334, of which 25,926 were paid; and Oct. 28, Thomas Day, with an attendance of 98,579, of which 95,961 were paid.

*Expenses and Results.*—The total receipts were as follows: Subscriptions, $473,948.02; concessions, $124,757.50; admissions, $436,082.46; and receipts in connection with departments, $66,497.86; total, $1,101,285.84. The total disbursements were $1,101,246.40, leaving a balance in the bank on June 13, 1898, of $39.44. At that time it was estimated that the net value of the company's assets amounted to about $10,000, which was in excess of all liabilities, inclusive of about $6,000 of the Battle Abbey fund. The total amount spent upon the grounds and buildings, including sundry expenses, was $520,390.51.

The record of the exposition has been preserved in an *Official History of the Tennessee Centennial Exposition*, edited by Herman Justi (Nashville, 1898).

MARCUS BENJAMIN.

**Terry**, LUTHER: artist; b. in Enfield, Conn., July 18, 1813; after brief study under a portrait-painter in Hartford, went to Italy in 1838, studying for a year at the Accademia delle Belle Arti in Florence, and in 1839 went to Rome, where he afterward resided, at first devoting himself to copying from Raphael; was made an honorary member of the National Academy in 1846, like honor being conferred upon him by the academies of Philadelphia and Providence, R. I. His first important painting had for its subject Christ disputing with the doctors in the temple. Other of his works are *The Loves of the Angels*, from Byron's *Heaven and Earth*; *Columbus Before Ferdinand and Isabella*; *Jacob's Dream*; *Angel Announcing the Birth of Christ to the Shepherds*; *Toby and the Angel*; *Solomon's Choice*; and several subjects from Shakespeare.

**Thacher**, JOHN BOYD; author and collector: b. in Ballston, N. Y., Sept. 11, 1847; graduated at Williams College in 1869; served in the State Senate in 1884, and as mayor of Albany 1886–87 and 1896–97; represented New York at the Columbian Exposition 1893; has devoted much time to the collection of books, his library including many examples of the printing of the fifteenth century, one of his objects being to afford a means of identifying such early books as have no date or place of printing. A copy on vellum of the *Durandus* of 1459, the third dated book and the earliest dated book owned in the U. S., is in his collection, which also includes hundreds of autographs, and his library is rich in works relating to American history. He is the author of *The Continent of America: its Discovery and Baptism* (1896); *Charlecote, or the Trial of William Shakespeare* (1896); *Little Speeches* (1896); and *Cabotian Discovery* (1897).

**Thayer**, ELI: educator; b. in Mendon, Mass., June 11, 1819; d. in Worcester, Mass., Apr. 15, 1899. He was graduated at Brown University in 1845, and became principal of Worcester Academy. In 1848 he founded The Oread, an institute for young ladies, in Worcester. In 1853 he was an alderman of the city, and in 1853–54 a member of the Legislature. In the latter year he organized his Emigrant Aid

Company, his great plan for sending anti-slavery settlers into Kansas. Lawrence, Topeka, Manhattan, and Ossawatomie were settled under the auspices of this company. From 1856 till 1861 he was a representative in Congress, and in 1860 represented Oregon in the National Republican Convention, laboring for the nomination of Lincoln. He received patents for a hydraulic elevator, a sectional steam-boiler, and an automatic boiler-cleaner, and many other useful mechanical inventions. He published a volume of *Congressional Speeches* (1860); one of *Lectures* (1886); and *The History of the Kansas Crusade* (1889).

**Thayer**, William Makepeace: author; b. in Franklin, Mass., Feb. 23, 1820; graduated at Brown University: had charge of the orthodox Congregational church in Ashland, Mass., 1849–57, in the latter year relinquishing his pastorate and devoting himself to literature; was a member of the General Assembly in 1857 and 1863, and secretary of the Massachusetts Temperance Alliance 1860–76. He has chiefly written juvenile and religious books, and is credited with originating the conversational style. His publications include *The Poor Boy and Merchant Prince* (1858); *The Good Girl and True Woman* (1859); *The Bobbin Boy* (1859); a series of biographies (10 vols., 1859–63); *The Pioneer Boy* (1863); *Youth's History of the Rebellion* (1863–65); White House Series (1880–85); *Marvels of the New West* (1887); *From Log Cabin to the White House*; *Tact, Push, and Principle* (1880); *From Pioneer Home to the White House* (1882); and *From Tannery to the White House* (1885). He edited the *Home Monthly* and the *Mother's Assistant*. D. in Franklin, Mass., Apr. 7, 1898.

**Thomas**, M. Carey, Ph. D., LL. D.: educator; b. in Baltimore, Md., Jan. 2, 1857; A. B., Cornell University, 1877; studied at Johns Hopkins University 1877–78, University of Leipzig 1879–80; Ph. D., University of Zurich, 1883; LL. D., Western University of Pennsylvania, 1896; dean of the faculty of Bryn Mawr College and Professor of English 1885–91; president of Bryn Mawr College since 1894; elected trustee of Cornell University 1894. Author of numerous educational papers. C. H. Thurber.

**Thompson**, Albert: artist; b. in Woburn, Mass., Mar. 18, 1853; early studied painting, and traveled in Europe in 1872 and 1875: studied under masters in Paris 1880–81. Among his paintings, which are principally landscapes and cattle pieces, are *After the Shower*; *Clearing Up*; *More Wind than Rain*; *Changing Pasture*; and *An October Afternoon*. He is the author of *Principles of Perspective* (1878).

**Thompson**, Alfred Wordsworth: artist; b. in Baltimore, Md., May 27, 1840; studied art in Paris 1862–64, exhibiting at the Salon 1865, and returned to the U. S. in 1868, settling in New York city; became a member of the National Academy in 1875, and later a member of the Society of American Artists; has traveled extensively in Europe, Asia Minor, and Northern Africa. His paintings, which cover a wide range of subjects, include *Desolation*; *Lost in the Forest*; *Annapolis in 1776*; *Twilight in Corsica*; *Review at Philadelphia, 1777*; *The Market-Place in Biskra*; *The Hour of Prayer*; *Returning from a Boar-Hunt*; *Tangier*; *The Advance of the Enemy*; *Departure for the War, 1776*; *A Sabbath Day in Troublous Times*; and *The Schoolhouse on the Hill*.

**Thompson**, Hugh Miller, S. T. D.: clergyman; b. in County Londonderry, Ireland, June 5, 1830; early removed with his parents to the U. S. and settled in Ohio; received academical education in Cleveland, his theological course being taken at Nashotah House, Wis.; was ordered deacon in Nashotah in 1852, and priest in Portage in 1856, after which he had charge of Grace church in Madison; removed to Maysville, Ky., in 1853, remaining but one year; engaged in mission work in Portage and Baraboo, Wis., in 1854, and on his ordination to the priesthood became rector of St. John's church in Portage; engaged in mission work at Milwaukee in 1857, where he organized the Church of the Atonement; became rector of St. Matthew's, Kenosha, in 1858, and one year afterward removed to Galena, Ill., where he became rector of Grace church; was made Professor of Ecclesiastical History at Nashotah in 1860, and founded Kemper Hall, in the same year becoming editor-in-chief of the *American Churchman*, Chicago; became rector of St. James's, Chicago, in 1871, and in 1872 removed to New York city and took the rectorship of Christ church and the editorship of the *Church Journal and Gospel Messenger*; became rector of Trinity church, New Orleans, in 1875, remaining there until his consecration as Bishop of Mississippi in 1883, and four years later, on the death of Bishop Green, succeeded to his office; attended the third Pan-Anglican conference in London in 1888; was given the degree of S. T. D. by Hobart College in 1863. He is the author of *Unity and its Restoration* (1860); *Sin and its Penalty* (1862); *First Principles* (1868); *Absolution* (1872); *Is Romanism the Best Religion for the Republic?* (1873); *The Kingdom of God* (1873); *The World and the Logos* (1885); *The World and the Kingdom* (1888); and *The World and the Wrestlers*; lectures, sermons, and pamphlets.

**Thomson**, César: violinist; b. in Liége, Belgium, of Swedish parents, in 1857, and educated principally in the conservatory of that city, where he received the gold medal when eleven years old. After continued study under Wieniawski, Vieuxtemps, and other good masters, he made a concert tour in Italy and Spain, with phenomenal success. Then he traveled all over Europe and the U. S., making his appearance in New York on Oct. 30, 1894. He is master of the most extraordinary technic. He is also an enthusiastic yachtsman, and is a member of the Royal Sailing Navy of Belgium. D. E. Hervey.

**Thomson**, Elihu: electrician; b. in Manchester, England, March 29, 1853; educated in the public schools of Philadelphia; graduated Central High School in 1870. He was professor of chemistry and mechanics in Central High School from 1870 till 1880; and since that time he has been electrician for the Thomson-Houston and General Electric companies, who manufacture his inventions. Has obtained more than 450 patents. Invented electric welding, which bears his name, and many improvements in electric power and lighting. He was awarded the Grand Prix in Paris in 1889 for his inventions, and was decorated Chevalier and Officer of the Legion of Honor by the French Government for electrical research and inventions; Hon. A. M., Yale, and Ph. D., Tufts College. He is a member of many American and foreign scientific societies, and has contributed many papers to technical journals.

**Thorpe**, Rose (*Hartwick*): author; b. in Mishawaka, Ind., July 18, 1850; early removed to Litchfield, Mass., where she received a common-school education, and later settled in San Diego co., Cal. Among her more popular poems are *Curfew Must Not Ring To-Night*; *The Station-Agent's Story*; and *Remember the Alamo*. Her publications include *Fred's Dark Days* (1881); *The Yule Log* (1881); *The Fenton Family* (1884); *Nina Bruce* (1886); *The Chester Girls* (1887); *Temperance Poems* (1887); and *Ringing Ballads* (1887).

**Throop**, Montgomery Hunt: lawyer; b. in Auburn, N. Y., Jan. 26, 1827; took part of the course at Geneva (now Hobart) College, studied law, and was admitted to the bar in Utica; after an intermission of two years, spent in Michigan, continued the practice of law in Michigan with Roscoe Conkling for seven years; then removed to New York city; in 1870 was appointed a member of the commission which prepared the present (1899) Code of Civil Procedure of the State of New York; in 1880 he removed to Albany and devoted himself to the writing of legal treatises. Among his published works are *A Treatise of the Validity of Verbal Agreement as Affected by the Legislative Enactments in England and the United States, Commonly Called "Statute of Frauds"* (1876), and *The New Revision of the Statutes of New York*. F. Sturges Allen.

**Thurber**, Samuel, Ph. D.: educator; b. in Providence, R. I., Apr. 4, 1837; educated in the schools of Providence; A. M., Brown University, 1858; Ph. D., Brown University, 1891; principal classical department, Providence high school, 1858–65 (being absent one year in the army); principal of Hyde Park, Mass., high school for two and one-half years to 1872; principal of Syracuse, N. Y., high school 1872–78; principal of Worcester, Mass., high school 1878–80; master in Girls' High School, Boston, since 1880. He is author of several editions of English texts and a large number of addresses and articles, not yet collected in book form. C. H. Thurber.

**Thwing**, Charles Franklin, D. D.: clergyman; b. in New Sharon, Me., Nov. 9, 1853; graduated at Harvard in 1876 and at Andover Theological Seminary in 1879; was pastor of a Congregational church in Cambridge, Mass., until 1886, then taking charge of the Plymouth church in Minneapolis, Minn.; received the degree of D. D. from the Chicago Theological Seminary in 1888. He is associate editor of

*Bibliotheca Sacra*, and is the author of *American Colleges: their Students and Work* (1878); *Reading of Books: its Pleasures, Profits, and Perils* (1883); *The Family: an Historical and Social Study*, in connection with Carrie F. Butler-Thwing (1886); and *The College Woman* (1894).

**Tibesti**: a range of mountains in the Sahara, S. of Tripoli, that was known only by name until visited by Nachtigal in 1869. In its climate the region is somewhat allied to the Sudan, a slight rainfall differentiating it from the surrounding desert. Considerable grass grows and the water collects in the fissures of the rocks and in deep caverns, around which the inhabitants and their cattle live. The natives are Tibbus. They are rock-dwellers and troglodytes, living in caves or in spaces between the rocks, which they cover with roofs of palm or acacia branches. They are not confined to their mountain home, but range over a wide area of the Eastern Sahara. Their stronghold, however, is the mountains of Tibesti, where they raise hardy breeds of camels and asses, and have goats, sheep, and a few horses. Goat's milk, the berries of a few plants, and the fruit of the dûm-palm are staple articles of food, meat being eaten only rarely. The people are thought to number not more than 30,000 souls. Tibesti is included in the French sphere of influence.

**Tiffany**, Louis Comfort: artist; b. in New York city, Feb. 18, 1848; studied art at home and in Paris, and for five years traveled and sketched in Europe and Africa; became a member of the Water-color Society in 1870, and a member of the National Academy in 1880; is also a member of the Society of American Artists; has given special attention to decorative work, furnishing many designs for windows. Among his water-colors are *Meditation*; *A Shop in Switzerland*; *Old and New Mosques at Cairo*; *Lazy Life in the East*; *Algiers*; and *Cobblers at Borifarik*. His works in oil include *A Fruit-Vender Under the Sea-Wall at Nassau*; *Market-Day, Morlaix*; *Duane Street, New York*; and *Bow-Zarea, Algiers*.

**Timm**, Henry C.: pianist; one of the pioneers in the development of music in the U. S.; b. in Hamburg, Germany, July 11, 1811, and went to New York when twenty-two years old. He had received a fine musical education, and at once took a prominent place in New York musical life, taking part in a concert in Sept., 1835, in the Park theater. He was one of the founders of the New York Philharmonic Society in 1842, a director until 1848, and then its president until 1863, and from that date an honorary member until his death. In addition to being a fine pianist, he was organist, horn-player, trombone-player, composer, and conductor, both of opera and concerts. His influence was always exerted in favor of the best music. His last appearance in public was at a benefit concert in Steinway Hall, New York, conducted by Theodore Thomas, Nov. 21, 1885. D. in Hoboken, N. J., Sept. 4, 1892.

D. E. Hervey.

**Titchener**, Edward Bradford, A. M., Ph. D.: psychologist; b. in Chichester, England, Jan. 11, 1867; educated at Malvern College and Brasenose College, Oxford; B. A., Oxford, 1889; Ph. D., Leipzig, 1892; M. A., Oxford, 1894; Extension lecturer in biology, Oxford, 1892; Assistant Professor of Psychology, Cornell University, 1892–95; Sage Professor of Psychology, Cornell University, since 1895. He is author of *An Outline of Psychology* (1896); *A Primer of Psychology* (1898); and articles in *Mind*, *Brain*, *Philosophische Studien*, *Philosophical Review*, *American Journal of Psychology*, etc. He is one of the editors of *Mind*, and of the *American Journal of Psychology*.

C. H. Thurber.

**Tittmann**, Otto Hilgard: mathematician; b. in Belleville, Ill., Aug. 20, 1850; nephew of Julius E. and Eugene W. Hilgard; educated in St. Louis. In 1867 he entered the service of the U. S. Coast Survey as an aid, and has since been steadily advanced, until in 1889 he was made assistant superintendent of that service. In 1874 he served as first assistant astronomer on the transit of Venus expedition sent to Japan, and in 1893 he represented the U. S. at the international geodetic conference held in Berlin. For many years he was in charge of the office of weights and measures in the Coast Survey, and in 1890 visited the various bureaus of that character in Europe for the service. He is a member of various scientific societies, and is corresponding secretary of the American Meteorological Society and president of the Philosophical Society of Washington. His writings have been for the most part confined to the official reports of the service with which he is connected, and have been quite numerous.

Marcus Benjamin.

**Tobacco**: No one has yet discovered what are the properties of climate or soil that give peculiar excellence to the tobacco-leaf grown in certain regions. Tobacco grows well in all parts of Cuba, and the soil of the plantations is mostly composed of calcareous rocks; but the reason why the leaf grown along the southern slope of the Cordillera de las Organos in Pinar del Rio, in the west end of the island, is the best in the world is not known. The best tobacco of this famous Vuelta Abajo region is almost worth its weight in gold. Because of the excellence of its leaf, Cuba is the most famous tobacco-growing region, and many imagine that it is the chief center of tobacco production. The Cuban product, however, in the best of times, is very small in comparison with that of several other countries. The U. S. is one of the greatest tobacco-growing countries, and prepares over 220,000 tons of dried leaf every year, while India prepares about 150,000 tons, Russia 100,000, and Austria-Hungary 60,000. The normal tobacco crop of Cuba averages about 31,000 tons a year. The Philippines, whose tobacco is in high repute throughout the Orient, as Cuban tobacco is in the Occident, exported 119,977 tons of tobacco and 140,080,-000 cigars in 1894, the year before the internal troubles greatly reduced the export trade.

All countries make tobacco an important source of revenue, and in some lands, most conspicuously in France, Austria-Hungary, Italy, and Spain, the tobacco trade is a Government monopoly, and no one may engage in it unless he pays well for the privilege. In Spain one company pays to the Government a very large sum for the monopoly of manufacturing and selling tobacco. Every cigar-store is owned by this company. It has 11 manufactories in different parts of Spain, maintains nearly 19,000 places for the retailing of its product, and more than 50,000 families are supported by the money it disburses in wages. Egyptian cigarettes are made in Egypt, but the tobacco comes mostly from Turkey, the paper from Austria, Germany, or Italy, and most of the labor employed is Greek except for the common brands, which are consumed in Egypt and made by the natives. Tobacco-raising has been prohibited by law in Egypt since 1890, the Government preferring to derive income from duties on tobacco importations, and also desiring to maintain the reputation of Egyptian cigarettes, which seemed likely to suffer from the dishonest admixture of inferior native tobacco with the Turkish article.

C. C. Adams.

**Todd**, Charles Burr: author; b. in Redding, Conn., Jan. 9, 1849; was fitted for college, which he was prevented from entering by failure of sight; taught for some time, afterward devoting himself to literature; was appointed commissioner for erecting a monument on the winter quarters of Gen. Israel Putnam's division of Continentals in Redding, Conn. He is the author of *A General History of the Burr Family in America* (1878); *Life and Letters of Joel Barlow* (1886); and *The Story of the City of New York* (1888).

**Todd**, David Peck, Ph. D.: astronomer; b. in Lake Ridge, N. Y., Mar. 19, 1855; graduated at Amherst in 1875, and was soon afterward appointed chief assistant to the U. S. transit of Venus commission in Washington; reduced the observations of the transit, his result for the parallax of the sun being the first derived from the American photographs of the transit; observed the satellites of Jupiter during an entire revolution of the planet, his observations resulting in theoretical researches on the orbits of those bodies; published *A Continuation of De Damoiseau's Tables of the Satellites of Jupiter to the Year 1900* (1876), which tables are now used in the *American Ephemeris and Nautical Almanac*, the *Berliner Astronomisches Jahrbuch*, and elsewhere, and were extended by him back to 1665; in 1877 began to investigate the possibility of an extra-Neptunian planet; was sent to Texas in charge of the Government expedition to observe the total eclipse of the sun in 1878, on his return being appointed assistant to the editor of the *American Ephemeris*, holding that position until 1881, when he took the chair of Astronomy at Amherst and the directorship of the observatory there; was Professor of Astronomy and Higher Mathematics at Smith College 1881–87, and planned the construction of the new observatory; directed the observations of the transit of Venus at the Lick Observatory in 1882, and had charge of the expedition to Japan to observe the total eclipse of 1887, after which he organized an expedition to the summit of Fujiyama for meteorological observations. His writings consist principally of reports to the Government and contributions to the *Transactions* of societies. He received the degree of Ph. D. from Washington and Jefferson College in 1888.

**Tomlins**, William Laurence: conductor; b. in London, England, in 1844, and early developed a talent for music. He directed a performance of the *Messiah* when seventeen years old; went to New York in 1870, and filled several positions as organist, but soon went to Chicago to take charge of the Apollo Club, which he conducted for twenty-five years. He trained the choruses for the festivals there, especially for the Columbian Exhibition in 1893, and was a valuable assistant to Theodore Thomas. In 1898 he left Chicago, and has since been delivering lectures in various cities. D. E. Hervey.

**Torrens System** (of land registration): the name by which is commonly known the system of Government registration of titles to land under which the Government guarantees the title of the land to the registered owner. This system is sharply distinguished from the system of registration of deeds where the registration carries with it no guaranty of title, but simply serves either as a protection to third parties, by affording them notice of transfers, or incumbrances of real estate, or assistance to the owners of property in affording them a cheap and convenient method of ascertaining the title to their property. Under the guaranty system every deed of transfer, conveyance, or lien must be examined with respect to its validity as a condition of registration, while under the system of registration of deeds such examination is not necessary, except so far as it may be required to comply with certain requirements, such as being properly acknowledged and witnessed. See Registration of Titles. F. Sturges Allen.

**Townsend**, Thomas S.: compiler; b. in New York city, Aug. 27, 1829; received classical education, afterward engaging in mercantile business. He began in 1860 a chronological history of all important occurrences in connection with the civil war, consisting of clippings from newspapers, which work resulted in about 120 volumes containing 60,000 pages, and of which William Cullen Bryant said: "The age has given birth to few literary undertakings that will bear comparison with this work. The forty academicians who compiled the dictionary of the French language had a far less laborious task." The work is now in the library of Columbia University.

**Townsend**, William Kneeland: jurist; b. in New Haven, Conn., June 12, 1849; graduated at Yale College in 1871, and at the Yale Law School in 1874; Professor of Contracts in Yale Law School since 1881; in 1892 was appointed U. S. district court judge. He is author of the *Connecticut Civil Officer* and various municipal articles. Since his appointment as U. S. district judge he has decided many important patent cases.

**Tracy**, Roger Sherman: sanitarian; b. in Windsor, Vt., Dec. 9, 1841; graduated at Yale in 1862, taught for five years, and then took his medical degree at the College of Physicians and Surgeons of Columbia; was house physician at Bellevue Hospital in 1868, afterward becoming inspector of prisons and hospitals for the department of charities and corrections in New York city; became sanitary inspector in the health department in 1870, chief of the corps in 1887, and subsequently registrar of vital statistics. Besides contributing articles on sanitary science to various periodicals and to Buck's *Hygiene* (1879), he is the author of *The New Liber Primus* (1878); *A Handbook of Sanitary Information for Householders* (1884); and *Essentials of Anatomy, Physiology, and Hygiene* (1885).

**Trans-Mississippi and International Exposition**: an exposition held in Omaha, Neb., from June 1 to Oct. 31, 1898.

*Origin.*—At a meeting of the Trans-Mississippi Congress held in Omaha in Nov., 1895, a resolution was introduced by the Hon. William J. Bryan, saying that "We believe that an exposition of all the products, industries, and civilization of the States west of the Mississippi river, made at some central gateway where the world can behold the wonderful capabilities of these great wealth-producing States, would be of great value, not only to the trans-Mississippi States, but to all the home-seekers in the world." This was adopted, and after a thorough canvass of the matter the Trans-Mississippi and International Exposition was organized on Jan. 18, 1896, and articles of incorporation obtained. These required that the capital stock should be $1.000,000, issued in shares of $10 each, and that the life of the exposition should be from June 1 to Oct. 31, 1898. The following officers were chosen: President, Gurdon W. Wattles; vice-president, Jacob E. Markel; treasurer, Herman Kountze; and secretary, John A. Wakefield. To secure national aid, bills were introduced in both the House and the Senate asking for an appropriation of $250,000 to be available only after a like amount of the capital stock of the exposition had been obtained. A local canvass for subscriptions resulted in the securing of $330,000 by Nov., 1896, which amount was deemed sufficient to warrant the beginning of building operations. The failure of President Cleveland to sign the bill containing the Government appropriation, which had been cut down to $200,000, delayed work on the Government building until the passage of the bill by the extra session of Congress called by President McKinley. Local subscriptions had, however, increased until $420,000 had been promised, and the State of Nebraska and Douglas County each subscribed $100,000. Aid from various State Legislatures was received as follows: Illinois, $45,000; Iowa, $35,000; Montana, $15,000; Utah, $8,500; and New Mexico, $1,500. Among Eastern States the following sums were appropriated by their respective Legislatures: Georgia, $10,000; New York, $7,500; Massachusetts, $6,000; and Ohio, $3,000. The Kansas Legislature refused to appropriate money, but the people themselves made contributions equivalent to nearly $30,000, and the following amounts may be credited to the people of the respective States: Minnesota, $20,000; Montana, $15,000; Wisconsin, $12,000.

*Officers of the Fair.*—President, Gurdon W. Wattles; resident vice-president, Alvin Saunders; treasurer, Herman Kountze; secretary, John A. Wakefield. Executive committees: Chairman and manager of department of ways and means, Zachary T. Lindsley; manager of department of publicity, Edward Rosewater; manager of department of promotion, Gilbert M. Hitchcock; manager of department of buildings and grounds, Freeman P. Kirkendall; manager of department of exhibits, Edward E. Bruce; manager of department of concessions and privileges, Abram L. Reed; and manager of department of transportation, William N. Babcock. Later the departments of publicity and promotion were consolidated under the management of Edward Rosewater. The organization also included a vice-president from each of the trans-Mississippi States, appointed by their respective Governors.

*Location.*—The site chosen was the Kountze tract, lying across Twentieth Street and extending from Sherman Avenue to Twenty-fourth Street, on the north side of Omaha, within the city limits. It was 670 feet in width and about half a mile in length, and through the center extended a canal which was 150 feet wide at the east end, while at the west end it widened into a three-lobed lake 400 feet across. On the E., lying at right angles to the Kountze tract, was the Bluff tract of 60 acres stretching along the bluffs and overlooking the river-country beyond. In this were grouped the State buildings. The remainder of the grounds were N. of the Kountze tract, W. of Sherman Avenue, and included the old fair-grounds and the land beyond it, embracing in all about 80 acres. In this were the amusement features.

*Buildings.*—The principal structures on the grounds numbered about fifty. The larger buildings devoted to exhibition purposes were grouped along the sides of the lagoon with the Arch of States, the main entrance, on the S., the Government building on the W., the Administration arch facing the Arch of States on the N., and the Towers on the E. The general scheme of the architecture was the concept of Messrs. Walker & Kimball, of Boston and Omaha, who were the supervising architects of the exposition, while the landscape effects were under the direction of Mr. Rudolph Ulrich, of New York. Among the larger structures were the following:

*Administration Arch.*—This was 50 feet square and 150 feet high, and was Renaissance in style. On the front of the arch near the main cornice line were the seals of the State of Nebraska and of the city of Omaha, one on each side. Statuary of heroic size was used above the cornice to heighten the architectural effect. On each of the four pavilions were symbolic figures, and at the center of the south side, facing the lagoon, was a group symbolizing "Administration." On each side of the arch were covered colonnades connecting with the Manufactures building on the

E. and the Agricultural building on the W. It was designed by Messrs. Walker & Kimball.

*Agricultural Building.*—This was 400 feet long and 148 feet wide, with a floor-space of 84,260 sq. feet. The architecture followed was the Renaissance or classical style, and the building was decorated with ornaments modeled from agricultural products, such as festoons of corn and other cereals, including even common market-garden products. On each side of the semicircular niche forming the entrance were figures representing the "Sower" and "Digger" from Millet's paintings. Over the whole composition was a figure representing "Prosperity" supported by "Labor" and "Integrity." The architect was Mr. Cass Gilbert, of St. Paul, Minn.

*Arch of States.*—This was 50 feet wide, 25 feet deep, and 68 feet to the top of the parapet. It was in the form of a triumphal arch, the opening being 20 feet wide and 35 feet high to the keystone. The arch was flanked on each side by exedras which advanced in semicircles partially embracing the open space in front of it. This structure, which was one of the most conspicuous among the buildings, was decorated with a frieze composed of the arms in colors of the trans-Mississippi States, the whole being surmounted by sculptured figures, bearing the shield of the U. S. It was designed by Messrs. Walker & Kimball.

*Fine Arts Building.*—This was 246 feet long and 130 feet wide, with its longer side parallel to the lagoon. It consisted of two separate symmetrical domed buildings connected by an open court surmounted by colonnades. The structures were slightly raised from the avenue, and were entered by a flight of steps leading to the portico, whence access was had to either building, in which were the central domed rooms lighted from above and connected with smaller rooms for special exhibits, and by means of which the necessary hall-space was obtained. The basis of design of the building was the Corinthian order, and Messrs. Eames & Young, of St. Louis, Mo., were the architects.

*Horticultural Building.*—This was 300 feet long, 130 feet wide, and 160 feet high. The basis of design was the chaste Ionic, and the details were modeled from flowers, fruits, and foliage. On each side of a stately central entrance were mosque-like minarets, which were also reproduced on four sides, forming an octagon from which sprang the dome. Between the minarets were circular colonnades, surrounded by statuary emblematical of the seasons. Above the dome was an open observatory balcony from which could be obtained a grand view. At the ends of the wings were octagonal-roofed pavilions in harmony with and emphasizing the general form of design. It was designed by Charles F. Beindorf.

*Liberal Arts Building.*—This was 246 feet long and 130 feet deep, and was designed in the French Renaissance style of architecture. The exterior of the building had an appearance of two stories, the first of which was low in treatment, and had small windows cut into a plain wall-surface. The second story was ornamented by Corinthian columns set in pairs with windows between. At each corner of the building were ornamental pediments surmounted by octagonal bases on which were set groups of statuary each of which was composed of four heroic figures. Messrs. Fisher & Laurie, of Omaha, Neb., were the architects.

*Machinery and Electricity Building.*—The design of this structure was modern Renaissance, and the building was 304 feet long and 144 feet deep. In front of the building, flanking both sides of the main entrance, was an open portico 16 feet wide, extending along its entire front. The center entrance projected beyond the portico, thus forming a grand entrance-vestibule. A gallery 32 feet in width, extending around the four outer walls, was reached by staircases in the corners of the building. Groups of statuary symbolizing the principles and functions of machinery were placed on the building, and at each of the four corners were groups significant of the early supremacy of man over the untamed forces of nature. The architect was Mr. D. H. Perkins, of Chicago, Ill.

*Manufactures Building.*—This was 400 feet long and 152 feet wide. At the center and ends of the façade fronting the lagoon were pavilions 64 and 40 feet long, respectively. The height of the building to the top of the main cornice was 40 feet, and the height of the order 30 feet, resting on stylobate 10 feet high. The height of the center pavilion to the top of the crowning group of statuary was 85 feet. The center entrance, 24 feet wide and 34 feet high, was very rich in decoration. The interior decoration was confined to classic ornamentation and on the walls were paintings emblematic of manufactures. The architect was Mr. John J. Humphreys, of Denver, Col.

*Mines and Mining Building.*—This building was 304 feet long and 140 feet wide, and was in the Greek Ionic style of architecture. On the façade facing the lagoon was a circular dome 150 feet in circumference that formed a grand open vestibule, which served as an entrance to the building. The inner dome was ornamented with ribs and panels, while the outer one was formed by a series of steps rising in the shape of a cone to the apex. An outer row of detached dome columns with entablatures broken at the head of each, over which was a statue on a pedestal with a background formed by the stylobate of the dome, was an important feature. Flanking the central dome were Ionic colonnades which formed covered ways along the entire façade, stopping at the corner towers. The four corners of the building were marked by square towers surmounted by columned circular pavilions. The architect was Mr. S. S. Beman, of Chicago, Ill.

*Transportation Building.*—This was 432 feet long, 249 feet wide, and covered 3 acres of ground. It was of characteristic farm architecture of half timber and half plaster. Its entire surface was marked off into panels by a network of framing timber, posts, brackets, and braces. A recessed porch sheltered the east and west entrances, and a pleasant light pervaded all portions, coming through a skylight of a new material, which promises to displace glass for that purpose. Wide overhanging bracketed cornices gave the broad shadows so desirable for this style of architecture. The building was designed by Messrs. Walker & Kimball.

*U. S. Government Building.*—This building was arranged in three sections, that at the center having a frontage on the lake of 208 feet, and a height to the top of the balustrade over cornice of 58 feet, with a depth of 750 feet. The main entrance, which faced the center of the lagoon, was reached by a broad flight of steps and through a colonnade. Over the main building was a dome that towered above all other buildings and was capped with a heroic figure of "Liberty Enlightening the World." The side sections, which were separated from the central portion of the building by colonnades connecting with the adjacent buildings, had each a frontage of 148 feet, and were 100 feet deep. The building was designed by the supervising architect's office of the U. S. Treasury Department.

In addition to the foregoing there were the following minor buildings, the uses of which are indicated by their names: Apiary building, Auditorium, Boys and Girls' building, and the Dairy building. On the bluff tract were buildings erected by Georgia, Illinois, Iowa, Kansas, Minnesota, Montana, Nebraska, New York, and Wisconsin.

*Amusement Features.*—On the north side of the grounds, on two streets called North and East Midway, at right angles to each other, were the amusement features. These included a giant seesaw, a scenic railway, shooting the chutes, and a Union Pacific miniature train, together with an Afro-American village, a Chinese village, an English county fair, a Flemish village, a German village, an Irish village, a Japanese tea-garden, a Moorish village, streets of all nations, Streets of Cairo, and the usual Wild West show, a mammoth whale, an ostrich-farm, Hagenback's trained animals, a baby-incubator, cycloramas of Havana and the Maine, and of the fight between the Merrimac and the Monitor, as well as Night and Morning, the haunted swing, the mirror maze, lunette, and several vaudeville theaters. In addition to these, a conspicuous feature of the exposition was the congress of Indians, which consisted of more than 500 Indians, representatives of some 25 tribes, who had been brought from the various reservations, with their special forms of houses and household articles. Entertainments, including various dances and sham fights, were given by them at periodic intervals.

*Opening Exercises.*—The formal opening of the exposition occurred on June 1, when a civic procession 2 miles long marched to the Arch of States from the business center of Omaha under the grand marshalship of Major T. S. Clarkson. The exposition officials, State and county officers, and invited guests were conveyed in carriages. After entering the grounds the procession went to the wide space at the east end of the main court, where a temporary platform had been erected on which were distinguished guests, U. S. Marine Band, and the Exposition Chorus. "The Star-Spangled Banner" was sung by the chorus to the accompaniment of the band, and after an invocation by Rev. Samuel J.

Nichols, of St. Louis, addresses were delivered by President Wattles, Hon. John L. Webster, Hon. John N. Baldwin, and Gov. Silas A. Holcomb, after which a telephone message from President McKinley, who was in the reception parlors of the White House, was delivered to the audience, at the conclusion of which an electric button that set the machinery in motion was touched by President McKinley, and the exposition was declared open.

*Exhibits.*—There were 4,642 separate exhibits distributed among the various buildings, including a small number from foreign nations. These were on exhibition in a small building to the N. of the Administration Arch. In addition to the foregoing, 245 concessions and privilege contracts were made, from which a revenue of $306,365.45 was obtained.

*Attendance.*—The total number of persons visiting the exposition was 2,613,508, of which 1,778,250 paid and the remainder were free. The record of the admissions on the more important days was: June 1, opening day, 27,998; Sept. 22, Modern Woodman's Day, 52,725; Oct. 11, Government Day, 48,051; Oct. 12, President's Day, 98,845; Oct. 13, Army and Navy Day, 49,710; and Oct. 31, Omaha Day, 52,725. The largest single week was that of Oct. 7–15 (jubilee week), when the admissions amounted to 314,151, for which $116,320.10 was taken as gate receipts. The total gate receipts during the exposition were reported as follows: Preliminary period, $20,074.37; exposition period, $781,441.10; total, $801,575.47.

*Special Features.*—This exposition had its life characterized by a series of commemorative stamps that were issued by the Post-office Department in recognition of it. On each stamp was a picture illustrative of some event or scene on or west of the Mississippi, as follows: One-cent, "Marquette on the Mississippi"; two-cent, "Farming in the West"; four-cent, "Indian Hunting Buffalo"; five-cent, "Frémont on the Rocky Mountains"; eight-cent, "Troops Guarding Train"; ten-cent, "Hardships of Emigration"; fifty-cent, "Western Mining Prospector"; one-dollar, "Western Cattle in Storm"; and two-dollar, "Mississippi River Bridge." The usual commemorative medal issued by the exposition was struck under the direction of the U. S. Treasury Department, and the obverse showed a composite head from the photograph of 48 young women, native of the 24 Western States and Territories, thus idealizing the highest type of Western young womanhood; while on the reverse a group showed a typical American Indian mounted on a pony in the act of spearing a buffalo.

During the second week in October, the results of the war with Spain having foreshadowed peace, the exposition authorities decided to hold a peace jubilee, and invited the President, his cabinet, and other distinguished persons in official life to visit the exposition at that time. Beginning on Oct. 10, the following days were celebrated: Monday, Mayor's Day; Tuesday, Governor's Day; Wednesday, President's Day; Thursday, Army and Navy Day: Friday, Civil Government Day; and Saturday, Children's Day. On President's Day President McKinley visited the exposition, and addresses appropriate to the occasion were made on the plaza.

*Results.*—The total receipts of the exposition from all sources up to Dec. 1 were $1,924,077.69, of which amount the gate receipts were $801,575.47, and the receipts from concessions $306,365.45. At this time a payment of dividends amounting to 75 per cent. had been returned to those stockholders who had paid their subscriptions in full, leaving a surplus of $115,853.79, more than enough to cover the 25 per cent. still due. This result of an exposition paying entirely for itself was unique in the history of such enterprises. MARCUS BENJAMIN.

**Trent**, WILLIAM PETERFIELD, A. M.: author; b. in Richmond, Va., Nov. 10, 1862; studied at the University of Virginia, taking his degree of A. M. in 1884, and took history as a post-graduate course at Johns Hopkins; became Professor of English and History at the University of the South in 1888, and in 1894 accepted the post of dean of the academic department. He is the author of *English Culture in Virginia* (1889); *The Period of Constitution-making in the American Churches* (1889); *William Gilmore Simms*, in the American Men of Letters Series (1892); *Southern Statesmen of the Old Régime*, in Crowell's Library of Economics and Politics (1897); and was the first editor of the *Sewanee Review*.

**Tristram**, HENRY BAKER, D. D., LL. D.: b. in Eglingham, Northumberland, England, May 11, 1822; graduated B. A. at Oxford 1844; chaplain in Bermuda 1847–49; rector of Castle Eden, County Durham, England, 1849–60; master of Greatham Hospital and vicar of Greatham 1860–73; rural dean of Stockton 1872–76; of Chester-le-Street 1876–80; of Durham since 1880, and since 1873 canon of Durham. He declined the bishopric of Jerusalem 1879. He is a very eminent biblical naturalist and traveler in Bible lands. He has published *The Great Sahara* (London, 1860); *The Land of Israel: Journal of Travels with Reference to its Physical History* (1865; 4th ed. 1882); *The Natural History of the Bible* (1867; 5th ed. 1880); *Ornithology of Palestine* (1867); *The Daughters of Syria* (1869; 3d ed. 1874); *Scenes in the East* (1870); *The Seven Golden Candlesticks* (1875); *Bible Places, or Topography of the Holy Land* (1872; 13th 1,000, 1897); *The Land of Moab* (1873; 2d ed. 1874); *Pathways of Palestine* (1882, 2 vols.); *Fauna and Flora of Palestine* (1884); *Eastern Customs in Bible Lands* (1894); *Rambles in Japan* (1895). S. M. J.

**Trumbull**, GURDON: artist; b. in Stonington, Conn., May 5, 1841; studied art in Hartford and in New York city, giving special attention to the painting of fishes. Among his best-known pictures are *Over the Fall*; *A Plunge for Life*; and *A Critical Moment*. He has recently devoted himself to the study of ornithology, and is the author of *Names and Portraits of Birds which Interest Gunners, with Descriptions in Language Understanded of the People* (1888).

**Trust Companies**: This term is now applied to a modern form of banking organization, which in many respects resembles the national banks of the U. S. in the methods of doing business. The trust companies are incorporated under the specific provisions of State laws, and their business is managed under restrictions regarding the character of the investments which they may make, intended for the purpose of protecting the trust funds which they hold, and with these restrictions may also be combined the statutory guards which are imposed upon national banks to protect the depositors against dangerous or improper loans.

These companies have greatly increased in number during the last decade of the nineteenth century, and the foremost of them are powerful and very large moneyed institutions, most of which have been very successful in making money for stockholders. The great trust companies of the U. S. are in their most important features like the joint-stock banks of London, and, like them, they have a capital stock which is small as compared with the volume of business transacted.

Such companies are generally authorized to receive and hold moneys and property in trust and on deposit from courts of law or equity, executors, administrators, assignees, guardians, trustees, corporations, and individuals, and are also usually authorized to be appointed by probate courts as trustee under wills upon terms and conditions agreed upon or prescribed by statute. They are also usually made legal depositories of money paid into court by parties to legal proceedings or of money brought into court by reason of an order or judgment.

Another prominent feature of the business which they transact is that of acting as agents for the transfer of the stock or securities of railroads and other stock corporations, and as agents for the purpose of issuing, registering, or countersigning certificates of stock, bonds, and other evidences of debt; and as agents for the payment of dividends and interest of corporations, associations, and municipalities. They also usually undertake to act as agent or attorney according to agreement for the court in the management of invested property, the collection of dividends and interest, and the management of trust estates.

They differ from the national banks in that they customarily allow interest on deposits, usually on the average daily balances of some specified amount, such as $500, reserving the right, however, to change the rate of interest allowed on deposits.

It is customary for the articles of incorporation and the by-laws of such companies to prescribe the nature of the investments which the corporation shall have the power to make. The securities investments in which are allowed under these provisions are usually the duly authorized loans of the U. S. or any of the individual States which may be specified, as those within a certain region surrounding the State in which the corporation exists; the duly authorized loans of cities or towns of the State under the laws of which the company is incorporated; the stock of the national banks within that State; the first mortgage bonds of railroad companies which have earned and paid regular dividends for a given number of years next preceding the date of investment, as for two or five years; the bonds of any such railroad company as is unincumbered by mortgage, or the stock of such railroad companies as are incorporated under the laws of the State to which the company belongs, or it may be even under the laws of other States; mortgages on real estate, usually within the State to which the company belongs; the notes of domestic corporations, and the notes of individuals having a sufficient collateral security; the duly authorized loans of any of the counties, cities, and towns within certain specified districts, such as the State to which the corporation belongs or the surrounding States. It is also not unusual to provide that the corporation may make loans to the State or to a city or town situated therein under certain provisions, and in addition to these such companies are uniformly authorized to invest their capital and deposits on trust funds in all other securities in which savings-banks may then or thereafter be allowed to invest their funds, subject to the same provisions as those which regulate the investment of savings-bank funds.

Such corporations ordinarily receive deposits which may be drawn upon by checks in the same manner as the national and State banks, in which respect they are hardly to be distinguished from them, although their powers in this respect are usually more restricted than those of ordinary banking corporations. It is customary for them to distribute as deposits among national banks a large proportion of their funds on deposit or arising out of trusts, making such deposits upon condition that they shall be payable on demand and with interest. The general rules of law by which trust companies are governed are those governing other corporations. See CORPORATIONS and JOINT-STOCK COMPANIES. F. STURGES ALLEN.

**Tunis**: The condition of Tunis, which has been under a French protectorate for eighteen years, has vastly improved under the new *régime*. In 1880 it was as difficult and dangerous for a white man to travel in the regency as it is now in the far interior of Morocco; but to-day there is security for life and property throughout the country. Roads and railways have been constructed; the ruthless destruction of forests has been stopped; wells have been sunk, manufactures encouraged, and useful public works set on foot. The agricultural resources are numerous, but, in the opinion of Sir H. H. Johnston, the olive-tree promises to become the most important asset in the future. The export of halfa or esparto grass has recently diminished. The fisheries are destined to be a large source of wealth, and the live stock includes horses, donkeys, camels, oxen, sheep, and goats. It is believed that Tunis is certain to become a white man's country, such as Cape Colony. In the ten years ending in 1897 $25,862,000 was spent in public works; $6,562,000 on ports; $279,590 on lighthouses and buoys; $12,545,000 on railways; $2,316,000 on highways; $2,026,500 on public buildings; $482,500 on sewers; $250,000 on aqueducts, etc. Highways to the extent of 1,069 miles were constructed, and 303 miles of railways. European immigrants held 1,200,000 acres of land. Bizerta, which had a very fine natural harbor until it was shallowed by deposits of silt, is to be thoroughly dredged and strongly fortified. C. C. ADAMS.

**Turkey**: In 1899 an American firm started a direct steamship line between New York and Constantinople. The first vessel carried 15,000 bags of American flour and returned with a good share of freight from Constantinople, Smyrna, and Greece. If the line is a success it will open good markets for American goods in Turkey, Bulgaria, Roumania, and Southern Russia. In European Turkey manufacturing activity is now mostly confined to house and small industries. Even the few articles with which Turkey once commanded the markets, such as Morocco leather and some kinds of silk textiles and carpets, can no longer compete with foreign products. There are a few steam mills for the manufacture of silks and fezes in Constantinople and Salonica. The wool manufactures of Salonica and Monistir and the few cotton-factories of Salonica are also somewhat noteworthy. But, on the whole, Turkey is chiefly a market for Western manufactures. The heavy freight charges, due partly to transshipment at Liverpool and other ports, have almost kept American products out of the market. The total exports for the year ending Mar. 12, 1895, were $60,516,743, of which America received only $983,531; the total imports were $105,932,154, of which America sent $320,979. C. C. ADAMS.

**Turkey, History of**: The Turkish Government has been confronted with many domestic and foreign troubles. The finances are in a poor condition. Such storm-centers as Macedonia have been at times threatening. Insurrections have occurred in Arabia and among the Druses. In 1894 the gathering discontent among the Armenians culminated; massacres of Armenians were encouraged by the Turks; during the next two years there were riots in Constantinople and outbreaks in various places in Asiatic Turkey. These events excited much indignation in Europe and America, but, although many Armenian sufferers were relieved, nothing tangible was accomplished. In 1896 the Cretan question again became uppermost, and involved a war with Greece in 1897. (See GREECE.) Turkey gained a slight addition of territory, and increased her prestige. Her forces evacuated Greece and Crete in 1898. EDMUND K. ALDEN.

**Tutuila**: the easternmost of the three larger islands of the Samoan group. It is of volcanic origin, built up above the sea by basaltic rocks. The island is much smaller than Savaii and Upolu, farther W., but is not so mountainous. Pago Pago is the best harbor in the Samoan group. Tutuila came into the possession of the U. S. in Jan., 1900. (See SAMOA.)

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