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Freon



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How to use the MICROPAEDIA

The 12 volumes of the MICROPAEDIA contain tens of thousands of shorter articles on specific persons, places, things, and ideas, arranged in alphabetical order. The MICROPAEDIA can be used as an information resource on its own; and it can function as support for the longer articles in the MACROPAEDIA (to which it refers whenever appropriate). The MICROPAEDIA in turn is supported by references in the INDEX and by the lists of suggested readings in the PROPAEDIA. Finally, the MICROPAEDIA is the portion of the *Encyclopædia Britannica* best suited for the reader who wishes to browse among the countless subjects in all fields of human learning and history in all times and places.

Alphabetization

Entry titles are alphabetized according to the English alphabet, A to Z. All diacritical marks (such as in ö, ð, or ñ) and foreign letters without parallels in English (such as ayin ['] and hamza [']) are ignored in the alphabetization. Apostrophes likewise are ignored. Titles beginning with numbers, such as **1812, War of**, are alphabetized as if the numbers were written out (**Eighteen-twelve, War of**).

Alphabetization proceeds according to the "word-by-word" principle. Thus, **Mount Vernon** precedes **mountain**; any **John** entry precedes **John Henry**, which in turn precedes **Johne's disease**. Any character or string of characters preceding a space, hyphen, or dash is treated as a word and alphabetized accordingly. Thus, **De Broglie** precedes **debenture**, and **jack-o'-lantern** precedes **jackal**. Titles with identical spellings are arranged in the following order: (1) persons, (2) places, (3) things.

For many rulers and titled nobility, chronological order, as well as alphabetical order, governs placement. Rulers of the same given name (e.g., **William**) may be grouped together, separate from other entries, and indicated by the symbol •. They may be subgrouped alphabetically by country and, within each country, arranged chronologically (**William I, William II**, etc.). Nobility or peers of the same titled name (e.g., **Essex, EARLS OF**) are similarly grouped together, separate from other entries; they are indicated by the symbol • and arranged chronologically.

Places with identical names are arranged in the alphabetical order of the countries where they are located. Identical place-names in the same country are alphabetized according to the alphabetical order of the state, province, or other political subdivision where they are found.

Entry arrangement

The titles of entries are arranged according to the forms commonly found in indexes and dictionaries, with some special conventions.

Entry titles for certain physical features, institutions, structures, events, and concepts are ordinarily inverted to place the substantive word first. Thus, the Bay of Bengal is entered as **Bengal, Bay of**; the Bank of England as **England, Bank of**; the Tower of London as **London, Tower of**; the Siege of Vienna as **Vienna, Siege of**; and the balance of power as **power, balance of**. If the name of a physical feature, institution, structure, event, or concept has two or more descriptors, it is entered under the descriptor appearing first. Thus, the Episcopal Church in Scotland is entered as **Episcopal Church in Scotland** (not **Scotland, Episcopal Church in**); the Leaning Tower of Pisa as **Leaning Tower of Pisa**; and the kinetic theory of gases as **kinetic theory of gases**.

The entries for most Western persons are arranged so that one can read a name in correct order by beginning after the first comma, proceeding to the end of the boldface type, returning to the beginning word or words, and proceeding forward to the first comma. Thus, the entry **March, Patrick Dunbar, 2nd Earl of**, is read "Patrick Dunbar, 2nd Earl of March"; the entry **Orléans, Louis, duc d'**, is read "Louis, duc d'Orléans." Names of Far Eastern origin are given in Oriental order, with the surname preceding the personal name (e.g., **Tōjō Hideki, Deng Xiaoping, Nguyen Cao Ky**).

Cross-references

Some cross-reference entries appear in the MICROPAEDIA for the purpose of leading a reader from names that are familiar to alternate names that may not be. Cross-references also appear frequently within or at the ends of standard entries, where they are identified by *see*, *see also*, *see under*, *q.v.* (*quod vide*, "which see"), or *qq.v.* (*quae vide*, "which see," plural).

Certain entries serve both as relatively brief essays on general subjects and as cross-references to the same subjects treated at greater length and in greater depth in the MACROPAEDIA. Such an entry (e.g., **igneous rock**) begins with a definition of the subject and then provides the following cross-reference: "A brief treatment of igneous rocks follows. For full treatment, *see* MACROPAEDIA: Minerals and Rocks."

Entries on certain broad subjects (e.g., **music**) direct the reader to several relevant articles in the MACROPAEDIA and also to the PROPAEDIA for listings of related articles in the MICROPAEDIA.

Abbreviations

Abbreviations used in the MICROPAEDIA are given in a list that appears at the end of every MICROPAEDIA volume.

Territorial boundaries

In articles and maps indicating disputed geopolitical boundaries and territories, the attribution of sovereignty or administrative subordination to any specific area does not imply recognition of the status claimed by an administering power.

Freon (trademark), any of a group of aliphatic organic compounds containing the elements carbon and fluorine and, in many cases, other halogens (especially chlorine) and hydrogen. The name Freon is a trademark registered by the E.I. du Pont de Nemours & Company.

The Freons are colourless, odourless, non-flammable, noncorrosive gases or liquids of low toxicity introduced as refrigerants in the 1930s; they have also proved useful as propellants for aerosols and in numerous technical applications. Their low boiling points, low surface tension, and low viscosity make them especially useful refrigerants. The presence of fluorine atoms in Freon molecules makes them extremely stable, inert compounds that are entirely harmless to humans. The Freons neither present a fire hazard nor give off a detectable odour in their circulation through refrigerating and air-conditioning systems. The most important members of the group have been dichlorodifluoromethane (Freon 12), trichlorofluoromethane (Freon 11), chlorodifluoromethane (Freon 22), dichlorotetrafluoroethane (Freon 114), and trichlorotrifluoroethane (Freon 113). In the mid-1970s it was suggested that halogenated organic propellants were, by chemical reaction, destroying the ozone present in the stratosphere. Depletion of the ozone could create a threat to animal life on the Earth because ozone absorbs ultraviolet radiation that can induce skin cancer.

frequency, in physics, number of waves that pass a fixed point in unit time; also the number of cycles or vibrations undergone during one unit of time by a body in periodic motion. A body in periodic motion (*q.v.*) is said to have undergone one cycle or one vibration after passing through a series of events or positions and returning to its original state. *See also* angular velocity; simple harmonic motion.

If the period, or time interval, required to complete one cycle or vibration is $\frac{1}{2}$ second, the frequency is 2 per second; if the period is $\frac{1}{100}$ of an hour, the frequency is 100 per hour. In general, the frequency is the reciprocal of the period, or time interval—i.e., $\text{frequency} = 1/\text{period} = 1/(\text{time interval})$. The frequency with which the Moon revolves about the Earth is slightly more than 12 cycles per year; the frequency of the A string of a violin is 440 vibrations or cycles per second.

The symbols most often used for frequency are *f* and the Greek letters nu (ν) and omega (ω). Nu is used more often when specifying electromagnetic waves, such as light, X-rays, and gamma rays; omega is mostly used by electrical engineers in referring to alternating current. Usually frequency is expressed in the hertz unit, named in honour of the 19th-century German physicist Heinrich Rudolf Hertz, one hertz being equal to one cycle per second, abbreviated Hz; one kilohertz (kHz) is 1,000 Hz, and one megahertz (mHz) is 1,000,000 Hz.

In spectroscopy another unit of frequency, the wave number (*q.v.*), is sometimes used.

frequency meter, device for measuring the repetitions per unit of time (customarily, a second) of a complete electromagnetic waveform. Various types of frequency meters are used. Many are instruments of the deflection type, ordinarily used for measuring low frequencies but capable of being used for frequencies as high as 900 Hz. These operate by balancing two opposing forces. Changes in the frequency to be measured cause a change in this balance that can be measured by the deflection of a pointer on a scale. Deflection-type meters are of two types, electrically resonant circuits and ratiometers.

An example of a simple electrically resonant circuit is a moving-coil meter. In one version, this device possesses two coils tuned to different frequencies and connected at right angles to one another in such a way that the whole

element, with attached pointer, can move. Frequencies in the middle of the meter's range cause the currents in the two coils to be approximately equal and the pointer to indicate the midpoint of a scale. Changes in frequency cause an imbalance in the currents in the two coils, causing them and, in turn, the pointer to move.

Another type of frequency meter, not of the deflection type, is the resonant-reed type, ordinarily used in ranges from 10 to 1,000 Hz, although special designs can operate at lower or higher frequencies. These work by means of specially tuned steel reeds that vibrate under the effect of electric current; only those reeds that are in resonance vibrate visibly, however.

frequency modulation (FM), variation of the frequency of a carrier wave in accordance with the characteristics of a signal. *See* modulation.

Frere, Sir (Henry) Bartle (Edward), 1ST BARONET (b. March 29, 1815, Brecknockshire, Wales—d. May 29, 1884, Wimbledon, Surrey, Eng.), British colonial administrator



Sir Bartle Frere, detail of an oil painting by Sir George Reid, 1881; in the National Portrait Gallery, London
By courtesy of the National Portrait Gallery, London

in India and finally in South Africa, where his administration as high commissioner became highly controversial.

After graduation from college at Haileybury in 1834, Frere began his long career in the Indian civil service. He became chief commissioner of Sind in 1850, and during his nine years in that post he did much to foster the economic development of the region. During the great Indian Mutiny of 1857 the Sind remained relatively quiet, enabling Frere to send troop reinforcements to the neighbouring Punjab. These successes led to knighthood and a place on the viceroy's council at Calcutta (1859–62) for Frere.

After serving as governor of Bombay for five years, he returned to England as a member of the India Council (1867–77), in which posts he concerned himself with the development of Indian agriculture and communications and with educational improvements. He was created a baronet in 1876.

Lord Carnarvon, the British colonial secretary, sent Frere to the Cape Colony as governor and high commissioner in 1877 in order to carry out the planned confederation of British South Africa and the Boer republics. When he landed at Cape Town, Frere found that events were conspiring against his mission. There were Zulu uprisings, the colonists were unsympathetic to federation, and the Transvaal Boers were growing rebellious after the annexation of the Transvaal by the British shortly before his arrival. Accustomed to ruling Asians, Frere's policies were precipitate. He regarded the spear-wielding Zulu tribes as a standing menace whose elimination would enhance the prospects for federation. Thus, he provoked a war with them by an ultimatum in December 1878. The initial disaster to British arms at Isandhlwana was his undoing. After sharp political debates, in and out of Parliament, Frere was officially censured and eventually recalled in July 1880.

Frere, John (b. Aug. 10, 1740, Roydon Hall, near Diss, Norfolk, Eng.—d. July 12, 1807, East Dereham, Norfolk), British antiquary and a founder of prehistoric archaeology.

Frere was a country squire, and, from 1771, he was also an active member of the Royal Society of Antiquaries. In 1790 he discovered Stone Age flint implements among some fossilized bones of extinct animals at Hoxne, near Diss. Anticipating later archaeological methods, Frere carefully noted and described the strata uncovered. Though fettered by the then-popular belief that the Earth had been created in 4004 BC, in reporting his findings (1797) Frere nevertheless suggested that the remains may have dated from a time considerably earlier than 4004. His report was politely received but had to wait some 60 years to be appreciated.

Frere, John Hookham, pseudonym WILLIAM AND ROBERT WHISTLECRAFT (b. May 21, 1769, London—d. Jan. 7, 1846, Valletta, Malta), British diplomat and man of letters.

Frere was educated at Eton, where he met the future statesman George Canning (with whom he collaborated on *The Anti-Jacobin*), and at Cambridge University. He entered the Foreign Office, in 1799 becoming undersecretary of state for foreign affairs and in 1800 going to Portugal as envoy extraordinary. His diplomatic career ended disastrously in 1808, when he was blamed for endangering the British Army by advising its commander, Sir John Moore, against retreat from the French



John Hookham Frere, detail of a pencil drawing by Henry Edridge; in the National Portrait Gallery, London
By courtesy of the National Portrait Gallery, London

to La Coruña, Spain. Recalled, he spent the rest of his life in retirement, after 1820, in Malta.

Frere is remembered for witty parodies in *The Anti-Jacobin* (1797–98), a weekly that opposed revolution in England and abroad; for his brilliance as a translator; and for his experiments with metre. He reintroduced into English verse the Italian ottava rima, an eight-line stanza with a skillfully interwoven rhyme scheme, which he used effectively in his mock-heroic Arthurian epic *The Monks and the Giants* (1817–18). He also showed mastery of metre in his translations of four plays by Aristophanes, greatest of the Greek comic dramatists.

Frère-Orban, Hubert Joseph Walther (b. April 22, 1812, Liège, French Empire—d. Jan. 1, 1896, Brussels), Belgian statesman and Liberal Party reformer who was twice prime minister (1868–70 and 1878–84).

A strong advocate of free trade, Frère-Orban played a prominent part in the Liberal movement while practicing law in Liège. He was sent in 1847 to the Chamber of Representatives as a member from that city. From 1847 to 1894 he served as the leading Liberal member of the lower house in addition to holding many ministerial posts. As minister of finance (1848–52), he founded the Banque

Nationale, abolished the newspaper tax, reduced the postage, and modified the customs duties as a preliminary to a decided free-trade policy.



Frère-Orban, detail of an oil painting by Louis Gallait, 1880; in the Banque Nationale, Brussels

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To facilitate negotiations for a new commercial treaty, he conceded to France a law of copyright, which proved highly unpopular in Belgium. He resigned and the rest of the Cabinet soon followed him. Finance minister again in 1857, he embodied his free-trade principles in commercial treaties with Great Britain and France and abolished the *octroi* duties (local import taxes) and tolls on national roads. Becoming prime minister in 1868, he defeated a French attempt to gain control of the Luxembourg railways (1869). In his second term, he provoked the bitter opposition of Belgium's Catholic party by establishing secular primary education (1879) and by breaking off diplomatic relations with the Vatican (1880). Although Frère-Orban grudgingly conceded an extension of the franchise (1883), the hostility of the Radicals and the discontent caused by a financial crisis resulted in the overthrow of his government in the elections of 1884. He continued to lead the Liberal opposition until 1894.

Frerichs, Friedrich Theodor von (b. March 24, 1819, Aurich, Hanover—d. March 14, 1885, Berlin), German founder of experimental pathology whose emphasis on the teaching of physiology and medical biochemistry helped give clinical medicine a scientific foundation.



Frerichs, c. 1880

Archiv für Kunst und Geschichte, Berlin

Frerichs worked at the University of Breslau (1851–59) and then directed the Charité Hospital at the University of Berlin (1859–85). A leading exponent of clinical medicine supported by exacting laboratory analyses and experiments, he decisively influenced the development of his students, one of whom was Paul Ehrlich, a co-recipient of the 1908 Nobel Prize for Physiology or Medicine for work in immunity. Frerichs' investigations into the general biochemistry of diseased organisms led

to improvements in the diagnosis and treatment of diabetes and liver diseases.

Fréron, Louis(-Marie-Stanislas) (b. Aug. 17, 1754, Paris—d. July 15, 1802, Santo Domingo, Hispaniola), journalist of the French Revolution and leader of the *jeunesse dorée* ("gilded youth") who terrorized Jacobins (radical democrats) during the Thermidorian reaction that followed the collapse of the Jacobin regime of 1793–94.

His father, Élie-Catherine Fréron, was the editor of *L'Année Littéraire* ("The Literary Year"), which combatted the ideas of Voltaire and other Philosophes. Louis took over the management of the journal upon his father's death in 1776, and, soon after the outbreak of the Revolution in 1789, he founded the newspaper *L'Orateur du Peuple* ("The Spokesman of the People"), which violently attacked the new system of constitutional monarchy.



Louis Fréron

By courtesy of the Bibliothèque Nationale, Paris

After King Louis XVI's abortive flight from Paris in June 1791, Fréron called for the King's execution. Threatened with arrest, Fréron went into hiding until the monarchy was overthrown on Aug. 10, 1792. He sat with the Montagnards (deputies from the Jacobin Club) in the revolutionary National Convention, which convened in September 1792, and in March 1793 he was sent to suppress counterrevolutionary activity at Marseille and Toulon. In both cities, Fréron ordered mass executions of hundreds of captured insurgents. As a result, Robespierre, chief spokesman for the Jacobin regime, had Fréron recalled in March 1794. Fearing that Robespierre intended to order his execution, Fréron became one of the most active participants in the conspiracy that brought about Robespierre's downfall on 9 Thermidor (July 27, 1794). In the ensuing Thermidorian reaction, Fréron vigorously denounced the Jacobins in *L'Orateur du Peuple* and organized the gangs of fashionably dressed *jeunesse dorée* who assaulted Jacobin workmen in the streets. He led the raid on the Parisian Jacobin Club that gave the government an excuse to order the club closed in November 1794. In November 1801, two years after Napoleon Bonaparte came to power, Fréron was appointed subprefect of Santo Domingo.

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fresco painting, method of painting on freshly applied, wet lime-plaster walls with colours made by grinding artists' dry-powder pigments in pure water. The colours dry and set with the plaster to become a permanent part of the wall.

Buon', or "true," fresco is the most durable technique, others such as fresco secco being somewhat more superficial. Fresco painting is



Early Renaissance Italian artists painting a fresco and grinding pigments, detail of a print attributed to Maso Finiguerra, mid-15th century; in the British Museum

By courtesy of the trustees of the British Museum; photograph, J.R. Freeman & Co. Ltd.

ideal for making murals because it lends itself to a monumental style, is durable, and has a mat surface.

Frescobaldi FAMILY, family of Florence, medieval bankers prominent in Florentine business and politics, who financed the wars of Edward I and II of England.

Important in Florentine public affairs from the 12th century, the Frescobaldi belonged to the wealthy "magnate" class, occupying a street in Florence that still bears their name. In the 1290s the family split into Whites and Blacks, representing Florentine factions that became allied with the Ghibelline (imperial) and Guelph parties. By the early 14th century, only the White (Ghibelline) Frescobaldi remained. The family's conservatism virtually excluded it from government office from 1285 to 1433.

Opening a branch in England in the 1270s, in two decades the Frescobaldi firm rose to the position of royal bankers, formerly occupied by the Riccardi company of Lucca, which had been driven into bankruptcy by loans for Edward I's wars in Wales and France. Between 1302 and 1310, the Frescobaldi loaned £150,000 to Edward I and II. In return they were given virtual control of the revenues of England, including the mint and the customs, and were granted lands, honours, and privileges. In 1310 Edward II's barons, jealous of the Italians' power, drew up ordinances forbidding the assignment of customs to foreigners and calling for the arrest of foreign merchants and seizure of their goods. Before the ordinances could be implemented, the Frescobaldi fled to the Continent, taking refuge at Avignon and then at Florence.

Active participants in the unsuccessful revolt of Florentine magnates in 1343, the Frescobaldi were excluded from the democratic government when it was reinstated.

The family included several literary figures, among them the poet Dino Frescobaldi (died c. 1316) and Leonardo Frescobaldi, who visited Egypt and the Holy Land in 1384 and left an account of value to historians of the social and economic life of the countries he visited.

Frescobaldi, Girolamo (b. September 1583, Ferrara, Papal States—d. March 1, 1643, Rome), Italian organist and one of the

first great masters of organ composition. He strongly influenced the German Baroque school through the work of his pupils, J.J. Froberger and Franz Tunder. Frescobaldi began his public career as organist at the church of Sta. Maria in Trastevere in Rome, in 1607. He travelled to the Netherlands the same year and published his first work, a book of madrigals, in Antwerp. In 1608 he became organist at St. Peter's in Rome, and, except for the period when he was court organist at Florence (1628–34), he remained at St. Peter's until his death.

Frescobaldi's fame rests on his instrumental works. Among these, keyboard compositions predominate, but the canzone for unspecified instruments with basso continuo are of outstanding historical significance in the development of the trio sonata. They are of a transitional type that led to the fully developed trio sonata, which was the principal chamber music medium until it was displaced by the string quartet.

In 1608 Frescobaldi published 12 fantasias in open score that are notable for their variety and for contrapuntal mastery of the highest order. The textures are idiomatic in a way rarely found in earlier examples of the form. In 1624 he published, again in open score, a collection of 10 *ricercari*, 5 *canzoni*, and 11 *capriccios*. The composer's preface contains valuable information about performance: "Should the player find it tedious to play a piece right through he may choose such sections as he pleases, provided only that he ends in the main key. . . . The opening passages should be played slowly so that what follows may appear more animated. The player should broaden the tempo at cadences. . . ."

Much of Frescobaldi's keyboard music was intended for the harpsichord, as is made clear in the title of his *Toccate d'intavolature di cimbalo e organo* (1637). The volume includes also partitas on various melodies and pieces on ground basses. These show Frescobaldi's free inventiveness in genuine keyboard textures and figuration. The preface of another collection, first published in 1627, again gives information of great value to the interpretation of Baroque instrumental music: "Play the opening of a toccata slowly and arpeggiando. . . . If one hand has a trill, while the other plays a passage, do not play note against note, but play the trill rapidly and the other expressively." Such directions indicate the extent to which keyboard style had moved



Girolamo Frescobaldi, engraving by Christian Sas, c. 1619

By courtesy of the trustees of the British Museum; photograph, J.R. Freeman & Co. Ltd.

away from its origin in transcriptions of vocal or instrumental compositions. Frescobaldi's remaining publication, the *Fiori musicali* of 1635, consists of organ music intended for liturgical use.

Frescobaldi's style is characterized by a dramatic inventiveness and a bold use of chromaticism, but these qualities were carefully subordinated to a logical, effective construction within the piece. He was one of the first

to develop the modern principle of monothematic writing, which replaced the rapid presentation of a number of themes typical of the early *ricercar* and *canzone*.

Fresenius, Carl Remigius (b. Dec. 28, 1818, Frankfurt am Main—d. June 11, 1897, Wiesbaden, Prussia), German analytical chemist whose textbooks on qualitative analysis (1841) and quantitative analysis (1846) became standard works. They passed through many editions and were widely translated.

Apprenticed to an apothecary (1836), he became an assistant to Justus von Liebig at the University of Giessen (1841) and a privatdocent (1843). From 1845 he was active



Fresenius, engraving after a photograph
Bavaria-Verlag

in scientific and technological education and research at Wiesbaden. Many of his papers appeared in the *Zeitschrift für Analytische Chemie* ("Journal of Analytical Chemistry"), which he founded (1862) and edited until his death.

Freshfield, Douglas William (b. April 27, 1845, London—d. Feb. 9, 1934, Forest Row, Sussex, Eng.), British mountaineer, explorer, geographer, and author who advocated the recognition of geography as an independent discipline in English universities (from 1884).

On an expedition to the central Caucasus Mountains (1868), Freshfield made the first ascent of Mt. Elbrus (18,510 feet), the highest peak in the range and in Russia west of the Ural Mountains. Later, he failed in attempts to climb the Himalayan mountain Kāngchenjunga (1899; 28,208 feet) and the Ruwenzori Range in Central Africa (1905). Freshfield was secretary (1881–94) and president (1914–17) of the Royal Geographical Society and chairman of the Society of Authors (1908–09). Among his books are *Italian Alps* (1875), *The Exploration of the Caucasus* (1896), *Round Kangchenjunga* (1903), and two editions of *Murray's Guide to Switzerland*.

Freshwater, parish, South Wight district, county of Isle of Wight, England. It lies close to Alum Bay, notable for its many-coloured sandstone cliffs and for the Needles, a group of chalk sea stacks.

Farringford House at Freshwater was the home of Alfred, Lord Tennyson, who is commemorated by a tablet in All Saints' Church and by a large cross on High Down. Pop. (1981) 5,073.

freshwater duck: see dabbling duck.

freshwater jellyfish, any medusa, or free-swimming form, of the genus *Craspedacusta*, class Hydrozoa (phylum Cnidaria). *Craspedacusta* is not a true jellyfish; true jellyfish are exclusively marine in habit.

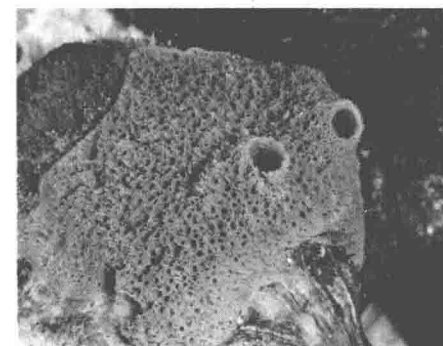
Craspedacusta sowerbyi, which is widespread in freshwaters of the Northern Hemisphere, grows to about 2 centimetres (0.8 inch) in diameter. Several hundred short tentacles extend, fringed, from the margins of the animal's bell-shaped body.

The medusoid form alternates in generations with a polypoid form (cylindrical, stalklike, and permanently attached to a surface). The polyp, about 2 millimetres (0.08 inch) high, produces a medusoid form by budding; i.e., an extension of the main body breaks away. The medusa is either male or female, rather than bisexual, and produces eggs or sperm. These unite to form a planula, a free-swimming larva, that settles onto a surface and develops into a polyp. The *Craspedacusta* polyp is notable for its lack of tentacles.

freshwater snail, any of the approximately 5,000 snail species that live in lakes, ponds, and streams. Most are members of the subclass Pulmonata; some are members of the subclass Prosobranchia; both subclasses belong to the class Gastropoda. The southeastern United States has the greatest number of species; another notable location is Lake Tanganyika, in Africa.

Freshwater snails are distributed via birds' feet, wind-blown leaves, and floods. Several species are hosts of flatworms causing disease in warm-blooded animals; e.g., schistosomiasis. Large forms used to keep aquariums clean include the amphibious snail *Ampullarius gigas*.

freshwater sponge, any of about 20 species of the genus *Spongilla* (class Demospongiae, siliceous sponges), a common, widely occurring group. *Spongilla* species are found in clean lake waters and slow streams.



Freshwater sponge (*Spongilla*)

Larry West—The National Audubon Society Collection/Photo Researchers

Freshwater sponges are delicate in structure, growing as encrusting or branching masses. They usually appear greenish because of the algae that live on them. Freshwater sponges may attain a volume of more than 2,500 cubic centimetres (150 cubic inches). The larva of the spongillafly lives as a parasite on freshwater sponges.

Fresnay, Pierre, original name PIERRE-JULES-LOUIS LAUDENBACH (b. April 4, 1897, Paris—d. Jan. 9, 1975, Paris), versatile French actor who abandoned a career with the Comédie-Française for the challenge of the cinema. Groomed for the stage by his uncle, the actor Claude Garry, Fresnay made his first stage appearance in 1912 before entering the Paris Conservatory.

Admitted to the Comédie-Française as a pensionnaire (contract player) in 1915, he played 80 roles there, making a particular impression in the plays of Alfred de Musset, and became a sociétaire (life member) four years before he resigned in 1927. During the next 10 years he worked in England and the United States as well as in France. He was outstanding in the title roles in *Cyrano de Bergerac* (1928) and *Don Juan* (London, 1934). In London and New York City Fresnay made his English-language debut in Noël Coward's *Conversation Piece* (1934) opposite his wife, the actress Yvonne Printemps. Subsequently, the

couple became managers of the Théâtre de la Michodière in Paris (1937).

Although he made several silent films, his reputation as a cinema actor was established with his portrayal of Marius in the screen adaptations of Marcel Pagnol's trilogy: *Marius* (1931), *Fanny* (1932), and *César* (1936). His appearance as the young French officer opposite Erich von Stroheim in Jean Renoir's *La Grande Illusion* (1937; *Grand Illusion*) was a high point in his film career, although his principal honours came for later works: the Venice Biennial Prize (1947) for *Monsieur Vincent* and awards for *Dieu à besoin des hommes* (1950; *God Needs Men*).

Fresnel, Augustin-Jean (b. May 10, 1788, Broglie, Fr.—d. July 14, 1827, Ville-d'Avray), French physicist who pioneered in optics and did much to establish the wave theory of light advanced by Thomas Young.



Fresnel, detail of an engraving by Ambroise Tardieu after a contemporary portrait, 1825

H. Roger-Viollet

Fresnel served as an engineer in various departments of France but lost his post temporarily during the period following Napoleon's return from Elba (1814). About that time he seems to have begun his researches in optics. He studied the aberration of light, created various devices for producing interference fringes, and, by applying mathematical analysis to his work, removed a number of objections to the wave theory.

With François Arago he studied the laws of the interference of polarized light. He obtained circularly polarized light and developed the use of compound lenses instead of mirrors for lighthouses. Although his work in optics received scant public recognition during his lifetime, Fresnel maintained that not even acclaim from distinguished colleagues could compare with the pleasure of discovering a theoretical truth or confirming a calculation experimentally.

Fresnel lens, succession of concentric rings, each consisting of an element of a simple lens, assembled in proper relationship on a flat surface to provide a short focal length (see illustration). The Fresnel lens is used particularly in lighthouses and searchlights to concentrate the light into a relatively narrow beam. It would be almost impossible to make a large lighthouse lens of the usual solid glass-disk



Cross section of a Fresnel lens indicating its construction

type because the thickness and weight would be prohibitive; the lighter Fresnel lens is constructed of elements that are separately ground and polished from suitable glass blanks and assembled to make up the complete lens.

A one-piece molded-glass Fresnel lens is convenient for spotlights, floodlights, railroad and traffic signals, and decorative lights in buildings. Cylindrical Fresnel lenses are used in shipboard lanterns to increase visibility.

A wide variety of thin Fresnel lenses are molded in plastic, the width of the rings being only a few thousandths of an inch, for use as field lenses with ground-glass screens in cameras and small projectors to increase the brightness of the outer parts of the screen.

Georges-Louis Leclerc de Buffon (1748) originated the idea of dividing a lens surface into concentric rings in order to reduce the weight significantly. In 1820 this idea was adopted by Augustin-Jean Fresnel in the construction of lighthouse lenses.

Fresnillo, in full FRESNILLO DE GONZÁLEZ ECHEVERRÍA, city, central Zacatecas state, north central Mexico. It lies on an interior plateau more than 7,000 ft (2,100 m) above sea level and northwest of Zacatecas city, the state capital. It was founded in 1554 and has been an important silver-mining centre since 1569. Limited quantities of gold, copper, lead, and zinc are also produced. Irrigation has increased grain and vegetable production in the area; the livestock industry dates from the colonial period. The city is accessible by highway and air and is near a major rail line. Pop. (1980) 132,365.

Fresno, city, seat (1874) of Fresno county, central California, U.S., in the San Joaquin Valley. Settled in 1872 as a station on the Central (later Southern) Pacific Railroad, it became an agricultural community after the introduction of irrigation in the 1880s. It processes and markets cotton, grain, fruits, wines, sugar beets, and dairy products and is the site of the huge Sun Maid Raisin processing plant. Fresno (Spanish: "Ash Tree") is headquarters of the Sierra National Forest and is a gateway to resort areas of the Sierra Nevada. It is the home of California State University, Fresno (1911), and Fresno City College (1910). Inc. 1885. Pop. (1990) city, 354,202; Fresno MSA, 667,490.

fret, also called KEY PATTERN, in decorative art and architecture, any one of several types of running or repeated ornament, consisting of lengths of straight lines or narrow bands,



Mosaic fret in S. Apollinare Nuovo, Ravenna, 6th century

Alinari—Art Resource/EB Inc.

usually connected and at right angles to each other in T, L, or square-cornered G shapes, so arranged that the spaces between the lines or bands are approximately equal to the width of the bands. Occasionally the system is arranged so that the lines intersect or interlace, as in the common swastika fret. Because the fret is one of the simplest and most natural of decorative forms, it is one of the most widely spread, found from early times in most art forms and on all continents. Thus, it was a favourite decoration, during and after the 4th dynasty, for the ceilings of tombs in Egypt, where in later examples it was combined with rosettes, scarabs, and the lotus into patterns of great richness.

In America the design has been found in early Peruvian textiles, on extant sculpture and architecture of the Mayan and Aztec cultures in Meso-America, and as a universal pottery decoration among American Indians.

Highly developed by both the Chinese and the Japanese for textiles as well as for architectural ornament, the fret occurs not only as a band but also as a complicated all-over pattern, sometimes with acute and obtuse angles instead of the more usual right angles. Its most important development, however, came at the hands of the Greeks (hence the common name Greek fret or Greek key), who used it for pottery and for painted decoration of architectural members, such as the abaci of capitals, where it was later carved.

Like so many Greek motifs, the fret was widely used by the Romans, particularly in Syria (e.g., the propylaea at Damascus and the great temple at Baalbek), and it occurs in Byzantine and Romanesque work.

Fretwork, either painted or carved, is the most often used of any small-scale repeated ornament in which geometrical forms occur.

Freud, Anna (b. Dec. 3, 1895, Vienna—d. Oct. 9, 1982, London), Austrian-born British founder of child psychoanalysis and one of its foremost practitioners. She also made fundamental contributions to understanding how the ego, or consciousness, functions in averting painful ideas, impulses, and feelings.



Anna Freud, c. 1970

Archiv für Kunst und Geschichte, West Berlin

The youngest daughter of Sigmund Freud, Anna was devoted to her father and enjoyed an intimate association with developing psychoanalytic theory and practice. As a young woman she taught elementary school, and her daily observation of children drew her to child psychology. While serving as chairman of the Vienna Psycho-Analytic Society (1925–28), she published a paper (1927) outlining her approach to child psychoanalysis.

Publication of Anna Freud's *Das Ich und die Abwehrmechanismen* (1936; *The Ego and Mechanisms of Defense*, 1937) gave a strong, new impetus to ego psychology. The principal human defense mechanism, she indicated, is repression, an unconscious process that develops as the young child learns that some impulses, if acted upon, could prove dangerous to himself. Other mechanisms she described include the projection of one's own feeling into another; directing aggressive impulses against the self (suicide being the extreme example); identification with an overpowering aggressor; and the divorce of ideas from feelings. The work also was a pioneer effort in the development of adolescent psychology.

In 1938 Anna Freud and her father, whom she had cared for during a number of years of his terminal illness, escaped from Nazi-dominated Austria and settled in London, where she worked at a Hampstead nursery until 1945. During World War II she and a U.S. associate, Dorothy Burlingham, recounted their work in *Young Children in Wartime* (1942), *Infants Without Families* (1943), and *War and Children* (1943).

Anna Freud founded the Hampstead Child

Therapy Course and Clinic, London, in 1947 and served as its director from 1952 to 1982. She viewed play as the child's adaptation to reality but not necessarily as revealing unconscious conflicts. She worked closely with parents and believed that analysis should have an educational influence on the child. A summation of her thought is to be found in her *Normality and Pathology in Childhood* (1968).

Freud, Sigmund (b. May 6, 1856, Freiberg, Moravia, Austrian Empire [now Příbor, Czech.];—d. Sept. 23, 1939, London), Austrian neurologist, founder of psychoanalysis. Freudian theory had a great effect on psychology, psychiatry, and other fields.

A brief account of the life and works of Sigmund Freud follows; for a full biography, see MACROPAEDIA: Freud.

Freud entered the University of Vienna in 1873 as a medical student and the General Hospital of Vienna in 1882. In 1885 he went to Paris to study with the neurologist Jean-Martin Charcot, which proved a turning point in his career. Charcot's work with patients classified as hysterics introduced Freud to the possibility that mental disorders might be caused by purely psychological factors rather than by organic brain disease.

Upon his return to Vienna he entered into a fruitful partnership with the physician Josef Breuer. They collaborated on *Studien über Hysterie* (1895; *Studies in Hysteria*), which contains a presentation of Freud's pioneering psychoanalytic method of free association. It was this method that allowed Freud to arrive at numerous new insights; he developed theories concerning the deeper layers of the mind, the unconscious; he arrived at an understanding of neuroses; and in 1899 he published *Die Traumdeutung* (*The Interpretation of Dreams*), in which he analyzed the highly complex symbolic processes underlying dream formation. In 1905 appeared his controversial study *Drei Abhandlungen zur Sexualtheorie* (*Three Essays on the Theory of Sexuality*), in which he presented his discoveries concerning infantile sexuality and in which he delineated the complicated stages of psychosexual development, including the formation of the Oedipus complex.

Freud also applied his psychoanalytic insights to mythological, anthropological, cultural, and religious phenomena. Among his most noted works in this vein are *Totem und Tabu* (1913; *Totem and Taboo*) and *Das Unbehagen in der Kultur* (1930; *Civilization and Its Discontents*).

Freudenstadt, city, Baden-Württemberg Land (state), southwestern Germany, in the Schwarzwald (Black Forest). Founded in 1599 as a refuge for Protestants from Salzburg, Freudenstadt ("Town of Joy") was severely damaged by fire during World War II. The central city, including the Renaissance arcades in the marketplace and the Evangelical church (1601–08), was rebuilt in its original form. The town is a winter sports centre and one of the most frequented resorts in the Black Forest. Its spa has been reconstructed with modern facilities. Pop. (1989 est.) 21,355.

Freudenthal, Axel Olof (b. Dec. 12, 1836, Sjuneda, Fin.—d. June 2, 1911), philologist, Swedish nationalist, and the leading ideologist for the nationalist movement of Finland's Swedish minority in the 19th century.

An adherent of the Pan-Scandinavian movement while still a student in the 1850s, Freudenthal was strongly influenced by one of the leaders of the movement, August Sohlman, a Swedish journalist who had written a racist defense of Finland's dominant Swedish minority against the claims of the Finnish nationalist movement.

Basing his position largely on Sohlman's views, Freudenthal, after becoming professor of Swedish language and literature at the

University of Helsinki (1878–1904), developed the notion that nationality is primarily determined by language and that, by forsaking Swedish for Finnish, the educated classes would therefore be destroying the Swedish nation in Finland. He further maintained that because Finland had advanced culturally under Swedish influence, the annihilation of the Swedish cultural element would mean general decline. The Svecoman (Swedish nationalist) movement that arose in the 1860s based itself on Freudenthal's ideology.

Freudian criticism, literary criticism that uses the psychoanalytic theory of Sigmund Freud to interpret a work in terms of the known psychological conflicts of its author or, conversely, to construct the author's psychic life from unconscious revelations in his work.

Freudian critics depart from the traditional scope of criticism in reconstructing an author's psychic life on the basis of his writings. Edmund Wilson's *Wound and the Bow* (1941) explored this realm, and Van Wyck Brooks used this approach to biography in works such as *The Ordeal of Mark Twain* (1920). Professional analysts have applied their techniques to literature, notably Ernest Jones in *Hamlet and Oedipus* (1910 and 1949), which traces the famous problem of Hamlet's irresolution back to Shakespeare's own Oedipal guilt.

Freundtsberg, Georg von: see Frundsberg, Georg von.

Frey, Adolf (b. Feb. 18, 1855, Külligen, near Aarau, Switz.—d. Feb. 12, 1920, Zürich), Swiss novelist, poet, and literary historian whose most lasting achievements are his biographies of Swiss writers and his Swiss-German dialect poetry.

As a biographer Frey showed a predilection for rich character studies in the manner of the 19th-century Realists. Because he knew many writers and painters personally when he was a professor of German literature at Zürich (1898–1920), his portraits of them contain



Adolf Frey

By courtesy of the Bibliothèque Nationale Suisse, Bern

important personal material. Among these biographies are *Erinnerungen an G. Keller* (1892), *C.F. Meyer* (1899), *A. Böcklin* (1903), and *Der Tiermaler R. Koller* (1906). With his poetry, notably *Duss und uderm Rafe* (1891), rooted in the style of the folk song, he helped inaugurate creative and stylistic developments in Swiss poetry. His historical novels, such as *Die Jungfer von Wattenwil* (1912), and his plays are considered to be of less importance.

Frey, Roger (b. June 11, 1913, Nouméa, New Caledonia), French Gaullist politician, considered a brilliant administrator with a flair for reform.

Frey was reared in New Caledonia. When World War II broke out, he rallied to Charles de Gaulle in 1940 and served in the Italian, French, and German campaigns. In 1945–46 he served on a government mission to the Far East.

He was a key member (1947–52) of the Rassemblement du Peuple Français (RPF), which was the fledgling Gaullist party. Frey

was a critical component of the movement in the Fourth Republic to restore de Gaulle to power. He managed, with consummate skill, to merge different and sometimes contentious pro-de Gaulle groups and fuse them into the Union pour la Nouvelle République (UNR). After serving as secretary-general of the UNR (1958–59) when de Gaulle came to power, Frey served in nearly every Cabinet under de Gaulle and his successor, Georges Pompidou. He was minister of information (1959), minister of the interior (1961–67), and minister of state (1967–72). Elected deputy successively from 1962 on, Frey left his seat in the National Assembly in 1974 to serve as president of the Constitutional Council (until 1983).

Frey-Wyssling, Albert F(riedrich) (b. Nov. 8, 1900, Küssnacht, Switz.), Swiss botanist and pioneer of submicroscopic morphology who helped to initiate the study later known as molecular biology.

He was educated at the Federal Institute of Technology, Zürich, at the University of Jena, and at the Sorbonne. From 1928 to 1932 he was a plant physiologist at Medan, Sumatra. He became a lecturer at the Federal Institute of Technology (1932), served as a professor in the department of botany and plant physiology (1938–70), and was also rector of the institution (1957–61).

In 1938 he began his studies in submicroscopic morphology, using polarizing microscopy and other optical techniques to obtain indirect evidence concerning submicroscopic structures. He held that the studies of the histologists (those who deal with structures discernible through the microscope) and of the physiological chemists, who study submicroscopic structures, would eventually be unified on the level of macromolecular chemistry. This subject, later known as molecular biology, became a practical reality with the application of the electron microscope in biological research (1940). Frey-Wyssling found that the basic concepts he evolved from his indirect methods were corroborated by the direct imaging of submicroscopic structures with the electron microscope. He wrote several books based on his submicroscopic studies.

Freyberg (of Wellington and of Munstead), Bernard Cyril Freyberg, 1st Baron, also called (from 1942) SIR BERNARD CYRIL FREYBERG (b. March 21, 1889, Richmond, Surrey, Eng.—d. July 4, 1963, Windsor, Berkshire), commander in chief of the New Zealand forces in World War II and governor-general of New Zealand from 1946 to 1952.

In 1891 Freyberg immigrated with his parents to New Zealand and was educated at Wellington College. He soldiered in the territorial army in New Zealand in 1911–12, and early in World War I he took part in the retreat from Antwerp and in the operations in Gallipoli. Later in France he fought in many of the fiercest battles and was awarded the Victoria Cross in December 1917. He was promoted to brigadier general at 27, then the youngest of that rank in the British Army. He commanded the 29th Division in 1917–18. Freyberg was nine times wounded, and his bravery became legendary.

Between the wars he held senior staff appointments and a command in England. In World War II, as major general, he commanded the New Zealand Expeditionary Force (1939–45) and commanded the Allied forces during the battle for control of Crete in 1941. Later in the war he fought in North Africa and in Italy under Montgomery and Alexander. In 1942 he received a knighthood. Freyberg in 1946 became governor-general of New Zealand, an appointment he held for six years. In 1951 he was created a baron.

Freycinet, Charles-Louis de Saulces de (b. Nov. 14, 1828, Foix, Fr.—d. May 15, 1923, Paris), French political figure who served in 12 different governments, including four terms as premier; he was primarily responsible for important military reforms instituted in the last decade of the 19th century.

Freycinet graduated from the École Polytechnique and entered government service as a mining engineer, eventually rising to the position of inspector general of mines in 1883. Upon the establishment of the French Republic in September 1870, during the Franco-German War, he offered his services to Léon Gambetta, who appointed him prefect of Tarn-et-Garonne and, in October, chief of the military Cabinet of the provisional government of national defense at Tours. It was largely Freycinet's powers of organization that



Charles de Freycinet, photograph by Nadar (Gaspard-Félix Tournachon)
Archives Photographiques, Paris

enabled Gambetta to muster forces with which to oppose the advancing German armies. Freycinet's account of his experience, *La Guerre en Province pendant le siège de Paris, 1870-1871* ("The War in the Provinces During the Siege of Paris, 1870-71"), was published in 1871.

Freycinet was elected to the Senate in 1876. Joining Jules Dufaure's government as minister of public works the next year, he directed a policy—often called the Freycinet Plan—whereby the government purchased railroads and built extensive new railways and waterways. In December 1879 he became premier for the first of four terms, but the issue of state support for religious organizations soon brought about the fall of his Cabinet.

Freycinet headed a new government and simultaneously served as foreign minister in January–August 1882; this time it fell because of his decision to occupy the Isthmus of Suez. He was in and out of governments for the next 17 years; in 1887 he lost the presidential election to Sadi Carnot. In April 1888 he became the first civilian war minister since 1848. For the next five years, in five successive governments, including one of his own (1890–92), he directed an impressive reform of the Army, which included the introduction of three-year terms of service, the establishment of a general staff, and the creation of a supreme war council. In January 1893 he was forced to resign as war minister because of a financial scandal over the proposed construction of a Panama canal. He returned to the War Ministry briefly in 1899 and then served as minister without portfolio in 1915–16.

Freycinet became a member of the Académie Française in 1890. In addition to many technical and scientific works, he wrote his memoirs, *Souvenirs, 1848-1878* (1912).

Freycinet, Louis-Claude de Saulces de (b. Aug. 7, 1779, Montélimar, Fr.—d. Aug. 18, 1842, near Loriol, Fr.), French naval officer and cartographer who explored portions of Australia and islands in the Pacific Ocean.

In 1800 he joined Captain Nicolas Baudin on a voyage of exploration to southern and southwestern coastal Australia and Tasmania. After his return to Paris in 1804, he completed an account of this expedition, *Voyage de découvertes aux terres australes* (1807; "Voyage of Discovery to Southern Lands"), for which he also drew maps.

In 1817 he took command of *l'Uranie* to conduct magnetic and oceanographic researches in the Pacific. His wife, Rose, disguised as a sailor, was smuggled aboard and accompanied the voyage, which she described in a journal published in 1827. After a stop at Rio de Janeiro, *l'Uranie* rounded the Cape of Good Hope and visited Timor, north of Australia, and the Mariana and Hawaiian islands. Freycinet named Rose Island in the Samoa group for his wife.

On the return voyage from Sydney to France, via Cape Horn, *l'Uranie* was wrecked in the Falkland Islands, but the scientific data and specimens aboard were saved. Freycinet purchased an American whaler, renamed *la Physicienne*, and in it returned to France. Observations from the expedition were published in *Voyage autour du monde... sur les corvettes de S.M. "l'Uranie" et "la Physicienne"*, 13 vol. and four atlases (1824–44; "Voyage Around the World... in H.M. Corvettes *l'Uranie* and *la Physicienne*").

Freycinet Peninsula, peninsula extending south into the Tasman Sea from east-central Tasmania, Australia. Measuring about 14 miles (23 km) by 4 miles (6.5 km), with an area of 25 square miles (65 square km), it rises to a high point at Mount Freycinet (2,011 feet [613 m]), one of the peaks along a high central granite ridge known as the Hazards. The peninsula is joined to the mainland by twin sandspits. Off its southern tip lie the Schouten Passage and Island and, to the west, Oyster Bay. The promontory was surveyed in 1802 by the French captain Nicolas Baudin and was named after his lieutenant, Louis-Claude de Saulces de Freycinet. In 1916 part of the peninsula was made a national park, which is entered via the resort town of Coles Bay, 70 miles (115 km) northeast of Hobart.

Freyja (Old Norse: "Lady"), most renowned of the Norse goddesses, who was the sister and female counterpart of Freyr and was in charge of love, fertility, battle, and death. Her father was Njörd, the sea god. Pigs were sacred to her, and she rode a boar with golden bristles. A chariot drawn by cats was another of her vehicles. It was Freyja's privilege to choose one-half of the heroes slain in battle for her great hall in the Fölkvangar (the god Odin took the other half to Valhalla). She possessed a famous necklace called *Brísinga men*, which the trickster god Loki stole and Heimdall, the gods' watchman, recovered. Greedy and lascivious, Freyja was also credited with the evil act of teaching witchcraft to the Aesir (a tribe of gods). Like the Egyptian goddess Isis and the Greek Aphrodite, Freyja traveled through the world seeking a lost husband and weeping tears of gold. She was also known by four nicknames—Mardöll, Hörn, Gefn, and Syr.

Freyr, also spelled FREY, also called YNGVI, in Norse mythology, the ruler of peace and fertility, rain, and sunshine and the son of the sea god Njörd. Although originally one of the Vanir tribe, he was included with the Aesir. Gerd, daughter of the giant Gymir, was his wife. Worshiped especially in Sweden, he was also well-known in Norway and Iceland. His sister and female counterpart, Freyja, was goddess of love, fertility, battle, and death. The boar was sacred to both. Freyr and Freyja figure in many lays and stories of medieval Iceland.

Freyre, Gilberto de Mello, Freyre also spelled FREIRE (b. March 15, 1900, Recife, Braz.—d. July 18, 1987, Recife), sociologist,

considered the 20th-century pioneer in the sociology of the Brazilian northeast.

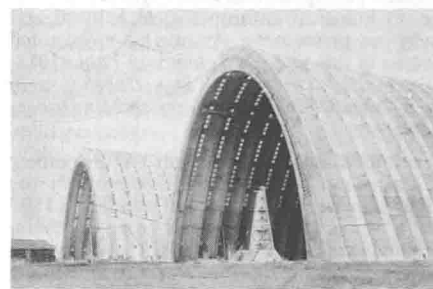
Freyre received a B.A. from Baylor University, Waco, Tex., and his M.A. from Columbia University in 1923. In 1926 he organized the first northeastern regionalist congress in Recife and published the "Regionalist Manifesto." He was joined in this endeavour by the northeast writers Jorge de Lima, José Américo de Almeida, José Lins do Rego, and Luís Jardim, among others.

Most of Freyre's numerous sociological essays are concerned with the socioeconomic development of the northeastern region of Brazil and the attempt to relate this pattern constructively to the Portuguese-speaking African nations. Freyre's basic premise is that, by reason of its wide Afro-European cultural experience prior to the discovery of Brazil, the Portuguese nationality was uniquely endowed to work out in the New World a successful multicultural and multiracial society that could be imitated to advantage elsewhere.

Among Freyre's numerous published works in Portuguese and English, the best-known is *Casa-grande e senzala* (1933; "The Big House and the Slave Quarters"; Eng. trans. *The Masters and the Slaves*), an account of the relationship between Brazil's Portuguese colonizers and their African slaves. His other works include *Sobrados e mucambos* (1936; "The Rich and the Servants"; Eng. trans. *The Mansions and the Shanties*), *Brazil: An Interpretation* (1945), *Nordeste* (1937; "The Northeast"), and *Ordem e progresso* (1959; "Order and Progress"). *Sobrados e mucambos* traces the processes of urbanization and the decline of the rural patriarchal society in Brazil.

Freyre organized several university departments of sociology in Brazil and was the prime mover in the first Congress of Afro-Brazilian Studies in 1934. In 1949 he represented Brazil in the UN General Assembly.

Freyssinet, (Marie-) Eugène (-Léon) (b. July 13, 1879, Objat, Fr.—d. June 8, 1962, St. Martin-Vésubie), French civil engineer who successfully developed pre-stressed concrete—i.e., concrete beams or girders in which steel wire is embedded under tension, greatly strengthening the concrete member.



Hangars at Orly Airport, near Paris, designed by Freyssinet, 1916–24

By courtesy of the Musée de l'Air, Paris

Appointed bridge and highway engineer at Moulins in 1905, Freyssinet designed and built many reinforced-concrete bridges, including one with a 300-foot (91-metre) span. From the end of World War I until 1928 he worked for a contracting firm, and in 1930 he completed the Plougastel Bridge across the Elorn River at Brest. With three 612-foot (187-metre) spans, this was the largest reinforced-concrete bridge constructed up to that time.

After 1928 Freyssinet devoted himself to the development of pre-stressed concrete and also to the manufacture of high-strength concrete. His most significant discovery was that only a high-strength steel at a high stress would achieve a permanent pre-stress in concrete. At first little recognized, Freyssinet's methods were successfully applied at the Gare Maritime (harbour station) at Le Havre, Fr., in 1933 and gradually became universally adopted. After

invention in 1938 of a practical tool for applying tension to steel, the use of pre-stressed concrete became worldwide.

Freytag, Gustav (b. July 13, 1816, Krenzburg, Silesia, Prussia—d. April 30, 1895, Wiesbaden, Ger.), German writer of realistic novels celebrating the merits of the middle classes.

After studying philology at Breslau and Berlin, Freytag became Privatdozent in German literature at the University of Breslau (1839), but he resigned after eight years to devote himself to writing. He was much excited by the revolutions of 1848 and became, with Julian Schmidt, joint editor of the Leipzig weekly *Die Grenzboten*, which he made into the leading organ of the middle-class liberals. He abhorred both the democratic radicalism of the *Jungdeutschen* ("Young Germany") and the escapism of the Romantics. From 1867 to 1870 he represented the national liberal party in the North German *Reichstag*, and he served at the headquarters of the 3rd Army in the Franco-German War until the battle of Sedan (1870).

His literary work was influenced by his early reading of English novelists, especially Sir Walter Scott and Charles Dickens, and of French plays. His name was made with the comedy *Die Journalisten* (1854; *The Journalists*), still regarded as one of the most successful German comedies, and he acquired an international reputation with his widely translated novel *Soll und Haben* (1855; *Debit and Credit*, 1857). It celebrates the solid bourgeois qualities of the German merchants, and the close relationships between people's characters and the work they do is well brought out. The success of the novel was such that its author was recognized as the leading German writer of his day. He attempted to realize a similar intention with *Die verlorene Handschrift* (1864; *The Lost Manuscript*, 1865), which depicts Leipzig university life in the same realistic manner, but the plot is much weaker and the effect less successful. His most ambitious literary work was the novel-cycle *Die Ahnen*, 6 vol. (1873–81) which unfolded the story of a German family from the 4th century AD up to Freytag's own time. His *Bilder aus der deutschen Vergangenheit*, 5 vol. (1859–67; partial Eng. trans. *Pictures of German Life*, 1862–63) were originally contributed to *Die Grenzboten* and give a vivid and popular account of the history of the Germans, in which Freytag stresses the idea of folk character as determinative in history. His collected works, *Gesammelte Werke*, 22 vol. (1886–88) were reissued, edited by E. Elster (12 vol.) in 1926.

Fria, town and administrative capital of Fria region, western Guinea, West Africa, near the Amaria Dam on the Konkouré River. The Fria Company's bauxite-reducing factory at nearby Kimbo was one of Africa's first alumina-processing plants and is Guinea's largest industrial enterprise. Bauxite deposits were discovered in 1954, and alumina was first exported in 1960 via rail to Conakry, 55 mi (88 km [91 mi by rail]) south. The site of the largest technical training school in the country, Fria also has a hospital, a stadium, a mosque, and a Roman Catholic mission (1959). The town is also the chief trade centre for a region inhabited mainly by the Susu (Soussou) people. Pop. (1977 prelim.) region, 45,000.

friar (from Latin *frater* through French *frère*, "brother"), one belonging to a Roman Catholic religious order of mendicants. Formerly, friar was the title given to individual members of these orders, as Friar Laurence (in *Romeo and Juliet*), but this is no longer common. The 10 mendicant orders are the Dominicans, Franciscans, Augustinians (Augustian Hermits), Carmelites, Trinitarians, Mercedarians, Servites, Minims, Hospitallers of St. John of

God, and the Teutonic Order (the Austrian branch).

Friar Lands Question, problem confronting the U.S. government after the takeover of the Philippines from Spain in 1898, concerning the disposition of large landed estates owned by Spanish monastic orders on the islands.

For more than 300 years the Roman Catholic Church had been intimately involved with Spanish colonial government in the Philippines. During that time three religious orders—Dominicans, Augustinians, and Recollects—had acquired about one-tenth of all the improved land in the islands. The discontent of the Filipino peasants with this situation had been a contributing factor in the Philippine Revolution of 1896–98.

In the Treaty of Paris (1898), which settled the Spanish-American War, the U.S. government agreed to protect the friars' property rights, but it was clearly dangerous to allow them to return to their lands. An agreement was eventually reached under which the U.S. purchased 410,000 acres (about 170,000 hectares) for a sum of \$7,000,000. The land was then resold to tenant farmers on an installment basis. This solution was not entirely satisfactory; numerous disputes arose over the accuracy of surveys and terms of repayment. Continued monastic possession of certain parcels of land has been a source of contention ever since, as has the issue of land reform in general.

Fribourg (French), German FREIBURG, canton, western Switzerland, bounded by Lake Neuchâtel and the cantons of Vaud on the west and south and Bern on the east, with enclaves within Vaud. Occupying an area of 644 sq mi (1,669 sq km), it lies in an elevated plain (Swiss Plateau) and rises from flat land in the west through a hilly region up to the PreAlps in the south and east. The highest summits are to the south in La Gruyère district and include the Vanil Noir (7,836 ft [2,389 m]). The canton is bisected by the Saane River (La Sarine), which flows from south to north (to join the Aare), and by its tributaries. On the west, La Broye flows northeast into Lakes Morat (Murtensee) and Neuchâtel, and, in the southwest, La Veveyse flows south to Lake Geneva (Lac Léman).

Traces of prehistoric settlements have been found on the shores of Lakes Neuchâtel and Morat. The canton, made up of districts acquired by its capital, the city of Fribourg (*q.v.*), reached its present extent with the inclusion of Morat (now Murten) in 1803. It joined the Sonderbund (separatist league of Catholic cantons) in 1846 but surrendered to the federal army in 1847. Predominantly Roman Catholic, it has numerous monasteries and convents.

The canton is predominantly agricultural. Cattle breeding and dairying (including the processing of milk and cheese, notably in La Gruyère district) are important. Market gardening, cereals, tobacco, and fruit prosper in the fertile north and on hillsides in the centre of the canton. Light industries are largely concentrated in Fribourg city, Düdingen, and Murten and the timber industry in La Gruyère. Power plants in La Sarine district generate electricity for home use and for export. Tourism is most developed in the mountain and lake regions and in Fribourg. The canton is served by the main railway line from Lausanne to Bern, with several branch lines.

Situated on the Swiss linguistic frontier, Fribourg's population is two-thirds French speaking (west) and one-third German speaking (east). Pop. (1983 est.) 187,608.

Fribourg (French), German FREIBURG, capital of Fribourg canton, Switzerland, on a loop in La Sarine (Saane) River, southwest of Bern. Founded in 1157 by Berthold IV, duke of Zähringen, to control a ford across the river, it passed to the sons of Rudolf of

Habsburg in 1277. The Habsburgs abandoned it in 1452; it then accepted the suzerainty of the dukes of Savoy. Fribourg assisted the Swiss in defeating Charles the Bold of Burgundy at Grandson and Morat (now Murten) in 1476 and was admitted to full membership in the Swiss Confederation in 1481. Occupied by the French in 1798, Fribourg became part of the Helvetic Republic and then one of the cantons of the Swiss Confederation as reconstituted by Napoleon's Act of Mediation in 1803.

The oldest part of the city (the Bourg) is high above the river bank; the Neuveville, Auge, and Planche (Matte) quarters form the lower part (Basseville). West of the Bourg and still higher are the modern Places and Pérolles quarters. The old quarters retain much of their medieval appearance, characterized by Gothic-fronted houses and the remains of towers and gateways with 13th- to 17th-century ramparts, which originally surrounded the city. Medieval buildings include St. Nicholas Cathedral (13th–15th century) with a famous organ built by Aloys Mosser; the Franciscan church (Église des Cordeliers [1281; altered 1748]) with a 15th-century reredos; the former Augustinian Church of St. Maurice (1255) with a baroque reredos; and numerous chapels and



Fribourg, Switz., on the Sarine River, with the Point de Zähringen
Josef Muench

former convents and monasteries. The town hall dates from 1506–22 with a tower of 1642. Modern architecture includes the university buildings (1941) and the Church of Christ the King (1954). The Sarine River is spanned by several bridges, notably the seven-arched Pont de Zähringen. The seat of the bishopric of Lausanne–Geneva–Fribourg and of a Roman Catholic state university (founded 1889), Fribourg is the centre of Swiss Catholicism. It possesses numerous works of art, mainly preserved in its churches and in the Musée d'Art et d'Histoire.

Situated on the main railway from Lausanne to Bern and a junction of lines to Murten and Payerne, the city is also a centre for bus and postal road services. There are breweries, a foundry, and factories for chocolate, cardboard boxes, machinery, electrical equipment, wood products, clothing, and chemicals. The population is primarily French speaking. Pop. (1983 est.) 37,100.

fricative, in phonetics, a consonant sound, such as English *f* or *v*, produced by bringing the mouth into position to block the passage of the airstream, but not making complete closure, so that air moving through the mouth generates audible friction.

Fricatives (also sometimes called "spirants") can be produced with the same positions of the vocal organs as stops; bilabial, labiodental, dental, alveolar, palatal, velar, and uvular consonants. In addition to the *f* and *v* sounds,

examples of fricatives in English are *s* as in "sitter," *z* as in "zebra," and the two *th* sounds as in "think" and "this."

Frick, Henry Clay (b. Dec. 19, 1849, West Overton, Pa., U.S.—d. Dec. 2, 1919, New York City), U.S. industrialist, art collector, and philanthropist who helped build the world's largest coke and steel operations.

Frick began building and operating coke ovens in 1870, and the following year he organized Frick and Company. Taking advantage of the difficult times following the financial panic of 1873, he acquired extensive coal deposits and supplied Pittsburgh with the coke required for its steel and iron industry.

In 1889 Frick was made chairman of Carnegie Brothers and Company to reorganize their steel business. He initiated far-reaching improvements and bought out Carnegie's chief competitor, the Duquesne Steel Works. He was responsible for building Carnegie into the largest manufacturer of steel and coke in the world. As a result of his leading role in the dispute during the Homestead (Pa.) steel strike of 1892, he was shot and stabbed by Alexander Berkman, an anarchist, but survived.

Frick played a major role in the formation of the United States Steel Corporation in 1901 and later became a director. He also served as a director of a number of railroads.

Upon his death Frick bequeathed \$15,000,000 and his Fifth Avenue mansion to New York City to establish the Frick Collection, a trove of paintings, bronzes, and enamels he had collected over a 40-year period. It is generally considered one of the great privately owned museums of the world. His other gifts include a 150-acre (61-hectare) park and a \$2,000,000 endowment to the city of Pittsburgh, as well as liberal contributions to Princeton University.

Frick, Wilhelm (b. March 12, 1877, Alsenz, Ger.—d. Oct. 16, 1946, Nürnberg), longtime parliamentary leader of the German National Socialist Party and Adolf Hitler's minister of the interior, who played a major role in drafting and carrying out the Nazis' anti-Semitic measures.

An official in the police administration at Munich, Frick was convicted of high treason for participating in Hitler's Munich (Beer Hall) Putsch of November 1923 but managed to avoid imprisonment. Elected to the Reichstag (parliament) in May 1924, he began to lead the Nazis in that body in 1928.

During 1930–31, as minister of the interior in the state government of Thuringia, Frick was the first Nazi to hold any ministerial-level post in Germany. Thereafter he became the recognized party expert in German domestic politics. As Hitler's national minister of the interior (1933–43), he played a significant role in devising and obtaining passage of legislation providing for government by decree (March 1933) and in drafting subsequent measures against the Jews, especially the notorious Nürnberg laws of September 1935.

With the growth of the SS (Schutzstaffel) as the state's principal internal-security force, however, Frick's importance in the government declined, and in 1943 he was replaced at the interior ministry by SS chief Heinrich Himmler. Thereafter Frick served as Reich protector for Bohemia and Moravia until the end of World War II. Arraigned before the Allied war-crimes tribunal at Nürnberg (1946), he was convicted and subsequently executed for his "crimes against humanity."

Frick Collection, gallery of paintings, sculpture, and decorative arts in New York City. The art, spanning the history of Western art from the Middle Ages to the late 19th century, was amassed by the industrialist Henry Clay

Frick (1849–1919) under the guidance of the art dealer Joseph Duveen and the English art critic Roger Fry.

The collection, as well as an art reference library, is housed in Frick's Manhattan townhouse. It includes decorative arts, drawings, furniture, paintings, prints, and sculpture.

friction, force that resists the sliding or rolling of one solid object over another. Frictional forces, such as the traction needed to walk without slipping, may be beneficial; but they also present a great measure of opposition to motion. About 20 percent of the engine power of automobiles is consumed in overcoming frictional forces in the moving parts.

The major cause of friction between metals appears to be the forces of attraction, known as adhesion, between the contact regions of the surfaces, which are always microscopically irregular. Friction arises from shearing these "welded" junctions and from the action of the irregularities of the harder surface plowing across the softer surface.

Two simple experimental facts characterize the friction of sliding solids. First, the amount of friction is nearly independent of the area of contact. If a brick is pulled along a table, the frictional force is the same whether the brick is lying flat or standing on end. Second, friction is proportional to the load or weight that presses the surfaces together. If a pile of three bricks is pulled along a table, the friction is three times greater than if one brick is pulled. Thus, the ratio of friction *F* to load *L* is constant. This constant ratio is called the coefficient of friction and is usually symbolized by the Greek letter mu (μ). Mathematically, $\mu = F/L$. Because both friction and load are measured in units of force (such as pounds or newtons), the coefficient of friction is dimensionless. The value of the coefficient of friction for a case of one or more bricks sliding on a clean wooden table is about 0.5, which implies that a force equal to half the weight of the bricks is required just to overcome friction in keeping the bricks moving along at a constant speed. The frictional force itself is directed oppositely to the motion of the object. Because the friction thus far described arises between surfaces in relative motion, it is called kinetic friction.

Static friction, in contrast, acts between surfaces at rest with respect to each other. The value of static friction varies between zero and the smallest force needed to start motion. This smallest force required to start motion, or to overcome static friction, is always greater than the force required to continue the motion, or to overcome kinetic friction.

Rolling friction occurs when a wheel, ball, or cylinder rolls freely over a surface, as in ball and roller bearings. The main source of friction in rolling appears to be dissipation of energy involved in deformation of the objects. If a hard ball is rolling on a level surface, the ball is somewhat flattened and the level surface somewhat indented in the regions in contact. The elastic deformation or compression produced at the leading section of the area in contact is a hindrance to motion that is not fully compensated as the substances spring back to normal shape at the trailing section. The internal losses in the two substances are similar to those that keep a ball from bouncing back to the level from which it is dropped. Coefficients of sliding friction are generally 100 to 1,000 times greater than coefficients of rolling friction for corresponding materials. This advantage was realized historically with the transition from sledge to wheel.

friction drum, musical instrument made of a membrane stretched across the mouth of a vessel and set in vibration by rubbing with wet or resined fingers a stick or string passed through the membrane or tied upright from underneath; in some types the membrane is rubbed with another piece of skin. Closer in



Flemish *rommelpot* friction drum; in the Musée Instrumental du Conservatoire Royal, Brussels

By courtesy of the Musée Instrumental, Brussels; photograph © A.C.L. Brussels

sound production to primitive friction, or rubbing, boards, it probably evolved separately from the beaten drum, which is associated with different rites in nonliterate societies.

The friction drum—found in Africa, Europe, Asia, and the Americas—is primarily a ritual instrument. In Europe this ritual association survives in places where the instrument has not become a toy—e.g., in Italian religious processions and Romanian New Year's festivities. Other European friction drums include the Flemish *rommelpot* and the Spanish *zam-bomba*.

Friday, sixth day of the week (*q.v.*).

Fridolin OF SÄCKINGEN, SAINT (b. Ireland—d. 6th or 7th century AD, Säckingen, Ger.; feast day March 6), Irish-born missionary who is said to have established churches among the Franks and Alamanni and who, in modern times, has been revered in southern Germany, Switzerland, and Austria.

Accounts of his life (generally unreliable and deriving principally from the 10th-century monk Balther of Säckingen) describe him as a man of noble birth who became an itinerant preacher in Ireland, travelling from town to town, and then crossed over to France. He lived for a while at a monastery at Poitiers and then travelled to the Rhine, building churches along the way. At Säckingen he purportedly founded a church and monastery, with a nunnery nearby.

Fried, Alfred Hermann (b. Nov. 11, 1864, Vienna—d. May 5, 1921, Vienna), Austrian pacifist, publicist, co-founder of the German peace movement, and co-winner (with Tobias Asser) of the Nobel Prize for Peace in 1911.

In 1891 Fried, in Berlin, founded the paci-



Fried

By courtesy of the Bild Archiv, Österreichische Nationalbibliothek, Vienna

first periodical *Die Waffen nieder!* ("Lay Down Your Arms!"), from 1899 called *Friedenswarte* ("The Peacekeeper"). In 1892 he founded the *Deutsche Friedensgesellschaft* (German Peace Society), which became the focus for the German pacifist movement before World War I. Fried advocated "fundamental pacifism" and believed that "international anarchy" should be met by both legislative measures and spiritual regeneration.

With the outbreak of World War I he immigrated to Switzerland in protest against German policy. As editor of *Blätter für internationale Verständigung und zwischenstaatliche Organisation* ("Papers for International Understanding and Inter-State Organization"), he worked for an immediate peace. Fried protested against the Treaty of Versailles but warned the Germans against attempting to revise it by force. His works include *Handbuch der Friedensbewegung*, 2 vol. (1911-13; "Handbook of the Peace Movement"), and *Mein Kriegstagebuch*, 4 vol. (1918-20; "My War Diary").

Friedan, Betty (Naomi), née GOLDSTEIN (b. Feb. 4, 1921, Peoria, Ill., U.S.), American feminist best known for her book *The Feminine Mystique* (1963), which explored the causes of the frustrations of modern women in traditional roles.

Friedan was awarded a B.A. in psychology (1942) from Smith College, Northampton, Mass., and did graduate work at the University of California at Berkeley. She worked for a time in New York City but married in 1947 (divorced 1969), moved to the suburbs, and reared three children. Friedan's unhappiness with her role as housewife and mother coupled with the discovery that her dissatisfaction was shared by other women, prompted her to write *The Feminine Mystique*. One result of this work was her further involvement in the women's movement.

In 1966 Friedan cofounded and became the first president of the National Organization for Women (NOW). Her second book, *It Changed My Life* (1976), is an account of her campaigns of the 1960s and early '70s as recorded in speeches, essays, and interviews. *The Second Stage*, an assessment of the status of the women's movement, was published in 1981.

Friedel, Charles (b. March 12, 1832, Strasbourg, Fr.—d. April 20, 1899, Montauban), French organic chemist and mineralogist who, with the American chemist James Mason Crafts, discovered in 1877 the chemical process known as the Friedel-Crafts reaction.

In 1854 Friedel entered C.A. Wurtz's laboratory and in 1856 was appointed conservator of the mineralogical collections at the Superior National School of Mines. In 1871 he began to lecture at the École Normale and in 1876 became professor of mineralogy at the Sorbonne, but on the death of Wurtz in 1884 he exchanged that position for the chair of organic chemistry.

He collaborated in efforts to form diamonds artificially, studied the pyroelectric properties of crystals, determined crystallographic constants, and did research on ketone and aldehyde compounds. Friedel was the chief founder of *Revue Générale de Chimie* in 1899.

Friedel, Georges (b. July 19, 1865, Mulhouse, Fr.—d. Dec. 11, 1933, Strasbourg), French crystallographer who formulated basic laws concerning the external morphology and internal structure of crystals.

Friedel studied at the École Polytechnique and the Superior National School of Mines, where his father, the chemist Charles Friedel, was curator of the mineralogical collections. After graduation he worked as a mining engineer and then turned to teaching and research, first at the School of Mines of Saint-Étienne and later at the University of Strasbourg.

Friedel's observations established the general validity of the hypothesis, put forward by Auguste Bravais, that the different faces of crystals were external expressions of a periodic, internal arrangement of atoms, or lattice structure. His own law of rational symmetric intercepts (1905) and law of mean indices (1908) are generalizations of the regularities observed in the external symmetry of crystals. After conclusive proof of the lattice structure was achieved in 1912 by the X-ray diffraction experiments of Max von Laue, Friedel showed that, because the X-ray diffraction pattern is always symmetric, it is impossible (except under special circumstances) to determine whether the crystal actually has a centre of symmetry and that only 11 different types of crystal symmetry can be distinguished. This result is known as Friedel's law, and the 11 possible types of symmetry are known as Friedel classes (or Laue symmetry groups).

Friedland, Battle of (June 14, 1807), victory for Napoleon that compensated for a setback the preceding February at Eylau and led to the Treaty of Tilsit between Napoleon and Alexander I of Russia. It was fought at Friedland (modern Pravdinsk, Russia), 27 miles (43 km) southeast of Königsberg in East Prussia.

About 80,000 troops of Napoleon's Grand Army (including Polish, Dutch, Italian, and German units) confronted about 58,000 Russians under the command of General Leonty Leontyevich Bennigsen. Most of the Russian troops crossed to the west bank of the Alle River at Friedland and early on June 14 attacked the seemingly isolated French corps of Marshal Jean Lannes. Outnumbered by more than two to one, Lannes held off the Russian attacks, led by Prince P.I. Bagration, for nine hours while Napoleon concentrated his forces. At 5 PM Napoleon launched his main attack, employing about 65,000 men, and in two hours pushed the southern half of the Russian army back into the tiny village of Friedland. There, close-packed, they were cut down by volleys of canister and grapeshot fired by the French guns at close range. The Russians were either killed, captured, or driven into the river, since the bridges had earlier been destroyed by the French. The Russians lost about 19,000 men, and the French about 9,000. Bennigsen's army was shattered, and the next day his ally, the Prussian general Anton Lestocq, with about 25,000 men, abandoned Königsberg and retreated to Tilsit. The French occupied Königsberg.

Friedländer, Ludwig Heinrich (b. July 16, 1824, Königsberg, Prussia [now Kaliningrad, Russia]—d. Dec. 16, 1909, Strassburg, Ger. [now Strasbourg, Fr.]), German historian noted for his comprehensive survey of Roman social and cultural history.

Friedländer studied at the University of Leipzig, where, under the influence of Theodor Mommsen and Jacob Burckhardt, he developed an interest in the history of civilization. After a period of work on Greek culture in 1847 and a trip to Italy in 1853-54, he taught philology and archaeology and worked on his masterpiece, the *Darstellungen aus der Sittengeschichte Roms*, 3 vol. (1864-71; "Representations from Roman Cultural History"), a detailed and vivid portrait of the social life, customs, art, and manners of the first two centuries of the Roman Empire. The work remains one of the most complete surveys of Roman life and society.

Friedman, Ignacy (b. Feb. 14, 1882, Podgórze, near Kraków, Pol., Austria-Hungary—d. Jan. 26, 1948, Sydney, Australia), Polish pianist noted for his performances of the works of Frédéric Chopin.

Friedman studied music theory with Hugo Riemann in Leipzig. In Vienna he studied composition with Guido Adler and studied pi-

ano with Theodor Leschetizky for four years. After his debut in 1904, he gave more than 2,800 concerts around the world. In 1940 he moved to Sydney. He was a famous interpreter of Chopin, editing the Breitkopf & Härtel annotated edition of his works in 12 volumes. He wrote about 100 piano pieces in the popular salon style; the best-known of these are in a group of *Fantasiestücke*. He also transcribed for piano some 18th-century orchestral music, but he is remembered mostly for his brilliant concert career.

Friedman, Jerome Isaac (b. March 28, 1930, Chicago, Ill., U.S.), American physicist who, together with Richard E. Taylor and Henry W. Kendall, received the Nobel Prize for Physics in 1990 for their joint experimental confirmation of the fundamental particles known as quarks.

Friedman was educated at the University of Chicago, from which he received his Ph.D. degree in 1956. After conducting research there and at Stanford University, where he met Taylor and Kendall, he began teaching at the Massachusetts Institute of Technology in 1960. He became a full professor there in 1967 and head of the physics department in 1983.

Friedman conducted his prizewinning research jointly with Kendall and Taylor at the Stanford Linear Accelerator Center of Stanford University. In a series of experiments from 1967 to 1973, the three physicists used a particle accelerator to direct a beam of high-energy electrons at target protons and neutrons. They found that the manner in which the electrons scattered from the targets indicated that both protons and neutrons are composed of hard, electrically charged, pointlike particles. As the three men continued their experiments, it became clear that these particles corresponded to the fundamental particles called quarks, whose existence had been hypothesized in 1964 by Murray Gell-Mann and George Zweig.

Friedman, Milton (b. July 31, 1912, Brooklyn, N.Y., U.S.), American laissez-faire economist, professor at the University of Chicago, and one of the leading conservative economists in the second half of the 20th-century. He was awarded the Nobel Prize for Economics in 1976.

After studying at Rutgers University and the University of Chicago, Friedman received his Ph.D. from Columbia University in 1946 and joined the faculty of the University of Chicago that same year. Friedman became one of the leading American advocates of the monetarist school of economics, which holds that the business cycle is determined primarily by money supply and interest rates rather than by a government's fiscal policy. In *Capitalism and Freedom* (1962; with his wife, Rose D. Friedman) Friedman argued for a negative income tax, or guaranteed income, to supersede centralized, bureaucratized social welfare services, which in his view are inimical to the traditional values of individualism and useful work. Among his other works, many of which concern the theory of money, are *A Monetary History of the United States, 1867-1960* (1963) and *Monetary Trends of the United States and the United Kingdom* (1981).

Friedman, William F(rederick); and Friedman, Elizabeth S(mith), née ELIZABETH SMITH (respectively b. Sept. 24, 1891, Chisinau, Russia [now in Moldova]—d. Nov. 2, 1969, Washington, D.C., U.S.; b. 1892, Huntingfield, Ind., U.S.—d. Oct. 31, 1980, Plainfield, N.J.), American cryptologists who helped decipher enemy codes from World War I to World War II.

William Friedman was still an infant when

his family immigrated to the United States; he studied genetics at Cornell University (B.S., 1914). Elizebeth Smith majored in English at Hillsdale (Michigan) College (B.A., 1915). They met at the Riverbank Laboratories (Geneva, Ill.), where they both eventually became involved in cryptology, working often for the government in decoding diplomatic messages. In 1917–18 William served in the U.S. Army, partly in France, analyzing German code books.

After the war, in 1921, the Friedmans (they had married in May 1917) moved to Washington, D.C., where, over the years, Elizebeth Friedman worked for several government departments, notably cracking the codes used by rumrunners and other smugglers, and where William Friedman, in the War Department, became the chief cryptanalyst in the Signal Intelligence Service, notably leading the teams that broke various Japanese codes, including ultimately the Purple machine cipher initiated by Japan in 1939. After World War II, William Friedman worked awhile for the National Security Agency, and Elizebeth Friedman for the International Monetary Fund.

William Friedman wrote *The Index of Coincidence and Its Applications in Cryptography* (1922), one of the standard works in the nomenclature and classification of ciphers. Together, the Friedmans wrote *The Shakespearean Ciphers Examined* (1957), in which they denied Francis Bacon's purported authorship of the William Shakespeare plays and sonnets.

Friedmann, Aleksandr Aleksandrovich, Friedmann also spelled FRIDMAN (b. June 17 [June 29, New Style], 1888, St. Petersburg, Russia—d. Sept. 16, 1925, Leningrad [St. Petersburg]), Russian mathematician and physical scientist.

After graduating from the University of St. Petersburg in 1910, Friedmann joined the Pavlovsk Aerological Observatory and, during World War I, did aerological work for the Russian army. After the war he was on the staff of the University of Perm (1918–20) and then on the staffs of the Main Physical Observatory and other institutions until his death in 1925.

Friedmann was first to formulate (1922) the mathematics of a model universe in which the average mass density is constant and all fundamental parameters are known except the expansion factor, or radius of curvature. His model has been of great significance in the mathematical derivation of cosmological models from Albert Einstein's general theory of relativity. Friedmann was also one of the first to postulate (1922, 1924) a "big bang" model for the evolution of the universe. He was also a founder of the science of dynamic meteorology.

Friedmann, Andrei: see Capa, Robert.

Friedrich (German personal name): see under Frederick, except as below.

Friedrich, Caspar David (b. Sept. 5, 1774, Greifswald, Pomerania [Germany]—d. May 7, 1840, Dresden, Prussia [Germany]), pioneer early 19th-century German Romantic painter. His vast, mysterious landscapes and seascapes proclaimed man's helplessness against the forces of nature and did much to establish the idea of the sublime as central concerns of the Romantic movement.

Friedrich studied from 1794 to 1798 at the academy at Copenhagen but was largely self-taught. Settling at Dresden, he became a member of an artistic and literary circle that included the painter Philipp Otto Runge and the writers Ludwig Tieck and Novalis. His drawings in sepia, executed in his neat early style, won the poet J.W. von Goethe's



Self-portrait, drawing by Caspar David Friedrich; in the Kupferstichkabinett und Sammlung der Zeichnungen, Berlin

By courtesy of the Staatliche Museen zu Berlin

approval and a prize from the Weimar Art Society in 1805. His first important oil painting, "The Cross in the Mountains" (c. 1807), established his mature style, characterized by an overwhelming sense of isolation, and was an attempt to replace the traditional symbolism of religious painting with one drawn from nature. Other symbolic landscapes, such as "Shipwreck in the Ice" (1822), reveal his fatalism and obsession with death. Though based on close observation of nature, his works were coloured by his imaginative response to the atmosphere of the Baltic coast and the Harz Mountains, which he found both awesome and ominous. In 1824 he was made professor of the Dresden academy. For a long time his work was forgotten; but it was revived when the 20th century recognized its own existential isolation in his work.

Friedrich August (German personal name): see under Frederick Augustus.

Friedrich Karl (German personal name): see under Frederick Charles.

Friedrich Wilhelm (German personal name): see under Frederick William.

Friedrichshafen, city, Baden-Württemberg Land (state), southwestern Germany, on the north shore of Lake Constance (Bodensee). It was formed in 1811 by Frederick I of Württemberg through unification of the former free imperial city (1275–1802) of Buchhorn and the monastery and village of Hofen. Hofen (from 1050 a Benedictine convent) became a provostship of monks in 1420, was suppressed in 1802, and passed to Württemberg in 1805. Buchhorn was assigned to Württemberg in 1810.

Before World War II, in which the town was heavily damaged, Zeppelin airships were built there, and it now has a Zeppelin museum. Largely reconstructed, it is a lake resort with an annual fair and ferry connections to Switzerland. Industries include ship and railroad car repair, leatherworking, and the manufacture of cars, textiles, and electrical machinery. Pop. (1989 est.) 52,295.

Friel, Brian (b. Jan. 9, 1929, near Omagh, County Tyrone, N.Ire.), playwright noted for his portrayals of Irish Catholic conditions, in both Ireland and Northern Ireland.

Educated at St. Patrick's College, Maynooth (B.A., 1948), and St. Joseph's Training College, Belfast (1949–50), he taught school in Londonderry for 10 years. After *The New Yorker* began regular publication of his stories, he turned to writing full time in 1960, issu-

ing short stories and radio and stage plays. After a six-month tutelage at the Tyrone Guthrie Theatre in Minneapolis, Minn., U.S., in 1963, he wrote his first dramatic success, *Philadelphia, Here I Come!*, produced first by the Dublin Theatre Festival (1964) and subsequently appearing in New York City and London to critical and popular acclaim. The play told of a young Irishman's mood changes in contemplating emigrating from Ireland to America. Soon, Friel himself was settled in County Donegal, Ireland.

Thereafter he had plays produced almost yearly for the next decade. After writing *The Loves of Cass McGuire* (1966), *Lovers* (1967), *Crystal and Fox* (1968), and *The Mundy Scheme* (1969), he turned more to political themes, relating the dilemmas of Irish life and the troubles in Northern Ireland in such plays as *The Freedom of the City* (1973), *Volunteers* (1975), *Living Quarters* (1977), and *Making History* (1988). Many of his plays—notably *Aristocrats* (1979) and *Translations* (1980)—deal with family ties and with mythmaking as a human need.

Friendly Islands (Pacific Ocean): see Tonga.

friendly society, mutual-aid organization formed voluntarily by individuals to protect members against debts incurred through illness, death, or old age. Friendly societies arose in the 17th and 18th centuries and were most numerous in the 19th century. They had their origins in the burial societies of ancient Greek and Roman artisans. In the Middle Ages the guilds of Europe and England extended the idea of mutual assistance to other circumstances of distress, such as illness.

The friendly societies went a step further by attempting to define the magnitude of the risk against which it was intended to provide and how much the members should contribute to meet that risk. Offshoots of the friendly societies include trade unions, fraternal orders (such as the International Order of Odd Fellows), and life insurance companies.

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Friends, Society of, also called FRIENDS CHURCH, byname QUAKERS, Christian group that arose in the mid-17th century in England and the American colonies, advocating direct inward apprehension of God without creeds, clergy, or other ecclesiastical forms.

A brief treatment of the Society of Friends follows. For full treatment, see MACROPAEDIA: Protestantism.

Quakerism represents the extreme left wing of the 17th-century English Puritan movement. The three chief emphases of its founder, George Fox (1624–91), were the immediacy of Christ's teaching and guidance, the consequent irrelevance of special buildings or ordained ministers, and the application of Christ's teaching to the whole of life. The early Quakers gathered for worship without liturgy or prearrangement of any kind, or any appointed preacher, believing that out of an energetic and expectant silence God might use any one of the worshipers as a minister.

The rapid spread of Quakerism in the north of England was followed by a vigorous expansive movement to London and the rest of England, to Scotland and Ireland, to the continent of Europe, and to North America. The main centres of Quaker missionary activity in the New World were New England, New Amsterdam and Long Island, Maryland, Virginia, and the West Indies. Almost everywhere they went, the Quakers met with persecution for what were considered unconventional Christian practices. Although the Toleration Act (1689) brought an end to the worst violence of

persecution in Great Britain, many disabilities long remained.

During the 18th century, Quaker thought felt the influence of two conflicting tendencies. Quietism, on the one hand, advocated passivity and self-abnegation in deference to divine direction, while the energy and theology of Wesleyanism and other evangelical movements inspired a new fervour. This tension precipitated several separations within Quakerism in the 18th and 19th centuries, most notably in the United States, where followers of Elias Hicks established a number of regional meetings. With the adoption of revivalist methods, of a worship pattern with hymns and set sermons, and of paid pastors, it was inevitable that opposition by traditionalist Friends should lead to further divisions. By the beginning of the 20th century there were thus (1) a group of "orthodox" or evangelical yearly meetings in fellowship, (2) a group of "conservative" yearly meetings in fellowship following the traditional Quaker patterns of worship, speech, and dress, and (3) a group of Hicksite yearly meetings, rigorously separated from all other Quaker groups for 70 years, increasingly interested in "modern thought" and suspected by other groups of being Unitarian in theology. During and after World War I the barriers of suspicion were broken down and cooperation and reunion among different branches ensued.

The Quaker system of church government has remained substantially unaltered since the time of George Fox. The principal unit is the monthly meeting, a body usually meeting once a month and responsible for all matters of membership, for finance and property, and for deliberation on concerns raised by individual members or referred to it by superior meetings. The extreme austerity characteristic of early Quaker worship services has been modified in many areas with the adoption of hymn singing, set prayers, and prepared sermons. Almost alone among Christian bodies, Friends have no form of outward observance of the sacraments. They believe in a spiritual baptism and a spiritual communion.

Friends of Constitutional Government (Japan): see Rikken Seiyūkai.

Friends of God, German GOTTESFREUNDE, medieval Christian fellowship that originated during the early part of the 14th century in Basel, Switz., and then spread to Germany and the Netherlands. Primarily a middle-class, democratic lay movement espousing a Christian life of love, piety, devotion, and holiness, the Friends of God presaged the 16th-century Reformation. Some of its leaders, attacking corruption in the Western church and expecting a subsequent intervention of God, were tried and executed for heresy.

Friends of the Constitution, Society of the: see Jacobin Club.

Friends of the Rights of Man and the Citizen, Society of the: see Cordeliers, Club of the.

Friends World Committee for Consultation (FWCC), international organization of the Society of Friends (Quakers) founded at Swarthmore, Pa., in 1937. It promotes visits, conferences, and study groups among Friends from all parts of the world and maintains contact with various Friends organizations and activities. It is concerned with the work of the United Nations and has a Friends representative to the United Nations in New York City and in Geneva.

Representatives to the FWCC are appointed by the various Friends yearly meetings and other Friends organizations. Meetings are held every three years. It produces several publications, including the *Friends World News*, issued three times a year. The central FWCC office is in Birmingham, Eng.; the European

office is in Edinburgh; and American offices are in Philadelphia and Plainfield, Ind.

Fries, Elias (Magnus) (b. Aug. 15, 1794, Femsjö, Swed.—d. Feb. 8, 1878, Uppsala), Swedish botanist, developer of the first system used to classify fungi.

Fries received his Ph.D. from the University of Lund in 1811 and was appointed as a science lecturer there. Later he was appointed professor and demonstrator in botany but left to accept a professorship at the University of Uppsala, from which he retired in 1859 to study fungi.

During his stay at Lund, Fries had begun to collect and describe known species for his *Systema Mycologicum*, 3 vol. (1821–32), in which he introduced a new system for classifying fungi. With the exception of a few changes with respect to microscopic discoveries, the system is still valid for many groups of fungi.

Fries also developed a system for classifying lichens based on the characters of the organs that produce fruit. This system, presented in his *Lichenographia Europaea Reformata* (1831), was widely accepted until the use of the microscope revolutionized knowledge in



Elias Fries

By courtesy of the Kungliga Biblioteket, Stockholm

this field. Fries was the first person to distinguish between lichens with external coverings on the fruit and those without.

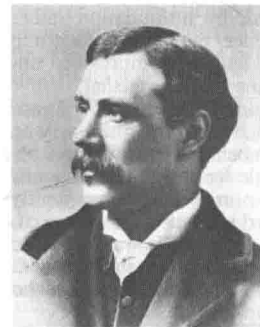
Fries, Jakob Friedrich (b. Aug. 23, 1773, Barby, Saxony [Germany]—d. Aug. 10, 1843, Jena, Thuringia [Germany]), German philosopher.

Fries studied at Leipzig and at Jena, and he became professor of philosophy and elementary mathematics at Heidelberg in 1805. His attitude toward contemporary philosophies is set forth in *Reinhold, Fichte und Schelling* (1803; reprinted 1824 as *Polemische Schriften* ["Polemical Writings"]), *System der Philosophie als evidente Wissenschaft* (1804; "System of Philosophy as Intuitive Science"), and *Wissen, Glaube und Ahndung* (1805; "Knowledge, Belief, and Superstition"). His important *Neue oder anthropologische Kritik der Vernunft*, 3 vol. (1807; "New or Anthropological Critique of Reason") attempted to give a new foundation of psychological analysis to the critical theory of Immanuel Kant, which he sought to reconcile with the philosophy of F.H. Jacobi. His *System der Logik* ("System of Logic") appeared in 1811. In 1816 Fries accepted the chair of theoretical philosophy at Jena, but because of his liberal, nationalist views, he was deprived of his professorship. In 1824 he was recalled to Jena as professor of mathematics and physics, and in 1838 the right of public lecturing on philosophy was restored to him.

Among the most important works of his Jena professorate were the *System der Metaphysik* (1824; "System of Metaphysics") and *Die Geschichte der Philosophie* (1837–40; "The History of Philosophy").

Friese-Greene, William (b. Sept. 7, 1855, Bristol, Gloucestershire, Eng.—d. May 5, 1921, London), British photographer and inventor, sometimes credited with the invention of cinematography.

Friese-Greene constructed a camera for taking a series of photographs on a roll of perforated film moving intermittently behind a shutter, the basic principle of a motion-picture camera. It would appear, however, that the camera was incapable of taking pictures at a sufficient rate for animation, for no successful



Friese-Greene

By courtesy of the Science Museum, London

presentation of moving pictures was given by him, and the credit for a successful cinematographic device must go to Thomas Edison.

Friese-Greene later pioneered stereoscopic and colour cinematography but lacked the technical knowledge necessary to bring his ideas to fruition.

BIBLIOGRAPHY. A biography by Ray Allister (pseud. for Muriel Forth), *Friese-Greene: Close-up of an Inventor* (1948, reprinted 1972), includes photographs from the 1951 film *The Magic Box*, based on this book.

Friesland, coastal province, northern Netherlands, extending inland from the IJsselmeer and the North Sea (west and north) and including four of the West Frisian Islands (see Frisian Islands) off the north coast. The province is drained by a vast system of canals, waterways, and lakes, particularly in the north and west; the principal lakes are Tjeukemeer, Slotermeer, Fluessen, and Sneekemeer. Its area is 1,295 square miles (3,353 square km), rarely exceeding 50 feet (15 m) above sea level, and the population density is less than half the national average. The predominantly Protestant Frisians have maintained both their own language and their own literature to a considerable degree.

The terrain in the southeast, supporting woodlands, orchards, and Frisian cattle, is sandy heathland bordered by fens; some reclamation of peat areas continues. Between fen and coast stretch almost flat clay marshlands and polders, where reclamation continues slowly, chiefly near the north coast. The last serious flooding was in 1825. These lands support potatoes, wheat, sugar beets, and pasture for the Frisian cattle. Agriculture is the basis of the provincial economy; beef and dairy products are sold in large quantities. There is some manufacturing of agricultural machinery in the province, and tourism, largely based on water sports, is an economic asset.

Leeuwarden, the capital, is the only large town, and Harlingen, the only port, serves as its outlet. Other centres are Sneek, Heerenveen, Drachten, Bolsward, Franeker, and Dokkum. There is a nature reserve for seals that is located on the Frisian island of Terschelling. For history, see Frisia. Pop. (1988 est.) 599,104.

Fries's Rebellion (1799), uprising, in opposition to a direct federal property tax, by farmers in eastern Pennsylvania led by John Fries (c. 1750–1818). In July of 1798, the Federalist-controlled U.S. Congress, which greatly needed revenues for an anticipated war with France, had voted a direct federal tax on all

real property, including land, buildings, and slaves. This tax, which caused widespread national resentment against the John Adams administration, infuriated the German farmers of Bucks, Northampton, and Montgomery counties in Pennsylvania. Eventually, several hundred farmers took up arms under the leadership of John Fries. At Bethlehem, Pa., Fries and his men forced, by intimidation rather than by actual violence, the release of a group of tax resisters who had been imprisoned under the custody of the federal marshal.

In response, President Adams called out a group of federal troops and militia, who marched into the rebellious counties and began making wholesale arrests of the insurgents. John Fries was captured and subsequently tried twice, convicted of treason on each occasion, and sentenced to hang. He was pardoned by Adams in April 1800, when the president declared a general amnesty for all those who had been involved in the "rebellion."

frieze, in Greco-Roman classical architecture, the middle of the three main divisions of an entablature (section resting on the capital). The frieze is above the architrave and below the cornice. The term also refers to any long, narrow, horizontal panel or band used for decorative purposes—e.g., on pottery, on the walls of a room, or on the exterior walls of buildings.

The frieze in buildings using the classical Doric order (see order) is usually composed of alternate triglyphs (projecting rectangular blocks, each ornamented with three vertical channels) and metopes (spaces). In buildings using the Ionic, Corinthian, or Composite orders, the frieze is ornamented with relief figures, as in the treasury of the Cnidians at Delphi (early 5th century bc) or the choragic monument of Lysicrates at Athens (310 bc). In Roman buildings the frieze is decorated with plant motifs such as anthemions, acanthus foliage, or garlands. In late Roman and in many Renaissance structures the profile of the frieze is a convex curve and is known as a pulvinated frieze.

The most famous of decorative friezes is undoubtedly that carved on the top of the outer wall of the cella of the Parthenon, just under the ceiling of the portico. This frieze, which is 40 inches (101 cm) high and 525 feet (160 m) long, bears a representation of the ritual procession of the Panathenaic festival and is characterized by superb rhythmic design and

faultless execution. It is a perfect expression of Greek sculpture of the mid-5th century bc and is the most famous example of classical architectural sculpture.

frigate, either of two different types of warships, of the 17th through the 19th centuries and of World War II and after.

The Seven Years' War (1756–63) marked the definite adoption of the term frigate for a class of vessel that was smaller than the three-decked ship but was still capable of considerable firepower. A frigate was a three-masted, fully rigged vessel, with its armament carried on a single gun deck and with additional guns on the poop and forecastle. The number of guns varied between 24 and 56, but 30 to 40 guns were common. Frigates could not stand up to ships of the line in fleet engagements, but, sailing at greater speed, they served as scouts or as escorts protecting merchant convoys from privateers and enemy raiders; they also cruised the seas as merchant raiders themselves. With the transition from sail to steam the term frigate gradually gave way to cruiser.

During World War II, Great Britain revived the name frigate by assigning it to a small escort ship used to guard convoys from submarines.

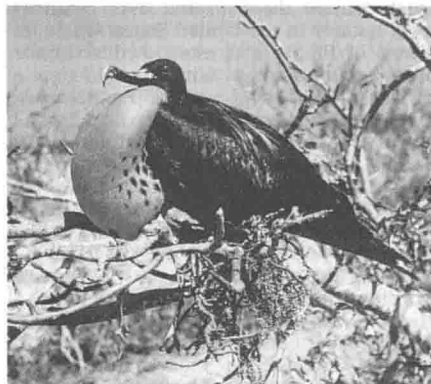


Battle between the frigates HMS *Shannon* and USS *Chesapeake* off Boston during the War of 1812; detail of a lithograph by J.C. Schetky
The National Maritime Museum, London

This vessel displaced about 1,500 tons, was capable of 20 knots, and was equipped with asdic, or sonar, and depth charges. In the postwar decades, the frigate also adopted an antiaircraft role, adding radar and surface-to-air missiles to its antisubmarine gear. Many frigates now carry helicopters to aid in submarine hunting. Such a vessel displaces upward of 3,000 tons, has a top speed of 30 knots or more and carries a crew of about 200.

For three decades after World War II, the U.S. Navy applied the term frigate to a type of escort ship that was somewhat larger than a destroyer. In 1975 these ships were reclassified as cruisers and destroyers, and the United States then used frigate in the same sense as most other navies.

frigate bird, also called MAN-O'-WAR BIRD, any member of five species of large seabirds



Great frigate bird (*Fregata minor*)

Jen and Des Bartlett—Bruce Coleman Inc./EB Inc.

constituting the family *Fregatidae* (order *Pelecaniformes*). Frigate birds are about the size of a hen and have extremely long, slender wings, the span of which may reach to about 2.3 m (nearly 8 feet), and a long, deeply forked tail. In general, adult males are all black, and adult females are marked with white below. The birds have a bare-skinned throat pouch, which in courting males becomes bright red and is inflated, for display purposes, to the size of a person's head. Other distinguishing characteristics are the almost helpless tiny feet with four webbed toes, and a long hooked bill that is used in attacking and robbing other seabirds of their fish.

The frigate bird is perhaps the most aerial of all birds except the swift and alights only to sleep or to tend its nest. The adult, with insufficient preening oil to waterproof its plumage, never willingly alights on the water, but it is unbelievably fast and skillful in the air, soaring effortlessly and often diving to recover falling fish dropped aloft by panic-stricken boobies or other seabirds. It also courses low over the water to seize fish.

Found throughout the world along tropical and semitropical coasts and islands, the frigate bird usually keeps within 100 miles (160 km) of land, to which it must return to roost. It breeds in crowded colonies on islands. Both parents incubate the single white egg.

The largest species (to about 115 cm [45 inches]) is the magnificent frigate bird, *Fregata magnificens*, found on both coasts of America, the Caribbean Sea, and Cape Verde. The great and lesser frigate birds, *F. minor* and *F. ariel*, breed on islands worldwide.

Frigg, also called FRIJA, in Norse mythology, the wife of Odin and mother of Balder. She was a promoter of marriage and of fertility. In Icelandic stories, she tried to save her son's life but failed. Some myths depict her as the weeping and loving mother, while others stress her loose morals. Frigg was known also to other Germanic peoples, as Frija (in German) and Frea; her name survives in English in the word Friday.

frigidity, in psychology, the inability of a woman to attain orgasm during sexual intercourse. In popular, nonmedical usage the word has been used traditionally to describe a variety of behaviours, ranging from general coldness of manner or lack of interest in physical affection to aversion to the act of sexual intercourse. Because of the derogatory connotations that have become



Ionic order frieze, east facade of the Temple of Athena Nike, the Acropolis, Athens, designed by Mnesicles, 5th century bc

By courtesy of the Deutsches Archäologisches Institut, Athens

associated with the term frigidity, it has been replaced in the vocabulary of sex therapists by the general term hypogynism, the inability of a woman to obtain sexual satisfaction under otherwise appropriate circumstances.

The lay term frigidity encompasses three distinct problems recognized by sex therapists: inability to experience a sexual response of any kind; ability to achieve sexual arousal only with great difficulty (hyposexuality); and the inability to achieve orgasm (anorgasmia). Failure of sexual response in females—as in males—may have specific physical sources; such is the case of women who experience vaginal spasms (vaginismus) or pain (dyspareunia) during attempted intercourse. Likewise, female sexual response may be impaired by purely psychological causes, triggered by emotional conflicts outside the sexual relationship or by anxiety and other stresses within the relationship. See also sexual dysfunction.

Friis, Johan (b. Feb. 20, 1494, Lundbygaard, Swed.—d. Dec. 5, 1570, Køge, Den.), Danish statesman who, as chancellor under Christian III, king of Denmark and Norway, helped to establish the Lutheran Church as the state church in Denmark and to reform the state and local administrations.

Friis served as secretary at the court of King Frederick I and became successor-designate to the chancellor. When a civil war (the Count's War; 1533–36) broke out over the succession to the throne following Frederick's death (1533), Friis tried to persuade the nobles of



Friis, detail from an oil painting by Jakob Binck, 1551

By courtesy of the Nationalhistoriske Museum paa Frederiksborg, Denmark

Fyn province to join their Jutland colleagues in supporting the claims of Frederick's eldest son, Christian III. He was taken prisoner by forces supporting the deposed (1523) king Christian II but escaped and rejoined Christian III in 1535.

After Christian III's assumption of power in 1536, Friis became the King's principal adviser, helping to carry out his religious and administrative reforms. Friis directly supervised the confiscation of Catholic church property, which helped Christian reduce his war debt.

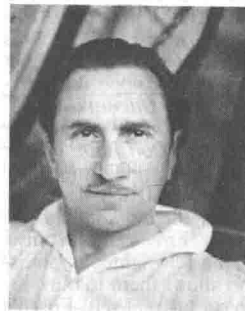
The growing influence of Friis and the Rigsråd (state council) caused the King to declare war on the emperor Charles V (who wanted to place the daughters of Christian II on the Scandinavian thrones). The war was resolved by the Diet of Speyer (1544), a settlement favourable to Denmark. Friis also overcame objections of the Holstein nobility in 1544 when he divided Schleswig and Holstein among the King and his younger brothers.

Friis inspired Danish nobles to enter careers of public service and was also a great patron of the arts. He sponsored continuation and translation of the work of the 12th- and 13th-century Danish historian Saxo Grammaticus and introduced Renaissance architecture to Denmark in the building of his own houses. He was disappointed by the outbreak of the Seven Years' War of the North (1563), believing that war could have been avoided if his advice to Christian III and to Christian's

successor, Frederick II, to assert Danish power in Scandinavia had been heeded.

frilled lizard: see Chlamydosaurus.

Friml, (Charles) Rudolf (b. Dec. 7, 1879, Prague—d. Nov. 12, 1972, Hollywood), U.S.



Rudolf Friml, c. 1932

The Granger Collection, New York City

composer of operettas showing strong European musical influences and suggesting pre-World War I European lightheartedness.

After study under the Czech composer Antonín Dvořák at the Prague Conservatory, Friml served as piano accompanist for the violinist Jan Kubelík in Europe and the United States, where he remained from 1906. In 1912 he was hired to replace Victor Herbert as composer of an operetta proposed for the singer Emma Trentini. The result, *The Firefly* (book and lyrics by Otto Harbach), was highly successful. In the 1920s Friml achieved his greatest popularity. *Rose Marie* (1924; book and lyrics by Harbach and Oscar Hammerstein II), best remembered for the song "Indian Love Call," was followed in 1925 by *The Vagabond King* (book and lyrics by Brian Hooker and W.H. Post), with its popular songs "Only a Rose" and "Some Day," and in 1928 by *The Three Musketeers* (book and lyrics by Clifford Grey and P.G. Wodehouse). From 1934 Friml composed for motion pictures. His last important song, "The Donkey Serenade" (composed with Herbert Stothart; words by Chet Forrest and Bob White), was interpolated into a film version (1937) of *The Firefly*.

fringe, interference (physics): see interference fringe.

fringe benefit, any nonwage payment or benefit (e.g., pension plans, profit-sharing programs, vacation pay, and company-paid life, health, and unemployment insurance programs) granted to employees by employers. They may be required by law, granted unilaterally by employers, or obtained through collective bargaining. Employers' payments for fringe benefits are included in employee-compensation costs and therefore are not usually liable to corporate income tax. If the cost of fringe benefits were paid directly as wages, the worker would pay personal income tax on this amount and therefore have less to spend on such benefits as he might elect to furnish for himself. Thus, the employer can obtain more benefits for the employee with the same amount of money. He can also take advantage of lower group rates for insurance.

Fringe benefits have generally constituted a higher proportion of total employee compensation in Europe than in the United States. In Europe they are most often the result of legislation, whereas in the United States collective bargaining has been more important in gaining such benefits for workers. The prevalence of fringe-benefit programs increased sharply during World War II because controls on this type of compensation were less stringent than controls on wages.

fringe moss, any of the plants of the genus *Grimmia* (order Bryales), which includes sev-

eral hundred species distributed throughout the world, primarily on rocks or stone walls. A few species grow on roofs or in streams; *G. maritima* forms cushions up to four centimetres (1½ inches) tall on rocks along seashores. Nearly 50 species of *Grimmia* are native to North America, and about 30 are found in Great Britain. Most fringe mosses are one to three centimetres tall and have blackish-green, lance-shaped phyllids (leaves) about two millimetres (¼ inch) long, which are sometimes tipped with a white hair.

fringe tree, either of two tree species constituting the genus *Chionanthus* in the family Oleaceae. They get their name from the long, fringing, snow-white flowers that cover the trees in spring. The flowers hang in clusters of about the same length as the leaves and have four narrow petals.

The dark-blue fruits are oval. *C. virginicus*, from southeastern North America, reaches



Fringe tree (*Chionanthus virginicus*)

Gilbert L. Twiest

about 10 metres (33 feet). *C. retusus*, from China, seldom reaches 6 m.

Fringillidae, songbird family, order Passeriformes, sometimes collectively termed New World seedeaters. The group includes grosbeaks, cardinals, longspurs, Galápagos finches, New World sparrows, and Old World buntings. The relationships of seed-eating birds are the subject of great disagreement, many authorities preferring to place certain of these groups in the family Emberizidae (*q.v.*), with a somewhat different family composition.

fringing reef, a coral reef (*q.v.*) consisting of a sea-level flat built out from the shore of an island or continent.

Frio, Cape, Portuguese CABO FRIO, promontory on Brazil's southeast Atlantic coast, Rio de Janeiro state, 70 mi (113 km) east of the city of Rio de Janeiro. Discovered in 1503 by Amerigo Vespucci, the cape became a 16th-century pirate stronghold and now is the site of the towns of Cabo Frio and Arraial do Cabo. The cape attracts tourists for its good weather and the nearby São Mateus Fort, built by the French.

Frioul, Gérard-Christophe-Michel Duroc, duc de (duke of): see Duroc, Gérard-Christophe-Michel.

Frisch, Frank, byname of FRANK FRANCIS FRISCH, also called THE FORDHAM FLASH (b. Sept. 9, 1898, Queens, New York City—d. March 12, 1973, Wilmington, Del., U.S.), U.S. professional National League baseball player and manager, who played in 50 World Series games and was on four pennant winners with the New York Giants (1919–26) and four with the St. Louis Cardinals (1927–37).

Frisch played baseball, football, and basketball at Fordham University (New York City) and after graduating went directly to the Giants in 1919. He played the infield, mainly at second base, through the 1926 season and was then traded to the St. Louis Cardinals, where