(1853), he served in the Crimea, and was shot dead at Inkerman (1854). He was author of *Commentaries on the War in Russia and Germany in 1812–13* (1850).

Cathcart, Sir William Schaw (1755–1843), British general and diplomatist, first Earl Cathcart and Baron Greenock, born at Petersham; served in the wars in America (1777–80), Flanders and Germany (1805), and was commander-in-chief in Ireland (1803–5). Created Viscount Cathcart in 1807, he commanded the Copenhagen expedition, and became ambassador to Russia and Sweden (1813–21). He died at Gartside, near Glasgow.

Cathedral is the *seat* of a bishop. Although a cathedral is the parish church of a bishop's diocese, he possesses but little authority in his own cathedral, the administration being in the hands of the dean and chapter, in whom the property of the cathedral is vested, and by whom the bishop is elected, subject in England to the *congé d'élire* of the crown, which is accompanied by a letter missive, designating the name of the person chosen by the crown acting as patron of the bishopric. The bishop is the 'visitor' of his cathedral. In England deans of chapters are appointed by the crown, and must reside during eight months of the year. (See Dean.) The canons (who since 1840 include all other officers of a cathedral) are appointed either by the bishop or by the crown. In some cases the title prebendary is retained, but it is practically equivalent to honorary canons who have neither duties nor stipends from the cathedral revenues.

Cathedrals of Established Church of England. The table on p. 318 gives the Established Church cathedrals of England and Wales, with their archbishops or bishops, and indicates the year of their appointments and the salary attached to their sees.

Catherine, St. (1.) St. Catherine, virgin and martyr, commemorated November 25, is said to have been of royal parentage, and to have lived in the 4th century. She was martyred at Alexandria, being bound to a spiked wheel. Hence the 'Catherine wheel,' with which she is commonly represented. She must not be confounded with St. Catherine of Siena. (See Catherine of Siena). (2.) St. Catherine of Sweden, abbess of Wadstena (1381). Commemorated on March 21. (3.) St. Catherine of Bologna, abbess of the convent of St. Clairs, Bologna, who died in 1463. Commemorated March 9. (4.) St. Catherine of Genoa, noted for her devotion to the sick, especially during the plague of 1497–1501. Died 1510. Commemorated July 22. (5.) St. Catherine de Ricci of Florence (d. 1589). Commemorated Febuary 13.

Catherine I. (1680–1727), empress of Russia, first the mistress, then the wife (1707), of Peter the Great, was of humble parentage, and was married (1702) to a Swedish soldier. After Peter's death (1725) Catherine became empress in her own right.

Catherine II. (1729–96), empress of Russia, daughter of a Prussian field-marshal, was born at Stettin, and selected by the Empress Elizabeth as the wife for the heir to the Russian throne in 1745. On the accession of her husband to the throne in 1761 he endeavoured to divorce her. But Catherine, who had the clergy and the army with her, was able to organize a conspiracy against him, which ended in his being dethroned and murdered in 1762. Becoming sole ruler, Catherine governed her empire with great energy, and her reign is second only to that of Peter the Great in importance. She organized

Cathedral.	Archbp. or Bishop.	Appointed.	Salary.
Canterbury (Arcbhp.)	Davidson	1903	£15,000
York (Archbishop)	Lang	1909	10,000
London	Ingram	1901	10,000
Westminster (Dean)	Ryle	1910	2,000
Durham	Moule	1901	7,000
Winchester	Talbot	1911	6,500
Bangor	Williams	1899	4,200
Bath and Wells	Kennion	1894	5,000
Birmingham	Gore	1905	3,500
Bristol	Browne	1897	3,000
Carlisle	Diggle	1905	4,500
Chester	Jayne	1889	4,200
Chichester	Ridgeway	1908	4,200
Ely	Chase	1905	5,500
Exeter	Robertson	1903	4,200
Gloucester	Gibson	1905	4,300
Hereford	Percival	1895	4,200
Lichfield	Legge	1891	4,200
Lincoln	Hicks	1910	4,500
Liverpool	Chavasse	1900	4,200
Llandaff	Hughes	1905	4,200
Manchester	Knox	1903	4,200
Newcastle	Straton	1907	3,500
Norwich	Pollock	1910	4,500
Oxford	Paget	1901	5,000
Windsor (Dean)	Eliot	1891	2,000
Peterborough	Carr Glyn	1897	4,500
Ripon	Carpenter	1884	4,200
Rochester	Harmer	1905	4,000
St. Albans	Jacob	1903	3,200
St. Asaph	Edwards	1889	4,200
St. David's	Owen	1897	4,500
Salisbury	Wordsworth	1885	5,000
Sodor and Man	Drury	1907	1,500
Southwark (and Dean)			3,000
Southwell	Hoskyns	1904	3,500
Truro (and Dean)	Stubbs	1906	3,000
Wakefield	Eden	1897	3,000
Worcester	Yeatman-Biggs	1905	4,200

the administration of the country, dividing it into fifty governments (provinces) in 1775; reformed the taxation; created banks; encouraged agriculture (she introduced into Russia the cultivation of potatoes); attracted foreign colonists, especially Germans; and founded towns, which bear her name. The army was reorganized, and its discipline improved. In 1785 she regulated the privileges of the nobility, and the bourgeoisie was given a special status in the organization of the municipalities. She founded a college for surgeons, as well as hospitals (especially the famous hospital in Moscow) and military schools. She endeavoured also, at the beginning of her reign, to promulgate a general code of laws. She sought, but in vain, to introduce into Russia a complete system of education. She founded the

Academy, and herself wrote several comedies. In all her reforms she was animated by the spirit of the French philosophers of the 18th century, being in close touch through correspondence with Grimm, Voltaire, and others; while she attracted Diderot to St. Petersburg. But the prodigalities of her numerous favourites roused bitter discontent, and several pretenders appeared, claiming to be Peter III. (*e.g.* Pugachev). Catherine waged war with Turkey (1772 and 1792) and with Sweden (1790), and after each of these, as well as through the successive partitions of Poland, added to the extent of her empire. In the latter years of her reign she engaged in a war with Persia. Putting aside her loose private life and her numerous favourites—among the earliest being Stanislas Poniatowski, last king of Poland, and among the latest Potemkin—she fully deserves the title of 'Great' which has been bestowed upon her. In her last years the excesses of the French republic filled her with distaste for the liberal ideas of her earlier life. See W. Tooke's *The Life of Catherine II.* (1798–1800), Capefigue's *La Grande Cathérine* (1862), Bury's *Catherine II.* (1900), Waliszewski's *The Romance of an Empress: Catherine II. of Russia* (1894), and Sergeant's *Courtships of Catherine the Great* (1905).

Catherine de' Medici (1519–89), queen of France. Born at Florence, she married Henry II. of France, but played no great part in French politics till 1559, when her son, Francis II., ascended the throne. Against her she found two parties—the Guises and the ultra-Catholics on the one hand, and the Protestants on the other. Her whole life was spent in balancing between these two parties. For the Protestants she had no liking, as the doctrines of Calvin were not favourable to absolutism, at which she aimed; but none the less she entered into an alliance with them against the Guises, till the treaty of Amboise (1563) showed that they had become too strong. Then she entered into an alliance with Spain and the Guise party for the extirpation of heretics, which resulted in the massacre of St. Bartholomew. During the reign of Charles IX. (1560), and still more during the reign of Henry III. (1574), both of whom were her sons, she was virtual ruler of France. Her policy was Italian in its shiftiness, and she probably injured the royal cause by over-subtilty; but in spite of this, and in spite of her heartlessness and cruelty, she tided the kingdom over a period of grave difficulty. See Sichel's *Catherine de Medici* (1905–7); and *Lettres de C. de M.* (ed. De la Ferrière, 6 vols., 1880–91). See also COLIGNY, GASPARD DE.

Catherine of Aragon (1485–1536), first wife of Henry VIII. of England, was the youngest child of Ferdinand and Isabella of Spain. She was first married to Arthur, eldest son of Henry VII., in 1501, but was soon left a widow; and in 1509, by a papal dispensation, was married to her brother-in-law, afterwards Henry VIII. Though he fell in love with Anne Boleyn in 1522, it was not till 1529 that Henry began to entertain doubts of the legality of the papal dispensation which had enabled him to marry Catherine and prevented him from marrying his mistress, Anne Boleyn; but since the Pope proved obdurate and would not decree a divorce, Henry VIII. broke with Rome, and Cranmer in 1533 declared the parties no longer man and wife. Catherine was buried at Peterborough. Her only surviving child, Mary, later on suc-

ceeded to the throne. See Martin Hume's *Wives of Henry VIII.* (1905).

Catherine of Braganza (1638–1705), queen-consort of Charles II., daughter of John, Duke of Braganza (afterwards King of Portugal), and Louisa de Gusman, daughter of the Duke of Sidonia. She married Charles in May 1662, and brought him the island of Bombay as part of her dowry. Despite the infidelities and harsh treatment of Charles, her life was not unhappy. After her husband's death she continued to reside in England until 1692, when she returned to Portugal. See C. C. Davidson's *Catherine of Braganza* (1908).

Catherine of France or VALOIS (1401–38), daughter of Charles VI. of France. In 1420, in accordance with the treaty of Troyes, she became the wife of Henry V. of England. In 1423 she married Owen Tudor, and by him had three sons, the eldest being Edmund Tudor, father of Henry VII. See Strickland's *Lives of the Queens of England* (1877).

Catherine of Siena (1347–80), saint. In her youth she entered the Dominican order. The return of the Pope from Avignon to Rome (1377) may be partially ascribed to her influence; and the Florentines used her services in their negotiations with Gregory XI. She was canonized by Pope Pius II. (1461); her day is April 30. The best collected edition of Catherine's *Opere* was published by Gigli in 4 vols. (1707–15), the first of which contains the remarkable Life written by her confessor. Her letters were newly edited by Tommaseo (1860). Her dialogue on divine providence has been twice translated into English—by Dane James, *The Orcharde of Syon, in which is conteyned the reuelacyons of seynt Katheryne of Sene* (1519), and by A. Thorold, *Dialogue of St. Catherine of Siena* (1896). See English studies on her by Josephine Butler (1878; 3rd ed. 1894), Drane (1880; 2nd ed. 1887), Pierson (1898), Witte (1901); and *St. Catherine of Siena as seen in her Letters*, trans. by Vida D. Scudder (1905).

Catheter, a tube for introduction into the bladder for the purpose of removing urine, and into the Eustachian tube when obstruction is suspected there. The Eustachian catheter is usually rigid, curved for introduction through the nose, and made of silver or silver-plated. Air is forced through it into the Eustachian tube, and in that way the tube is kept open during catarrh or reopened (if possible) when inflammation has brought its walls together. Catheters for drawing off urine may be rigid, or of different degrees of flexibility according to their material, from the stiff silver instrument to that made of soft rubber, with intermediate degrees of flexibility in those made of coated silk webbing, celluloid, and gum-elastic. The flexible varieties are softened by hot water, so that they can be bent to the desired curve before use; and a wire stilette preserves the curve until the instrument has been introduced, after which the stilette is withdrawn.

Cathetometer, an instrument of precision for the accurate measurement of small vertical displacements or differences of height. It consists of an upright bar, which must be adjusted to a truly vertical position, and on which a telescope, kept always parallel to itself, moves up and down. The difference of level of two observed points is shown on the vertical scale engraved on the upright bar, the final refined measurements being made by means of the cross wires and micrometer eyepiece of the telescope. As an illustration of the use of one form of cathetometer,

we may refer to the determination of the index error and the error of capillarity in standard barometers. The barometer to be tested is placed in a vacuum chamber alongside a standard, and its indications are observed with the cathetometer and compared with the measurements as given by the standard.

Cathode and **Cation.** See ELECTROLYSIS; ANODE.

Catholic and Apostolic Church. See IRVING, EDWARD.

Catholic Church. See ROMAN CATHOLIC CHURCH.

Catholic Creditor. In Scots law, a catholic or universal creditor is one whose debt is secured over several or the whole subjects of the debtor. His rights must not be exercised to the prejudice of secondary creditors. If he receives the whole debt from one subject, he must assign to the secondary creditors his security over the other subjects covered by the catholic security, in order that they may be enabled to draw a proportional part of their debt from these.

Catholic Emancipation. In Protestant countries, after the Reformation, penal regulations, and in some cases civil disabilities, were imposed on Roman Catholics. For instance, the celebration of the Mass was, in England, felony in a foreigner, and high treason in a native. In both England and Ireland, though to a less extent in Scotland, Roman Catholics could not purchase land, and, where they held it by inheritance, could be summarily displaced by the nearest heir, being Protestant; and Roman Catholics were not deemed fit to act as guardians even of Roman Catholic children. The earlier measures taking the education of the children of Roman Catholics out of their parents' hands fell into abeyance in the 17th century; but no formal proposal was made till 1780 to remove even the more monstrous of these penal disabilities. In that year Parliament passed a bill freeing from the more oppressive disabilities those Roman Catholics who were prepared to take a test oath in which, among other things, the temporal jurisdiction of the Pope in England was denied. The effort to extend the provisions of this bill to Scotland provoked an outburst of popular fanaticism in Edinburgh, and this by sympathy created in England the movement which resulted in the Gordon riots. Further relief was granted in 1791, and extended to Scotland in the following year. In Ireland, where these laws were carried to the greatest extreme, Grattan moved for repeal in 1780, and the Irish rebellion in 1798 was largely due to continued enforcement of them. A certain amount of logical force had been given to the demand for repeal by the concessions which were made by the treaty of Paris (1763) to the French Canadians, who consequently enjoyed full civil rights which were denied to native Roman Catholics at home.

A Roman Catholic association was formed in Ireland in 1824, and O'Connell lent to the agitation the magic of his eloquence. In 1829 the Duke of Wellington at last introduced a measure which threw open to Roman Catholics the Houses of Parliament and most public offices. Many of the minor restrictions which even then remained have since been removed. Roman Catholic bishops have been tacitly allowed to assume territorial designations. On the coronation of Edward VII. the coronation oath came under discussion, but nothing was done. In 1910, however, on the accession of King George, a form of oath was devised less offensive to the susceptibilities of Catholic subjects. As the law stands at

present, the sovereign, the regent (when there is such), the lord chancellor, and the lord high commissioner to the Church of Scotland must not be of the Roman Catholic faith. See TEST ACTS.

Catholic (or General) Epistles, a title given to the seven letters in the New Testament traditionally associated with the names James, Peter (2), John (3), and Jude, and intended to indicate a feature which, common to them all, distinguishes them from the Epistles of Paul—viz. their being addressed, not to any particular church or individual, but to Christians at large. See separate articles, JAMES, EPISTLE OF, etc.

Catholic Truth Society, one of the most important of the Catholic organizations in Britain. It was originally founded by Dr. Vaughan in 1872. In 1884 the society was formally revived on a larger scale. The main objects of the society are to disseminate among Roman Catholics small and cheap devotional works; to assist the uneducated poor to a better knowledge of their religion; to spread among Protestants information about Catholic truth; to promote the circulation of good, cheap, and popular Catholic books. The society is non-political, and such matters are excluded from its publications. From the time of its re-establishment it has had the approval and support of the ecclesiastical authorities. The offices are at 69 Southwark Bridge Road, London, S.E.

Catholic University Question, IRELAND. For the last thirty years the Roman Catholics of Ireland have frequently demanded the establishment of a Roman Catholic university. In February 1898 Mr. Dillon raised the question on the address; but his amendment, though supported by W. E. H. Lecky and Mr. Balfour, was negatived without a division. Early in 1899 Mr. Balfour published a letter, in which he suggested the establishment of two new universities in Ireland, one in Dublin and one in Belfast, on similar lines, and rigidly subject to the Test Acts. All scholarships and fellowships paid out of public funds were to be open to public competition irrespective of creed, and no public endowment was to be given to the chairs of philosophy, theology, and modern history. In the case of Dublin the governing body was to be Roman Catholic; in the case of Belfast, Protestant. Mr. Balfour's letter aroused considerable opposition, especially amongst the Ulster Unionists, though he was careful to explain that his views were personal, and that they did not bind the government in any way. In 1901 the government granted a royal commission to inquire into the whole subject of university education in Ireland, Trinity College being withdrawn from the purview of the inquiry. The commission reported finally in March 1903. The report pointed out that there are only two universities in Ireland—Dublin University and the Royal University of Ireland; that the Catholic University of Ireland is only an association of colleges preparing for the Royal University examinations, and that Irish Roman Catholics, who form 74 per cent. of the population of the country, are as a body unprovided with any adequately endowed university; that the Roman Catholic population stands aloof from the existing state endowed colleges, and that the difficulty will continue unless met by a scheme acceptable to the Roman Catholic hierarchy. The commission, *inter alia*, recommended the reconstruction of the Royal University as a teaching university, with four constitu-

ent colleges—viz. the three existing Queen's Colleges and a new Roman Catholic College in Dublin. The chairs should be open to persons of all denominations, and the Catholic University School of Medicine should be the medical faculty of the college. The endowment and equipment of the college should be on a scale commensurate with a university college of the first rank. A meeting in the Mansion House, Dublin, January 1904, demanded the immediate settlement of the question; but the government announced that no measure would be introduced in the 1904 session. The question was fully debated in April 1905, but the amendment was defeated. The objectors urged that university education should be non-sectarian, that Trinity College was open to all denominations, and that the establishment of a Catholic university would accentuate rather than minimize Irish religious differences which are alleged to form a stumbling-block in the way of Ireland's progress. An Irish Universities Act was passed in 1908 by which the Royal University was abolished, and two new universities, at Dublin and Belfast, were created in its place. Both of these are autonomous and free from religious tests, and each is allowed to recognize other colleges. Trinity College, Dublin, is not affected by the Act.

Catholikos, a title which, in its ecclesiastical sense, seems to have been applied to the superintendent-general of missions, or of churches, on and beyond the borders of the Roman empire. It is also the title of certain dignitaries of the Armenian Church.

Catiline (CATILINA or CATALINA, LUCIUS SERGIUS), born about 108 B.C. He was in his youth a zealous supporter of Sulla. He was prætor in 68 B.C., and governed Africa the next year. In 63 B.C. he formed a conspiracy to secure the government, and is said to have plotted the murder of the consuls in 65 B.C., only failing by giving the signal too soon. In 63 the conspiracy assumed more dangerous dimensions; but Cicero denounced (Oct. 21, 63) Catiline and drove him from Rome. His accomplices were betrayed and executed in the city; and he fell at the head of his disorderly forces at Pistoria in Etruria, in a battle against Petreius, lieutenant of Antonius, Cicero's colleague in the consulship. He had courage and ability, but otherwise displayed the worst vices of the Roman character. Ibsen has idealized him in an early drama (2nd ed. 1875). See E. S. Beesly's *Catiline, Clodius, and Tiberius* (1878); G. Boissier's *La Conjuration de Cataline* (1905); and Sallust's monograph, *Catilina.*

Cat Island. See BAHAMAS.

Catkin, or AMENTUM, in botany, a deciduous spike—*i.e.* an inflorescence with a long axis and stalkless flowers—consisting of unisexual flowers, as the catkin of the willow.

Catlin, GEORGE (1796–1872), American painter and writer, born at Wilkesbarre, Pennsylvania. He lived for years (1832–40) among the American Indians, to record with pen and brush their fast-perishing characteristics. These paintings now form a separate gallery of the National Museum of the United States at Washington. He published *Manners, Customs, and Condition of the North American Indians* (2 vols. 1857); *Notes of Eight Years in Europe* (1848), a record of experience with parties of North American Indians in Europe; and *Last Rambles among the Rockies and Andes* (1868).

Catmint, or CATNIP (*Nepeta*), a genus of hardy labiate plants with a five-toothed tubular calyx,

a corolla tube longer than the calyx, and its two front stamens shorter than the others. Of British species, *N. Glechoma*, the ground ivy, is a common little trailing herb with kidney-shaped, crenate, aromatic leaves, and purplish flowers in early summer. *N. Cataria*, the catmint, not so common or well known, is also aromatic; but its flowers, which are produced in late summer, are white with purple dots, and are borne in dense axillary whorls. Of the foreign species may be named *N. Mussini*, which bears pale-blue flowers in May, and *N. spicata*, an Indian kind, bearing purple spikes in autumn.

Cato, DIONYSIUS, the author of a 3rd-century collection of moral precepts or distichs (*Catonis Disticha de Moribus*); but they might as well be anonymous for all that is known of their writer. They are a species of aphorism, couched in the Latin of the silver age, and written in dactylic hexameters. They won great popularity during the early middle ages. The best Latin editions are those of Zanke (1852) and Nemethy (1892). Caxton published an English version (1481). See F. Plessis's *Poésie latine* (1909).

Cato. (1.) MARCUS PORCIUS CATO (234–149 B.C.), known as 'the Censor,' was keenly opposed to new ways, especially Greek culture, and to the great house of the Scipios. He was consul in 195, and censor in 184, and in the latter office attempted to repress luxury and to maintain the simplicity of old Roman habits. He governed Spain (194) with great severity, and reduced the rebellious tribes; he also assisted in the defeat of Antiochus, king of Syria, at Thermopylæ (191 B.C.). In 150 B.C. he was member of a commission sent to Africa to settle a dispute between Carthage and Masinissa, and was so impressed by the strength of Carthage that for the rest of his life, whatever question was before the senate, he always introduced the phrase, *Delenda est Carthago* ('Carthage must be destroyed'). Cato represents the Roman character in its extremest type, both of virtue and of vice—courageous, plain living, and patriotic, he was yet revengeful, arrogant, morally coarse, and even brutal to his inferiors. In his old age he wrote *De Re Rustica* ('On Farming Operations'); and fragments of his speeches, and of his Roman history, called *Origines*, survive. See Keil's edition of *De Re Rustica* (1882), and Warde Fowler's *Social Life at Rome* (1909). (2.) MARCUS PORCIUS CATO (95–46 B.C.), known as *Uticensis* ('of Utica') to distinguish him from (1.) his great-grandfather. He early devoted himself to Stoic philosophy, and his morality was conspicuous in that corrupt age. In 63 B.C., as tribune of the plebs, he strongly supported Cicero in the senate on the question of the treatment of Catiline's fellow-conspirators. Cicero had proposed their execution. Until the civil war between Cæsar and Pompey, Cato was an active supporter of the senatorial party; but after Pompey's defeat at Pharsalia (48 B.C.) he went to Africa and joined Metellus Scipio, who was routed at Thapsus in 46 B.C. Utica held out; but Cato advised the townspeople to surrender for fear of provoking Cæsar's indignation, and committed suicide himself. Cicero published a panegyric on him, to which Cæsar replied; and he became, as it were, canonized as a personification of virtue, even under Augustus. See Lucan's *Pharsalia* and Addison's drama *Cato*. A very favourable character sketch of him is given by Sallust in his *Catilina*, ch. 54.

Catoptrics. See DIOPTRICS.

Catorce, or ALAMOS DE CATORCE, tn., Mexico, in state of and 110 m. N. of San Luis Potosi; has important silver and tin mines. Pop. 10,000.

Cato Street Conspiracy, so called because the conspirators met in Cato Street, London, was a plot by certain revolutionary spirits to murder Castlereagh and other ministers at a cabinet dinner at Lord Harrowby's, Feb. 23, 1820. The chief conspirators—Thistlewood, Ings, Brunt, Tidd, and Davidson—were hanged; five others were transported for life. Connected with it was a minor outbreak at Bonnymuir in Scotland, in the following April, and a treason scare in Glasgow, both serious enough to justify the severity of the government. See *Political History of England*, vol. xi. ch. 98 (1906).

Catrail, ancient earthwork, possibly pre-Roman, which has been traced from Galashiels through the classic Border-land, by Yarrow, Deloraine, Liddesdale, and Hermitage Castle, to Peel Fell, Northumberland. In parts it is known as the 'Deil's Dyke' and the 'Picts' Work.' It consists of a fosse and double rampart with round forts at intervals, and is about 20 ft. broad.

Catrine, tn., Ayrshire, Scotland, 3 m. S.E. of Mauchline; manufactures cotton, and has bleachfields. Pop. 2,400.

Cats, JAKOB (1577–1660), Dutch poet, born at Brouwershaven (Zeeland). After filling civil appointments in Holland, he was sent in 1627 as ambassador to London; became, in 1648, minister of justice in Holland, and in 1651 was again ambassador in London. Cats was the author of several volumes of poetry, characterized by their easy style, which, with their popular, moral, and didactic tone, has made them immensely popular with his countrymen; in fact, the poems of 'Father Cats' were long associated with the Bible in popular favour. Amongst his best works are *Moral Emblems* (1618; Eng. trans. 1860), *Selfstryt* (1620; Eng. trans. 1680), *Houwelyk* (1625), *An Emblematical Dialogue* (1632; Eng. trans. 1637), *Spiegel van den Ouden en Nieuwen Tydt* (1632), *Klagende Maeghden* (1644), and his most ambitious effort, *Trouring* (1653). See Derudder's *Un Poète Néerlandais: Cats, sa Vie et ses Œuvres* (1898); and Kalff's *Life*, in Dutch (1902).

Cat's-eye, an ornamental stone used especially for rings. It is always cut *en cabochon;* and when light falls on the rounded surface, a narrow bright line of paler colour is produced by reflection from numerous long parallel fibres which traverse the mineral. The resemblance to the narrow elongated pupil of the eye of the cat is the source of the name. As the stone is turned, the line of light changes its position. There are two varieties of cat's-eye, the Occidental and the Oriental. The former is quartz enclosing fine fibres of asbestos; but often these have weathered out, leaving narrow tubules: the appearance, however, is not affected by this. (See also CROCIDOLITE.) The Oriental is far more valuable, and among Eastern peoples is one of the most highly prized of gems. It is chrysoberyl, with similar fibrous enclosures, and is much more beautiful, with a far finer lustre. The most esteemed are those of a brown colour, with a narrow and well-defined bluish line of light. In quartz cat's-eye the colour may be white, pale or dark gray, yellow, brown, green, or sometimes blue. Oriental cat's-eye is found principally in Ceylon, and is also known as cymophane. Occidental cat's-eye is found in Bavaria, Malabar (India), Ceylon, and many other localities. See Street-

er's *Precious Stones and Gems* (1898).

Catskill. (1.) A group of the Appalachian Mountains, New York, U.S.A., lying west of the Hudson R. Their sides are precipitous, with plateau-like summits. The beautiful scenery of the group, diversified by lofty precipices, ravines ('cloves'), and picturesque cataracts, attracts many tourists. The chief peaks of the range are Slide Mt. (4,200 ft.), High Peak, Overlook Mt., Hunter Mt., and Pine Orchard Mt. Washington Irving lays the scene of Rip Van Winkle (*Sketch Book*, 1820) in the Catskills. (2.) Village and summer resort, co. seat of Greene co., New York, U.S.A., 34 m. S.S.W. of Albany, on the Hudson R. Mountain House, a noted summer resort, stands 12 m. W. of the village, on a slope of Pine Orchard Mt. Pop. (township) 8,600.

Catt, HENRI ALEXANDRE DE (1725–95), Swiss diarist, born at Morges, near Lausanne, Switzerland. In 1758–80 he was reader to Frederick the Great of Prussia, and accompanied him during the Seven Years' war. From 1758 till July 1760 he kept a very minute *Diary* of all the observations made by the king, and of his conversation with him. After Frederick's death, Catt composed *Mémoires* covering the whole of the time he was reader to the king. Both his *Diary* and *Mémoires* were published in 1884.

Cattaro (Slav. *Kotor*), seapt., Austria, in the S. of Dalmatia, 35 m. E.S.E. of Ragusa; stands at the head of the Bocche di Cattaro, and is strongly fortified. The town gives name to a Roman Catholic see and an Orthodox Greek see. Originally a small independent state, Cattaro joined herself to Venice in 1420, and shared her fortunes down to 1797; in 1814 she passed under the rule of Austria. The town was almost destroyed by earthquake in 1563, and again in 1667. Pop. 6,000.

Cattaro, BOCCHE DI, also CANALE DI, a beautiful spacious inlet of the Dalmatian coast, Austria, affording deep water close up to the shore, and divided into several basins connected by narrow straits. Length, over 20 m.

Cattegat. See KATTEGAT.

Cattermole, GEORGE (1800–68), English water-colour painter and book illustrator, born at Dickleborough, Norfolk. Having executed drawings for John Britton's *English Cathedrals* in 1816, he exhibited in the Royal Academy (1819–27), and in 1833 became a member of the Society of Painters in Water Colours. Cattermole illustrated the *Waverley Novels* (1830), *Master Humphrey's Clock* (1840–1), and other works.

Catti, or CHATTI, tribe of ancient Germany, inhabiting part of modern Westphalia, Nassau, Hesse-Darmstadt, and Hesse-Kassel. They were never subdued by the Romans.

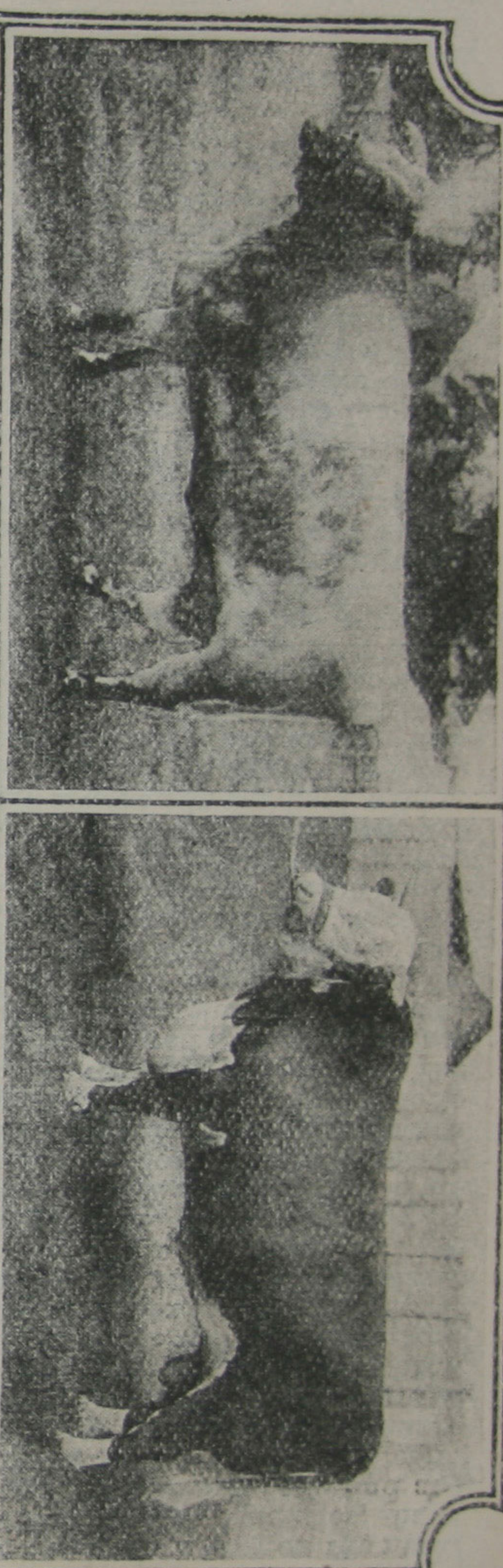
Cattle. Although sometimes used in a looser sense, the word 'cattle' is properly applied to a group of oxen of mixed origin, which have been domesticated in Europe and Asia from prehistoric times. European cattle are zoologically related to other oxen, such as the bisons of Europe and America, buffaloes, yaks, the gaur, the gayal, the musk ox, Java cattle, and the zebus, and with them form the Bovidæ, or oxen, division of the Ruminantia. They are not far removed in classification from the heavy or boviform antelopes, nor yet from the true antelopes; and they, as well as sheep, are included in the Cavicorniæ, or hollow-horned ruminants.

European Cattle.—MM. Moll and Gayot describe 149 distinct races of European cattle. In the

United Kingdom alone there are nineteen well-defined races. It was the Prussian naturalist Pallas who first pointed out that, under confinement, allied species, which naturally only breed *inter se*, would mate with each other and produce fertile offspring. Crossing is, of course, a main cause of the existence of so many breeds, but it is by no means the only cause. Islands and mountainous regions are generally inhabited by more or less diminutive races, such as those of Shetland, Jersey, Kerry, the remoter Scottish Highlands, Wales, and Norway. A severe climate induces the growth of hair and a greater development of horn, for hair and horn generally are correlated to each other. The character of the pasturage in time causes changes in outward form; but these natural effects are small compared with the extraordinary alterations which occur under the selective care of man. Cattle may be bred with a view to the production of milk or beef, or for draught. The cultivation of these properties alters the external form, so that a type of milking animal becomes different from a beef-producer. Colour is a principal character of a race.

The Two Original Types of Cattle.—European cattle appear to be the result of the crossing of at least two (and possibly more) species now extinct as wild animals. One of these, *Bos primigenius*, is still preserved in a semi-wild condition in certain ancestral parks, such as Chillingham in Northumberland, Chartley Holme in Staffordshire, Burton-Constable in Yorkshire, and Hamilton, or Cadzow, in Lanarkshire. These cattle preserve many wild instincts, such as that of hiding their calves in the long grass or coverts. They are difficult to approach, and endeavour to keep out of sight. These cattle are of white or light gray colour, shaded to dark gray on the neck, shoulders, and haunches, have black muzzles and feet, and are reddish brown inside the ears. They are smaller than ordinary cattle, and the bulls carry longer hair on the neck. They have been named *B. sylvestris*, but are more properly regarded as descendants of *B. primigenius*. They closely resemble the Hungarian and Podolian oxen, which are highly esteemed in E. Europe. The Hungarian cattle, although domesticated, also hide their calves, which squat like hares and lie close to the ground when approached. The red Devon, red Sussex, and black Pembroke cattle are thought to be largely, if not exclusively, derived from *B. primigenius;* and the present colour of these cattle is considered to have been the result of selection, particularly as red or black calves are occasionally dropped in herds of wild or park cattle. *B. longifrons* was a smaller species, spoken of by Darwin as 'very distinct,' although no marked characters are mentioned by him except that it had a short body and fine legs. It was introduced into Britain at a very early period, and supplied food for the Roman legionaries. The N. Welsh and Highland cattle represent this species. *B. frontosus* of Nillson is considered by some authorities to be identical with *B. longifrons*, while others consider it distinct; in the latter case it makes the third ancestral race from which modern domesticated breeds are descended. Darwin concluded that European cattle are descended from these two species—viz. *B. primigenius* and *B. longifrons*.

British Cattle.—Britain was spoken of as rich in cattle as early as the time of the Venerable Bede. The improvement of cattle in the modern sense only commenced in the middle of the 18th century.



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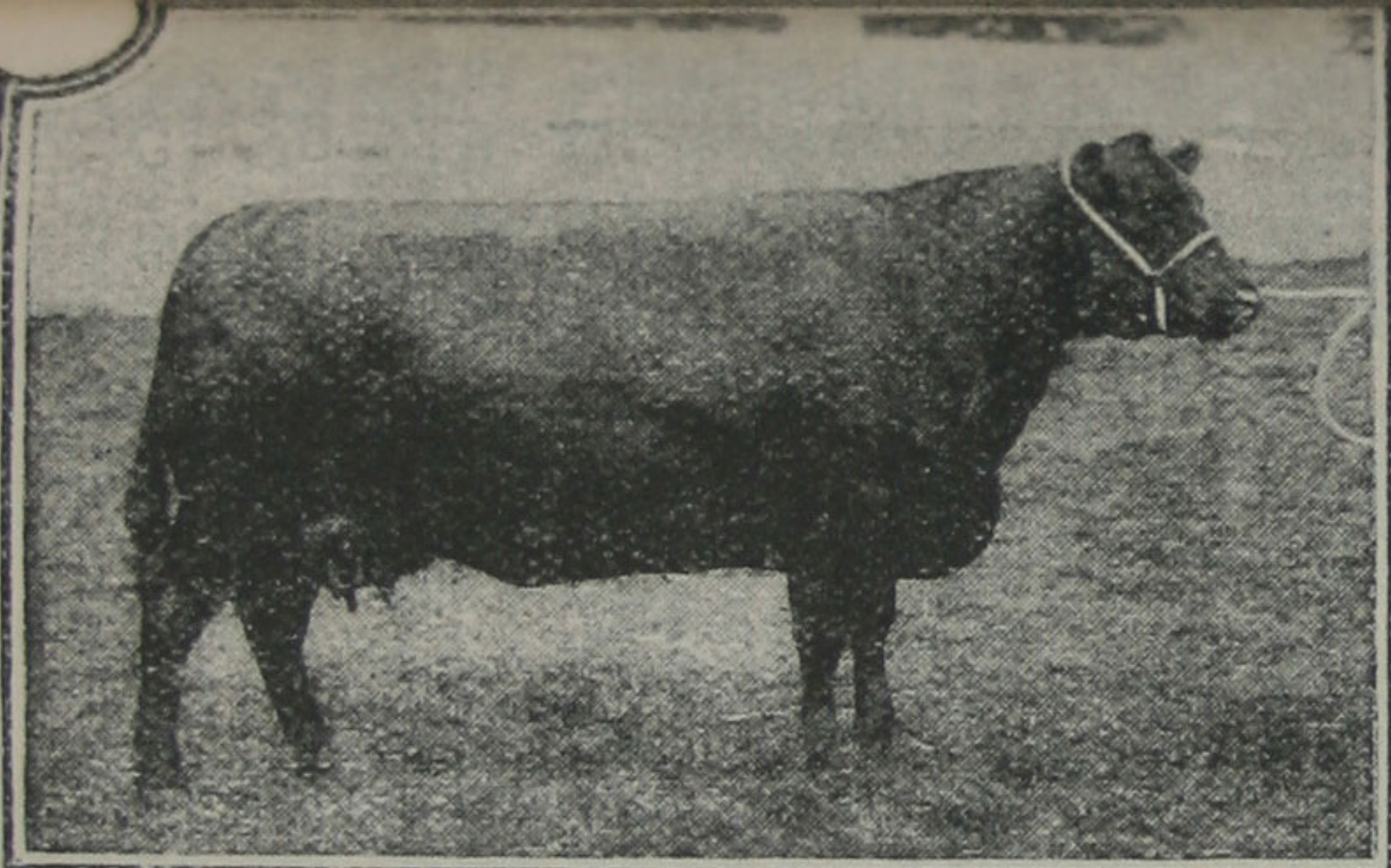

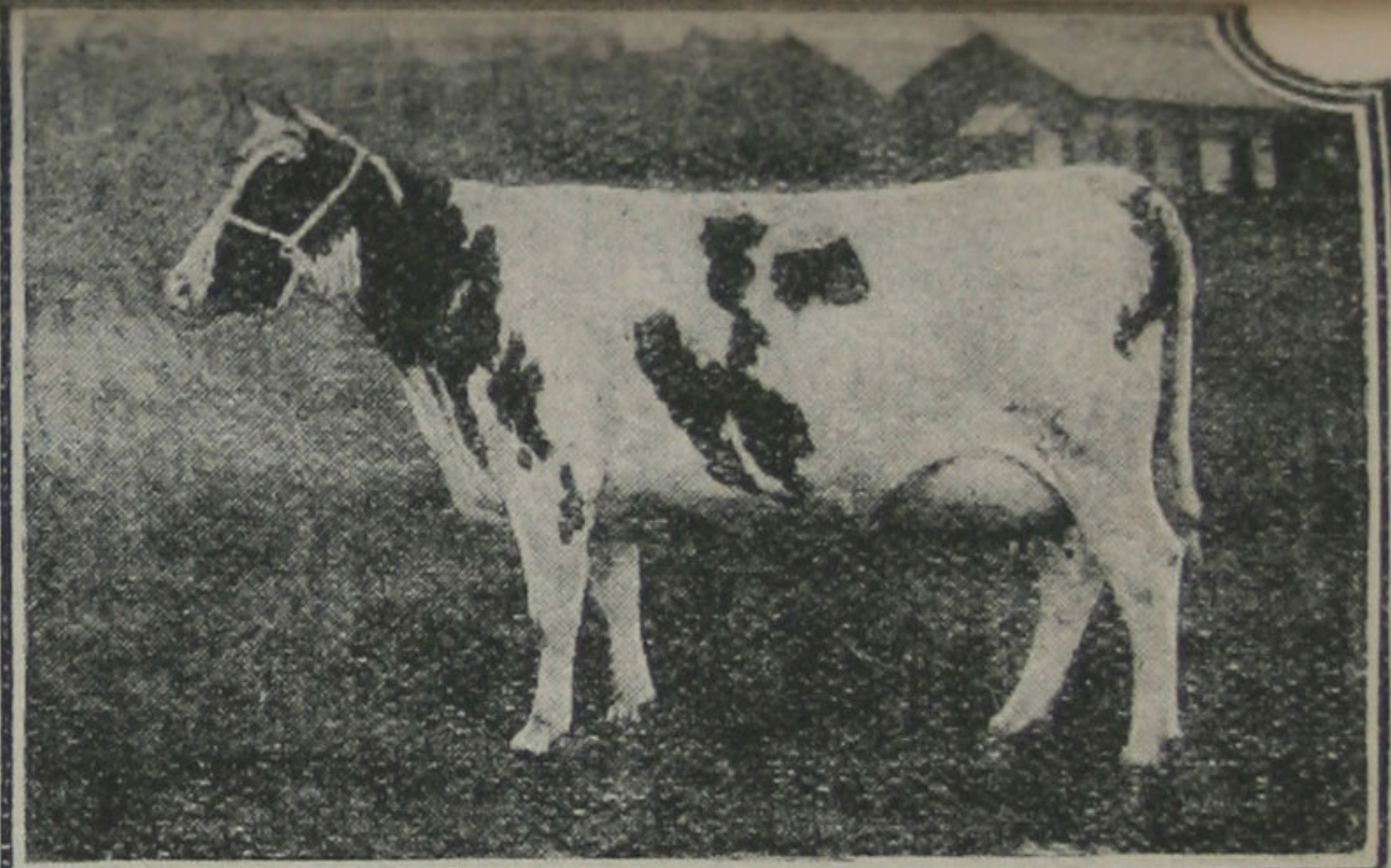

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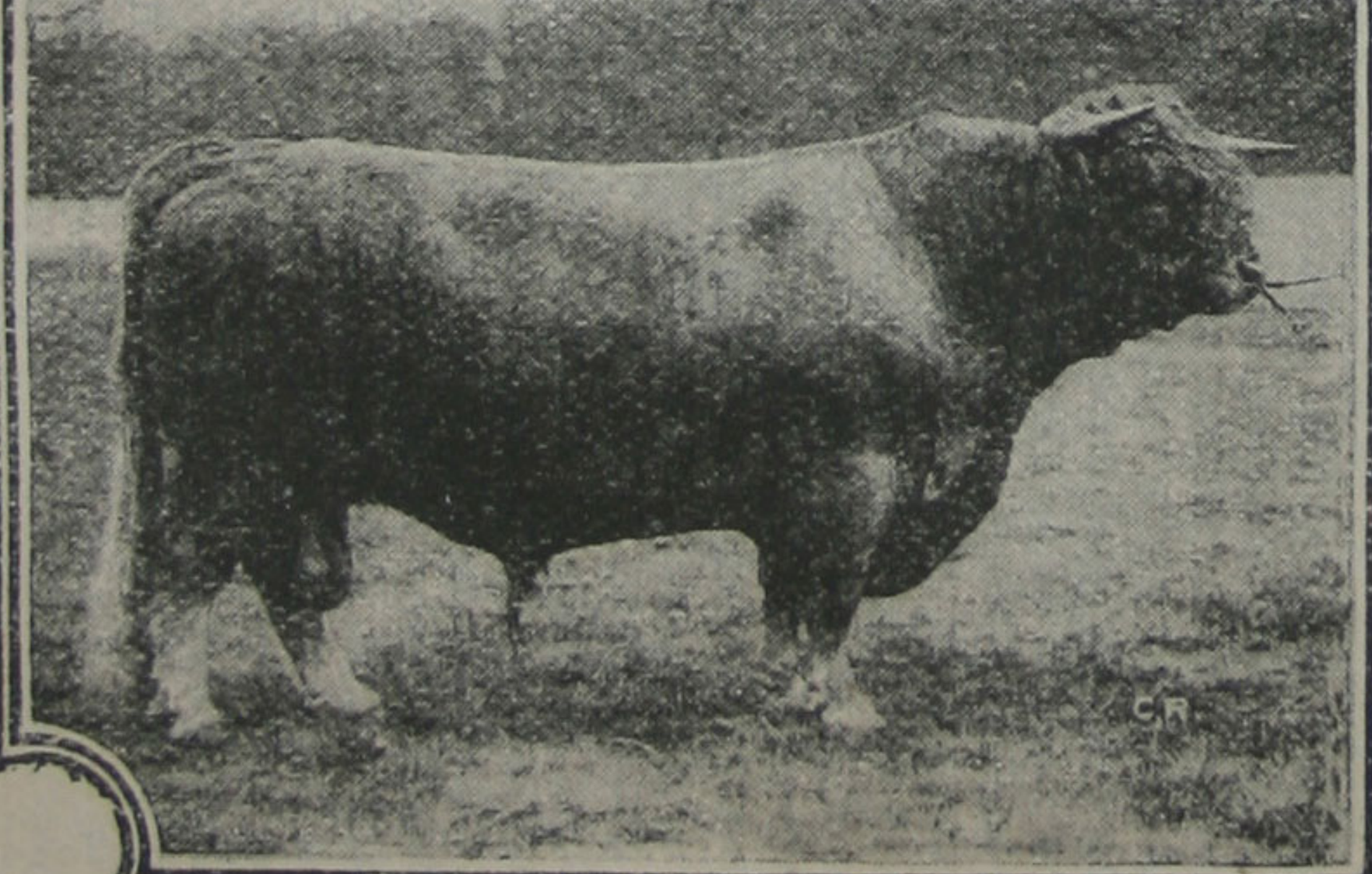

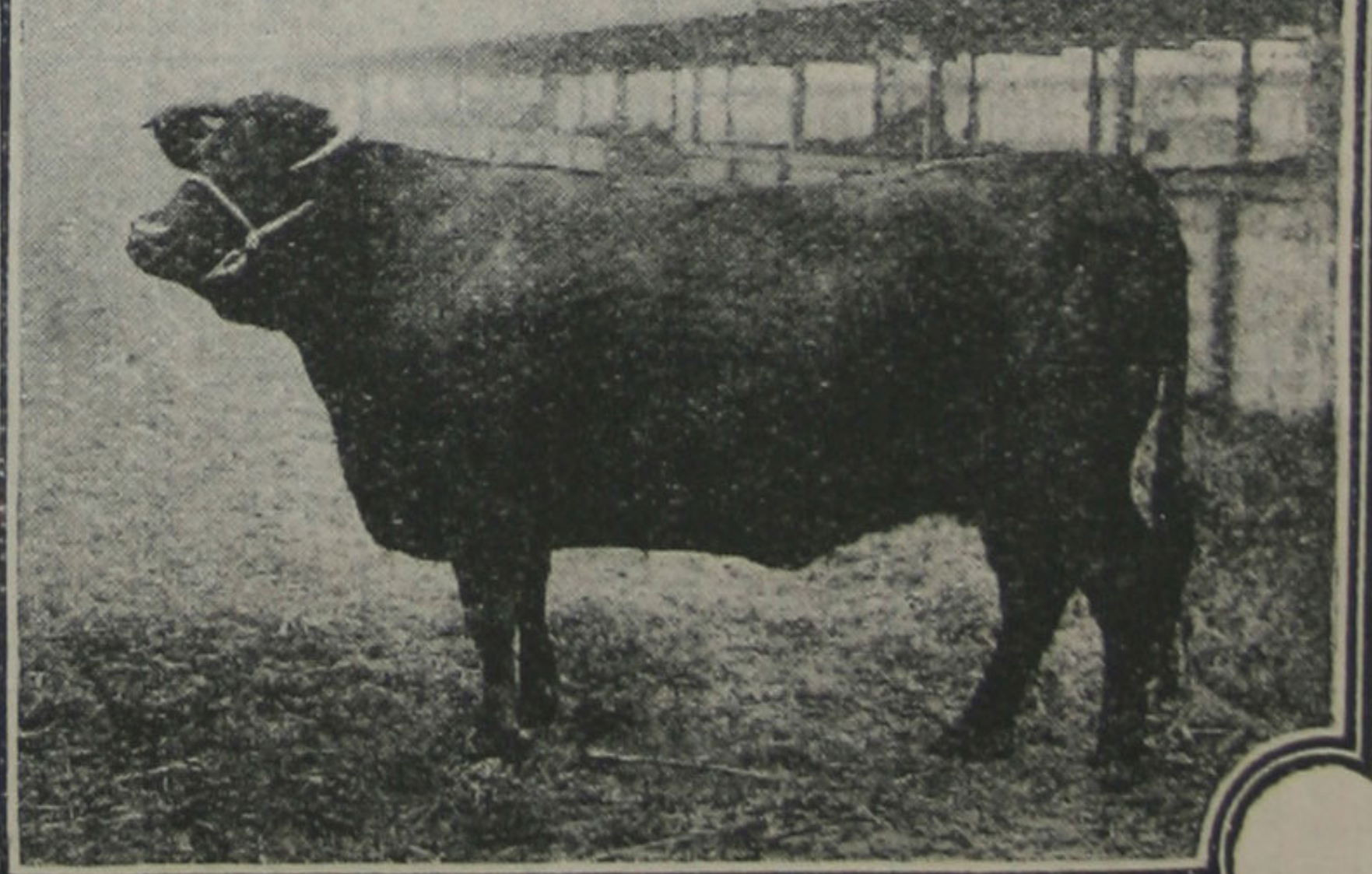

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British Breeds of Cattle.—II. [*Photos by Reid, Wishaw.*

1. Polled Angus, 'Blooming Rose.' 2. Ayrshire, 'Harvey.' 3. Highland, 'Laoich.' 4. Welsh cow, 'Wern Gem.'

Bakewell undertook the improvement of the Longhorns, and was followed by the Culleys, the brothers Colling, the Booths, and Bates, who undertook a similar task for the Shorthorns of the northern counties. At that time it was thought impossible to fatten an ox under four or even five years old, but by increased care and skill, combined with intelligent selection, it became possible to fatten them at the age of two years. The principal objects aimed at by the great breeders of the latter end of the 18th century were: (1) early maturity; (2) utility of form; (3) beauty of form; (4) uniformity of type; (5) aptitude to fatten; (6) strength of constitution. To guard against reversion or breeding back to unworthy ancestors, cattle were selected the pedigrees of which were known, and no animals were used that were not purely bred. The difficulty of procuring suitable sires caused the same bull to be mated with females closely related to him, and some of the most famous sires were used for three or four generations in the same herd. This system of 'in-and-in' breeding proved less injurious than might have been expected. The longer the pedigree the more reliable was the result—that is, if the successive sires and females used in building it up were all of the requisite merit and purity of blood. This system of careful breeding was accompanied with rigorous weeding out of all inferior animals.

Shorthorns were established in N. Yorkshire, Durham, and Northumberland at an early date, and were improved by the importation of Dutch bulls. They excel both as milk and beef producers, although in some degree milking properties have been sacrificed to beef. Some of the highest-bred Shorthorns give but little milk, but the race is capable of producing dairy cows of the highest value. They are red, red and white, white, and mixed red and white, or roan, and the more popular colours are rich dark red and rich roans. The skin is mellow, and the coat deep and mossy. The bulls are large and grand in appearance, and both sexes are deep and square in form, with wide backs, well-sprung ribs, and massive shoulders and thighs. The horns are of medium length—short in the bull, and nicely curved in the cow. The Shorthorn has been exported into America, Argentina, Australia, and New Zealand, and is highly esteemed upon the continent of Europe. By far the greater number of the ordinary dairy cattle of the country, as well as of the fat cattle which appear at our markets, are the result of crossing with Shorthorns.

Hereford cattle are distinguished by a white face, with a red body, broken with white on the breast, belly, feet, tail-end, and top of the shoulder. The Hereford markings are therefore distinct, and serve to distinguish them from all other races. These animals are essentially beef-producers, but some Hereford cows are extraordinary milkers; and no better dairy cow can be produced than that resulting from a cross between a Shorthorn bull and a Hereford cow. These cattle are found in perfection in their native county and in the Midlands.

The purest type of Devon cattle is found in N. Devon. They are of medium size, and of perfect symmetry. The colour is deep red, except a little white in front of the region of the udder. The muzzle, the skin around the eyes, and the insides of the ears are yellow or orange tinted. The animals are fine in the bone, and more fitted for beef than milk production. Devon steers grow to a

much greater size than either the bulls or the cows, and are considered to be very good for draught.

Sussex cattle resemble the Devons in general appearance and qualities, and are known principally as beef-producers. They are larger in frame, and, although red, duskier in colour. The features are not brightened by the yellow tint which characterizes the Devon cattle.

Norfolk polls, as their name implies, are hornless. They are red in colour, and famous as dairy cattle. They are also kind fatteners and excellent beef-producers, and of late years have come into favour beyond their own county.

Cattle of the Jersey breed are small and elegant in form, and the eyes and head have a deerlike appearance. The colour varies from a light fawn to a gray or smoke colour, beautifully shaded. Jersey cattle, which resemble the dairy races of Switzerland and the Austrian Tyrol, are valued chiefly for their milking properties. The milk is extremely rich in butter fats, and the butter is naturally of a rich yellow colour. The fat of the beef has a yellow tinge.

Guernsey cattle are larger and squarer in form than Jerseys, and the colour is light yellow interspersed with patches of white. They also are principally kept for dairying.

Galloway cattle are principally found in the south-west of Scotland, in the counties of Dumfriesshire and Galloway. They are black and hornless, long, cylindrical, and short-legged. They are kept in the open air all through the year, and their milking properties have not been cultivated. They are kind and quick feeders, and are sold in large numbers to the graziers of the eastern counties of England at the Border fairs.

Aberdeen-Angus cattle occupy the north-east peninsula formed by the counties after which they are named, and extend into Inverness. They are black and hornless, or polled, and are of larger size and looser make than the Galloways. These handsome cattle are essentially a beef-producing race.

The Ayrshire race occupies a district north of, and adjacent to, that of the Galloway cattle, and is the chief Scottish dairy breed; it is famous around Kilmarnock, and is seen in perfection around Glasgow. The Ayrshire is exceptionally fitted for cheese production, and is a frugal animal, thriving upon poor pastures as well as upon good land. It is of medium size, with rather upright horns, and varies in colour from almost white to dark brown, and is frequently yellow-red and white, or brown and white.

The West Highland cattle occupy the central highlands of Scotland, and are found in great perfection in the Hebrides, and especially in Skye. They are of very picturesque appearance, carrying magnificent horns and a shaggy coat of long silky hair. The colour varies from silver-gray to mouse-dun brown, red, and black. They are favourite park cattle, and are ornamental as well as profitable. The West Highland cattle are good fatteners, and yield beef of the highest quality, but they are not milkers.

The Zetland cattle are small, and often diminutive, hardy black and white cattle, found in Shetland and the extreme north of Scotland.

Wales has four races of cattle—the Pembrokes, which are black, and have white, glistening horns tipped with black; the Glamorgans, which have been extensively crossed with the Hereford; the Castle-Martins, an improved type of Pembrokes; and the Anglesea

cattle, from which the Longhorn were originally derived.

Ireland possesses the little black and horned Kerry, and the derived race of Dexters, originated by Captain Dexter by crossing the Kerry with Shorthorn bulls.

The Longhorn is now seldom seen, but is still found around Kenilworth in Warwickshire. It was at one time widely distributed, but has been outrivalled by the Shorthorn. The feature which at once distinguishes the Longhorn is its long, drooping horns, which grow downwards and curve towards each other, sometimes threatening to pierce the jaw of their bearer. The cattle are of brindled colour, pied with white along the back, and the bodies are long and level.

Forest Cattle.—The New Forest in Hampshire possesses a hardy and unimproved race of cattle often called Normans, which are much esteemed as good milkers.

Numbers of Cattle.—In 1909 the total number of cattle in the United Kingdom was 11,761,830. The number of cattle of all ages per 100 acres of agricultural land under corn and grass taken over the United Kingdom is almost exactly twenty-four; and the amount of land devoted to each head of cattle is 4·160 acres. Remembering the well-known electioneering cry of 'three acres and a cow' of twenty-five years ago, the average area of 4·160 acres per head over the entire kingdom indicates that we are well stocked with cattle. See Housman's *Cattle: Breeds and Management* (1905); Youatt's *Complete Grazier* (15th ed. 1908); Wilson's *Evolution of British Cattle* (1909); Mayall's *Cows, Cow-houses, and Milk* (1909); Macdonald and Sinclair's *History of Hereford Cattle* (new ed. 1909); Sinclair's *History of Shorthorn Cattle* (1908); and Bruce's *Fifty Years among Shorthorns* (1907). For Breed Societies, see under BREEDING.

DISEASES OF CATTLE. Some of the most serious diseases of cattle are caused by bacteria, as tuberculosis, anthrax, and actinomycosis. In some diseases, such as rinderpest and 'foot-and-mouth disease,' the causal micro-organism has not been satisfactorily isolated, but there are good reasons for the belief that their infective poisons are of bacterial origin. Diseases of the digestive, respiratory, and generative organs are common in cattle. Cattle also suffer from external and internal parasites.

Bovine Tuberculosis.—This has been known since the age of Moses, and exists in almost every country in the world. It is an infectious disease, characterized by the formation of tubercles or nodules—small grayish-yellow bodies, which may exist in almost every organ, and give rise to numerous disease processes which vary according to their situation. The *Bacillus tuberculosis* discovered by Koch in 1882 is the cause of human and animal tuberculosis.

Predisposing Causes.—Bad ventilation, overcrowding, insufficient air space, and all conditions hostile to general health.

Numbers Affected.—Twenty-five to thirty per cent. of dairy cows in Great Britain; fifteen per cent. of other stock over two years old; one per cent. or less of cattle under two years. In other European countries the numbers are not much, if any, less.

Dissemination.—Diseased cattle cough up discharge; in warm sheds the discharge dries, is gradually pulverized, floats in the air, is inhaled by healthy cows, and produces in them tuberculosis. Food contaminated by the sputum of diseased animals, when swallowed by healthy animals, will produce the disease. Calves and

pigs fed on milk containing tubercle bacilli contract the disease and die, often in six or seven weeks. Heredity is not now considered a method of transmission of tuberculosis to any appreciable extent; only about three calves per thousand born suffer from congenital tuberculosis, and this does not prove heredity.

Clinical Symptoms (not reliable in early stages).—A fat bullock apparently in perfect health may be found after death to exhibit extensive tubercle lesions. 'Tuberculin,' a glycerin extract from pure cultures of tubercle bacilli, is the most reliable diagnostic agent, proving correct in ninety out of every hundred trials. Injected subcutaneously, it produces a distinct rise of temperature in tuberculous animals, while in cattle free from tuberculosis it produces no effects. The disease may be localized in one organ or generalized through the system. It gives rise to many apparently different diseases—*e.g.* pneumonia, pleurisy, abortion, mammitis, diarrhœa, peritonitis, metritis, cerebro-spinal, bone, and glandular affections, etc. The eradication of tuberculosis would diminish by from 20 to 30 per cent. the annual death-rate of British cattle.

The prevention of bovine tuberculosis lies in providing an open-air life for cattle wherever possible; ample ventilation and good sanitary conditions in cow-sheds.

Eradication of Tuberculosis.—The Danish method initiated by Professor Bang appears the most feasible, and consists briefly of—(1) testing all cattle with tuberculin at the expense of the state; (2) isolation of all reacting animals to be fattened for the butcher; (3) separation of calves from diseased cows at birth, and feeding them on boiled milk, so that they may grow up free from infection.

Foot-and-Mouth Disease (*Aptha epizootica*).—Foot-and-mouth disease is an acute infectious disease which readily attacks all ruminating animals, though horses and dogs less readily; man is easily infected. It has been well known since the beginning of the 18th century. Germany, France, and other European countries have frequently been ravaged by it. It was introduced into England in 1839. The cause is a virus which exists in the saliva, the respired air, and in all the secretions and discharges of the body. No specific organism has yet been definitely isolated. The poison is both fixed and volatile. All litter, food, places, persons, and things that infected cattle come in contact with may convey the disease to healthy animals. The disease spreads rapidly, attacks large numbers, interferes seriously with health and condition, decreases the milk supply, and hampers the cattle trade owing to the necessary restrictions imposed. The loss in England during 1883 was estimated at a million sterling. One attack does not confer immunity from another, so that the same animal may be attacked repeatedly at short intervals. Average period of incubation, from three to five days.

Symptoms.—Salivation; smacking of lips; vesicles or bladders in the mouth, on tongue, lips, palate, etc. The vesicles burst and leave ulcers or red eroded patches in the mouth, which may reach one and a half inches or more in diameter. The feet become affected after the mouth. The skin round the hoofs is reddened, and small vesicles form and burst, leaving a sore surface. The animal is stiff and lame, lies down a great deal, and becomes rapidly emaciated. The secretion of milk is decreased 50 to 75 per cent. The disease runs its course in from eight to fourteen days, as a rule. Complications are sometimes serious and

fatal. Abortion is not uncommon. Pharyngitis, congestion of the lungs, pneumonia, and gastro-enteritis occur occasionally. Blood-poisoning may arise from the condition of the feet.

Mortality.—One per cent. or less in the mild ordinary form of disease; five to fifty per cent. in the malignant form, which sometimes appears. The disease may last in a herd for a month or six weeks, although individually it lasts only eight to fourteen days.

Treatment.—Liquid nourishing diet, administered if necessary; a dry floor; antiseptic washes for mouth and feet. Inoculation with saliva helps to cut short an attack, but is not effective as a protective measure.

Prevention.—Strict inspection by veterinary experts at ports and frontiers. Prompt police measures of restriction and slaughter in small outbreaks, with compensation to owners. Thorough disinfection after outbreak.

Rinderpest, or *Cattle Plague*, is the most fatal of all cattle diseases. It is highly infectious, and only attacks ruminating animals. It has been known since the 4th century, and its original habitat is believed to be the steppes of S. Russia. It has been estimated that during the first half of the 18th century, 200,000,000 cattle died in European countries from rinderpest. It was introduced into England in 1865 from Russia by Russian cattle. After terrible losses it was stamped out, but reappeared in 1866, again in 1872, and its last invasion of England was in 1877. For some years rinderpest has played havoc with the cattle in S. Africa, the last serious outbreak having occurred in 1902. It appears to be a form of septicæmia. The virus is both fixed and volatile. It exists in all the secretions and excretions of the body; can be conveyed by diseased animals and by intermediary bearers, gaining access to the blood through the respiratory or digestive passages. The poison of rinderpest remains infective for four or five months, but is not difficult to destroy by disinfectants. The period of incubation is from three to seven days.

Symptoms are, first, high fever, rapid pulse, shivering fits, loss of appetite, cessation of rumination and of milk secretion. The more characteristic symptoms are discharge from eyes, nose, and vagina in females; flow of saliva from mouth; very violent, offensive diarrhœa, sometimes mixed with blood; red discolorations and patches on mucous membranes of mouth and vagina. These patches soon become covered with branlike scales or crusts, which are shed, and leave red erosions or ulcers in the mucous membrane. There is great prostration; the animal lies down continually, grinds its teeth, the temperature falls, and the animal dies.

Mortality is from 90 to 95 per cent. One attack confers immunity for life, on recovery.

Treatment.—Useless, and forbidden. The poleaxe is generally resorted to in order to stamp out an outbreak. The carcasses should be carefully buried with quicklime, and thorough disinfection practised.

Preventive Measures.—Inoculation with the serum of animals which do not take the disease has been tried with good results in S. Africa. Strict inspection to prevent introduction is necessary in countries free from the disease.

Pleuro-pneumonia Contagiosa.—Contagious pleuro-pneumonia of cattle is a disease peculiar to the bovine race, and cannot be transmitted to other animals. It has been known since the 17th century, and consists of an infectious inflammation of the lungs and pleura. Its actual cause is unknown, but is probably a mi-

nute organism. The disease can be readily conveyed by diseased cattle, or by intermediate bearers, as attendants, litter, etc. Respired air is, however, the chief cause of infection, and the poison can be carried in the air forty yards or more and still prove infective. The virus may exist in infected sheds for a year or more and then become active, if there has been no disinfection. The period of incubation is from three to six weeks as a rule, but may be much longer. One attack confers immunity on recovered animal for years, and probably for life.

The *mortality* is from 30 to 50 per cent.—second in fatality to rinderpest. The cattle in W. Europe, Great Britain, America, Africa, and Australia have been seriously affected with pleuro-pneumonia at various times.

Symptoms are those of ordinary pleuro-pneumonia, with cough, difficulty in breathing, grunting, emaciation, fever, etc. Skill is required to differentiate this from other diseases of the lungs. There are two forms of the disease—the acute and the chronic. Post-mortem examination reveals the characteristic marbled appearance of the lungs in section, due to broad bands of connective tissue surrounding the lobes. The lung tissue is hepatized, and of various colours.

Treatment.—Curative measures are useless and dangerous. All diseased animals, and all animals that have been in contact with diseased cattle, must be slaughtered; and there must be thorough disinfection of sheds, which must be kept vacant as long as possible. Also there should be strict port and frontier inspection of all foreign cattle. Inoculation has been tried with serum from diseased lungs, but the results are disputed. Inoculation appears to cut short an outbreak in an infected herd, but its application to healthy animals on farms free from contagious pleuro-pneumonia is doubtful.

Besides these, cattle also suffer from contagious abortion in cows, infectious diarrhœa of calves, anthrax, actinomycosis, 'red water' (a form of malaria in cows), parturient paralysis, variola, and parasitic affections.

Prior to 1892 a strong agitation was raised by cattle breeders against the importation of live stock for fattening purposes from Canada and elsewhere, on the ground that disease was being reintroduced into Great Britain. In that year a provisional order was made putting an embargo on such importation, and in 1896 the Diseases of Animals Act was passed, which provides that all animals landed must be slaughtered at the port of importation within eight days. The main conditions imposed by the act are that the cattle must be landed at a foreign animals wharf after a prescribed request in writing has been made by the importer or his agent setting forth the number of each kind intended to be landed. The animals will then be inspected by the officers, and the request and a certificate will be forwarded by them to the authorities. Animals brought from certain countries, scheduled from time to time by the authorities, may not be landed. The vessel in which they are imported (1) must not within twenty-eight days before taking them on board have had on board any animal exported or carried coastwise from a port or place in any scheduled country; (2) nor within twenty-one days before taking them on board, nor since, have entered or been in any port or place in any scheduled country; (3) the animals while on board the vessel must not have been in contact with any animal from any scheduled country. After the landing of such animals the vessel's gangways and

other approaches must be disinfected. The fatteners of cattle for market, on the other hand, are strongly opposed to this legislation, and are actively working for its repeal.

See F. Friedberger and E. Fröhner's *Veterinary Pathology* (trans. Captain Hayes, new ed. 1904–5); J. Woodroffe Hill's *Bovine Medicine and Surgery* (1882); Fleming's *Text-book of Veterinary Obstetrics* (1896); T. Walley's *Practical Guide to Meat Inspection* (1901); J. H. Steel's *Diseases of the Ox* (1881); Williams's *Principles and Practice of Veterinary Medicine* (new ed. 1909); E. Nocard's *Animal Tuberculosis* (1895).

Cattle Insurance. See INSURANCE.

Cattleya, a genus of orchids, natives of Central and S. America, distinguished for the large beautifully-coloured flowers which are borne by most of the species. The number of species and of varieties derived from them is very large, and they are mostly not very difficult of cultivation. The flowers differ from those of the allied genus Lœlia in that they have two pollinia instead of four. The members of the genus best known to gardeners are *C. labiata* and its varieties. It is possible from these alone to have plants in flower the year through: in January *C. labiata Percivaliana*, with a brilliant yellow throat marked with purple; this is followed by *C. labiata Trianæi* and its sub-varieties *C. labiata Trianæi alba* and the fragrant *C. labiata Trianæi Schrœderiana; C. labiata Warnerii* blooms in May and June, and *C. labiata Warscewiczii*, with yellow and crimson markings, in July and August; in autumn we have the fragrant mauve-flowered *C. labiata Eldorado* and its white sub-variety *C. labiata Eldorado Wallisii; C. labiata* itself carries on the flowering season down to December. Among other species specially worth growing may be named *C. Walkeriana*, *C. Dowiana*, *C. maxima*, *C. Skinnerii*, and *C. Aclandiæ*. Nearly all the species and varieties do best in a moist, warm atmosphere, the temperature being kept at 55° to 65°. During the time of active growth plenty of light and air is essential; but for a time after potting the plants should be shaded from direct sunshine. See J. Lindley's *Sertum Orchidaceum* (1838).

Cattolica, tn., prov. Girgenti, Sicily, 13 m. N.W. of Girgenti, with salt and sulphur mines. Pop. 8,000.

Catullus, GAIUS VALERIUS (87–*c.* 54 B.C.), a native of Verona, was one of the greatest Roman poets. He lived an irregular and extravagant life in Rome, and accompanied the prætor Memnius to Bithynia with the object of restoring his fortunes. His poems consist of 116 pieces, mostly of short length. Many of them are close imitations of Greek poetry, especially of the style of Callimachus of Alexandria; but it is rather on his love poems, satirical and society verses, and elegies that his reputation is founded. As compared with those of Horace, his lyrics are possibly rough; but it is the roughness of vigour and power, which was more congenial to the character and language of Rome than the polish of the later poet. Among his longer compositions are *Epithalamium Pelei et Thetidos*, *Coma Berenices*, and *Attis*. Editions: Text—Postgate (1894), Palmer (1896), Owen (1893); with notes, R. Ellis (1889), Riese (1884), Merrill (Boston, 1893). See W. Y. Sellar's *Roman Poets of the Republic* (3rd ed. 1889); *Poems*, edited by MacNaghten and Ramsay (1900). Trans.: T. Martin (1863), Ellis (1871), Munro (1878; 2nd ed. 1905).

Catulus, Roman family of the Lutatian clan. (1.) GAIUS LUTATIUS CATULUS, consul in 242 B.C., and proconsul in the next year, when he brought the first Punic war to an end by defeating the Carthaginian fleet near the Ægatian Islands. (2.) QUINTUS LUTATIUS CATULUS, consul in 102 B.C.; in the next year, as proconsul, he succeeded, along with Marius, in annihilating the invading hordes of the Cimbri at Vercellæ. In politics he belonged to the aristocratic party, and in the civil war of 87 B.C. was proscribed by Marius, and, unable to escape, committed suicide. (3.) QUINTUS LUTATIUS CATULUS, son of the above, was consul in 78 and censor in 65 B.C. Though a supporter of the aristocratic party, his upright character won him the respect of the people. He opposed, in 67 and 66 B.C., the Gabinian and Manilian laws, which conferred unusual powers on Pompey; was a keen opponent of Cæsar, who defeated him in his candidature for the pontificate, 63 B.C.; and applauded Cicero's action in suppressing the conspiracy of Catiline.

Catumbella, or KATUMBELA, riv. of Angola, W. Africa, rising in the N. dist. of Benguella and falling into the Atlantic 14 m. N.E. of Benguella vil. Near the mouth is the village of Catumbella, which, being more healthy than Benguella, is rising in importance.

Caub, or KAUB, tn., prov. Hesse-Nassau, Prussia, on r. bk. of the Rhine, 10 m. N.W. of Bingen; has slate quarries. Here, on Jan. 1, 1814, Blücher effected the crossing of the Rhine. Pop. 2,400.

Cauca, riv., Colombia, rising in the Andes, S.E. of Popayán, flows N., and joins the Magdalena near Tacaloa. Its valley is healthy, and remarkable for its natural beauty and mineral wealth. Length, about 500 m.

Caucasus. The Russian governor-generalship of the Caucasus lies between the Black and Caspian Seas. Its most striking natural feature is the great chain of the Caucasus, some 900 m. long, and with an average height of 12,000 ft. Its central portion is covered with snow and glaciers, and rises into many lofty peaks, of which the chief are Elbruz (E. peak, 18,345 ft.; W. peak, 18,465 ft.), Kosh-tan-tau (16,875 ft.), and Kazbek (16,546 ft.). The range consists of a core of granite and gneiss, flanked by clay slates, probably of Palæozoic age. The S. part of the territory is occupied by the numerous ranges of the Minor Caucasus, culminating in the Kapujikh, at a height of 12,855 ft. Here Cretaceous rocks are widely distributed. The two systems are connected by the short Suram range, forming the watershed between the Kura and the Rion. Nearly all the prominent peaks of the Caucasus have been ascended by Alpinists since 1868, the pioneers being D. W. Freshfield, A. W. Moore, and C. Tucker, who climbed Elbruz E. peak and Kazbek in 1868; and F. C. Grove, H. Walker, and F. Gardiner, who climbed Elbruz W. peak and others in 1874. C. P. Woolley ascended Kosh-tan-tau in 1888. The most important mineral product of the Caucasus is petroleum, obtained at Baku and several other localities. Copper, iron, manganese, coal, and other ores are also worked. The rivers are torrential in their upper courses, and meander through marshes near their mouths, so that they are more utilized for irrigation than navigation. The chief are the Kura and its great tributary the Áras or Araxes, the Kuban, and the Terek, north of the Caucasus; the

Rion and smaller streams on the Black Sea slope. Lakes are fairly numerous in the Minor Caucasus, the largest being Gok-cha. The climate of the Black Sea slope is warm and moist, with an annual mean temperature of fully 58° F., and a rainfall of 59 to 93 in. At Derbend and Petrovsk the mean is lower, but the range greater, and the rainfall in the N. and E. is under 20 in. The flora is very varied, including trees, shrubs, and fruits of N. and S. Europe, as well as Oriental forms. The Black Sea littoral and the Talyshin Mts. are clothed with pine forests, but the E. and N. have a scanty vegetation, in many places of a steppe character. Salmon, trout, and other fish are plentiful. Fully forty different tribes—Circassians, Georgians, Lesghians, Ossetes, Tartars, Turks, Kurds, Armenians, etc.—dwell in the Caucasus, in addition to Russian settlers. They belong to many different religious sects, and are ignorant, fanatical, and superstitious, thus providing material for almost constant internecine warfare. During 1904–5 anarchy prevailed at many centres of disorder. Oil wells were burned at Baku, and massacres took place there, also at Erivan, Tiflis, Batum, and elsewhere, the whole district being in a state of civil war, and the authorities quite powerless to preserve order. Cereals, tobacco, cotton, and hemp are grown; wine, felt, and jewellery are manufactured; silk, carpets, and other woollen goods are woven. Tea has been introduced. Cattle-grazing is almost the sole occupation of the semi-nomads in the mountains. Russian annexation commenced in 1835, and the territory attained its present extension on the cession by Turkey in 1878 of the districts of Kars and Batum. The country is under the control of a governor-general at Tiflis. Railways run from Baku to Batum and Poti, from Baku to Petrovsk and Novorossiysk, and from Tiflis to Kars, with a branch from near Alexandropol through Julfa into Persia. An important military road connects Vladikavkas with Tiflis, crossing a pass only 7,977 ft. above sea-level. Area, 180,843 sq. m. Pop. 10,600,000. See Abich's *Geologische Forschungen in den Kaukasischen Ländern* (3 vols. 1878–87); Chantre's *Recherches Anthropologiques dans le Caucase* (4 vols. and atlas, 1885–7); Wardrop's *The Kingdom of Georgia* (1888); Freshfield's *The Exploration of the Caucasus* (2 vols. 1896); Merzbacher's *Aus den Hochregionen des Kaukasus* (2 vols. 1901); Villari's *Fire and Sword in the Caucasus* (1906).

Cauchy, AUGUSTIN LOUIS, BARON (1789–1857), French mathematician, was professor (1816) at the Ecole Polytechnique, and at the Collège de France and the university, also member of the Institute. Following Charles X. into exile (1830), he became scientific tutor to the Duc de Bordeaux (1832), and afterwards professor (1848) of mathematical astronomy at Paris. Among his very numerous and important works are *Théorie des Ondes* (1815), crowned by the Institute; *Leçons sur les Applications du Calcul Infinitésimal à la Géométrie* (1816-28); *Leçons sur le Calcul Différentiel* (1829); *Mémoire sur la Dispersion de la Lumière* (1836). His *Œuvres Complètes* were published by the French Academy in twenty-six volumes (1882, etc.). See Valson's *Le Baron A. Cauchy* (2 vols. 1868).

Caucus, in politics, a meeting of supporters of a definite line of policy for the purpose of choosing representatives who desire to express their views, or of deciding upon some change of political creed. It is also applied to the organized leaders or framers of the policy. The word is certainly

of American origin, but was used by Burke, Bentham, Cobbett, Sydney Smith, and others, while Murray gives an instance of its use by Adams in 1763.

Cauda-galli Grit. See CORNIFEROUS PERIOD.

Caudan, comm., Morbihan dep., France, 5 m. N. by E. of Lorient; manufactures tiles and bricks. Pop. 9,600.

Caudata, or URODELA, an order of amphibians which includes newts, salamanders, the axolotl, and others that retain throughout life the tail present only in the larva of frog and toad. The body is always elongated, and the limbs are much weaker than those of the anura, or tailless forms.

Caudebec. (1.) C.-EN-CAUX, tn. and river port, dep. Seine-Inférieure, France, on r. bk. of Seine, 19 m. W. by N. of Rouen. Prior to the revocation of the Edict of Nantes it was a Huguenot industrial centre. Pop. 2,200. (2.) C.-LES-ELBEUF, manufacturing tn., dep. Seine-Inférieure, France, 15 m. S. by W. of Rouen; has Roman remains and woollen industries. Pop. 9,400.

Cauderan, a W. suburb of Bordeaux, France; has chocolate and chemical manufactures. Pop. 11,500.

Caudine Forks. See CAUDIUM.

Caudium, an ancient tn. in Samnium, Italy, on the road between Capua and Beneventum. Near it was the pass known as the Furculæ Caudinæ, or Caudine Forks, in which a Roman army was compelled to surrender by the Samnites in 321 B.C.

Caudry (anc. *Cambrésis*), manufacturing tn., dep. Nord, France, 8 m. S.E. of Cambrai; manufactures textiles, and has breweries, distilleries, etc. Pop. 11,000.

Caul, a part of the amnion or fœtal membrane; receives this name when a child is born with it covering the head, instead of with the head piercing it, as is generally the case. To be born with a caul (Byron is an instance) was, and in some places still is, considered lucky. The caul is also believed to bring luck to the person who afterwards owns it, and especially to guard the bearer against drowning. Large sums were formerly paid for one by seafaring men—thirty guineas have been given—but such values do not obtain now.

Caulaincourt, ARMAND AUGUST LOUIS, MARQUIS DE (1772–1827), French statesman, born at Caulaincourt, dep. Aisne. He was imprisoned as a royalist, but escaped. Under Bonaparte he became grand equerry (1804), general (1805), and finally (1808) Duke of Vicenza. After being ambassador at Russia (1807), he shared in the Russian campaign, having vainly urged Napoleon against it. During the 'Hundred Days' he was Napoleon's foreign minister. The Restoration deprived him of office and peerage. His memoirs appeared as *Souvenirs du Duc de Vicence* (1837–40).

Caulfield, tn., co. Bourke, Victoria, Australia, 6 m. by rail S.E. of Melbourne. Pop. 10,000.

Cauliflower. The cauliflower is, like the broccoli, a cabbage in which the flower stems and abortive flowers have been artificially developed. It was introduced to England, probably by Flemings, in the 16th century. But for long it remained a luxury both in England and in France. The soil should be deeply dug, lightish, and well-manured. The earliest sowing should be made on warm, sheltered borders about the end of August, selecting such a variety as the Walcheren. The protection of hand-glasses will be required during the winter in cold localities. The young seedlings should be planted out as soon as they can be easily handled, or they may be potted and placed

in a cool house or frame. Such kinds as Sutton's first crop or early forcing may be sown in heat in January, and pricked out first in a warm bed, and subsequently hardened and planted in the open. These should be ready by midsummer. In March or April a sowing in the open should be made of dwarf, favourite, or Erfurt for early autumn use, and of the autumn mammoth and dwarf mammoth for the late supply.

Caulking, or CALKING, the process of driving oakum (or old ropes untwisted and pulled asunder) into the seams of a ship's planks, in sides or decks, and covering it with pitch or rosin, to make the vessel tight.

Caulonia, formerly CASTELVETERE, tn., Calabria, Italy, near the Mediterranean, and 45 m. N.E. of Reggio. The site of the ancient *Caulonia* or Aulonia, founded by the Achæans, is on the coast, 4 m. distant. Pop. 6,400.

Caulopteris, a name given to certain fossil tree-ferns the external surface of which is densely covered with leaf scars. *Ptychopteris* and *Psaronius* are similar plants in a different state of preservation. These stems are often silicified, and their interior structure can be perfectly made out. Some of them were of large size; it is believed that they may have been forty feet and more in height. They are especially characteristic of the Carboniferous formation, in which certain coal beds are practically entirely made up of the trunks of tree-ferns.

Caunt, BENJAMIN (? 1815–61), pugilist, champion of England (1838), was born at Hucknall-Torkard, Nottinghamshire; began to attract attention as a fighter in 1837. His style was not particularly scientific, but he was resolute and powerful, standing 6 ft. 2½ in., and fighting at 14 st. 7 lbs. He earned the championship by beating Bendigo at their second encounter (April 1838), in seventy-five rounds.

Caunus, an important ancient city on the S. coast of Caria, in Asia Minor, opposite the island of Rhodes; was a colony of Crete; famous for its dried figs.

Cauquenes, tn., Chile, cap. of Maule prov., 75 m. N.E. of La Concepcion. Wheat and vines are extensively cultivated. Pop. 8,500.

Caus, CAUX, or CAULX (for all forms exist), SOLOMON (1576–1626), French engineer, born in Normandy; educated in England, where he spent his early years. He was employed successively by James I.; James's son, Henry, Prince of Wales; the Elector Palatine (1614); and the king of France (1620). He in 1615 published *Raisons des Forces Mouvantes avec Diverses Machines*, wherein he gave such unmistakable foreshadowing of the steam-engine that its invention has been claimed for him.

Cause. The Aristotelian doctrine of causation recognized four kinds of causes—material, formal, efficient, and final. Thus, in the case of a house, the stone and wood are the material cause, the plan of the house the formal cause, the builder the efficient cause, and the shelter which the house is intended to afford the purpose or final cause of its construction. In the case of organic or living things, to which probably Aristotle's scheme was primarily applied, the form—that is to say, the principle of life—is immanent from the beginning (though undeveloped), and is, moreover, when fully realized, itself the end or final cause of the organism. So that the formal and the final cause are here coincident and identical, while the efficient cause becomes merely the first impulse from without that starts the process of immanent self-de-

velopment. The modern scientific doctrine of cause and effect is concerned primarily with mechanical processes, the fundamental feature being the uniformity of succession exhibited. If the phenomenon or set of conditions A B C is followed by the phenomenon or set of consequences $\alpha\beta\gamma$ on one occasion, it is assumed that the like set of conditions will be followed by the like set of consequences on every other occasion. Upon this general assumption the methods of physical science—*e.g.* the inductive methods analyzed by Mill—are based.

Two main problems have been discussed in connection with this fundamental assumption. The first of these, started and argued with great acuteness by Hume, is whether the assumption is a rational and necessary principle, or only a blind though persistent belief, produced in each particular case of its application by the constant association of ideas which results from the repetition of a particular sequence of events. Hume's continually reiterated ground for denying the necessity of the principle is, that, so far as we can see *à priori*, a given phenomenon A might just as well cause the result β as its actual result α (for example, for anything we can see, bread might have been poisonous instead of nourishing); and the mere frequency with which α does follow upon A cannot generate a necessity which was absent from their first connection. But to this it must be replied: (1) that the particular necessity for the particular connection A—α is precisely the problem which science has to solve (for example, to discover why bread is nourishing, we must ascertain the chemical nature of bread on the one hand, and of human tissue on the other); (2) that the general principle asserts only the stability or necessity of causal connection in general, and does not promise us any insight into the particular nature of particular connections.

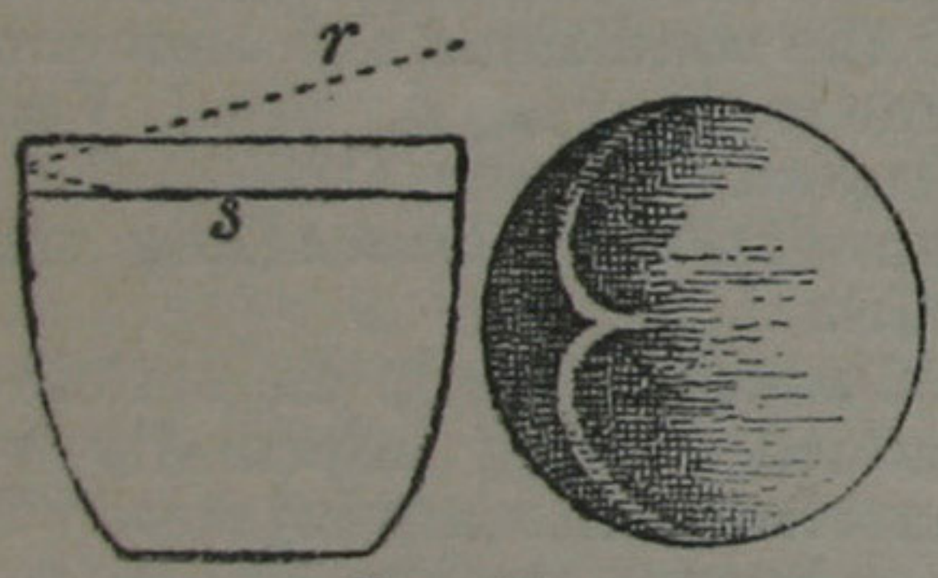
The second problem in connection with the principle of causality arises when the analysis of the causal relation is pushed to its logical conclusion. In the ordinary scientific use of the conception of causation, a distinction in time is assumed between the cause and the effect. Now, this distinction is possible only so long as our statement of the cause or conditions is incomplete. If all the conditions of an effect are given, the effect is given with them, being, in fact, nothing distinct from the totality of its conditions or partial causes: for example, the conjunction of gunpowder and a spark is already an explosion. It would seem, then, that with the complete statement of the conditions the element of time is eliminated. See J. Venn's *Empirical Logic* (1889), ch. ii.; Janet's *Final Causes* (Eng. trans. 1878).

Causerie (Fr.), an article or lecture dealing informally with matters of literary interest. The best known are the *Causeries du Lundi* of Sainte-Beuve, where, however, the causerie, like the essay, belies its humble title, and has become a very elaborate production. Causeries are regularly published in many newspapers and periodicals on art, literature, the drama, etc.

Causses (Lat. *calx*, 'lime'), lofty calcareous plateaus in the deps. of Aveyron, Lozère, Gard, and Hérault, France, on the steep western slopes of the Cévennes (area, some 2,000 sq. m.). Numerous streams have excavated cañons that divide the plateaus into four main and many smaller 'causses' or promontories, the chief being Sauveterre, Méjean, Noire, and Larzac. Surface pits (*avens*),

subterranean streams (the Tarn alone, in a distance of 31 m., receives thirty), and stalactite caverns abound. On the southern frontier of the Noire stands Montpellier-le-Vieux, 'the dolomite city.' See M. Betham-Edwards's *The Roof of France* (1889); E. A. Martel's *Les Cévennes et la Région des Causses* (1890).

Caustic, in chemistry, a term used for certain substances which have a corrosive action. 'Lunar caustic,' or nitrate of silver, is used in surgery to destroy and stimulate unhealthy and sluggish-healing surfaces. The word is used as a prefix to 'potash,' 'soda,' and 'lime,' indicating respectively the hydroxide of potassium (KOH) and of sodium (NaOH), and the oxide of calcium (CaO). All these have a corrosive action on cellular tissue, owing to their powerful attraction for water.



Caustic.

r, Ray of light; *s*, surface of liquid.

Caustic is the name given to the curve or surface of maximum brightness formed by the concentration of rays of light after they have been reflected from a reflecting surface, or refracted into a new medium. One of the simplest and most familiar examples is the caustic formed on the surface of tea or coffee when light from a window or a flame falls on it after reflection from the polished interior side of the cup. The two-arched curve formed in this way separates the surface into two regions, on one of which no reflected ray whatever falls. All such rays pass through the other region, and every ray is a tangent to the caustic curve. Each point of the caustic may, therefore, be regarded as the meeting-point of two consecutive rays at least. Where the two caustic arches meet there is a comparatively great concentration of rays, so that this point, known as the focus, is much brighter than other parts of the caustic. Caustics may also be produced by rays which have been refracted; and here, because of the dispersion of the differently-coloured constituents of white light, beautiful colour effects are frequently observed. Each ray forms its own caustic slightly displaced from the caustic formed by a ray of a different colour, so that the appearance is that of a coloured band. A very good example of this is the rainbow.

Cauterets (formerly *Cauldrets*), health resort, picturesquely situated in dep. Hautes-Pyrénées, France, 25 m. S. by W. of Tarbes. It has over a score of mineral springs with temperatures ranging from 71° to 130° F., which attract many invalids. Pop. 1,400.

Cautery (Gr. 'burner') is the application of dry heat to the body tissues, so as to cause marked local irritation or even destruction of tissue, according to the degree of heat used, and the time for which it is applied. The usual forms of cautery are the (1) actual, (2) thermo, (3) galvano, (4) hot air, and (5) cautery by concentrated solar rays. The actual cautery is heat directly applied through a heated metal instrument—*e.g.* Corrigan's button. The degree of heat (black, red, or white heat) is decided by the effect desired. Black heat acts as a counter-irritant; dull red heat is counter-irritant and styptic, besides destroying tissue locally. An instrument applied at a bright red heat destroys tis-

use, but does not form a good seal for stopping hæmorrhage. White heat forms no eschar at all, and so cannot be used to stop hæmorrhage; and a white-hot wire practically cuts like a knife. In Paquelin's cautery and in similar instruments (thermo-cautery), the hollow blade to be applied is first heated in a spirit-lamp, and its heat is retained and regulated by means of spirit vapour driven through it. The galvano-cautery is heated by a galvanic current. Antisepsis must be secured, both in the surface to be cauterized and in the instruments, before the operation is performed. For the recent application of hot air and sun rays as cauterizing agents, it is claimed that no mechanical injury is done to the tissues, that healing is more satisfactory, and that scarring is much less.

Cautin. (1.) Coast prov., Chile. In the prov. is the active volcano Llaimas (9,800 ft.). Chief export, wheat. Cap. Temuco; chief port, Tolten. Area, 5,830 sq. m.; pop. 95,000. (2.) Or RIO IMPERIAL, riv., Chile. It rises on W. side of Andes, and flows W. for 180 m. to the Pacific.

Caution (Scots law). A cautionary obligation, known in England as suretyship, is an obligation in which one person becomes bound for another who is already bound. A cautioner's obligation cannot be more extensive than that of the principal debtor, but he may be more strictly bound. All cautionary obligations must be in writing. The cautioner has right of relief against the principal debtor, and he is freed by the primary obligation coming to an end. He is also free if the creditors discharge the debtor without his consent. If there be more than one cautioner, all must bear their share. See DISCUSSION.

Cautley, SIR PROBY THOMAS (1802-71), English soldier and engineer, born in London. He projected the great Ganges canal, whose main stream was opened in 1854, and which is regarded as a masterpiece of engineering.

Cauvery, riv., India, rising in the mountains of Coorg, flowing through Mysore (where, below Seringapatam, it descends in beautiful falls and rapids round the island of Sivasa-múdram) and Madras for about 475 m., to empty itself by means of one of the largest deltas in India (N. arm, Coleroon; S. arm, Cauvery) into the Bay of Bengal. Of little value for navigation, the river is exceedingly useful for irrigation, the deltaic system in vogue prior to the British occupation irrigating 1,000,000 ac.

Cava dei Tirreni, tn. and episc. see, prov. Salerno, Italy, 6 m. by rail N.W. of Salerno; stands high (980 ft.) amid charming surroundings, and is much visited in spring, summer, and autumn. The people manufacture textiles—silk, woollen, linen, and cotton. Pop. (comm.) 24,000. A little to the S. is the former famous Benedictine monastery of La Trinità della Cava, founded in 1025, with extremely valuable archives, now the property of the nation, and used in part as a higher school.

Cavagnari, SIR PIERRE LOUIS NAPOLEON (1841-79), British soldier and diplomatist, was born at Stenay, France. Naturalized as a British subject in 1857, he served in many campaigns in India; was murdered at Kabul by rebel troops of the Ameer. See *Life* by Kaliprasanna (1881).

Cavaignac, JACQUES MARIE EUGÈNE GODEFROY (1853-1905), son of Louis Eugène Cavaignac. He entered the Chamber as a republican (1882), becoming under-secretary of war (1885) and minister of marine (1892). As minister of war under M. Brisson (1898) he played a prominent part in the Dreyfus case: it was

he who discovered the Henry forgery, but he resigned his position rather than countenance a new trial of Dreyfus. He wrote *La Formation de la Prusse Contemporaine* (1891–8).

Cavaignac, LOUIS EUGÈNE (1802–57), French soldier and politician, born at Paris. He acquired great distinction in Algeria. At the revolution of 1848 he was appointed governor-general of Algeria; and then, as minister of war and dictator, he drove the insurgents from the barricades in a series of sanguinary engagements. The risings having been quelled, Cavaignac resigned his dictatorship, but was immediately appointed president of the Council. In the election for president of the republic he was beaten by Louis Napoleon. Though a quiescent spectator of the *coup d'état* of 1851, he was temporarily imprisoned. See *Life* by Deschamps (2 vols. 1870).

Cavaillon (anc. *Cabellio*), tn. (canton), dep. Vaucluse, France, 14 m. S.E. of Avignon. Cultivates mulberry and olive trees, vines, and 'melons de Cavaillon.' It boasts a model silkworm-rearing establishment. Pop. 10,000.

Cavalcanti, GUIDO (*c.* 1255–1300), Italian poet, born at Florence of a Guelph family. In 1300, when the Guelphs split up into the Blacks and Whites, and the former were in the ascendant, Guido, as a White, was exiled to Sarzana, but was permitted to return to Florence, where he died. Dante dedicated his *Vita Nuova* to Guido (see § 31), and several times refers to him, as in *Inf.*, vi. 73, x. 60 *et seq.*, *Purg.*, xi. 97–99; there are also numerous allusions to him in the *De Vulg. Eloq.* Dante and he were the most distinguished representatives of the Florentine school of lyrical poetry—that of the *dolce stil nuovo*. His most famous poem is the *canzone* on the Essence of Love (*Donna mi prega*), which contains much original thought. His other lyrics are less philosophical, but, on that very account, more beautiful. His ballads and pastorals are especially charming. The best edition of the poems is Ercole's *Guido Cavalcanti e le sue Rime* (1885). See, too, Salvadori's *La Poesia Giovanile e la Canzone d'Amore di Guido Cavalcanti* (1895); Pasqualigo's edition of the famous *canzone* (1891); Del Lungo's essay on Guido in the *Nuova Antologia* (Nov. 1, 1889); and D. G. Rossetti's rendering of several of the poems in *The Early Italian Poets* (1861), reprinted in 1874 and 1892 as *Dante and his Circle*.

Cavalcaselle, GIOVANNI BATTISTA (1819–97), Italian author and art critic, born at Legnano. Having taken part in the Italian revolution of 1848, he was obliged to seek refuge in London, where in collaboration with Mr. (afterwards Sir Joseph) Crowe, he prepared *Early Flemish Painters* (1857), which is still a standard work. After his return to Italy he published his *History of Italian Painting* (1864–71; new ed. 1903, etc.), and the Lives of Titian (1876) and Raphael (1883), in which he was assisted by Crowe. He was subsequently appointed (1878) chief of the National Art Gallery and art department in Rome. See *Reminiscences of Thirty-five Years of my Life*, by Sir Joseph Crowe (1895); also biography prefixed to Italian edition of *Flemish Painters* (1899), which contains Cavalcaselle's portrait.

Cavalier, a horseman, whence a knight, a gentleman. In monarchical France 'chevalier' was a title of honour. The name is most familiar to us as applied to the followers of Charles I. First given to them in derision (Nov. 1641), it afterwards came to be esteemed. The name survived until the struggle over the Exclu-

sion Bill in 1679, when it gave place to Tory.

Cavalla, more correctly KAVALA, seapt., Turkey in Europe, on the Gulf of Cavalla (Ægean Sea), 80 m. E. by N. of Salonika. The total trade reaches nearly £2,300,000, of which £1,800,000 was for tobacco exported. It was the birthplace of Mehemet Ali. Pop. 24,000.

Cavalotti, FELICE (1842–98), Italian writer and politician, was born at Milan; was always opposed to the government of the day, first against foreign rule (when he published a bitter *Germania e Italia* in 1860, and joined Garibaldi's forces), and afterward against the national government. As editor of the *Gazzettino* he likewise proved himself a thorough democrat and radical. He was killed in a political duel in 1898. As a poet he sought to combine what was best in classicism and romanticism, and many of his lyrics are excellent—*Anticaglie* (1879); *Il Libro dei Versi* (1898). Cavalotti's sympathies were largely Greek: witness his *Italia e Grecia*, his translation of Tyrtæus, and his dramas, *Alcibiade* and the *Messeni*. Of all his works, a one-act play, *Cantico de' Cantici*, probably aroused most interest. An edition of the *Opere*, in 9 vols., appeared at Milan in 1896. See Mohr's *Felice Cavalotti, la Vita e le Opere* (1899); and *Felice Cavalotti nella Vita e nelle Opere*, by various writers (1898).

Cavalry. British cavalry consists of 3 household regiments and 28 regiments of the line. The household regiments are not liable for service abroad, and have an establishment of 435 of all ranks with 276 horses. The 28 regiments of the line are divided into heavy and light cavalry—the heavy comprising 7 regiments of dragoon guards, 3 of dragoons, and 6 of lancers; the light consisting of the 12 regiments of hussars. Of these regiments, 14 are now serving at home, 1 in Egypt, 4 in S. Africa, and 9 in India. The regiments at home have an establishment of 3 strong squadrons and 1 reserve squadron, or 715 of all ranks. In time of war, the reserve squadron falls away to form a depot, and the regiment consists of 3 squadrons, or 553 of all ranks with 590 horses (see also SQUADRON and REGIMENT). Regiments in India are maintained at practically war establishment. Twelve of the regiments serving at home are formed into 4 brigades, with headquarters at Aldershot, Canterbury, the Curragh, and Colchester. It is intended to concentrate cavalry also at Salisbury. Brigades and divisions (see BRIGADE and DIVISION) will be formed on mobilization. The brigade consists entirely of cavalry, but the division possesses sufficient supply and medical service to render each brigade independent, should necessity arise.

Duties.—Cavalry is essentially an arm of offence, and its distinctive characteristic is the action of man and horse combined. This enables it to cover long distances in short periods of time, and to combine attack with surprise to the best advantage. The fact that it is now armed with a long-range rifle has yet further increased its power of resistance and extended its sphere of action. These qualities are particularly desirable in a period when the great bulk of a modern army renders it almost impossible to extricate it from a deployment to which it has been once committed. They enable the cavalry to be pushed far further to the front than has been the custom in recent years, and, in short, to revert to the practice by which Napoleon won so many of his

victories. His cavalry, it will be remembered, was often more than 100 miles in front of his army, and was able not only to discover the dispositions of the enemy but to enable its own main body to complete its deployment in concealment and security. These are the main duties of the cavalry of to-day, and it is therefore distributed in the following manner:—

Strategical or Independent Cavalry moves far to the front, and, guided by the instructions of the commander-in-chief, endeavours to obtain information of the enemy.

Protective Cavalry forms the first line of security for the main army.

Divisional Cavalry is allotted to each division for scouting and inter-communication.

The strategical cavalry is made as strong as possible, and pushes forward in the direction in which it is desired to reconnoitre. Here it will, as a rule, find the hostile cavalry, and, until the latter is overcome, accurate information regarding the enemy's main columns will seldom be forthcoming. The first duty of the strategical cavalry will therefore be the overthrow of the opposing horsemen; the second will be to break through the more backward line of covering troops. For these duties concentration of force is essential.

Now, it is obvious that, to fulfil these demands, the strategical cavalry may have to work round a hostile flank and so uncover the front of its own main army. Protective cavalry is therefore necessary, and it follows that, during the early stages, its action will be defensive and its formation dispersed. As, however, the armies gain closer contact, the protective cavalry will concentrate, and either endeavour to clear up the tactical situation or co-operate with the strategical cavalry.

The divisional cavalry does little more than supply patrols for infantry outpost lines, and orderlies for inter-communication. In order to set cavalry free for its more important duties, it has recently been replaced by yeomanry and mounted infantry.

Reconnaissance.—The above duties entail reconnaissance, which may be strategical, tactical, or protective. Strategical reconnaissance is intended to locate the hostile columns while the opposing forces are not yet within striking distance. It is, as a rule, carried out by officers, or by very small patrols. If, however, the enemy be still at a great distance, it may be advisable to give such patrols a *point d'appui* by sending out 'contact squadrons.' Tactical reconnaissance becomes necessary as the hostile forces approach one another. As a rule, it involves fighting, so that the patrols must be stronger, and the contact squadrons more frequent. Protective reconnaissance is intended to secure the main columns against surprise, and is the duty of the protective and divisional cavalry.

Mounted action.—The enemy having been located, and an attack decided on, the 'approach march' is commenced. The force is, as a rule, divided into an advanced guard and a main body with two wings. 'Combat patrols' are sent out to ensure concealment. Their duty is to prevent the enemy viewing the direction of the march, and to give warning should he show signs of making an attack. The artillery moves massed on a flank. As the enemy is approached, the force is concentrated, and the actual attack is delivered in three lines, 250 to 500 yrads apart, the second and third

lines echeloned from the first, on opposite flanks, by 100 to 200 yards. Line must not be formed until the direction of attack is absolutely clear. A normal formation would be: 1st line—line of squadron columns; 2nd line—line of squadron columns, or echelon of regiments, with the flank regiment in column of troops; 3rd line—mass. The above formation results in greater depth towards the rear, and enables the second and third lines to deploy in any direction against a counter-attack.

Dismounted action.—One of the most notable results of the S. African war was the tendency to make a fetish of dismounted cavalry action. Indeed, for some years, it seemed not unlikely to oust shock tactics from British cavalry training. Saner views now prevail, and it is recognized that there is still ample room for both. Continental nations, it may be noted, are still in favour of mounted action, and the latest German cavalry drill-book goes so far as to say: 'The carbine will be resorted to only when the lance can no longer be used.' The main differences between dismounted cavalry and infantry fire action are that, in the former, there are no long advances on foot; that, instead of gradual reinforcement, every rifle is employed at once; that fire is intermittent and rapid instead of continuous and slow; and that, by means of the horse, every endeavour is made to outflank the enemy by securing successive positions. See Bernhardi's *Cavalry in Future Wars* (Eng. trans. 1907); Pelet-Narbonne's *Cavalry on Service* (Eng. trans. 1906); Haig's *Cavalry Studies* (1907); Denison's *History of Cavalry* (1877); Childers's *War and the Arme Blanche* (1910).

Cavan. (1.) Inland co., prov. Ulster, Ireland. The surface is mountainous in the N.W., with numerous streams and several lakes. The principal river is the Erne. There are several mineral springs. Agriculture is the chief industry, but, except in the valleys, the soil is poor. Linen-bleaching is also important. The county returns two members to Parliament. Area, 745 sq. m.; pop. 98,000. (2.) Mrkt. and assize tn., cap. of above co., 15 m. S.W. of Clones Junction, on railway to Mullingar. Pop. 2,800.

Cavarzere, comm., Venezia prov., Italy, on the Adige, 12 m. S.W. of Chioggia. Pop. 16,000.

Cavatina, a name given in music to an air of a smooth, melodious nature frequently forming part of a grand scena. The name may also form the title of an individual composition.

Cave. See CAVES.

Cave, a political sobriquet. See ADULLAMITES.

Cave, EDWARD (1691–1754), English printer, born at Newton, near Rugby; in 1731 started the *Gentleman's Magazine*, which he edited under the *nom de plume* of 'Sylvanus Urban' until 1754. See *Quarterly Rev.*, vol. cvii.

Cave, WILLIAM (1637–1713), English divine, born at Pickwell, Leicestershire. After being chaplain to Charles II., he became canon of Windsor (1684), and vicar of Isleworth, Middlesex (1690), till his death. He wrote *Primitive Christianity* (1672), *Antiquitates Apostolicæ* (1678), and *Scriptorum Ecclesiasticorum Historia Literaria* (1688–98). See *Cave's Works* (1672–1705).

Cave Animals. This term is used in zoology in two senses—first, and most legitimately, for the fauna of caves (*i.e.* for those animals which have been structurally modified to fit them for this particular mode of life); and second, as a convenient prefix to denote various mammals found fossil in European caves in Pleis-

tocene deposits, in order to distinguish these from their living allies. Thus, we have the cave bear (*Ursus spelæus*), the cave lion, the cave hyæna, and so on; but it should be clearly understood that these were not in any special sense cave-dwelling animals. The true cave dwellers are usually much modified in accordance with their habitat, especially as regards their eyes and colour. The conditions which obtain in the larger caves are not unlike those of the great depths of the sea; and in the partial or complete suppression of eyes, and the development of special tactile organs, the members of the two faunas resemble one another.

Perhaps the most interesting member of the cave fauna is the curious *Proteus anguineus* of the caves of Carniola and Dalmatia, a blind, colourless amphibian, which retains throughout life the external gills present in the young only of many other amphibians—*e.g.* the common frog. In captivity it shows itself very sensitive to light, and if persistently exposed to it, becomes dark-coloured, or even black. Quite recently there has been made the very interesting discovery that in caves in Texas an analogous amphibian occurs, described as *Typhlomolge rathbuni*, which has concealed eyes, and is colourless. There is no doubt that, as is probably also the case with the insects, etc., of the caves, the two amphibians named have originated independently of one another, as an adaptation to a similar mode of life, and they therefore illustrate what is known as convergence, or parallelism in development. Other cave animals are fish, especially the famous *Amblyopsis spelæus* of the Mammoth Cave in Kentucky, which has no eyes, but has a number of tactile processes on the head, and possesses very acute hearing. The body is colourless. There are many cave insects, notably beetles, such as carabids (especially the members of the widely-distributed genus Anophthalamus) and silphids (*e.g. Adelops*); also carnivorous grasshoppers, such as *Dolichopoda palpata* and other forms. Myriapods, spiders, and crustacea also occur, mostly characterized, like other cave animals, by the very wide distribution of their genera, and by the usual absence of eyes. See *The Natural Conditions of Existence as they affect Animal Life*, by Karl Semper, International Scientific Series (1881).

Caveat, a document lodged in some public office requiring the official not to act in a particular matter without notice to the person (the 'caveator') lodging the caveat. A caveat may be lodged against the issue of a marriage licence, against the registration of land (see REGISTRATION OF TITLE), and in other cases; but the most frequent use to which it is put is to prevent the grant of probate or administration without notice to the caveator.

Caveat Emptor (Lat. 'Let the buyer beware'), the common law maxim that the purchaser of land or goods takes them without implied conditions and warranties as to title or quality. If he needs such conditions or warranties, he must ask for them, and see that he gets them. The numerous modifications of this doctrine have been codified in the Sale of Goods Act, 1893. See SALE.

Cavedone, GIACOMO or JACOPO (1577–1660), Italian painter, born at Sassuolo, near Modena; studied under Ludovico Carracci at Bologna, where he settled, becoming for a time assistant to Guido. His works may be seen at Bologna, and one, *St. Cecilia*, at the Louvre, the chief being *The Last Supper*, *Among the Doctors*, and a remarkable *Madonna and Child*.

Cave Exploration. See CAVES.

Cavendish, LORD FREDERICK CHARLES (1836–82), English politician, second son of the seventh Duke of Devonshire, was born at Eastbourne, Sussex. From 1859 to 1864 he acted as private secretary to Lord Granville, then president of the Council and Liberal leader of the House of Lords. In 1865 Lord Frederick was returned for the W. Riding of Yorkshire, a constituency he represented till his death. He next became private secretary to Mr. Gladstone (1872), being next year appointed a junior lord of the Treasury, and in 1874 nominated financial secretary of the Treasury. On the resignation of Mr. W. E. Forster in April 1882, he succeeded him as chief secretary for Ireland; and on May 6, while walking in Phœnix Park in Dublin, he was murdered together with Mr. Burke, the permanent under-secretary for Ireland, by a band of Irish irreconcilables. In January following the crime the assassins were brought to justice, and the four principals, Brady, Curley, Caffrey, and Kelly, were executed, mainly owing to the evidence of one of the culprits, James Carey, who turned informer. See CAREY, JAMES.

Cavendish, GEORGE (?1500–61), Wolsey's friend and biographer, entered the cardinal's service as gentleman-usher (1526), accompanied him in his embassy to France, and attended upon him until 1530. Cavendish's *Life of Wolsey* was first printed in 1641. The best edition is that of Singer (1815; 2nd ed. 1827; and reproduced in Morley's Universal Library, 1885, and Dent's Temple Classics, 1900). See J. Hunter's *Who Wrote Cavendish's Life of Wolsey?* (1814).

Cavendish, GEORGIANA (1757–1806). See DEVONSHIRE, DUCHESS OF.

Cavendish, HENRY (1731–1810), English natural philosopher, born at Nice. He made important researches into the weights of gases, and into the constitution of the atmosphere. The 'Cavendish experiment' was an attempt to determine the density of the earth. (See EARTH—*Mass and Mean Density of.*) Cavendish's estimate was 5·45; more recent experiments give a slightly higher result. His *Electrical Researches* (1777–81) were edited by Clerk Maxwell (1879). See *Life* by J. Wilson (1846).

Cavendish, THOMAS (1560–92), English navigator, born at Trimley St. Mary, Suffolk, commanded an expedition to the South Seas (1586), and thence sailed round the world in 1586, returning home in 1588. This expedition was, in the main, a predatory excursion against the subjects of Philip of Spain, and was altogether successful. In 1591 Cavendish sailed on a similar voyage, but was obliged to turn back to England. He died while still at sea.

Cavendish, WILLIAM (1592–1676), Duke of Newcastle. In 1638 King James appointed him governor of the Prince of Wales, afterwards Charles II.—an office he resigned in 1641. He loyally supported the king in the civil war, and was general of the forces north of the Tweed. After the restoration he was created duke. He was the author of a *System of Horsemanship* (2 vols. 1743), also of several poems and dramas, some of them written in collaboration with his duchess, Margaret (1624–74). See *The Cavalier and his Lady: being Selections from the Works of the First Duke and Duchess of Newcastle*, by Edward Jenkins (1872).

Cavendish Experiment. See CAVENDISH, HENRY.

Cavendish Family. See DEVONSHIRE.

Caversham, par. and vil., S. Oxfordshire, England, on the Thames, 1 m. N. of Reading. Pop. 6,600.

Caves. From the method of their formation, caves may be divided into several groups. The sea caves, so numerous on rocky coasts, have been produced by the action of the billows, which, casting sand and gravel against the cliff, have gradually undermined it. This takes place most rapidly along lines of fracture and fissures, which are readily eaten into and depressions thus formed. In this process the air plays an important part; for driven by the pressure of the sea wave into every crevice of the rock, it suddenly expands when the wave falls back, and dislodges showers of fragments. In this way a cave is often prolonged far beyond the limits reached by the waves, and may tunnel upwards, emerging at the surface a long distance behind the edge of the cliff. Such 'blow-holes,' sending out puffs of spray with every billow of a storm, are frequent on rocky shores. Sea caves open on the shore within the reach of the waves, and when the cliffs are high, are most common at their base. In raised beaches such caves often stand high and dry above sea level, and these have sometimes been used for human habitation.

But the greater number of caves, including all the most famous and extensive, have been produced by the action of the water of springs and underground rivers dissolving the rocks in which they circulate. As limestone is of all common rocks the most soluble in spring water containing carbonic acid, it is in it that caves are most numerous. Well-known instances of limestone caves are those of Kentucky (Mammoth, etc.), Jenolan in New South Wales, Adelsberg in Carniola, and Matlock in Derbyshire. In extensive tracts of limestone the rivers may flow entirely in underground channels, the surface being an arid desert, while there is water in abundance below. Such a region is that known as the Causses in Central France. These channels are a succession of vaulted chambers, with stalactites pendent from the roof, and stalagmites forming on the floor. (See STALACTITES.) Sometimes the roofs fall in, leaving circular sinks in the ground above. The exploration of the deposits formed in these caves has thrown much light on the fauna of recent geological periods.

Another group of caves, which may be better described as rock shelters, is found in inland cliffs where hard and soft beds alternate. The softer layers are readily eaten back by the action of frost and rain, forming shallow recesses.

Lava caves are characteristic of volcanic regions, and are due to the escape of the central part of a lava flow at a period when the surface had cooled to form a hard crust, while the interior was still liquid. In the Sandwich Is. and in Iceland large caves of this kind are known.

Not only have natural caves been the refuge of primeval man and of many of his descendants, but from this custom has gradually developed the practice of artificially improving and elaborating such caves, and ultimately of hewing out habitations in what was previously solid rock. The cave temples of India, such as those at Elephanta, although they are not actually dwellings, are probably the finest illustrations of this custom; and other good examples occur in Asia Minor and in N. Africa. The cliff dwellings of Arizona are also partly cut out of the rock. In some parts of Hungary and among the gypsies of Granada tolerably comfortable habitations are made

by digging into the face of a steep bank, and penetrating so far that all except the front of the 'house' is an actual cave.

For a description of the artificial 'caves' or 'coves' of Scotland and Ireland, which are really built houses, although very rude in design, see the article EARTH-HOUSE. See N. S. Shaler's *Sea and Land* (1895); Lubbock's *Origin of Civilization* (1902); Lyell's *Antiquity of Man* (1863); Boyd Dawkins's *Cave Hunting* (1874); E. A. Martel's *Irlande et Cavernes Anglaises* (1897) and *Les Abîmes* (1894); and Pengelly's *Kent's Cavern* (1894).

CAVE EXPLORATION AND POT-HOLING. The exploration of the limestone caverns and chasms of the Pennines and the Mendips has been conducted of recent years with great assiduity. Though scientific research is a prominent object of these expeditions, their most attractive feature is the sport they afford. The work is exceedingly arduous and risky. It has been written that the explorer of pot-holes has to face all the perils of severe rock-climbing, and, moreover, to face them for the most part in the dark; and though all that is possible is done to eliminate the element of danger, it is never wholly absent. These expeditions are sometimes organized on a considerable scale, a score or more of men taking part in them. In addition to the 'underground' party, a 'surface' party is required to assist in the ascent and descent of the others, to provide assistance in case of accident, and to warn them of the approach of bad weather. The equipment consists of hundreds of feet of rope ladder, hundreds and hundreds of feet of rope, boatswain's chairs, derricks, pulleys, flare-lights, telephone apparatus, etc., and plentiful provisions (a very necessary precaution). In 1909 a party was imprisoned for thirty-six hours by a flood which rendered exit from a pot-hole impracticable. Generally speaking, caves are lateral or diagonal passages in the limestone, sometimes opening into wide chambers and breaking off into abrupt descents. A pot-hole is a vertical shaft terminating generally in a chamber from which ramifications, often impracticable, extend and carry off the water. Some of the openings of these pot-holes are really imposing, that of Gable Pot, on Lech Fell, near Kirkby Lonsdale, being 450 ft. in circumference. The most famous of these holes is Gaping Ghyll on Ingleborough, with a depth of over 400 ft. The dimensions of the great chamber are approximately 480 ft. long, 82 ft. wide, by 110 ft. high. See Baker and Balch's *Netherworld of Mendip* (1907), and Baker's *Moors, Crags, and Caves of the High Peak*.

Caviare. Caviare is strictly a preparation of sturgeon's roe, washed in vinegar, sun-dried, rubbed with salt, pressed between cloths, and packed in barrels. Astrakhan is the centre of the caviare trade, sturgeon being largely caught in the Volga. In Sweden, caviare is prepared in a similar way from cod's roe. It should be kept ice cold, and so served, with crisp dry toast.

Cavite. (1.) Province, Luzon, Philippines, S.W. of Manila Bay. It is mountainous but fertile, the principal products being sugar, rice, coffee, and indigo. Sugar-refining and the manufacture of cotton and hemp cloth are extensively engaged in. Its area is 510 sq. m. Pop. 135,000. (2.) Seapt. tn., Luzon, Philippines, cap. of above prov., 8 m. S.W. of Manila. It is the chief naval station of the archipelago, and has an arsenal and fortifications. Here, on May 1, 1898, the

Spanish fleet was destroyed by the American admiral Dewey. Tobacco is manufactured. Near it is Terra Alta, a sanatorium for foreigners. Pop. 5,000.

Cavour, comm., Piedmont, Italy, prov. of and 28 m. s.w. of Turin; manufactures silk, and has marble and slate quarries, tanneries, etc. Pop. 7,000.

Cavour, CAMILLO BENSO DI, COUNT (1810-61), the regenerator of Italy, born at Turin of an ancient Piedmontese family. In 1846, when a new era seemed to dawn for Italy, Cavour founded at Turin *Il Risorgimento*, a journal of moderate and constitutional views, in which he advocated a representative system and a new and liberal constitution. This was granted in February 1848. When Charles Albert declared war against Austria, Cavour opposed the ultra-democrats in the Chamber of Deputies, and urged an alliance with Britain. In the Marquis d'Azeglio's ministry he was appointed successively minister of agriculture and commerce, minister of marine, and minister of finance, and on the retirement of D'Azeglio in 1852 he became premier. He then entered on his life-work as the unifier of Italy. By inducing Sardinia to take part in the Crimean war, he paved the way for bringing the Italian question before the Congress of Paris in 1856, much to the chagrin of Austria.

The hostility between Austria and Italy became acute in 1858, and in the autumn of that year, at a secret interview between Cavour and Napoleon III., the programme of the war of 1859 was arranged. The allied troops were victorious; but Cavour's hopes were completely dashed by the peace of Villafranca, which left Austria in possession of Venetia. Almost broken-hearted he resigned office, but was induced to return to power in January 1860. Still keeping the one great end in view, he secured the absorption of Parma, Modena and Tuscany into the dominions of Victor Emmanuel; but to appease France, he was compelled to acquiesce in the cession of Savoy and Nice. For this he was much blamed by Garibaldi and his sympathizers. In March 1860 the states of Central Italy acknowledged the sovereignty of Victor Emmanuel, and by autumn the Sardinian troops and their Garibaldian allies had secured the Papal States and S. Italy. In the spring of 1861 the first Italian Parliament met at Turin, and Victor Emmanuel was king of Italy. See *Lives* of Cavour by Massari (1873), Mazade (1877), Edward Dicey (1861), Gottschall (1876), Cadogan (1907), and Countess Martinengo-Cesaresco in 'Foreign Statesmen' Series; *La Politique de Cavour*, by C. Bianchi (1885); *Cavour*, by F. X. Kraus (1902); his *Lettere*, edited by Chiala (1883-7); *Le Comte de Cavour: Récits et Souvenirs*, by De la Rive (1863); *Camillo di Cavour*, by Ciro d'Areo (1863); and *Œuvres du Comte de Cavour* (1872).

Cavy, a general name given to the members of the rodent family Caviidæ, which is confined to S. and Central America. From one of the wild cavies, possibly from the restless cavy (*Cavia porcellus*), the domesticated guinea-pig has been derived. All the cavies belonging to the genus Cavia have short limbs and ears, and no tail; the wild forms are mostly burrowing animals, and in some cases are much sought after as food. All are small animals. The Patagonian cavy (*Dolichotis patagonica*) is much larger, for it slightly exceeds the hare in size, the legs being so long as to make it resemble a small ruminant rather than a rodent. To the

family of Caviidæ the capybara also belongs.

Cawdor, par. and vil., Scotland, 5 m. S.W. of Nairn; the traditional scene of Duncan's murder (Shakespeare's *Macbeth*) in 1040. The castle, however, dates only from 1454. Pop. 900.

Cawdor, FREDERICK ARCHIBALD VAUGHAN CAMPBELL, THIRD EARL OF (1847–1911). He represented Carmarthenshire from 1874 to 1885, and in 1880 was appointed an ecclesiastical commissioner. He succeeded to the title in 1898, and from 1895 to 1905 was chairman of the Great Western Railway. From March to December 1905 he was First Lord of the Admiralty. He was a member of King George's (then Prince of Wales) Council (1908-10).

Cawnpur, or CAWNPORE, chief city of the dist. of the same name, United Provinces, India, 43 m. S.W. of Lucknow; is a large military cantonment. It lies on S. bank of the Ganges. The manufacture of saddles, boots, and leather work is an important industry. Cottons are also manufactured. There is a large trade in grain and other agricultural produce. Cawnpur was the scene of two tragedies during the sepoy mutiny of 1857. An exhausted garrison of Europeans, which, under promise of safe-conduct to Allahabad, had surrendered to Nana Sahib, the adopted son of the last Peishwa, were fired upon as they embarked on the river; and the women and children rescued from this massacre were brought back to the city and foully butchered. The events of the mutiny generally are commemorated by the Memorial Gardens. Area of dist. 2,366 sq. m.; pop. 1,260,000; of city, 200,000. See Sir G. O. Trevelyan's *Cawnpore* (new ed. 1910).

Caxamarca. See CAJAMARCA.

Caxias. (1.) Tn., Brazil, state of and 180 m. S.S.E. of Maranhão, on the Itapicuru R.; has important rice and cotton trade. Pop. 10,000. (2.) Italian colony, Brazil, in state of Rio Grande do Sul, 65 m. N. of Porto Alegre. Pop. 14,000.

Caxton, WILLIAM (?1421–91), the first English printer, was born near Hadlow in Kent. He left England in 1441 and settled at Bruges, where he remained for more than thirty years, being latterly (1462) 'governor' of the English Merchant Adventurers in that city. Edward IV. entrusted Caxton and another English envoy with the task of renewing an expiring commercial treaty between England and Burgundy. In 1474, with the co-operation of Colard Mansion, printer of Bruges, he issued his *Recuyell of the Historyes of Troye*, the first book printed in English; and, in 1475, *The Game and Playe of the Chesse*. Returning to England in 1476, he set up a printing press near Westminster Abbey. For fifteen years he assiduously printed chivalric romances, religious works, and translations. All of these publications he edited himself, and twenty-two of them he translated. The *Dictes and Sayings of the Philosophers*, published in 1477, is believed to have been the first work actually printed in England. His books, all printed in black letter, included Malory's *King Arthur*, translations of Cicero's *De Senectute* and *De Amicitia*, and editions of Chaucer, Lydgate, and Gower, and numbered ninety-nine in all. Any specimen of Caxton's press is now very valuable. The Osterly Park copy of the *Chesse* realized £1,950, and the first edition of the *Dictes and Sayings* was sold at the Ashburnham sale in 1897 for £1,320. His materials passed into the hands of his assistant, Wynkyn de Worde. See the *Life and Typography of William Caxton* (1861–3), and *The Biography and*

Typography of Caxton (1877), both by William Blades; also *Lives* by Ames (1785–90), Dibdin (1810–19), and Lewis (1737). Lowndes's *Bibliographers' Manual* (1834) contains a list of the works issued from Caxton's press.

Cayambe, volcano, Ecuador, under the equator, 60 m. E.N.E. of Quito. Alt. 19,255 ft.

Cayenne, seapt. and cap. of French Guiana, on the N.W. shore of Cayenne I. The harbour is protected by a fort and several batteries. The chief exports are cotton, coffee, sugar, cacao, cloves, skins, and gold. Thirty miles to the N.W. is Ile du Diable, on which Captain Dreyfus was incarcerated. Pop. 12,400.

Cayenne Pepper. See PEPPER.

Cayes, Aux. See AUX CAYES.

Cayey, tn., Porto Rico, West Indies, 30 m. S. by W. of San Juan; is a summer resort, and produces rice and coffee. Pop. dist. 14,000.

Cayley, ARTHUR (1821–95), English mathematician, born at Richmond in Surrey. At Cambridge he highly distinguished himself, and after a few years was elected to the Sadlerian professorship of mathematics. His address as president of the British Association in 1883 became historic, as it foreshadowed many developments in mathematical science that have since taken place. Among his most important contributions to mathematics are the theory of invariants, the Cayleyan curve, and Cayley's Theorem. As a writer he is best known by his *Elementary Treatise on Elliptic Functions* (1876; 2nd ed. 1895), and by his numerous papers, published by the Cambridge University Press (1889–98).

Caylus, ANNE CLAUDE PHILIPPE DE TUBIÈRES, COMTE DE (1692–1765), born at Paris; served in Spain in the war of the Austrian Succession. He was a most versatile man, being painter, engraver, writer, patron of art, and an accomplished antiquary. He was elected a member of the Academy of Painting in 1731. His great work was his *Recueil d'Antiquités Egyptiennes, Etrusques, Grecques, Romaines, et Gauloises* (7 vols. 1752–67). Besides this he wrote *Lives* of Mignard, Lemoine, Bouchardon, Watteau. Most of his other works have been published under the title of *Œuvres Badines* (12 vols. 1787). See Rocheblave's *Essai sur le Comte de Caylus* (1900).

Caylus, MARIE MARGUÉRITE LE VALOIS DE VILLETTE DE MURÇAY, COMTESSE DE (1672–1729), born at Paris, was the cousin of Mme. de Maintenon, and herself an ornament of the court of Louis XIV. Her interesting *Souvenirs* were published by Voltaire at Geneva (1770; reprinted 1804, 1860, and 1879). See *Life* by Armand de Cayes (1815).

Cayman. See CAIMAN.

Caymans, or CAYMAN ISLANDS, three islands (Grand Cayman, Little Cayman, and Cayman Brac) in Caribbean Sea, under the government of Jamaica, from which they are distant 200 m. to N.W. The islands are of coral formation, and are very fertile. The largest, Grand Cayman, 30 m. long by 4 to 7 m. broad, has a population of about 6,000. Its capital is Bodden Town. The chief exports are dyewoods, phosphates, and turtles. Cocoanuts are largely exported from Cayman Brac (10 m. long by 1 m. broad).

Cayor, or KAYOR, country of Senegambia (French), on W. coast of Africa, between Senegal R. and Cape Verde; inhabited by Joloffs or Yolofs. Cotton, indigo, and grain are produced. Pop. 150,000.

Cayster, river in Asia Minor, flowing into the sea N.W. of Ephesus. Homer alludes to its swans, which still abound.

Cayuga, lake, in New York State, U.S.A., of glacial origin, long and narrow in shape, stretch-

ing nearly N. and S. for 35 m., with a maximum breadth of 2 or 3 m., and an elevation of 381 ft. It drains N. to Lake Ontario by Seneca and Oswego Rs. Ithaca, the seat of Cornell University, Union Springs, and Aurora, the seat of Wells College, are on its banks.

Cazalès, EDMOND DE (1804–76), French political writer, born at Grenade (Haute-Garonne). He was largely occupied with the question of the reconciliation of the Roman Catholic Church with the principles of the Revolution. In 1843 he took holy orders, and two years later was made director of the ecclesiastical seminary of Montauban. He was active during the revolution of 1848 and in the events of 1871–2. During the first republic he served in the Constituent Assembly. He published *Etude historique et critique sur l'Allemagne contemporaine* (1853); *Nos Maux et leur Remèdes* (1874).

Cazalla de la Sierra, tn., Spain, in prov. of and 40 m. N.N.E. of Seville; with marble and jasper quarries. Pop. 8,000.

Cazembe, Africa. See KAZEMBE.

Cazin, JEAN CHARLES (1841–1901), French landscape painter, born at Samer (Pas-de-Calais). He was a poetic realist, original and imaginative, whose delicate themes are pervaded by a melancholy sentiment, expressed in restrained harmonious colours, with soft shadows. He was the creator of the French landscape of religious sentiment, exemplified in his *Hagar and Ishmael* (1880; in the Luxembourg at Paris), *Dusk*, and *A Dead City*. His pictures are characterized by fine qualities, delicate verisimilitude, and distinguished composition.

Cazorla, anc. tn., prov. Jaen, Andalusia, Spain, 41 m. E.N.E. of Jaen, with two very fine castles; has manufactures of paper, bricks, and leather. Pop. 8,000.

C.E., abbrev. for civil engineer.

Ceadda. See CHAD, ST.

Cean-Bermudez, JUAN AGUSTIN (1749–1829), Spanish man of letters, born at Gijon; became a well-known and prolific writer on Spanish art, as well as a friend of Jovellanos and a pupil of Mengs. His principal work, which is still the leading authority on its subject, is *Diccionario Historico de los mas Illustres Profesores de las Bellas Artes en España* (6 vols. 1800). He also wrote a Life of Jovellanos (1814), and descriptions of works of art and antiquities in Spain. See *Vida de Cean-Bermudez*, by Miñano.

Ceará. (1.) State of Brazil, on the Atlantic coast, between Piauhy and Rio Grande do Norte. In the interior are ranges rising to 3,300 ft. The streams are small, and of little use for navigation. The woods yield timber, and there are fine pastures. Excellent tobacco, cotton, coffee, cacao, sugar, and rubber are produced. The capital is Fortaleza. Area, 40,240 sq. m. Pop. 900,000. (2.) CEARÁ, or FORTALEZA, seapt. and cap. of above state, on the Atlantic, and terminus of railway to Cachoeira. Exports cotton, wax, hammocks, rubber, and hides. Pop. 65,000.

Ceará Mirim, tn., Rio Grande do Norte, Brazil, on the river from which it is named. Cattle-grazing, and cotton and sugar mills. Pop. 18,000.

Cebes, a Theban, a disciple of the Pythagorean philosopher Philolaus, and also of Socrates, at whose death he was present. Plato, in his *Phædo*, which describes Socrates' last hours, makes him the most important character, after Socrates, in the dialogue. Diogenes Laertius says he wrote three dialogues, the *Pinax*, *Hebdome*, and *Phrynichus;* none are extant, though there exists under the name of the first a work which was accepted as his until recently. It discusses the

trials and temptations of life, and inculcates the cultivation of philosophy and virtue as the only method to escape them. Editions: text, Praechter (1893); with notes, Jerram (1878).

Cebidæ, a family of monkeys entirely confined to S. America, and including the capuchin, howling monkey, spider monkey, woolly monkeys and others.

Cebú. (1.) Island and prov., Philippines, situated about the middle of the Visayan group; it runs nearly N. and S., 139 m. long and 24 m. wide, with Leyte and Bohol on the E., and Negros on the W. Area, 1,668 sq. m.; dependent islands, 114 sq. m. A mountain chain extends along its greater axis. Uling, the highest peak, is only 2,172 ft., but the narrowness of the island makes the slopes so steep that communication is difficult between the E. and W. shores. Coal has been discovered, and there are fine forests of building woods. The rainfall is plentiful, and the usual staples are grown. The island is famous for its cheese; chocolate of a superior quality, cocoanut wine, piña cloth, silk, and sinamay are manufactured. The exports (principally hemp and copra) are valued at £750,000 per annum. The rare shell, *Gloria maris*, is found on the shores, and also the glass sponge, or Venus's flower basket, *Euplectella*, the only one of its genus. Pop., all civilized, about 600,000. (2.) Capital of Cebu prov., 357 m. from Manila, on the E. coast, about 10° 20′ N. It has one of the best lighted and safest harbours in the Philippines, sheltered behind Mactan I. The cathedral has a tower of white coral. Other notable buildings are the picturesque old fort, the Episcopal palace, 'the Rizal,' and the government house. Cebu is supposed to be the oldest town of the archipelago. It was the capital for a few years in the 16th century. Mactan I. was the place of Magellan's death, April 27, 1521. There is a large leper hospital here, situated outside of the town. Pop. 32,000.

Cebus, the genus to which the capuchin monkey belongs.

Ceccano, tn., Italy, on the Sacco, prov. of and 50 m. E.S.E. of Rome. Pop. 7,000.

Cecchi, ANTONIO (1849-96), Italian traveller, born at Pesaro. In 1876 he accompanied the expedition of the Marquis Antinori to Abyssinia. He mapped the route from Zeila to Shoa. After that he explored (1878-80), in company with Chiarini, the Galla country; but they were taken prisoners, and Chiarini died, while Cecchi was only liberated at the end of 1880. In 1885, at the request of the Italian government, he accompanied a mission to Massowah, explored the coast, and concluded a treaty of commerce with the sultan of Zanzibar. He wrote *Da Zeila alle Frontiere del Caffa* (3 vols. 1886), and *L'Abissinia Settentrionale* (1887).

Cech, SVATOPLUK (1846), Bohemian poet, born at Ostredec. He has been editor of several papers; since 1879 of the *Kvêty*. Cech is at the present time the most popular poet of Bohemia. He is at his best in epic poems, such as *Admité* (1873), *The Dream*, etc., which with several others appeared in 1874, under the title *Poems*. A fresh collection of poems appeared in 1880, including *Europa*, *The Circassian*, etc. Cech is, besides, a vivid and humorous novelist, and has written *Povidky a Arabesky a Humoresky* (4 vols. 1878-80), the humorous novel *The Candidate for Immortality* (1884), and numerous other satirical pieces.

Cecidomyia, a genus of minute flies, the larvæ of which are often very destructive to crops. An

example is the Hessian fly, *C. destructor*. The larvæ of some cecidomyids are remarkable, because they are capable of producing new larvæ by a process resembling budding, which results in the death of the parent larvæ. This larval reproduction may continue for several successive generations before a sexually perfect fly appears.

Cecil, LORD EDGAR ALGERNON ROBERT GASCOYNE (1864), English politician, is the third son of the third Marquis of Salisbury. He entered the House of Commons in 1906 as member for East Marylebone. He was private secretary to his father, 1886-8; called to the Bar, 1887. He is a strong free trader, and has opposed the proposals of tariff reformers. On that account he did not stand for his old constituency of Marylebone in Jan. 1910, but contested Blackburn. In Dec. 1910 he contested Wisbech, but without success.

Cecil, LORD EDWARD HERBERT, (1867), English soldier (D.S.O.), 4th son of third Marquis of Salisbury. Entered Grenadier Guards (1887); was with the Dongola expeditionary force in 1896 as aide-de-camp to Kitchener, and was present at the engagement at Firket and the operations at Hafir. In the campaign (1898) which led to the reconquest of the Sudan he was again aide-de-camp to Kitchener, and took part in the battles of the Atbara and Khartum. In the interval between the two Sudan campaigns Lord Edward Cecil accompanied the special mission to King Menelik of Abyssinia (1897); and on the outbreak of the Boer war (1899) he took a leading part in the defence of Mafeking, under Baden-Powell. In 1902 he was appointed military secretary to the Sirdar of the Egyptian army; he then became director of intelligence in the Sudan; subsequently under-secretary for war; and finally secretary of finance, Egyptian Government.

Cecil, LORD HUGH RICHARD HEATHCOTE (1869), English politician, is the fifth son of the third Marquis of Salisbury. He entered the House of Commons in 1895 as member for Greenwich, but lost the seat in the general election of 1906. He was returned unopposed for Oxford University in 1910. He is keenly interested in matters appertaining to education and the church. Lord Hugh Cecil was stoutly opposed to the proposal for legalizing marriage with a deceased wife's sister, and when the bill of 1903 came before the Standing Committee on Law, he, in concert with Mr. Winston Churchill, so successfully obstructed its progress that the measure was killed for the session, though it was reintroduced and passed in 1907. Throughout the controversy provoked by Mr. Chamberlain's fiscal proposals, he has identified himself in the most unequivocal manner, both in Parliament and in the country, with the cause of free trade. He has not found it necessary to take the extreme step adopted by some of his most intimate political associates of joining the Liberal party. He spoke strongly in favour of Woman's Suffrage when the Conciliation Bill passed its second reading in the House of Commons in 1910. An eloquent speaker, many of his speeches have received the tribute of a first person report in the *Times*—a compliment usually reserved for ministers and ex-ministers. Lord Hugh was educated at Eton and at University College, Oxford.

Cecilia, ST., virgin and martyr, who, according to Alexander Severus, flourished in Rome about 229 A.D., but who, according to Fortunatus of Poitiers, lived in Sicily about 180. By tradition

she has been regarded as the patroness of music and the inventor of the organ. She is also the patron saint of the blind, having been herself blind; and it was long customary on her festival day (Nov. 22) to hold musical performances in praise of music, for which odes were written by famous poets, and set to music by celebrated composers. In England the chief poets who have contributed odes are Dryden, Shadwell, Congreve, Pope, and Addison; the music being composed by Blow, Eccles, Jeremiah Clarke, Purcell, and Boyce. Of these, the best known is Dryden's (1697), with music by Jeremiah Clarke, and reset by Handel in 1736.

Cecropia, a genus of soft-wooded evergreen trees, all natives of tropical regions. They are known as snakewood, and belong to the order Urticaceæ. The best known in Britain is *C. peltata*, a Jamaica species, which reaches a height of about 25 ft. in our greenhouses. It is easily grown in a light, peaty compost, and may be propagated by means of cuttings. It bears a fruit not unlike the raspberry in flavour.

Cecrops, the mythical founder and first king of Athens. To him are attributed the institution of marriage, the abolition of human sacrifice, and the establishment of a purer worship. Other stories, not so trustworthy, represent him as the leader of a band of Egyptian colonists.

Cedar. The cedars are among the most beautiful of coniferous trees. There are three species in the genus — *Cedrus atlantica*, a native of N. Africa; *C. deodora*, a native of the Himalayas; and the better-known *C. Libani*, or cedar of Lebanon. *C. deodara* is regarded by the Hindus as a sacred tree, and is in consequence frequently planted in the vicinity of the temples. The leaves grow in dense bunches, a little after the fashion of the larch, but the cedars are evergreen. They like a light soil of moderate richness, but whatever soil they have must be well drained. Cedar wood is one of the most durable of timbers, and is supposed to be the shittim wood referred to in the Bible. It was extensively used for the making of sacred images, as well as of coffins. The cedars of Lebanon, so often spoken of in the Old Testament, are by no means so impressive and numerous as once they were. From them was obtained the wood which lined the temple of Solomon. The tree grows slowly, and does not commonly produce cones until it is at least fifty years old. There are three kinds of timber known under the name of cedar wood—viz. (1) the whitish wood of *Cedrus Libani*, which is now scarcely a commercial product; (2) the pencil cedar, which is the wood of *Juniperus bermudiana*, and is reddish and fragrant; (3) W. Indian cedar, the wood of *Cedrela*, which is also reddish, but of inferior quality, and resinous.

Cedarberg, or CEDAR MOUNTAINS, mt. range in the N.W. of Cape of Good Hope, about 32° S. lat. It is covered with the South African cedar *Widdringtonia juniperoides*. The highest peak is Sneeuwkop (6,300 ft.).

Cedar-bird (*Ampelis cedrorum*), the American representative of the European waxwing (*A. garrulus*). It is a slightly smaller bird, without any white or yellow markings on the wings.

Cedar Creek, trib. of the Shenandoah, Virginia, U.S.A.; the scene of the defeat of the Confederates under Early by the Union forces under Sheridan, on Oct. 19, 1864.

Cedar Falls, city, Black Hawk co., Iowa, U.S.A., 93 m. W. of Dubuque, on Cedar R. The abundant water-power is utilized in

manufacturing lumber, furniture, canned goods, flour, etc. Pop. 5,400.

Cedar Gum, yellow transparent resin used in making varnish and in various medicinal preparations. It is obtained from *Lallitris arborea.*

Cedar Oil, an essential oil obtained from *Juniperus virginiana* (sp. gr. ·9622). Its use in mounting microscopical specimens was suggested by Professor Abbe.

Cedar Rapids, city, Linn co., Iowa, U.S.A., about 120 m. E.N.E. of Des Moines. Its valuable water-power accounts for its rapid growth during the last two decades of the 19th century. It manufactures carriages, agricultural implements, and textiles, and has large machine-shops, foundries, and pork-packing establishments. It is the seat of Coe College (1881). Pop. (1910) 32,811.

Cedar Resin, white resin exuded by the trunks of cedars, formerly used in embalming.

Cederschiöld, GUSTAV J. KRISTOFER (1849), Swedish philologist, born at Stockholm; became professor of the Northern languages at Gothenburg in 1893. He has edited old Norse texts, *Fornsögur Sudrlanda* (1884) and *Altnordische Sagabibliothek* (1891, etc.); written *Om Erikskrönikan* (1899), *Medeltidsberättelser* (1885–91), *Om Kvinnospråk* (1900), *Om Svenskan som Skriftspråk* (2nd ed. 1902), and *Rytmens trollmakt* (1906); and contributed (1889 onwards) to the new Dictionary of the Swedish Academy.

Cedula, or CEDOLA (Ital.), a Spanish word meaning a 'coupon.' S. American government securities are frequently referred to under the name of 'cedulas.'

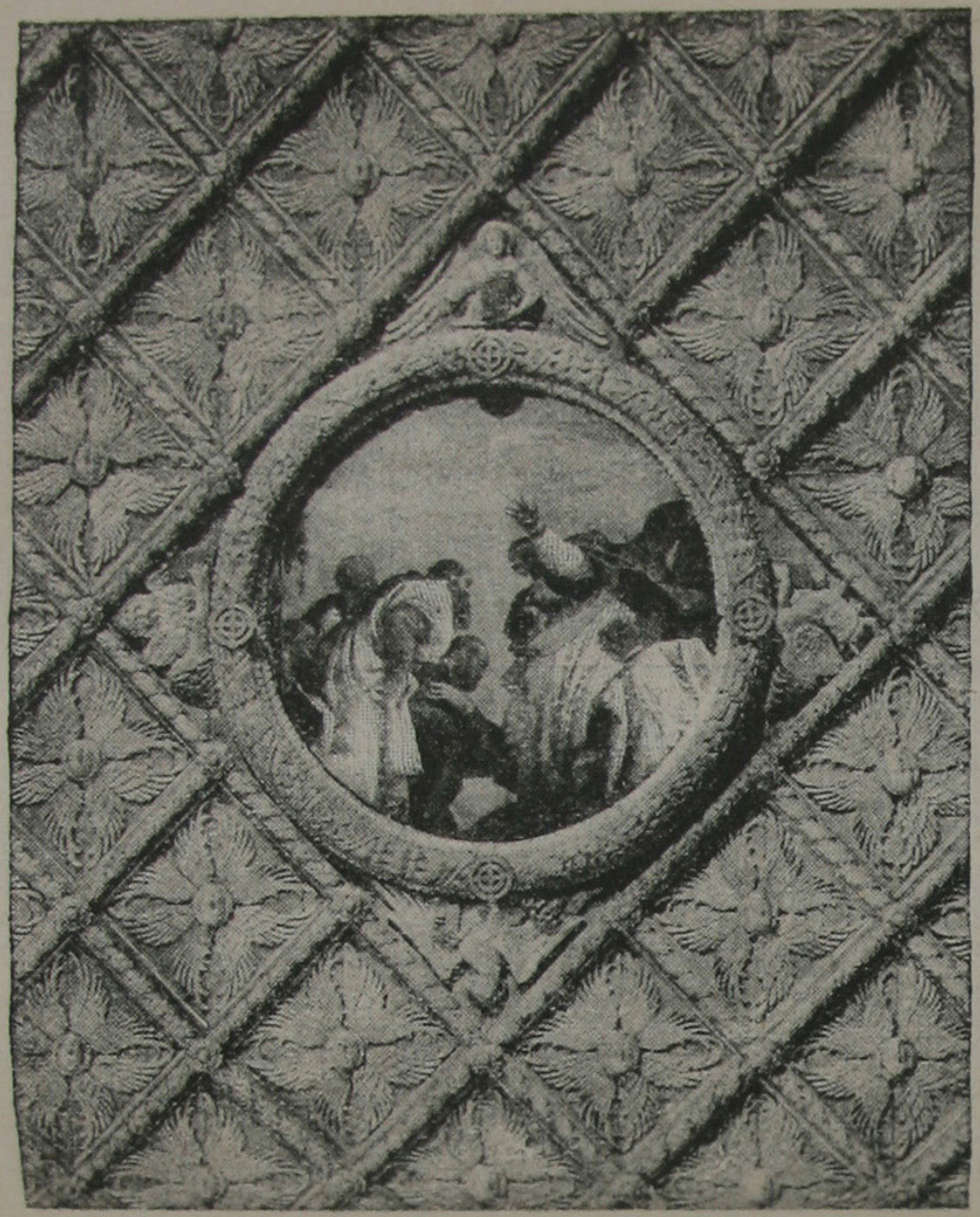
Cefalù, tn. and episc. see, prov. Palermo, Sicily, on the N. coast, 42 m. by rail E. by S. of Palermo; possesses one of the finest Norman cathedrals (12th century) in the island, with splendid mosaics. There are also ruins of a Norman castle and of the ancient Cephalœdium, destroyed by the Saracens in 858 A.D. Sardine-fishing. Pop. 13,000.

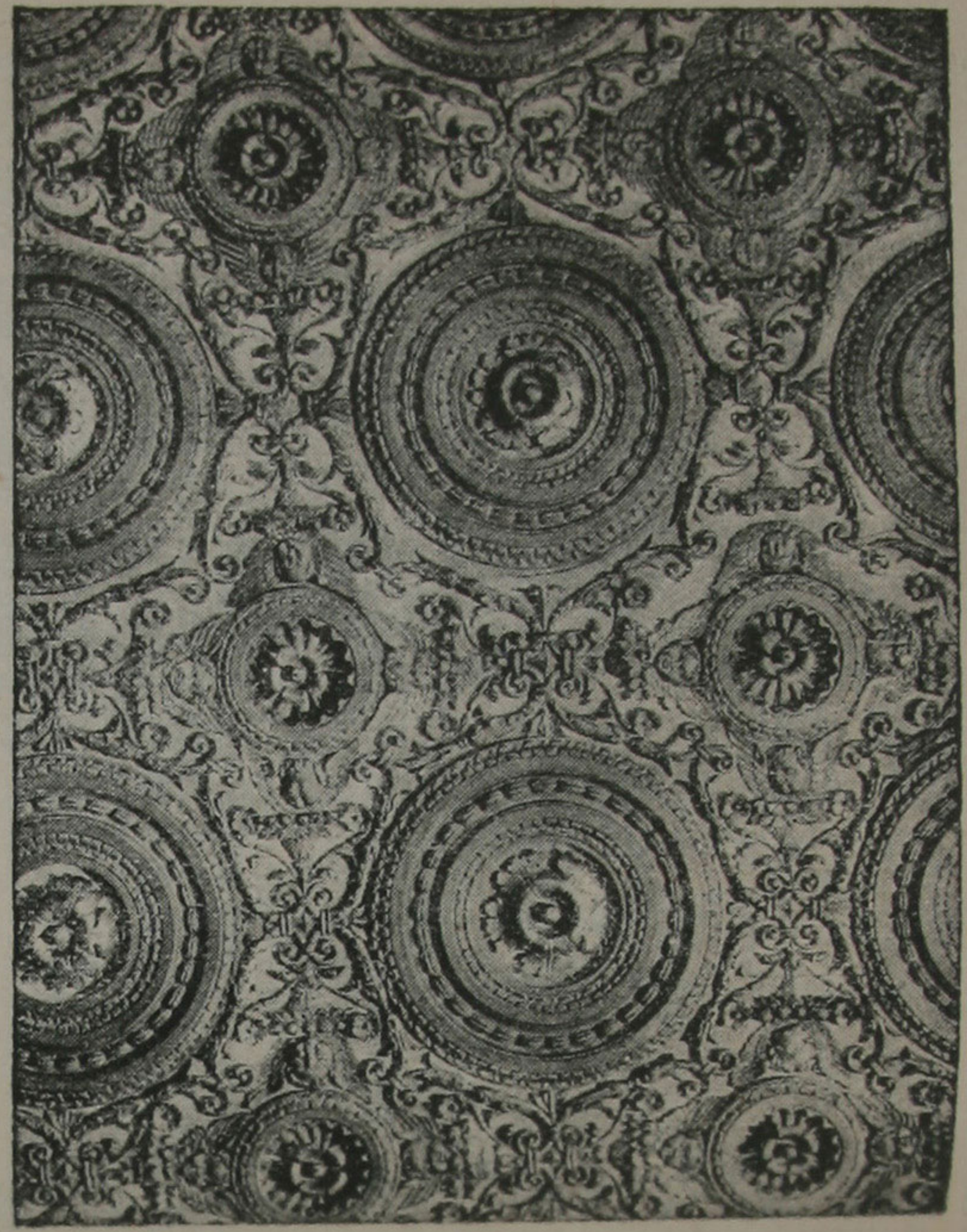
Ceglie, tn., Apulia, Italy, in Lecce prov., 19 m. N.E. of Taranto. Pop. 17,000.

Cehegin, tn., prov. Murcia, Spain, 35 m. W.N.W. of Murcia; produces cereals, wine, hemp, honey, and great quantities of esparto, which it manufactures into paper. Fine black marble quarries in outskirts. Pop. 12,000.

Ceiling. In the early middle ages ceilings in Britain were made of wood, and decorated with embossing to imitate the wainscotting of the walls. But in the 14th century the ancient expedient described by Serlio (*The First Book of Architecture,* Eng. trans. 1611) became perfected in the system of girders, binders, and joists; and the upper floors of rooms were constructed so as to form the ceiling of the room below. Large square timbers rested on wood plates, which formed the cornice; the under side followed the natural compartments of the floor; the intersections were decorated with floriated devices, and the panels with rich carving. Timber-groined ceilings in churches form a distinct class. The choir and Lady Chapel of St. Albans cathedral is an example: the ceiling of the nave in the abbey church is flat, and of early date. The library of Merton College, Oxford (15th century), is a good example of a flat ceiling.

Celakovsky, FRANTISEK LADISLAV (1799–1852), Bohemian poet and philologist, born at Strakonitz; filled the chair of Slav philology at Breslau (1842) and at Prague (1849). His principal works include collections of folk-songs and poems, notably his *Rüze Stolista* ('Rose with a Hundred Leaves') and his *Ohlas Pisni Ruskych* ('Echoes of Russian





Decorated Ceilings (Italian).

1. From the Academy of the Fine Arts, Venice, with paintings by Paul Veronese. 2. From the Ducal Palace, Venice (Renaissance).

Songs'). At the time of his death he was engaged in preparing a supplement to Jungmann's Bohemian Dictionary. Among numerous translations which he made was a version of Scott's *Lady of the Lake*.—His son, LADISLAV CELAKOVSKY (1834–1902), was professor of botany at the university of his native town of Prague from 1871 to his death. His works include *Prodromus der Flora von Böhmen* (1867–81); *Vergleichende Darstellung der Placenten in den Fruchtknoten der Phanerogamen* (1876); *Die Gymnospermen* (1890).

Celandine, a term applied to two very dissimilar British plants. One, the greater celandine (*Chelidonium majus*), known also as swallow-wort, belongs to the order Papaveraceæ, and is a perennial plant, bearing stalked umbels of small, yellow, fern-petalled flowers and irregularly pinnate leaves; whereas the lesser celandine (*Ranunculus Ficaria*) belongs to the order Ranunculaceæ, and is a perennial plant, bearing bright yellow, buttercup-like flowers in early spring, the petals being about nine in number. The leaves are heart-shaped. The lesser celandine is also known as the pilewort and the figwort.

Celano, tn., prov. Aquila, Italy, 55 m. E. by N. of Rome, near the N. border of the former Lake Fucino. Pop. 10,000.

Celano, LAKE OF. See FUCINO, LAKE OF.

Celano, THOMAS DE (d. ?1255), Latin poet, born at Celano in the Abruzzi; adherent of St. Francis, and custodian of the Minorite convent at Worms from 1221 to 1230. His claim to the authorship of the great Latin hymn *Dies Iræ* is generally admitted.

Celaya, tn., state of Guanajuato, Mexico, 30 m. W. by S. of Queretaro; noted for its cloth, carpets, and saddlery. Alt. 6,410 ft. Pop. 26,000.

Celbridge, vil., N.E. Co. Kildare, Ireland, on the Liffey, 11 m. W. of Dublin. Celbridge Abbey was the favourite retreat of Dean Swift, and was the home of his 'Vanessa' (Esther Vanhomrigh). Pop. 1,000.

Celebes (*Sel-ā'bez*), a singularly shaped isl. in the Dutch E. Indies, lies E. of Borneo, being separated from it by the Strait of Macassar. It consists of a long, narrow backbone stretching N. to S., from which similar long, narrow, octopus-like arms point E., N.E., and S.E., separated from each other by the Gulfs of Tomini, Tomori (Tomaiki), and Boni. The N.E. extremity of the N. arm, called Minahassa, and the S. extremity of the main axis, called Macassar, are the only parts which are really well known. Minahassa is of recent volcanic origin, rising to 7,500 ft. in Mt. Kema. In the S. Macassar runs up to 10,070 ft. in Bobokaraeng and 10,000 ft. in Bonthaeng (Bonthain). Another characteristic feature is the number of lakes, mostly at considerable altitudes, and some of great size, such as Lake Posso, in the centre, 1,640 ft. above sea-level; Lake Tondano, in Minahassa, 2,000 ft. The principal river is the Sadang in the W., but it is barely navigable. The climate is unusually healthy, the extreme heats being tempered by sea breezes, rains, and the prevailing north wind. Gold is found, and sulphur is plentiful in Minahassa. Coal (lignite) is mined in the E. and N.E. of Macassar. The island is destitute of the large carnivora, nor has it the elephant, rhinoceros, or tapir. The fauna is a largely specialized one. Reptiles are very numerous. Much of the country is covered with dense forest. Coffee, dammar, trepang, nutmegs, copra, copal, and tobacco are exported. Trade is chiefly confined to the ports of Vlaardingen or Macassar, Menado, and Kema in Mina-

hassa. The people are mostly Malays, Buginese, and, in the interior, Idonesians. The total area is about 70,000 sq. m. Pop. is believed to be under 2,000,000.

The Dutch established factories on the island shortly after the middle of the 17th century, and have retained possession of it ever since. See Rajah Brooke's *Narrative of Events in ... Celebes* (1848); Forbes's *Naturalist's Wanderings in the Eastern Archipelago* (1885); Guillemard's *Cruise of the 'Marchesa'* (1889); and Hickson's *Naturalist in North Celebes* (1889).

Celebes Sea, the division of the Pacific which lies between Celebes, Borneo, and the Philippines, in the E. Indies. Its greatest known depth is 16,760 ft.

Celery (*Apium graveolens*) is a native umbelliferous plant occurring wild in the temperate countries of Asia and Europe, in moist places, usually by the sea. It is supposed to be the 'selinon' referred to by Homer. Pliny described a cultivated variety, as also did Dioscorides. Celery is named in the list of vegetables grown by the monastery of St. Gall in 873; yet Parkinson, in the 17th century, reported that 'sellery' was still a rare vegetable in Britain. The principal sowing should be made in March. By the middle of June the plants may be planted out permanently. The trenches should be made about eighteen inches wide and six inches deep. At the bottom of the trench place well-rotted manure to the depth of three inches, incorporating it well with the soil. The celery plants should be lifted with a good ball of soil, and planted a foot apart. When the trenches are drawn parallel to one another, allow at least four feet from trench to trench. In July a little soil may be thrown into the trench to a depth of an inch. In the case of the main crop, give the roots a thorough soaking at the end of August, and on the next fine day remove all suckers; then throw in fine soil, so as to pack round and between the plants, taking the greatest care not to let any of it get into their hearts. Earth up again in September, and again in October. If through the winter it is necessary to cover the hearts of the plants, do so with hay, straw, or bracken, never with soil.

Of varieties, some of the best are Sutton's white gem, Veitch's superb white, and Clark's solid red. Celery is eaten in England as an accompaniment to cheese; but it may be eaten as a salad, also boiled, and in soup.

Céleste, MADAME (?1814-82), French actress, born in Paris, made her début at the Bowery Theatre, New York (1827), afterwards playing with much success in Philadelphia. Coming to Liverpool, she successfully essayed the part of Fenella in *Masaniello*. Her first appearance in London was at the Queen's Theatre, as an Arab boy in the *French Spy* (1831); but next year she played in the *Poetry of Motion* at the Surrey. After a tour through Italy, Germany, Spain, and Scotland, she returned to London (1833), appearing at Covent Garden in the *Maid of Cashmere*, succeeded by a season at Drury Lane. She paid a second visit to the United States (1834–7). Undertaking next the management of the Adelphi, London (1844), she there created her most famous rôle, Miami, in *Green Bushes* (1845), and in 1859 became manageress of the Lyceum. She retired in 1874.

Celestina, celebrated Spanish comedy (1502; new ed. 1900), is properly a dramatized novel. It appeared in English translation in 1631, and was reprinted in 1874 by Dodsley in *A Select Collection of Old English Plays*. Although the author or authors were long unknown, it is now accepted that the first act was written by the

poet Rodrigo de Cota about 1480, and that Fernando de Rojas wrote the rest about 1490. See Routledge's 'Library of Early Novelists' (1904), 'Molone Society Reprints' (1907), 'Tudor Facsimile Texts' (1907).

Celestine, a mineral consisting of sulphate of strontium, and belonging to the same group as barytes. It crystallizes in the rhombic system in crystals often long, columnar, and pointed. It has a good cleavage, and a hardness of 3½; and when a fragment is heated in the forceps before the blowpipe, the flame is coloured scarlet red—a characteristic reaction of minerals containing strontium. Celestine is colourless, white, or bluish, the occasional sky-blue colour being the source of the name. Although not one of the commonest minerals, it is by no means rare, and finds a limited commercial employment as a source of strontium compounds and in the refinement of sugar. It is found in the neighbourhood of Bristol, generally in Triassic rocks.

Celestine, or CELESTINUS, the title of five Popes: I. (422–432), II. (1143–4), III. (1191–8), IV. (1241—died sixteen days after his election), V. (1294–6). Under Celestine I. St. Palladius and St. Patrick were sent to Ireland. Celestine V. was the founder of the orders of the Celestine Monks and the Celestine Hermits.

Celestines, a branch of the Benedictine order which practised special austerities. Founded by Pietro da Murrone (1254), they were known as Murronites until his elevation (1294) to the papacy as Celestine V. The Celestine houses were numerous in Germany till the reformation, and in France till 1766. Few now survive even in Italy. The Celestine Hermits, an offshoot of the Franciscan order, due to the same founder, had but a short existence.

Celeus, king of Eleusis in Attica, and father of Triptolemus.

Celibacy. As a social and secular phenomenon celibacy is entirely accidental, depending on personal disposition and the distribution of population according to age and sex, and is not regarded with favour, especially in countries where there is compulsory military service. This disfavour manifests itself occasionally (*e.g.* more than once in the French House of Representatives) in proposals to impose a special tax on bachelors. The decadence of certain countries—*e.g.* Spain—has been attributed to the large proportion of the population rendered unproductive by the practice of celibacy. Some critics—*e.g.* Galton—have claimed that the withdrawal of the more refined members of society to a celibate life has, by the laws of heredity, reduced the quality as well as the quantity of succeeding generations.

As a religious observance celibacy has held a prominent place in two world religions—Buddhism and Christianity. Naturally it has but a limited place in nature and national religions. The instance of the vestal virgins of Rome is misleading, and is not typical of the religious practice of the ancient world. Religion was so much a family and a national concern, that celibacy found little place in its observance. Usually in the case of national religions a family or tribe was set aside as a perpetual priesthood—*e.g.* the tribe of Levi—and although continence was frequently prescribed during the period of exercising the priestly duties, celibacy was not prescribed. There is no trace in the Old Testament of any desire to exalt celibacy; and although among New Testament writers—*e.g.* St. Paul—chastity and virginity are regarded as the more excellent way, compulsory

celibacy is not insisted on. The earliest Christian celibates were not ecclesiastics, but hermits and anchorites, and only gradually was celibacy enjoined upon the active clergy. The law of celibacy has never been accepted by the Eastern or Greek Church; and Rome itself, in the United Greek Church, tolerates a married clergy, although no married priest can become a bishop. At the first Council of Nicæa (325 A.D.) an unsuccessful attempt was made to impose celibacy as a law on the church. Thenceforward the development of the idea is in the Western Church only. But the practice was not uniform, the rural clergy resisting the attempt to impose it obligatorily on them. Gregory VII. was powerful enough to secure a much more strict observance. He saw in a celibate clergy a potent engine of ecclesiastical power; and after the first and second Lateran Councils (1123 and 1139) clerical marriages were regarded as invalid. Practically, celibacy was extensively evaded by concubinage, ecclesiastically regarded as a more venial offence than marriage. Since the Council of Trent, in 1563, pronounced for celibacy in the strongest manner, it has been strictly enforced as a law and obligation. In the ritualist movement in the English Church, celibacy has been praised as a virtue and claimed as a duty by some advocates, but it has not, of course, been enforced as an obligation of the church. See H. C. Lea's *Historical Sketch of Sacerdotal Celibacy* (1886).

Cell is a mass of protoplasm containing a nucleus, both nucleus and protoplasm having arisen through the division of the corresponding elements of a pre-existing cell. A typical cell is spherical in form; but this shape is rarely retained in multicellular animals, where the cells are usually subjected to pressure, except in the case of egg cells. In spherical cells the nucleus occupies an approximately central position. Structurally, this nucleus is to be regarded as a specialized portion of the protoplasm, and it is therefore convenient to use the term protoplasm to designate both the substance making up the cell body and that constituting the nucleus, the terms cytoplasm and karyoplasm being employed respectively for these two forms of protoplasm. In addition, in many cells a minute body called the centrosome also exists; but it is still doubtful whether this persists from generation to generation as the nucleus does. The cytoplasm has a complex structure, and it is possible that the structure not only varies in different cells, but also in the same cell at different times. It is frequently possible to make out in the cytoplasm a network, or reticulum, made of a substance slightly denser than that which fills the spaces of the reticulum. Along the meshes of the net granules, or microsomes, are often scattered.

The nucleus, without which the cytoplasm is incapable of continued existence, is separated from the surrounding cytoplasm by a nuclear membrane, and is also of a complicated structure, but differs markedly from the cytoplasm. It exhibits an irregular reticulum composed of two different elements — first, of a substance called linin, apparently related to cytoplasm; and second, of the exceedingly important substance called chromatin. This stains very darkly with many dye-stuffs, whence its name, and its importance is shown by the fact that it is handed on from generation to generation. It contains a large amount of a phosphorus-containing substance called nuclein. Within the nucleus there are often bodies called

nucleoli, which may be made of an aggregation of chromatin, or may be plasmosomes ('true nucleoli'), whose nature and function are not well known. Finally, the meshes of the nuclear reticulum are filled up by what is known as nuclear sap.

The third important element of the cell is the centrosome, a minute body, either double or single, which stains intensely with the dye hæmotoxylin, and is surrounded by an 'attraction sphere,' or by a radiating aster. Only discovered in 1875, the centrosome is still inadequately known. It has been regarded as the centre of force in the cell, and is of great importance in cell division.

In many plant cells other cell organs exist in the form of plastids, which, like the nucleus, are capable of growth and division, and are handed on from generation to generation. The most important of these are the chloro-plastids, or chlorophyll corpuscles, and the starch-forming leuco-plastids. As a rule, the cell membrane, or cell wall, is only slightly developed in animal cells, but it is often thick and highly important in the cells of plants, where it is formed of the carbohydrate cellulose.

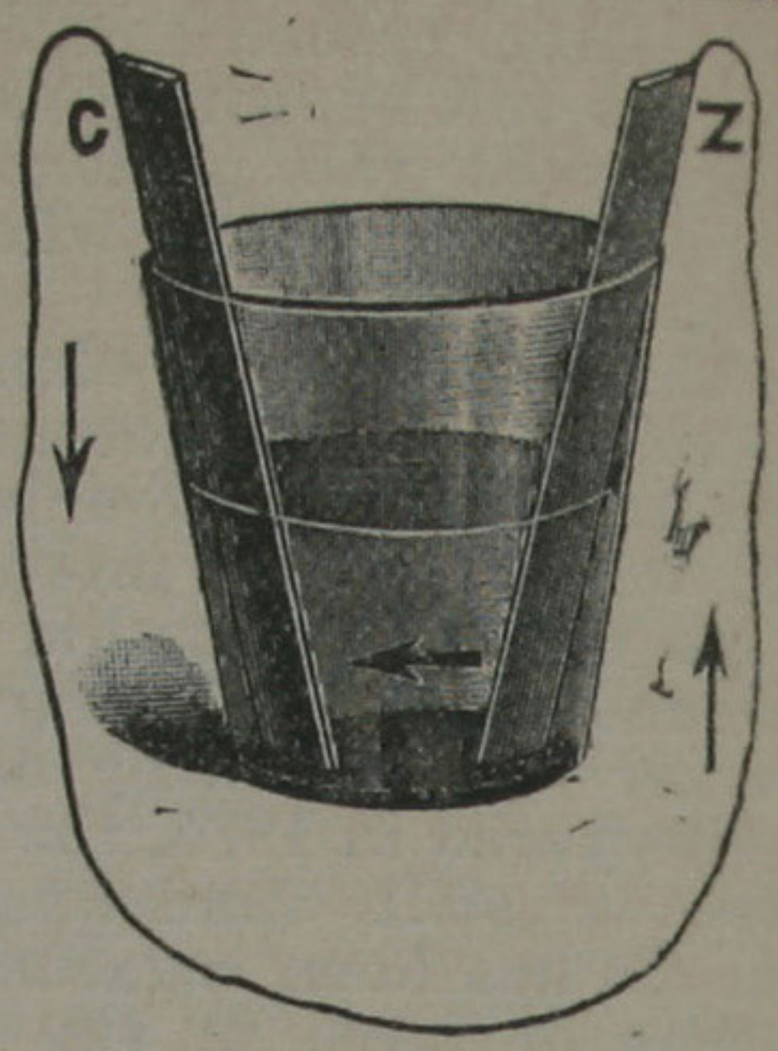
When cells have reached their limit of growth division takes place, the process, in the majority of cases, being of an exceedingly complicated nature. In a cell about to divide the nuclear membrane disappears, the chromatin increases in staining power, and takes on the form of a stout coiled thread. This thread, or skein, breaks up into loops, and the loops form a central star. Meanwhile the centrosome has divided into two, and these two take up positions at the poles of the cell, each being surrounded by a radiating aster. From one centrosome to another there run fine non-staining (achromatin) threads, which constitute the nuclear spindle. On these achromatin threads the chromosomes, or loops of chromatin, lie, and each splits into two. The halves then separate from one another, travelling along the achromatin threads to the poles of the cell, so that, in place of the original central aster, two daughter asters arise, one at each pole. From these daughter asters nuclei are constituted, the cytoplasm divides, and the cell division is complete. To the whole process the name of karyokinesis, or mitotic division, is given. In a few cases—*e.g.* in many Protozoa—cells divide directly, without any karyokinetic process, the parent nucleus becoming constricted in the centre so as to form two new nuclei. The object of the ordinary karyokinetic process appears to be to produce an accurate division of the parent chromatin between the two new nuclei.

As previously indicated, the cells which are usually taken as typical are the sex cells, which are easily obtained free. The cells which constitute the tissues of multicellular animals differ markedly from such typical cells, the differences depending upon their adaptation to serve special functions. Thus, a striped muscle fibre is a greatly elongated cell, made up of a number of slender longitudinal fibrils, marked with stripes, or alternating bands of light and dark substance; and a nerve cell may have many elongated processes extending outwards from the cell body. In the Protozoa the single cell performs all the animal functions, but in the Metazoa there is much histological division of labour, and this is reflected in the structure of the cells. See further under EMBRYOLOGY and HEREDITY. For a general description

of the cells of the Metazoa see Schäfer's *Essentials of Histology* (1892); and for a very full account of the problems connected with the cell and with cell theory, see E. B. Wilson's *The Cell in Development and Inheritance* (2nd ed. 1902), Hertwig's *Allgemeine Biologie* (1906), and Walker's *Essentials of Cytology* (1907).

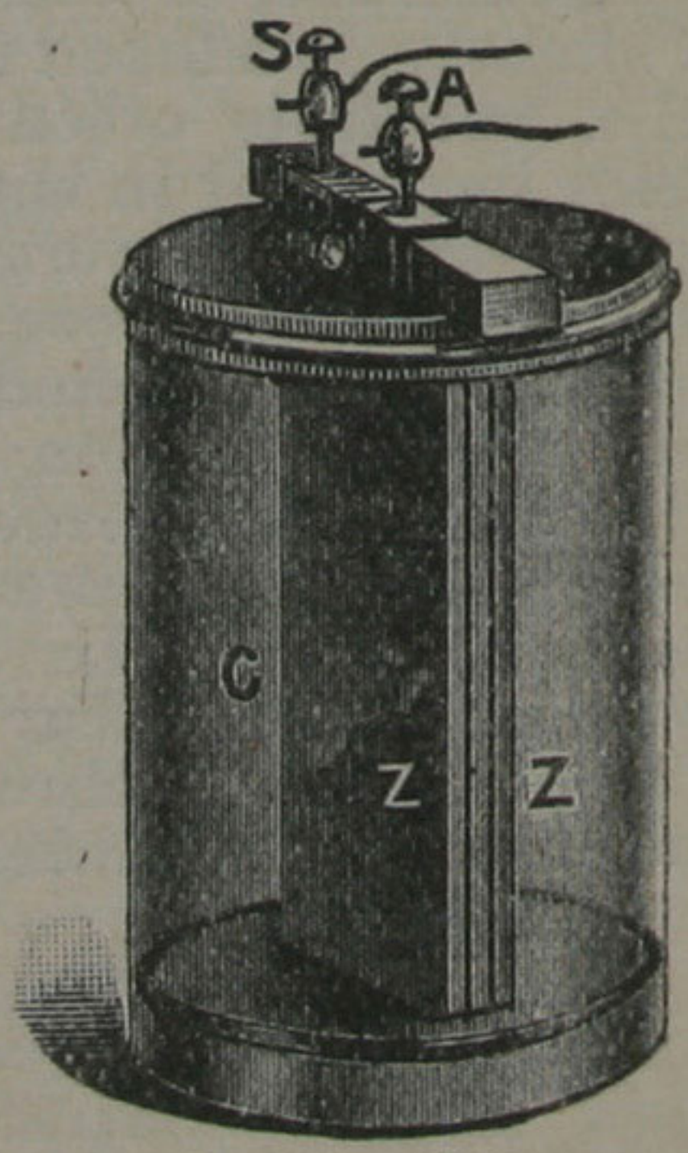
Cell, VOLTAIC, or PRIMARY BATTERY, also called GALVANIC BATTERY. A voltaic cell is any combination of metallic and liquid conductors capable of supplying a steady current in a circuit of which it forms a part. In all cases chemical action is the source of the energy. A good voltaic cell should be of high and, as far as possible, of constant electro-motive force; should be free from polarization, and of low internal resistance; should be quiescent on open circuit; should give off no fumes when in action; should be cheap, durable, not liable to rapid exhaustion, and easily renewed. No single cell meets all these requirements. For any ordinary commercial purpose, however, tolerable efficiency in one or two particulars is generally sufficient. The different kinds of cells in use fall into well-defined classes, the chief differences being in the various devices adopted to obviate polarization.

The Simple Cell.—A plate of copper C and a plate of zinc Z dipping into a beaker which contains dilute sulphuric acid (about twenty parts by volume of water to one of acid) constitute a simple voltaic cell. The electro-motive force of such a cell is 1·05 volts. As soon as circuit is made, zinc replaces the hydrogen in the sulphuric acid, and hydrogen bubbles are evolved at the surface of the copper plate. This produces what is known as electrolytic polarization, and the current falls off. The great problem for the electrician is how to dispose of this hydrogen, and, broadly speaking, the working efficiency of any cell depends on the extent to which this is done.



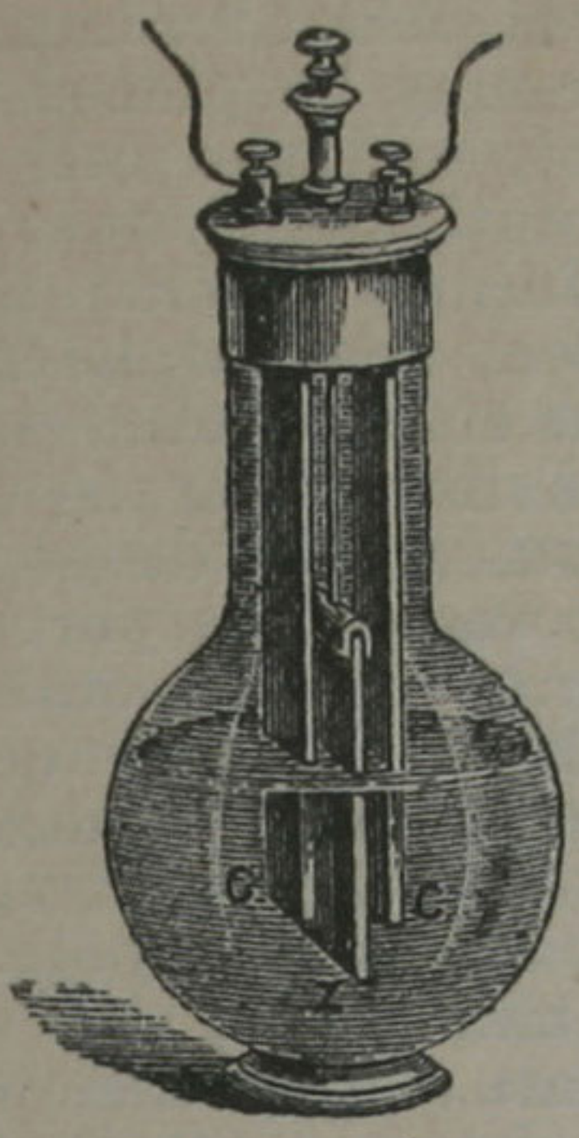
Simple Cell.

Smee's Cell.—In this type dilute sulphuric acid is again the exciting fluid. A zinc plate Z forms the negative pole, but the copper plate is replaced by one of platinized silver—*i.e.* by a silver plate whose surface is roughened by being coated with finely-divided platinum. As the hydrogen collects here in minute bubbles, it detaches itself from the fine points, and, rising through the liquid, bubbles off. The device is only moderately successful, much of the gas continuing to adhere to the plate.



Smee's Cell.

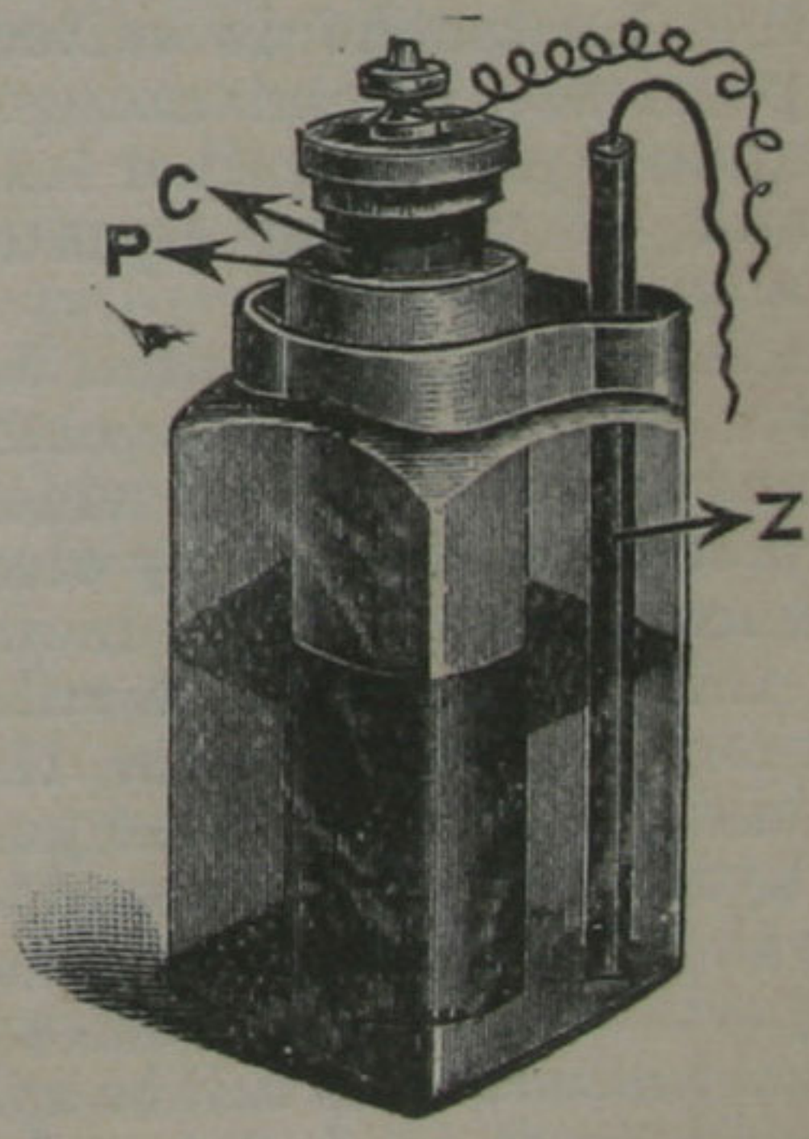
Bichromate of Potash Cell.—In this case bichromate of potash is the depolarizer employed. The excitant is again dilute sulphuric



Bichromate Cell.

acid, in which the bichromate is dissolved. The plates are of carbon and zinc, generally two carbon plates with the zinc between, the carbons being joined outside the liquid by a metal strip. As the solution would attack the zinc, this plate can be raised out of the liquid when the cell is not in action. This cell has the high electro-motive force of 2·1 volts and a low internal resistance. If employed to send a strong current for some time, the E.M.F. falls off, for the liquid in contact with the carbon has been used up; but the cell recovers on standing inactive, or on being stirred.

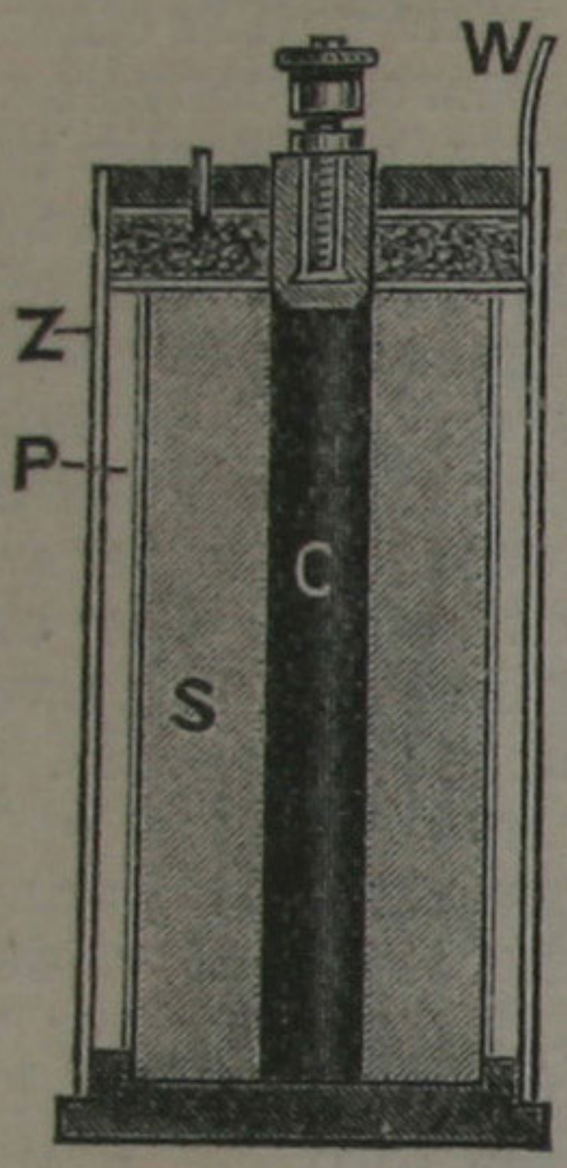
Leclanché Cell.—This is the cell most extensively used in bell circuits. It commonly consists of a glass vessel containing a saturated solution of sal-ammoniac (ammonium chloride) and a zinc rod Z or hollow cylinder. A porous pot of unglazed porcelain P occupies the centre of the cell, and holds a carbon plate C tightly packed round with small lumps of crushed carbon and black oxide of manganese (manganese dioxide). Diffusing through the porous pot, the sal-ammoniac moistens the powdered carbon and manganese dioxide, and thus enables the current to pass. The cell is clean, cheap, easily renewed, contains no corrosive acids, and emits no fumes. The E.M.F. is about 1·4 volts. In action the black oxide of manganese oxidizes the evolved hydrogen, but only somewhat slowly. Hence polarization soon occurs. This, however, matters little in bell work, where the current is kept running only for a very short time and at intervals. An important modification of this cell is the agglomerate Leclanché, in which the internal resistance is lessened by dispensing with the porous pot. Powdered carbon, manganese dioxide, and gum-lac resin, intimately mixed in the proportions of 40 parts of manganese dioxide, 55 parts of carbon, and 5 parts of resin, are pressed into rectangular blocks, which are held up against the sides of the carbon rod by india-rubber bands.



Leclanché Cell.

Dry Cells.—A popular form consists of a cardboard cylinder containing a zinc cylinder Z with wire W attached. This is lined with a paste P made of plaster of Paris

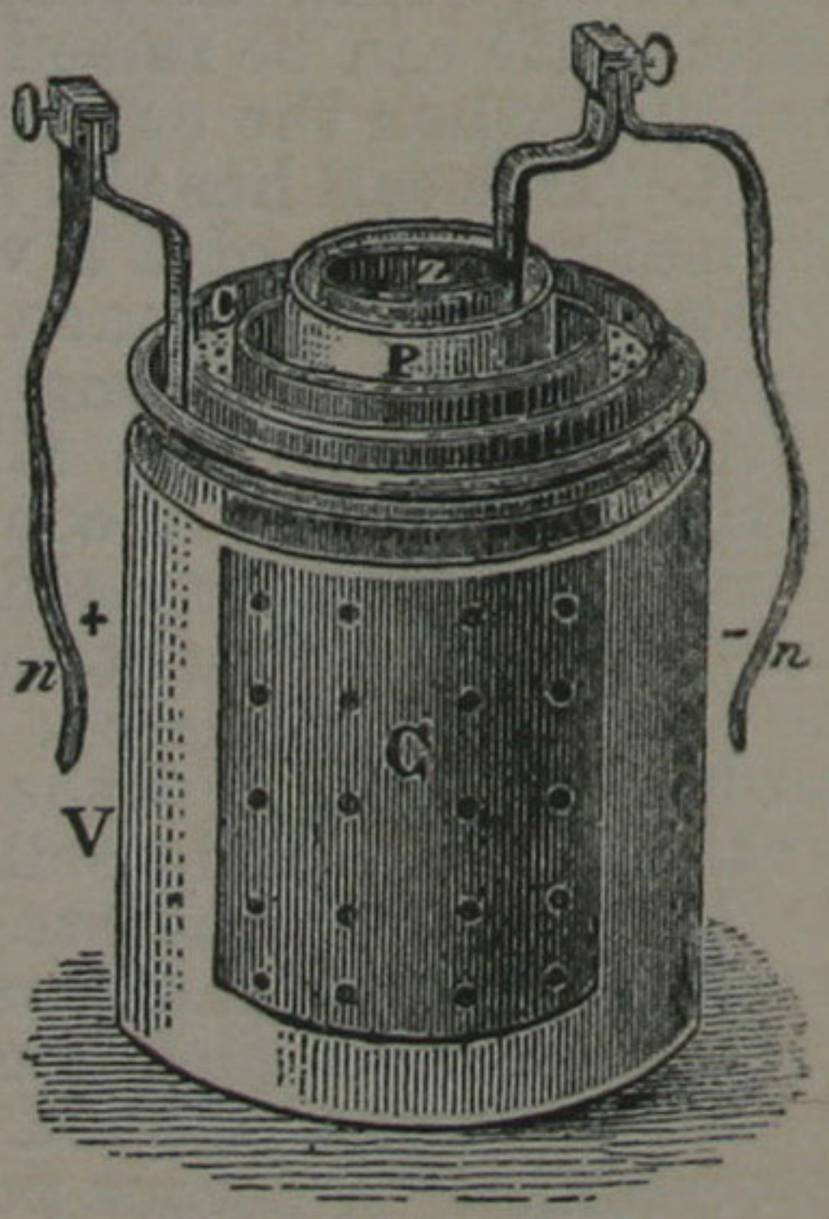
27 parts, water 51 parts, and sal-ammoniac 12 parts. A carbon rod C is then put in the centre, and the remaining space S filled up with



Obach Dry Cell.

a mixture of sal-ammoniac, powdered carbon, manganese dioxide, zinc sulphate, and glycerin, made into a paste with water. On standing, the paste hardens into a firm, gluelike mass. The cell may be used for all purposes for which the Leclanché is suited, and it possesses the advantages of having no liquid to spill or leak away, and of working equally well in any position.

Daniell's Cell.—The Daniell belongs to the important class known as two-fluid cells, in which depolarization is effected by electro-chemical means. The members of this class are, as a rule, much more constant than the single-fluid cells, because the polarizing hydrogen is not allowed to form on the positive pole. The essential parts of the Daniell cell are a zinc rod immersed in dilute sulphuric acid, or zinc sulphate solution, and separated by a porous pot of unglazed earthenware from a copper plate dipping into a solution of copper sulphate. The copper-sulphate solution must be kept saturated. This is effected by having in the solution a supply of copper-sulphate crystals, which, as the solution becomes weaker, gradually dissolve in the liquid and restore its strength. If the cell is not required for immediate use, water may be placed in the porous pot, and the cell short-circuited, until sufficient sulphate of zinc is formed. When the cell is in action, the sulphuric acid attacks the zinc, forming zinc sulphate and liberating hydrogen. The molecules of hydrogen traverse the pores of the porous pot and continue into the outer cell, where the hydrogen combines with the copper sulphate, forming sulphuric acid, and depositing pure copper on the copper pole. The hydrogen thus never reaches the copper plate. The chemical reaction consists essentially in the replacement of copper by zinc in the solution. If zinc sulphate is used instead of sulphuric acid, the resistance is considerably higher, but the action is similar. Though the E.M.F. of the Daniell is only about 1·08 volts, it is more constant than that of any other cell

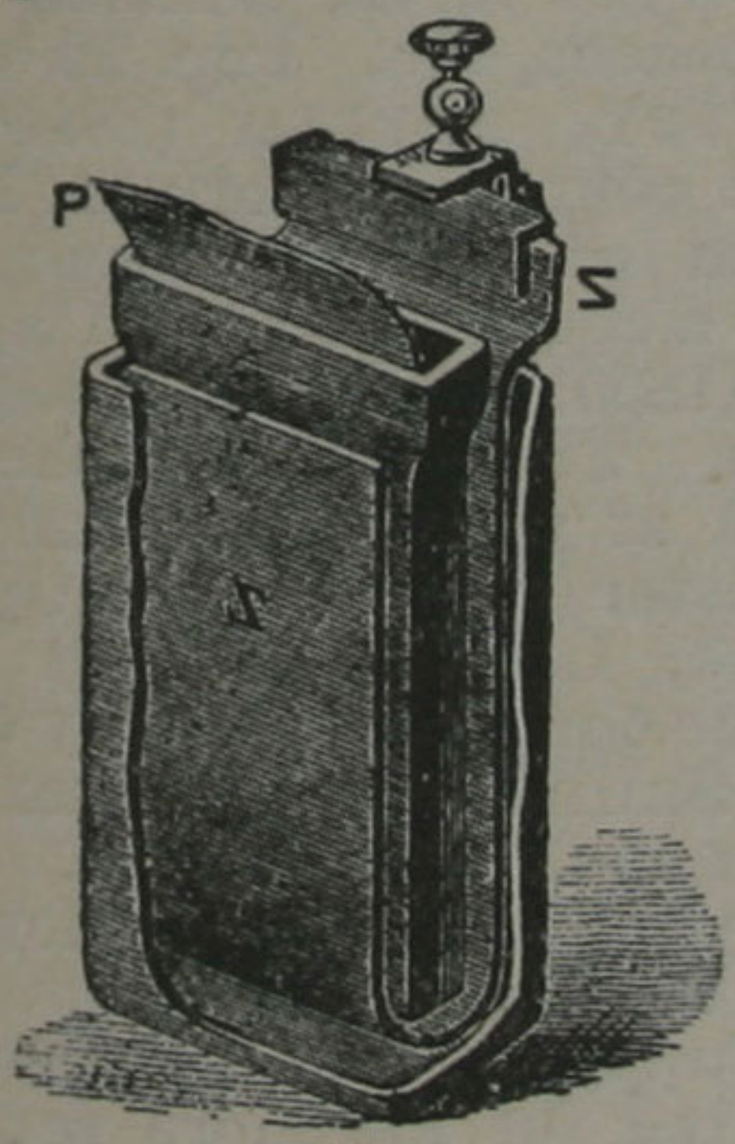


Daniell's Cell.

in common use. On this account the cell is well fitted to serve as a standard of electro-motive force.

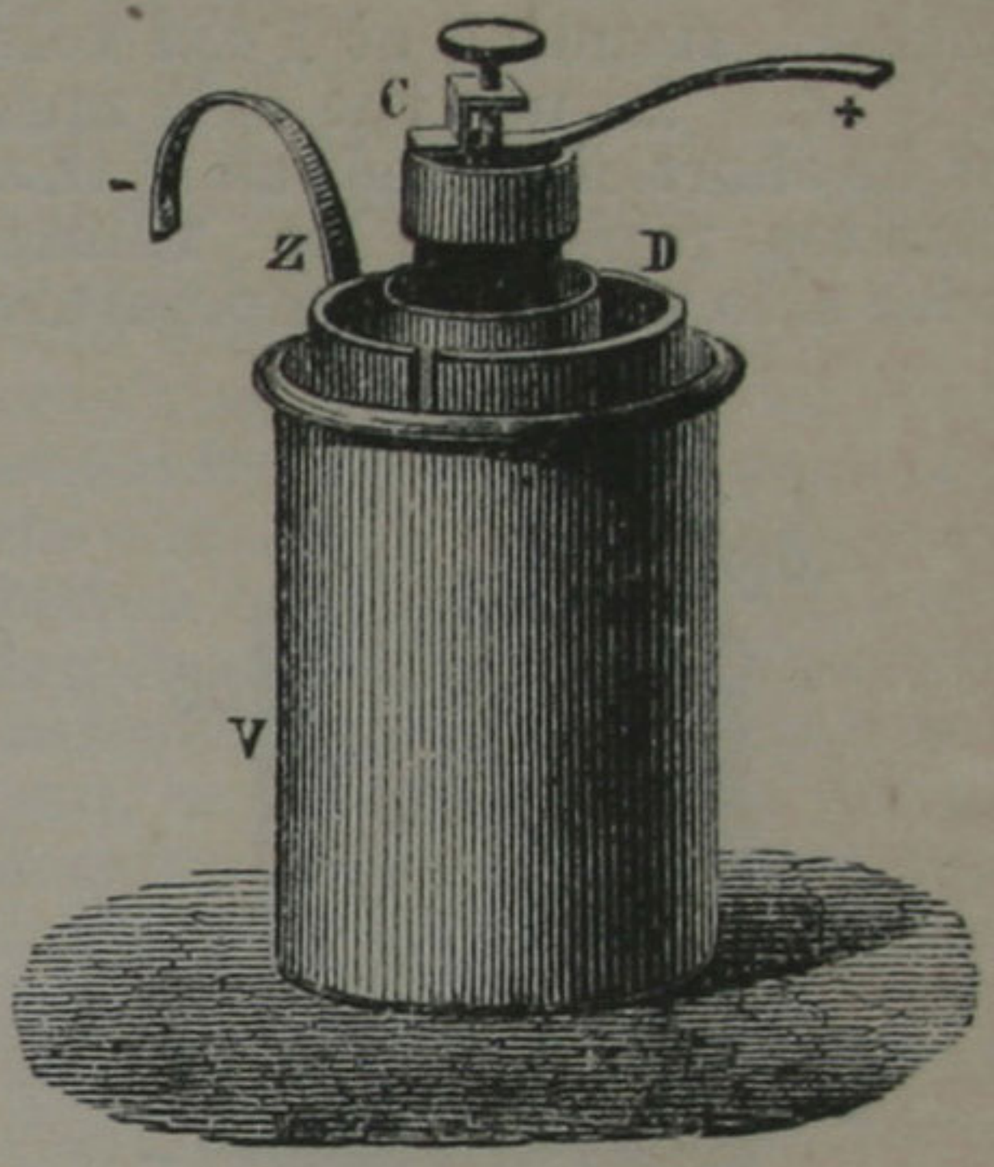
Grove's Cell.—Sir William Grove

devised a cell which has both a higher voltage (as much as 1·9 volts) and a lower internal resistance than the Daniell. It differs from the Daniell in having platinum foil immersed in concentrated nitric acid instead of copper in copper sulphate. The hydrogen liberated by the solution of the zinc in the sulphuric acid, passing through the depolarizing nitric acid towards the platinum, decomposes the nitric acid, and is itself oxidized, forming water and nitrogen peroxide gas. This gas appears in the form of red fumes in the inner pot; but it causes no polarization, for being very soluble in nitric acid, it does not attach itself to the platinum, nor does it set up a counter E.M.F. A Grove will send a current continuously for several hours without exhaustion. One cell will raise a few inches of platinum wire to red heat; fifty quart cells in series will produce an electric arc light.



Grove's Cell.

Bunsen's Cell.—This is merely a modification of the Grove cell in a cheaper form, the expensive platinum plate being superseded by a rod of carbon. The internal resistance and the voltage are practically the same as in the Grove cell; and the chemical action is also similar, the evolved hydrogen decomposing the nitric acid and uniting with part of its oxygen to form water, dark-red nitrogen peroxide fumes being given off. Like the Grove, too, the cell may be kept in action several hours without polarizing

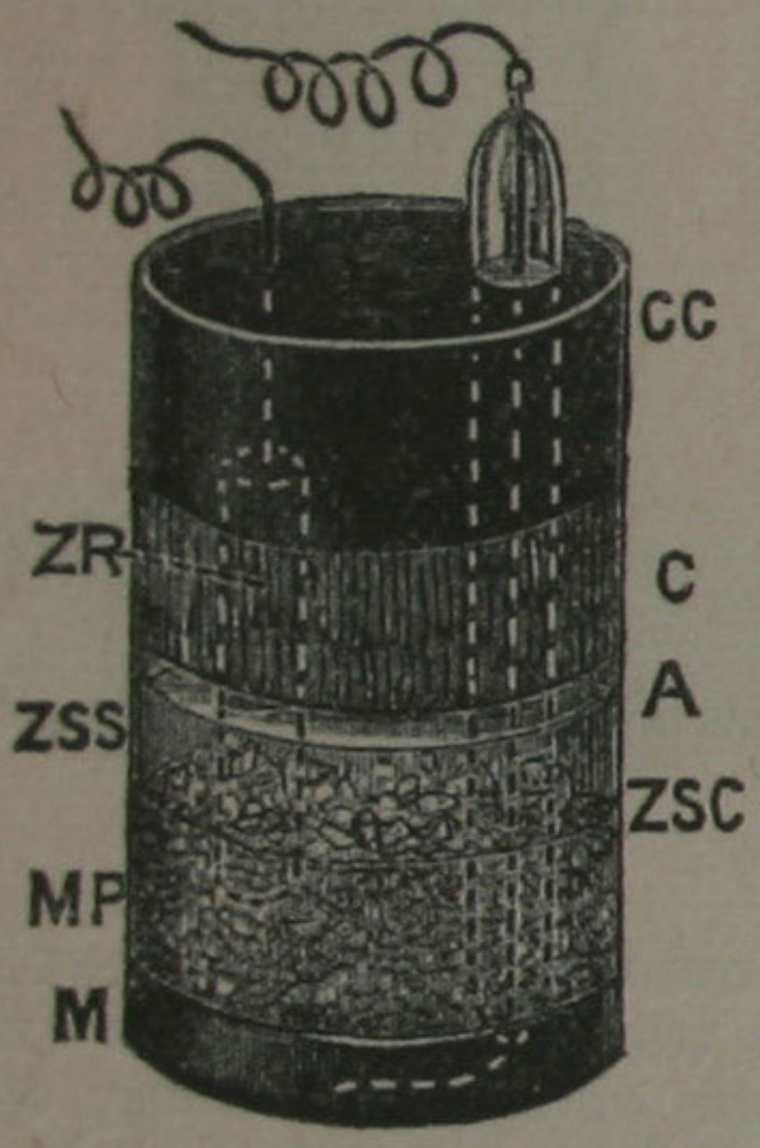


Bunsen's Cell.

appreciably, but care should be taken not to inhale the fumes. In view of its constancy, cheapness, and high E.M.F., the Bunsen is, on the whole, perhaps the best cell for general experimental work where a steady E.M.F. and large current are required.

Latimer Clark's Standard Cell.—To secure the greatest possible accuracy in the measurement of electro-motive force, it is desirable to use the Latimer Clark cell, now adopted as the international standard of E.M.F. Its construction is complicated and difficult, and need only be attempted by experts. A quantity of pure mercury M occupies the bottom of the cell, and is covered by a layer of paste of mercurous sulphate MP. Above this comes a saturated solution of zinc sulphate ZSS into which a zinc rod ZR dips. Above the solution we have a layer of paraffined cork C to prevent evaporation, and over all a layer of

cement CC. A represents an air space, and ZSC a supply of zinc-sulphate crystals. Contact is made with the mercury by a platinum wire enclosed in a glass tube which is hermetically sealed. When the cell has been set up for some time its voltage is remarkably constant, standing at 1·434 volts at 15° C. In use the cell must not be short-circuited, as it then polarizes rapidly. Its voltage varies also with the temperature.



Latimer Clark's Standard Cell.

For arrangements of batteries, see OHM'S LAW, ELECTRICITY, CURRENT, ACCUMULATOR. See W. R. Cooper's *Primary Batteries* (1901); Silvanus Thompson's *Elementary Lessons in Magnetism and Electricity* (1900); Poyser's *Magnetism and Electricity* (1892); Jamieson's *Elementary Manual of Magnetism and Electricity* (4th ed. 1897).

Cellarius, properly KELLER, CHRISTOPH (1638–1707), German humanist and pedagogue, born at Schmalkalden; after teaching for twenty-six years, was appointed (1693) professor of rhetoric at the newly-founded university at Halle. Cellarius contributed much to the revival of classical studies in Germany. Among his books are *Antibarbarus Latinus* (1677), *Orthographia Latina* (1700), *Historia Antiqua* (1685), *Historia Medii Ævi* (1688), *Historia Nova* (1696), also *Geographia Antiqua* and *Geog. Nova* (1686 and 1687). His *Dissertationes Academicæ*, with Biography, were published in 1712. See Kiel's *De Ch. Celarii Vita et Studiis* (1875).

Celle, formerly also ZELLE, tn., prov. Hanover, Prussia, on the s. margin of the Lüneburg Heath, 23 m. by rail N.E. of Hanover; was the place of residence of the Dukes of Brunswick-Lüneburg from the 14th century to the extinction of the line in 1705. The ducal castle was built partly in 1485 and partly in the 17th century. The parish church contains the tombs of the ducal family, including that of Sophie Dorothea, the divorced wife of George I. of England. In the castle park is the mausoleum of Caroline Matilda, queen of Denmark and sister of George III. of England. The chief products of the town are yarns, printing ink, soap, tobacco, etc. Pop. 22,000.

Cellier, ALFRED (1844–91), musical composer, born in London, but of French parentage; became a chorister in the Chapel Royal (1855), and conducted in Prince's Theatre, Manchester (1871–5), at the Opéra Comique, Manchester (1876), and the Opéra Comique, London (1877–9). In 1878–9 he conducted, jointly with Sir A. Sullivan, the promenade concerts at Covent Garden. His easy style and agreeable flow of melody are strongly in evidence in the *Sultan of Mocha* (1874), though less suited for his more serious setting to Gray's *Elegy* (Leeds Festival, 1883). His other works are *Charity begins at Home* (1870), *Pandora* (1881), *Tower of London* (1875), *The Spectre Knight* (1878), *The Carp* (1886), *Mrs. Jarramie's Genie* (1888), and *Doris* (1889), besides music adapted to the librettos *Dorothy* and *Mountebanks*.

Cellini, BENVENUTO (1500–71), the greatest of the Italian artificers in gold during the renaissance; born in Florence. This complex personality—goldsmith, sculptor, warrior, braggart, criminal, and author—has left in his *Autobiography* (1728) a graphic picture of his day, with its vivid contrasts of skilled genius and barbarism. His youth was a series of violent escapades, flights from justice alternating with intervals of admirable workmanship. Finally he settled in Rome under papal patronage, and made numberless works of art, from elaborate silver vases for cardinals, and statuettes, to coinage dies for Clement VII.; while, for the same pope, he defended the castle of San Angelo against the besieging Bourbon troops (1527). Later he spent some time (1540–5) in Paris, and made a basin and ewer in silver-gilt repoussé; the colossal bronze relief, *The Nymph of Fontainebleau*, now in the Louvre; and the fine golden salt-cellar now in Vienna. His one large bronze statue of Perseus, in Florence, made for the Grand-Duke Cosmo de' Medici, is technically a triumph; though, artistically, the bronze portrait of Bindo Altoviti, so much admired by Michael Angelo, is finer. For translation of his *Autobiography*, see *Life of Benvenuto Cellini* by J. A. Symonds (5th ed. 1903); also *Lives*, by Tassi (1847), Mollinier (1894), and R. H. Cust (1910), and F. S. Potter's *A Wonderful Goldsmith* (1882). The most comprehensive work is by Eugene Plon (Paris, 1883).

'Cello, contraction of violoncello. See VIOLIN.

Cellulitis is inflammation of the loose cellular connective tissue of the body, either starting in the cellular tissue itself, or spreading to it from other tissues. It may be acute or chronic, circumscribed or diffuse. It may end in suppuration, in resolution, or in the formation of fibrous adhesions. Owing to the comparatively low vitality of connective tissue, suppuration is common. Cellulitis must be distinguished from erysipelas, which is caused by a specific organism. Whereas erysipelas begins with a redness of the skin, with well-defined limits, cellulitis, on the other hand, is present for some time before the skin becomes much affected, the resulting blush is not so bright, and it tends to be ill-defined about its circumference. When suppuration occurs, it may, of course, implicate important structures, burrowing into any adjacent organ, or disorganizing a joint, or causing death by general septic infection. In the early stages of cellulitis it is well to ensure the free action of the bowels. Pain is treated with anodynes, and locally by hot fomentations. If suppuration ensue, there must be free incisions made, to ensure the escape of pus, this being aided by warm antiseptic applications. Diet must be nutritious and easily digestible, and stimulants may be necessary. Vaccine treatment is sometimes of great value.

Celluloid, or XYLONITE, consists essentially of a solid solution of the lower nitrates of cellulose in camphor. The cellulose, in the form of bleached cotton or tissue paper, is immersed in a mixture of certain proportions of nitric and sulphuric acids. The nitric acid must not be too strong, so as to avoid the formation of the explosive and insoluble hexanitrate or gun-cotton. As, however, the water produced in the chemical reaction progressively weakens the acids, the temperature of the bath has to be so regulated as to compensate for the loss of strength, and ranges from 20° to 33° C. After

about half an hour the acids are run off, and finally squeezed out of the pulp as far as possible by a hydraulic press. The nitrocellulose, now in a compact cake, is broken up, thoroughly washed, bleached by the aid of permanganate or bleaching powder, and again washed and freed from water by pressure. The cake is again broken up, mixed with flake camphor, pigment, or dye, and often with naphthalene, oils, or other substances. The mixture is then filled into boxes, each layer being sprinkled with a bare sufficiency of alcohol or other solvent, and the whole is allowed to soak for some time, when it settles down into a dough. To render the mass homogeneous, it is cut in pieces and kneaded under steel rollers that can be warmed by steam. From these it is again cut in sheets, a number of which are placed together and welded into a solid block by hydraulic pressure. A planing machine cuts from the block sheets of any thickness required, and these can be moulded into shape.

Weeks or, in the case of thick pieces, months are occupied in drying off the solvent used for the camphor. The process is carried out in heated chambers, and is always attended by more or less shrinkage. When finished the material is tough and hard, and in elasticity rivals ivory, like which it may be planed, carved, or turned in the lathe. The particular methods by which ivory, tortoiseshell, etc., are so closely imitated are secrets of the manufacture, but depend on the blending together of dissimilar layers of the plastic material under pressure. The colour of the unpigmented material is buff, and the nature of the pigment added affects the specific gravity of the finished article, which averages about 1·4. Perfectly transparent varieties are also produced. It is not explosive, but is easy to kindle, and burns vigorously and rapidly. Attempts are constantly being made to render it uninflammable, without injury to its other properties, by mixing with the paste such substances as aluminium hydrate, mica, or asbestos, but hitherto without commercial success. Celluloid becomes plastic at 125° C., and separated pieces can be welded together by simple pressure at this temperature. It is easily cemented to wood, leather, etc., by the use of collodion or of a solution of shellac and camphor in alcohol. In spite of its comparatively high price, it finds widespread application for combs, knife handles, piano keys, and innumerable other articles of use and ornament. Celluloid varnishes are solutions of nitrocellulose alone, or with other substances in simple or mixed solvents, such as acetone, wood spirit, and alkyl acetates; under trade names these find wide application, especially as lacquers for brass or bronze. The amyl-acetate solution is used in photography, and as a cement for celluloid itself. Celluloid was first made in England by Parkes of Birmingham in 1856, and was known as parkesine. A few of the functions of celluloid have of late been usurped by viscoid, a form of cellulose itself, obtained by evaporation of an aqueous solution of its alkali-thiocarbonate compounds. These solutions (termed viscose) are, however, chiefly used for spreading on paper or cloth, so as to coat them, on evaporation, with a layer of cellulose. See Böckmann's *Celluloid* (Eng. trans. Scott, Greenwood).

Cellulose is the chief component of all vegetable tissues, in which it exists in elongated cells or fibres, and represents the result of the plant's activity in building up its structure from the elements

of carbon dioxide and water. In composition it is a carbohydrate of the type $(C_6H_{10}O_5)^n$, the constitution of which has not been definitely ascertained. Cotton-wool and filter-paper are almost pure cellulose, from which it may be seen that it is a white, opaque solid, appearing under the microscope to consist of thin flattened tubes. It gives a blue colour with iodine if previously or simultaneously treated with sulphuric acid, and is soluble in an ammoniacal solution of copper hydroxide. This latter property is made use of in the preparation of Willesden paper, etc., the ammoniacal solution dissolving the outside of the fabric, and thus covering it with a sort of dull green waterproof coat. Cellulose is also soluble in alkaline thiocarbonates, forming a solution that, under the name of viscose, has several technical applications. Moderately concentrated acids toughen and parchmentize cellulose, but in a more concentrated form they yield esters, of which the most important are the nitrates, made use of as pyroxylin and gun-cotton. Besides the applications of its derivatives, cellulose is employed in enormous quantities in the fibrous state in the form of cotton, linen, jute, hemp, etc., to make textiles, and in the state of pulp, obtained chiefly from wood and esparto, to make paper. See Cross and Bevan's *Cellulose* (1895), and same authors' *Researches on Cellulose* (1895–1905).

Celosia. In botany the genus Celosia is a subdivision of the order Amarantaceæ, and is composed of certain species of annual plants, natives of the more temperate regions of Asia. *C. cristata* (the common cockscomb) is the best known, having been grown in English gardens for over three hundred years. Its red flower spike forms a compact mass, with its greatest length horizontal, roughly resembling a cock's comb. Other species are *C. argentea*, which has erect spikes of whitish flowers; and *C. Huttoni*, with red oblong flower spikes and crimson leaves. The seed should be sown in heat in March, and kept near the glass. The young plants should be transplanted as soon as they are fit to handle, and brought on quickly in gentle heat until the heads show. They may then be moved into bigger pots, or, if June has arrived and the climate is mild, into the open garden in rich soil. Until the flower heads appear, water should be given sparingly.

Celsius, Magnus (1621–79), Swedish astronomer, born at Alfta, Helsingland, and died at Upsala, where he had been professor of mathematics and astronomy for twenty years. He was the discoverer and decipherer of the Helsing runes.—Olof Celsius (1670–1756), Orientalist and theologian, son of above, born at Upsala, where he became professor, and provost of the cathedral. He also studied runology, was an accomplished botanist, and the patron and friend of Linnæus. He published *Hierobotanicon* (1745–47), which contains descriptions of all the plants named in the Bible. —Anders Celsius (1701–44), Swedish astronomer and mathematician, nephew of Olof Celsius. Born at Upsala, became (1730) professor of astronomy and secretary of the Royal Society of Upsala. He was commissioned by the Swedish government to visit the chief European observatories, and accompanied Maupertuis, Clairaut, and the other French savants, in 1736, on their famous expedition to Lapland to measure a degree of meridian. He wrote numerous and important works on astronomy, but will be best remembered as the inventor of the centigrade thermometer. In 1740

he built the observatory of Upsala, and became director of the same.—OLOF VON CELSIUS, THE YOUNGER (1716-94), Swedish historian and poet, born at Upsala, son of the above Olof. In 1744 he became assistant librarian at the University of Upsala, and in 1747 professor of history there. Called as pastor to Stockholm in 1753, he became bishop of Lund in 1777. Celsius was a member of the Academy from its foundation (1786). His historical works are especially noteworthy for the thoroughness of their criticism and the brilliancy of their style. They are: *Konung Gustaf I.'s Historia* (2 vols. 1746–53); *Konung Erik XIV.'s Historia* (1795). He began an ecclesiastical history of Sweden (*Svea Rikes Kyrkohistoria*), but only finished (1767) the first volume (down to 1022).

Celsus, an Epicurean philosopher who flourished in the 2nd century, in the reigns of the Antonines. He is supposed to have been a native of Rome, and was a friend of Lucian. He is credited with the authorship of an attack on Christianity called *Logos Alēthēs* ('True Discourse'), which is not extant, but which was confuted by Origen in his treatise *Contra Celsum*. See Pélagaud's *Etude sur Celse* (1878).

Celsus, AULUS or AURELIUS CORNELIUS, a Latin writer on medicine. Nothing is known of his life. His work on medicine, in eight books, contains a discussion of the history of medicine; remarks on diet and the general principles of therapeutics, with the consideration of the treatment of the various diseases, the method advised being largely to allow nature to effect the cure, though he also recommends a free use of the lancet on occasions; an account of surgery, which shows that many of the most serious operations were practised; and finally a pharmacy, containing many excellent prescriptions. Editions: Ritter (1840); Daremberg (1859); Eng. trans. with Life by A. Lee (1831-6).

Celt, a now discarded term for the stone and bronze axes and chisels of prehistoric times. (1.) Stone axes present endless varieties of form, the extremes being those which have a cylindrical, pointed butt end, and those that are perfectly flat and thin. They vary in length from less than two inches to nearly sixteen inches, and in degree of finish from roughly-chipped forms to specimens possessing the highest possible polish. Stone chisels are rare. (2.) Bronze axes comprise (*a*) the flat axe, which is the earliest form; (*b*) the flanged, frequently ornamented with punched designs, and the higher forms of which pass into (*c*) the socketed axe. Chisels of bronze are extremely rare. See Sir J. Evans's *Bronze Implements* (1881), J. Anderson's *Scotland in Pagan Times* (1886), and Fr. Smith's *The Stone Ages in North Britain*, etc. (1909).

Celtiberi, Celts who at an early period invaded the Spanish peninsula and intermarried with the Iberians, the primitive inhabitants of the country. They dwelt in the mountainous country in the north and east. They became subjects of Rome in the second Punic war, but frequently rebelled. Scipio the younger reduced them to submission after the fall of Numantia, in 134 B.C.; but they rebelled again under Sertorius, and only after his death, in 72 B.C., were they definitely subdued and Romanized.

Celtis, KONRAD (1459-1508), German humanist, was the son of a Franconian peasant of the name of Pickel. In 1487 he was crowned by Frederick III., at Nuremberg, the earliest *poeta laureatus*. He wandered through many countries, lecturing at the

universities and founding literary societies (mostly short-lived); he was professor at Ingolstadt (1492) and Vienna (1497). He wrote a description of his travels and love adventures in elegiacs, and edited the works of Hroswitha in 1501. See Ruith's *Leben und Wirken des K. Celtis* (1852).

Celts, or KELTS. Their first historical appearance is in France, the centre of the race. But they were always restless, and about 100 B.C. they are found in eight main divisions—in Gaul, Britain, Belgic Gaul (Belgium), Spain (there called the Celtiberi), N. Italy, the Alps and the valley of the Danube, Thrace, and Galatia in Asia Minor. Their raids were the terror of the ancient world; only the victories of Cæsar and the administration of Augustus reduced them to inactivity. They never founded a lasting state alone. Though they began to live in towns at an early date, there were only slight bonds of union between the individual communities. They preferred a pastoral life to agriculture, and possessed little attachment to their native soil. They were dangerous fighters in the attack, with their powerful frames and heavy swords; but their lack of cohesion and discipline rendered them incapable of resisting a firm opposition. Cato the censor sums up their national character by saying that they were devoted mainly to warfare and witty conversation. But in Gaul itself, and indeed elsewhere, they became rapidly Romanized. The Celtic peoples, in so far as they can be identified by the uncertain test of language, are represented in modern Europe—(1) by the Gaelic-speaking communities of some parts of Ireland, of the Scottish Highlands and Islands, and of the Isle of Man; and (2) by the Cymric-speaking inhabitants of Wales and Brittany. Belonging to this second division, although without such a strong title from the linguistic point of view, are those Cornish people whose near ancestors used a Cymric form of speech. And further, there is presumably a large proportion of Celtic blood in the mixed race forming the population of England, notably 'to the north of the Trent and throughout the western counties' (Elton, p. 226). A similar deduction is warranted by the like conditions existing in several of those districts of Scotland and Ireland where Gaelic is not spoken.

Exclusive of the Bretons, none of the continental peoples have retained a Celtic language. Yet the testimony of history shows that, from the Galatians in the East to the Gauls and the hybrid Celtiberi in the West, Europe once possessed a large Celtic population. In the days of Pytheas (4th century B.C.) the Celts inhabited most of the north-west of Europe, and from there came the chief tide of Celtic invasion that swept over the British Islands, subduing the non-Celtic native races, at various periods before the days of Julius Cæsar. On the other hand, the pre-Celtic tribes of the British archipelago were by no means exterminated; and ethnologists are agreed in thinking that although the Celtic influence and language became predominant throughout the islands, yet in many districts thus Celticized the majority of the people continued to be of non-Celtic race.

The Celts are described as tall, pale, and light-haired. They wore a sleeved blouse, sometimes belted, with trousers fitting close to the ankle—the Highland *trews* of the 18th century. Across the blouse was thrown a tartan plaid, fastened at the shoulder with a brooch. Their attire, in short, was very much that of Highland noblemen and gentlemen in the days of Queen Anne, except that

the headgear of those early Celts was 'a soft hat of a modern pattern.' So much, indeed, was the wearing of trousers regarded as a Celtic characteristic, that *transalpinus* and *braccatus* were synonyms in Rome. The British Celts encountered by the Romans in the 1st century B.C. were conspicuous by their tartan clothing, usually of a red or crimson colour. They wore collars of gold, bracelets, finger-rings, and necklaces of glass beads. They knew how to work such metals as iron, bronze, gold, and tin. The Celts of Gaul and Belgium wore plated armour of bronze and iron, and at other times chain-mail coats; and they, as well as their British kindred, ornamented their armour with enamel. Their weapons were swords, daggers, pikes, bows, javelins, slings, and lassos (like the S. American bolas); and in battle they employed two-wheeled chariots with a bronze scythe projecting on either side. The British Celts were stock-breeders and agriculturists, and from their wheat they produced metheglin or honey-beer. And so highly advanced were they as seamen that, when Cæsar began his invasion of Britain, he found that the combined navy of the Britons and the Bretons was much superior to his own.

Generally, the civilization of the island Celts lagged behind that of their continental brethren, due to the fact that they were colonists. Thus, although those of Britain had long made use of coined money, they do not seem to have had mints of their own until about 200 B.C. Their coins were of gold, copper, and (later) silver. And while the Celts of Gaul had well-built cities, their island kindred were living in hamlets and hill forts. It is clear that they practised 'head-hunting,' and preserved the skulls of their enemies as trophies. Their chief religion, Druidism, inculcated human sacrifice.

From the time of Cæsar's invasion, and during the following four hundred years of Roman occupation, the Celts of South Britain were presumably quite abreast of all that was most advanced in European culture, and they probably not only acquired the language and the social customs of their conquerors, but also became closely allied with them in blood. The life of such a town as Silchester, as shown by the very interesting relics preserved in the museum at Reading, was clearly that of a highly-civilized people. And much may be said for the view, strongly advocated by Grant Allen and others, that the civilization thus established, although temporarily overborne by the incursions and conquests of races occupying a much lower plane of culture, has never ceased to assert itself in Britain.

See Charles Elton's *Origins of English History* (2nd ed. 1890), a work to which the present account owes much. See also W. F. Skene's *Celtic Scotland* (1876-80); Prof. Rhys's *Celtic Britain* (1882); Dr. Edwin Guest's *Origines Celticæ* (1883); H. d'Arbois de Jubainville's *L'Epopée Celtique en Irlande* (1883), *Les Celtes* (1904), *Les Auteurs de l'Antiquité sur la Civilisation Celtique* (1883); Rhys and Brynmor Jones's *Welsh People* (1900); Poste's *Celtic Inscriptions* (1861); Evans's *Coins of the Ancient Britons* (1864); J. Rhys's *Celtic Folklore* (1901). For Celtic literature see under WALES; BRETON LANGUAGE AND LITERATURE; GAELIC LANGUAGE AND LITERATURE.

Cement, any material, whether natural or manufactured, which causes adhesion between two surfaces, or serves as a matrix to combine particles into a whole. Cements may be divided for consideration into three classes—(1)

Building cements, all of which have lime as a basis, and which include cement proper, hydraulic lime, and plaster of Paris; (2) *bituminous cements*, which are prepared chiefly from pitch found in a natural form, and are used on a large scale in engineering and other operations; (3) *adhesive materials*, whether resinous, oleaginous, or gelatinous, which are softened by heat or by moisture.

(1.) *Building cements.* — Cements may be distinguished from limes as substances which are capable of solidifying when in contact with water, without material increase in volume, and with relatively trifling evolution of heat. At the close of the 18th century it was discovered that the calcareous nodules found plentifully in the London clay, and known as 'septaria,' would, when calcined and ground, furnish an excellent hydraulic cement. Under the name of Roman cement this material was largely produced in England, and employed for engineering and building purposes during the first half of the 19th century. This quick-setting cement has been latterly almost entirely displaced in England and on the Continent by an artificial compound of chalk or limestone and clay, called by its inventor 'Portland cement,' because of its fancied resemblance, when used as a stucco, to Portland stone. One of the first factories for producing this cement was started on the Thames, near Northfleet, about 1848.

The mode of manufacture practised in the first instance involved the use of wash mills, in which the chalk and clay were reduced to 'slip,' or thin liquid mud, and were by this means thoroughly incorporated. The slip was run into shallow tanks or 'backs,' where the bulk of the water was drained away, leaving the stiff mud or 'slurry' at the bottom of the backs. The slurry was then dug out, and wheeled on to drying-floors. These were frequently constructed over coke ovens. It was then introduced into bottle-shaped kilns capable of holding from thirty to fifty tons of raw materials, and calcined by means of interstratified coke. The 'clinker' thus obtained was finally ground under millstones to a fine smooth powder, when it was ready for use. It gradually became the practice to reduce the volume of water used in the washing; and finally the plan of incorporating together the chalk and the clay by passing the wet mixture through millstones was introduced. Another improvement was effected by using the waste heat of the kiln for the drying of the slurry by means of arched chambers or tunnels attached to the kilns.

In the process of grinding the cement, many attempts were made to supersede the somewhat costly system of using French burr stones, the plan of employing rollers and various types of ball-mills having been proposed for this purpose. Certain high-speed centrifugal mills, such as those of the Griffin type, have also been found to answer well in America and on the Continent. The so-called tube-mill (a long, hollow cylinder, partly filled with flint pebbles, driven at a comparatively slow speed, and depending for its action upon a large rubbing surface) is one of the latest and best contrivances employed for grinding Portland cement. The rotary kiln, which was first patented in England in 1887 by Mr. Ransome, has now been brought to great perfection, and has revolutionized the system of manufacture. The rotary kiln, which turns slowly on its own axis, is a long iron cylinder lined with firebrick, about six feet in diameter, and from sixty to eighty feet in

length. It is inclined downwards slightly from the chimney, at which end the cement materials, ground to a fine powder, are fed in continuously. At the farther end the fuel, which is almost invariably coal dust, is blown in by means of a fan or a jet of compressed air, and instantly bursts into violent combustion. The cement, which passes steadily forward owing to the revolution of the kiln, gradually reaches the hot zone, and is converted into clinker. The waste heat serves gradually to raise the cement materials nearly to the clinkering stage, as they approach the hot zone of the cylinder.

Ever since cement was first used, it has been subjected to a rigid system of testing by the engineer. The usual plan is to mould the neat cement, mixed with water into a stiff paste, into a briquette having a neck with a sectional area of one square inch. These briquettes are subjected to a gradually-applied strain seven days after being made, during which time they are left for one day in air, and placed for six days in water. The tensile stress is slowly and regularly increased until the briquettes break, the load at the moment of fracture being accurately noted. The recently issued standard specification of the Engineering Standards Committee requires that the briquettes shall bear on the average not less than the following tensile stresses before breaking:—7 days from gauging, 400 lbs. per sq. in. of section; 28 days from gauging, 500 lbs. per sq. in. of section. The increase from 7 to 28 days shall not be less than 25 per cent. when the 7 day test falls between 400 lbs. and 450 lbs. per sq. in. of section; 20 per cent. when the 7 day test falls between 450 lbs. and 500 lbs. per sq. in. of section; 15 per cent. when the 7 day test falls between 500 lbs. and 550 lbs. per sq. in. of section; 10 per cent. when the 7 day test is 550 lbs. per sq. in. or upwards. It is also specified that the cement shall be tested by means of briquettes prepared from one part cement to three parts by weight of dry standard sand; these briquettes to bear the following tensile stresses:—7 days from gauging, 120 lbs. per sq. in. of section; 28 days from gauging, 225 lbs. per sq. in. of section. The increase from 7 to 28 days shall not be less than 20 per cent. A common specification requires a fineness of not more than five per cent. residue on a sieve of 2,500 meshes per square inch. Recently, however, the sieve test has been made increasingly severe, and as little as two per cent. on a sieve of 10,000 meshes per square inch can now be attained—it being recognized that, to obtain a strong cement, the fineness of the grinding is all-important.

The time in which a cement sets or becomes hard varies very much, but it is possible to manipulate a cement by admixture with a small proportion of plaster of Paris, so as greatly to prolong the interval between the period of gauging (or mixing with water) and the initial set. From twenty minutes up to five or six hours may represent the speed of setting in different samples. Cements which have been stored for some time after manufacture gradually become slower in setting.

A number of cements, principally used in Britain for internal plastering, rely for their setting properties upon the combination of the sulphate of lime, which is their chief ingredient, with a portion of the water of crystallization, which has been expelled by gentle heat. These materials, commonly known by the name of plaster of Paris, set quickly when freshly made, and can be rendered very hard. They are even suscep-

tible of a high polish if the raw material is first calcined, then steeped in a solution of borax and cream of tartar, and again calcined (when the resultant cement is known as Keene's cement); or if a solution of carbonate of potash is employed, the plaster is converted into Martin's cement after recalcination. Alum solution also imparts great hardness to plaster.

Most of the plaster cements are prepared from gypsum, which is a sulphate of lime combined with two equivalents of water. At a heat of about 650° F. all the water may be driven off, in which case the plaster is said to be 'dead burned.' But generally it is roasted in ovens at a temperature of about 320°, at which heat three-fourths only of the water is expelled; and in this state, with about seven per cent. of water, it is fit for use, after being reduced to a fine powder. In France impure plasters containing a considerable percentage of carbonate of lime are used in place of lime mortar. The set of plaster of Paris differs from that of carbonate of lime in that it is almost entirely a process of crystallization, effected by a recombination with the water of crystallization which had been driven off in preparing the plaster for use. Recent experiments, however, tend to prove that the solubility of the sulphate of lime in water also plays a considerable part in the process.

(2.) *Bituminous cements* which are prepared chiefly from the natural asphalt, were used in the earliest times for compacting sun-dried bricks. Some of the best-known sources of asphalt are those in the Jura Mountains at Pyrimont and Seyssel (dep. Ain, France), where the limestone rocks are impregnated with mineral pitch. In the island of Trinidad there exists a large lake of natural pitch, and in many other petroliferous regions it occurs either alone or absorbed into shales or rock formations. The bituminous cements are generally prepared by strongly heating them and adding mineral tar and a small proportion of sand or grit. They are then applied hot to the surface of walls, to render them damp-proof; or if spread over concrete, they make a good hard floor or road surface.

(3.) *Adhesive materials.*—Under this class may be considered resinous cements, or those which soften by heat and harden when cold—*e.g.* sealing-wax, marine glue, shellac solutions; those in which adhesion results from the evaporation of the solvent employed—such cements being solutions of combinations in alcohol, benzine, chloroform, carbon bisulphide, or other hydrocarbon fluid. Another class of cements are of an oleaginous nature, or compounds in which oil is the solvent principle; this, by absorbing oxygen, causes the cementing compound to exhibit adhesive properties. Compounds of red or white lead in linseed oil are typical of this class. Still another class of cements are those possessing a gummy or gelatinous nature, there being two kinds—those which soften in water but not by heat (*e.g.* gum-arabic, dextrin, and gelatin glues), and those which are either gelatinized or dissolved in water or in aqueous solution, and harden through the absorption of the water by the materials cemented. Starch paste, gelatin in alcohol, liquid glues, gelatin in vinegar (acetic acid), white of egg (albumin), gum, glue, and pastes form cementing compounds, the uses of which are well known. See Redgrave's *Calcareous Cements, their Nature and Uses* (new ed. 1905); Butler's *Portland Cement* (new ed. 1905); Dibdin's *Lime, Mortar, and Cement*; Standage's *Cements, Pastes, Glues, and Gums* (1893); Sabin's *Cement and Concrete* (1905).