

**A DICTION-
ARY OF
SCIENCE**

A Dictionary of Science

BY

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A DICTIONARY OF SCIENCE

BY E. B. UVAROV,

D. R. CHAPMAN, AND ALAN ISAACS

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Foreword to the 1964 Edition

IN revising a dictionary of this size and scope, inevitably the problem must be not what to put in but what to leave out. This revision has been made with two criteria in mind: first, to keep the original flavour of Uvarov's work, particularly in the case of entries that needed to be rewritten, and second, to include only those new words that have come into use in the last decade which are of predominantly scientific rather than technological usage. From the rapidly expanding field of electronics, for example, only the more fundamental words have been included – the *Penguin Dictionary of Electronics* provides a more comprehensive coverage of the technological aspects of the subject. Nevertheless, most of the basic terms used in solid state and microwave physics will be found in this edition.

Probably the largest number of new entries relate to nuclear physics and what may be loosely called space science (including artificial satellites, radio astronomy and cosmology), for it is in these fields that progress has been most rapid in the last ten years. On the chemical side less radical revision has been necessary, though the dictionary has been brought up to date where necessary (e.g. synthetic rubbers and plastics, transuranic elements, chelation compounds, etc).

The earlier editions of this dictionary have dealt primarily with the pure sciences of physics, chemistry, mathematics, and astronomy. However, it was felt that, in view of the widespread interest in the advances that are currently being made in biochemistry, molecular biology, and biophysics, this edition should include a smattering of the key words used in these disciplines. Further and fuller treatment of these words will usually be found in the *Penguin Dictionary of Biology*.

The network of cross-references has been maintained throughout this edition, and cross-references are indicated in the text by the use of italics. Italics have not been used, however, for the elements, as the dictionary lists all the elements (including transuranic elements). Trade names are marked with an asterisk.

Finally, it is necessary to add that during the course of this revision too many reference books and indulgent colleagues have been consulted to permit individual acknowledgements to be made.

A.I.

Abbreviations used in the Text

A°.	Absolute (temperature)
At. No.	Atomic number
A.W.	Atomic weight
(astr.)	Astronomy; as used in astronomy
(bio.)	Biochemistry; as used in biochemistry (or biology)
b. p.	Boiling point
C.	Centigrade
c.c.	Cubic centimetre
(chem.)	Chemistry; as used in chemistry
cm.	Centimetre
conc.	Concentrated
F.	Fahrenheit
f.p.	Freezing point
gm.	Gram
°K.	Degrees on the Kelvin (absolute) scale
Km.	Kilometre
lb.	Pound
(math.)	Mathematics; as used in mathematics
mm.	Millimetre
m.p.	Melting point
(phot.)	Used in photography
(phys.)	Physics; as used in physics
S.G.	Specific gravity
sq.	Square
temp.	Temperature
wt.	Weight

A Dictionary of Science

- AB-**A prefix attached to the names of practical electric units (e.g. *ampere, volt*) to indicate the corresponding unit in the *electromagnetic system* (e.g. *abampere, abvolt*).
- ABERRATION** (astr.). Variation in the apparent position of a *star* or other heavenly body, due to the motion of the observer with the *Earth*.
- ABERRATION, CHROMATIC**. Formation, by a *lens*, of an image with coloured fringes, due to the *refractive index* of *glass* being different for *light* of different colours. The light is thus dispersed (see *dispersion of light*) into a coloured band. The effect is corrected by the use of *achromatic lenses*.
- ABERRATION, SPHERICAL**. Distortion of the image produced by a *lens* or *mirror* due to different rays from any one point of the object making different angles with the line joining that point to the *optical centre* of the lens or mirror (see *mirrors, spherical*) and coming to a focus in slightly different positions.
- ABRASIVE**. A substance used for rubbing or grinding down surfaces; e.g. *emery*.
- ABSCISSA** of a point *P*, in *analytical geometry*, is the portion of the *x* axis lying between the *origin* and a point where the line through *P* parallel to the *y* axis cuts the *x* axis. See Fig. 5, page 70.
- ABSOLUTE**. Not relative; independent. E.g. *absolute zero* of temperature, as distinct from zero on an arbitrary scale such as the *Centigrade scale*.
- ABSOLUTE ALCOHOL**. *Ethyl alcohol* containing not less than 99% pure ethyl alcohol by weight.
- ABSOLUTE EXPANSION** of a liquid. The true *expansion*, not relative to the containing vessel. The coefficient of absolute expansion is equal to the sum of the coefficient of relative or apparent expansion of the liquid and the coefficient of volume expansion of the containing vessel.
- ABSOLUTE THERMODYNAMIC TEMPERATURE**. Temperature measured on the *Kelvin scale of temperature*. The magnitude of the degree absolute is the same as on the *Centigrade scale*, but to convert temperatures on the Centigrade scale to degrees absolute ($^{\circ}\text{A}$ or $^{\circ}\text{K}$) add 273. See *absolute zero*.
- ABSOLUTE UNITS**. System of *units* in which the least possible number of independent *fundamental units* is used.
- ABSOLUTE ZERO**. Zero on the absolute temperature scale (see *absolute thermodynamic temperature*). The lowest temperature theoretically possible; $0^{\circ}\text{K} = -273.16^{\circ}\text{C}$ or -459.69°F .
- Absorption edge**. The *X-ray wave-length* at which a discontinuity appears in the intensity of an *X-ray absorption spectrum*.

ABSORPTION OF GASES

ABSORPTION OF GASES. The *solution of gases in liquids*. Sometimes also applied to the absorption of gases by *solids*.

ABSORPTION OF RADIATION. *Radiant energy* is partly reflected, partly transmitted, and partly absorbed by the surface upon which it falls, the absorption being accompanied by a rise in *temperature* of the absorbing body. Dull black surfaces absorb the greatest proportion of the incident energy, and brightly polished (reflecting) surfaces the least. Surfaces which are the best absorbers are also the best radiators. See *radiation*.

ABSORPTION SPECTRUM. A *spectrum* consisting of dark lines or bands which is obtained when the *light* from a source, itself giving a continuous spectrum, is passed through a *gas* into a *spectroscope*. The dark lines or bands will occur in the same position as the coloured lines in that substance's *emission spectrum* and will be characteristic of the substance. When the absorbing medium is in the *solid* or *liquid state* the spectrum of the transmitted light shows broad dark regions which are not resolvable into sharp lines. Characteristic *X-ray* and *ultra-violet* absorption spectra are also formed.

ABSORPTIVITY of a surface. The fraction of the *radiant energy* incident on the surface which is absorbed. The absorptivity is a pure numeric, but is often referred to as 'absorptive power'. From *Kirchhoff's laws* it follows that the absorptivity is equal to the *emissivity*.

ABUNDANCE. The ratio of the number of *atoms* of a particular *isotope* in a mixture of isotopes of an *element*, to the total number of atoms present. Sometimes expressed as a percentage, e.g. the abundance of $^{238}_{92}\text{U}$ in natural uranium is 0.71%.

ACCELERATION. Rate of change of *velocity*; measured as a change of velocity per unit time.

ACCELERATION DUE TO GRAVITY, *g*. *Acceleration* of a body falling freely in a *vacuum*; varies slightly in different localities as a result of variations in the distance from the centre of mass of the Earth. Standard accepted values = 980.6 cm./sec./sec. at latitude 45°; 981.19 cm./sec./sec. at Greenwich (32.17 and 32.19 ft/sec./sec. respectively).

ACCELERATOR (chem.). A substance which increases the rate of a *chemical reaction* (i.e. a *catalyst*), particularly in the manufacture of *vulcanized rubber*.

ACCELERATOR (phys.). A machine for increasing the *kinetic energy* of charged particles (e.g. *protons*, *electrons*, *nuclei*) by accelerating them in *electric fields*. In *electrostatic generators* (see also *Van der Graaff generator* and *tandem generator*) the acceleration is achieved directly by using a very high *potential difference*. In multiple accelerators a lower potential difference is used repeatedly to give the particle successive increments of energy. Multiple accelerators are classified as *linear accelerators* or *cyclic accelerators*. See *cyclotron*, *synchrotron*, *synchro-cyclotron*, *betatron*, and *bevatron*.

ACCEPTOR. An imperfection in a *semiconductor* which causes *hole* conduction.

ACCUMULATOR, storage battery, secondary cell. Device for 'storing' electricity. An electric current is passed between two plates in a liquid; this causes chemical changes (due to *electrolysis*) in the plates and the liquid. When the changes are complete, the accumulator is charged. When the charged plates are joined externally by a conductor of electricity, the chemical changes are reversed, a current flows through the conductor till the reversal is complete, and the accumulator is discharged. In the common lead accumulator, the liquid is *sulphuric acid* of *specific gravity* 1.20 to 1.28, the positive plate when charged is lead peroxide, PbO_2 , and the negative plate is spongy lead. During discharge both plates tend to become lead sulphate, PbSO_4 , and the *specific gravity* of the acid solution falls. Discharge should not be continued beyond the point at which the S.G. reaches 1.15, otherwise an insoluble sulphate of lead, not decomposed on re-charging, may be formed. When this occurs, the cell is said to be sulphated. Nickel-iron (Ni-Fe*) accumulators are also widely used, in which the negative plate is iron and the positive plate is a nickel oxide. In these cells the liquid is a 20% solution of *potassium hydroxide*.

ACETAL. An organic compound of the general formula RCH(OR')_2 , where R is hydrogen or an organic radical, and R' is an organic radical. Term is generally applied to $\text{CH}_3\text{CH(OC}_2\text{H}_5)_2$, a liquid, b.p. 104°C .

ACETALDEHYDE. CH_3CHO . Colourless liquid with a pungent fruity smell, b.p. 21°C . Formed by the *oxidation* of *ethyl alcohol*; further oxidation gives *acetic acid*. Used as an intermediate in the manufacture of many organic compounds.

ACETAMIDE. CH_3CONH_2 . Colourless crystals, m.p. 81°C ., odourless when pure. Used industrially as a *solvent*, etc.

ACETANILIDE, antifebrin. $\text{C}_6\text{H}_5\text{NHCOCH}_3$. White crystalline solid, m.p. 112°C . Used as an *antipyretic*.

ACETATE. A salt or an ester of *acetic acid*.

ACETATE PLASTICS. Plastics made from *cellulose acetate* (see also *rayon*).

ACETIC ACID. CH_3COOH . The acid contained in *vinegar* (3 to 6%). Colourless corrosive liquid with a pungent smell; m.p. 16.6°C ., b.p. 118.1°C . Solidifies at low temperatures to 'glacial acetic acid'. Commercially obtained from *pyroligneous acid*, from *vinegar* made when *alcohol* is oxidized by the action of *bacteria*, and by the *oxidation* of *acetaldehyde*. Used in the manufacture of *cellulose acetate* and in other industries.

ACETIC ETHER. See *ethyl acetate*.

ACETONE, dimethyl ketone. CH_3COCH_3 . Colourless inflammable liquid with a pleasant smell. B.p. 56.5°C . Used as a *solvent*, especially in the production of *rayon*.

ACETYLENE, ethyne. C_2H_2 . Colourless, poisonous, inflammable gas. Made by the action of water on *calcium carbide*, CaC_2 , or by the action of an electric arc on other *hydrocarbons*. Used as a starting material for many organic compounds, and for *welding* on account of the high flame

temperature (about 3300° C.) it produces when burnt in oxygen. (See *oxy-acetylene burner*.)

ACHROMATIC LENS. *Lens* free from chromatic *aberration*, giving an image free from coloured fringes. Consists of a pair of lenses, one of *crown glass*, the other of *flint glass*, the latter correcting the *dispersion* caused by the former.

ACID. Substance which liberates *hydrogen ions* in *solution*; substance which contains hydrogen which may be replaced by a *metal* to form a *salt*; substance having a tendency to lose *protons*. Many acids are corrosive, have a sour taste, and turn *litmus* red.

ACID AMIDES. See *amides*.

ACID DYES. Group of *dyes*, nearly all *salts* of *organic acids*; used chiefly for dyeing wool and natural silk from an acid dyebath.

ACID RADICAL. A *molecule* of an *acid* without the *acidic hydrogen*. E.g., the *bivalent sulphate radical*— SO_4 , from *sulphuric acid*, H_2SO_4 , is present in all sulphates.

ACID SALT. An *acid* in which only a part of the *acid hydrogen* has been replaced by a *metal*. E.g. *sodium bicarbonate*, NaHCO_3 .

ACID VALUE of a fat or oil. Measure of the free *fatty acid* present; the number of *milligrams* of *potassium hydroxide* required to neutralize the free fatty acids in one gram of the substance.

ACIDIC. Having the properties of an *acid*; the opposite of *alkaline*.

ACIDIC HYDROGEN. That portion of the hydrogen in an *acid* which is replaceable by *metals* to form *salts*.

ACIDIMETRY. Determination of the amount of *acid* present in a *solution* by *titration*. See *volumetric analysis*.

ACIDOLYSIS. *Hydrolysis* by means of an *acid*.

ACOUSTICS. The study of *sound*.

ACRE. British unit of area. 4840 square yards.

ACRIFLAVINE, 3:6-diaminomethylacridine chloride hydrochloride. Yellow substance used as an *antiseptic*.

ACROLEIN. $\text{CH}_2:\text{CH}.\text{CHO}$. Colourless liquid with an irritating smell. B.p. 52.5° C.

ACRYLIC ACID, $\text{CH}_2:\text{CH}.\text{COOH}$. Corrosive liquid, m.p. 13° C., b.p. 141° C. Derivatives form the basis of the important *acrylic resins*.

ACRYLIC RESINS. Class of *plastics* obtained by the *polymerization* of derivatives of *acrylic acid*. They are transparent, colourless, and *thermoplastic*; widely used, especially if a clear, transparent material is required.

ACRYLONITRILE, vinyl cyanide. $\text{CH}_2:\text{CH}.\text{CN}$. Colourless liquid, b.p. 78° C. Used in the manufacture of *plastics*, *synthetic rubbers*, and artificial textile fibres.

ACTINIC RAYS. Portion of the *Sun's* radiation rich in *ultra-violet radiation*, having a strong effect on a photographic plate.

ACTINIDES, actinons. The name of the group of *elements* with *atomic numbers* from 89 (actinium) to 103; analogous to the *lanthanides*. See Table 5, page 335.

- ACTINIUM.** Ac. Element. A.W. 227. At. No. 89. Radioactive. See *radioactivity*.
- ACTION.** The product of *work* and time. *Planck's constant* of action is measured in the C.G.S. units of *erg-seconds*.
- ACTIVATED ALUMINA.** Aluminium oxide which has been dehydrated in such a way that a porous structure of high surface area is obtained. Activated alumina has the power of adsorbing *water vapour* and certain gaseous *molecules*. Used for drying air and other gases.
- ACTIVATED CARBON, active charcoal.** Carbon, especially charcoal, which has been treated to remove *hydrocarbons* and to increase its powers of *adsorption*. Used in many industrial processes for recovering valuable materials out of gaseous mixtures; as a deodorant; and in *gas masks*.
- ACTIVATION** (phys.). The process of inducing *radioactivity*.
- ACTIVE MASS** (chem.), in the Law of *Mass Action* is taken to mean the *molecular concentration* of the substance under consideration.
- ACTIVITY.** The number of *disintegrations* of a *radioactive material* per unit time. See *Curie*.
- ACTOMYOSIN.** A complex of two *proteins*, actin and myosin, which is the major constituent of muscle. The contraction of muscles is due to the shortening of actomyosin fibrils.
- ACUTE ANGLE.** Angle of less than 90° .
- ADDITION COMPOUND.** Chemical *compound* formed by the addition of an *atom* or group of atoms to a *molecule*. E.g. *phosgene*, COCl_2 , is an addition compound of *carbon monoxide*, CO , and chlorine, Cl_2 .
- ADENINE.** 6-aminopurine. $\text{C}_5\text{H}_3\text{N}_4\text{NH}_2$. A *purine base* occurring in *nucleic acids*, which plays a part in the formulation of the *genetic code*. Also occurs in *adenosine triphosphate*.
- ADENOSINE TRIPHOSPHATE, ATP.** A *nucleotide* of importance in the transfer of *energy* within living *cells*. One of the phosphate groups can be readily transferred to other substances, in the presence of the appropriate *enzymes*, and with it goes a considerable amount of stored energy. It is as a result of the transfer of these phosphate groups that energy is made available in cells for chemical synthesis, muscle contraction, etc. ATP which has lost one phosphate group becomes the diphosphate (ADP). Adenosine is a *nucleoside* consisting of *adenine* and D-ribofuranose.
- ADHESION.** Sticking to a surface. The effect is produced by *forces* between *molecules*.
- ADHESIVES.** Substances used for sticking surfaces together; e.g. *glues*, *cements*, etc.
- ADIABATIC.** Taking place without *heat* entering or leaving the system.
- ADMITTANCE.** The reciprocal of *impedance*.
- ADRENALINE, epinephrine.** 3,4-dihydroxy- α -(methylaminoethyl)benzyl alcohol, $\text{C}_9\text{H}_{13}\text{NO}_3$. *Hormone* produced by the adrenal glands. Used in medicine.
- ADSORBATE.** The substance which is adsorbed on a surface. See *adsorption*.

ADSORPTION

ADSORPTION. Concentration of a substance on a surface; e.g. *molecules* of a *gas* or of a dissolved or suspended substance on the surface of a *solid*.

AELOTROPIC. See *anisotropic*.

AERIAL (U.S.A., antenna). That part of a *radio* system from which *energy* is transmitted into, or received from, *space* (or the *atmosphere*).

AEROBIC. In the presence of free oxygen.

AEROLITES. *Meteorites*; especially those consisting of stony material rather than iron.

AERO METAL. Casting *alloy* consisting chiefly of aluminium, zinc, and copper.

AEROSOL. A dispersion of *solid* or *liquid* particles in a *gas*; e.g. *smoke*.

AETIOLOGY (U.S.A., etiology). The science or philosophy of causation.

Used in medicine to mean the science of the causes of disease.

AFFINITY (chem.). Chemical attraction; *force* binding *atoms* together.

AFTER-DAMP. Poisonous mixture of *gases*, containing *carbon monoxide*, formed by the explosion of *fire-damp* (*methane*, CH_4) in coal-mines.

AFTER-GLOW. A glow sometimes observed high in the western sky after sunset. Caused by fine dust particles in the *upper atmosphere* scattering the *light* from the *Sun*.

AFTER-HEAT. *Heat* generated in a *nuclear reactor* after it has been shut down, by the *radioactive* substances formed in the *fuel elements*.

AGAR-AGAR. A *gelatin-like* material obtained from certain seaweeds. Chemically related to the *carbohydrates*. A *solution* in hot water sets to a firm jelly, which is used as a base for *culture media* for growing *bacteria*.

AGATE. Natural form of *silica*, SiO_2 . Very hard, used for knife-edges of *balances*, for mortars for grinding hard materials, and in ornaments.

AGONIC LINE. Line of zero *magnetic declination*.

AIR, THE. See *atmosphere*.

AIR THERMOMETER. See *gas thermometer*.

ALABASTER. Natural opaque form of *hydrated calcium sulphate*, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$.

ALBUMENS, ALBUMINS. Group of water-soluble *proteins* occurring in many animal tissues and fluids; e.g. egg-white (egg albumen), milk (lactalbumen), and blood (serum albumen).

ALBUMINOIDS. See *scleroproteins*.

ALCHEMY. Predecessor of scientific *chemistry*. An art by which its devotees sought, with the aid of a mixture of mysticism, *astrology*, practical chemistry, and quackery, to transmute *base metals* into gold, prolong human life, etc. Flourished from about A.D. 500 till the Middle Ages, when it gradually fell into disrepute.

ALCOHOL, ETHYL. See *ethyl alcohol*.

ALCOHOLOMETRY. The determination of the proportion of *ethyl alcohol* in spirits and other *solutions*; usually performed by measuring the *specific gravity* of the liquid at a standard *temperature* by a specially graduated *hydrometer*.

ALCOHOLS. Class of *organic compounds* derived from the *hydrocarbons*, one

or more hydrogen atoms in molecules of the latter being replaced by hydroxyl groups, $-\text{OH}$. E.g. ethyl alcohol (ordinary 'alcohol') is $\text{C}_2\text{H}_5\text{OH}$, theoretically derived from ethane, C_2H_6 . Alcohols which contain more than one hydroxyl group are called *polyhydric alcohols*.

ALDEHYDE. See *acetaldehyde*.

ALDEHYDES, THE. Class of organic compounds of the type $\text{R}-\text{C}\begin{smallmatrix} \nearrow \text{O} \\ \searrow \text{H} \end{smallmatrix}$ where R is an alkyl or aryl radical.

ALDOL, beta-hydroxybutyraldehyde, $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CHO}$. Thick oily liquid formed by the condensation of acetaldehyde.

ALGEBRA. Branch of mathematics dealing with the properties of and relationships between quantities by means of general symbols.

ALGEBRAIC SUM. The total of a number of quantities of the same kind, with due regard to sign. Thus the algebraic sum of 3, - 5, and - 2 is - 4.

ALGIN. A loose term for *alginic acid* or its sodium salt.

ALGINIC ACID. A complex organic compound related to the carbohydrates, found in certain seaweeds. Used for preparing emulsions and as a thickening agent in the food industry; its salts, the alginates, can be made into textile fibres which are soluble in alkalis and are used for special purposes.

ALGORITHM, algorism (math.). A systematic mathematical procedure which enables a problem to be solved in a finite number of steps. Problems for which no algorithms exist require *heuristic* solutions.

ALIDADE. Instrument for measuring vertical heights and distances.

ALIPHATIC COMPOUNDS. Organic compounds containing open chains of carbon atoms, in contradistinction to the closed rings of carbon atoms of the aromatic compounds. Comprise the paraffins, the olefins and the acetylenes as well as all their derivatives and substitution products.

ALIQOT PART. A divisor of a number or quantity which will give an integer. Thus 3 is an aliquot part of 6, but 5 is not.

ALIZARIN, 1:2 dihydroxyanthraquinone, $\text{C}_{14}\text{H}_6\text{O}_2(\text{OH})_2$. Orange-red crystalline solid, m.p. 289°C . Colouring matter formerly extracted from the root of the madder plant, now made synthetically. Used in dyeing with the aid of mordants.

ALKALI. Soluble hydroxide of a metal, particularly of one of the alkali metals; term is often applied to any substance which has an alkaline reaction (i.e. turns litmus blue and neutralizes acids) in solution. See also *base*.

ALKALI METALS. The metals lithium, sodium, potassium, rubidium, and caesium; belonging to Group 1 of the periodic table.

ALKALIMETRY. Determination of the amount of alkali present in a solution, by titration. See *volumetric analysis*.

ALKALINE. Adjective applied to an alkali; opposite of *acidic*.

ALKALINE EARTH METALS. The bivalent group of metals comprising beryllium, magnesium, calcium, strontium, barium, and radium belonging to Group 2 of the periodic table.

ALKALOIDS

ALKALOIDS. Group of *basic* organic substances of plant origin, containing at least one nitrogen *atom* in a ring structure in the *molecule*. Many have important physiological actions and are used in medicine. E.g. *cocaine*, *nicotine*, *quinine*, *morphine*.

ALKYD RESINS. See *glyptal resins*.

ALKYL RADICALS. *Univalent hydrocarbon radicals*, particularly those derived from hydrocarbons of the *paraffin series*, and having the general formula C_nH_{2n+1} . E.g. methyl, CH_3- ; ethyl, C_2H_5- .

ALLOMERISM. A similarity in the crystalline structure of substances of different chemical composition.

ALLOTROPES, *allotropic forms*. See *allotropy*.

ALLOTROPY. The existence of a chemical *element* in two or more forms differing in physical properties but giving rise to identical chemical *compounds*. E.g. sulphur exists in a number of different *allotropic forms*.

ALLOY. A composition of two or more *metals*; an alloy may be a *compound* of the metals, a *solid solution* of them, a heterogeneous *mixture*, or any combination of these.

ALLUVIAL. Deposited by rivers.

ALLYL RESINS. Synthetic *resins* formed by the *polymerization* of chemical *compounds* containing the allyl group, $CH_2 = CH - CH_2-$.

ALPHA PARTICLE, α -particle. Helium *nucleus*; i.e. a close combination of two *neutrons* and two *protons* (see *atom*, *structure of*), and therefore positively charged. Alpha particles are emitted from the *nuclei* of certain *radioactive elements*. See *radioactivity*.

ALPHA RAYS, α -rays. Streams of fast-moving *alpha particles*. Alpha rays produce intense *ionization* in *gases* through which they pass, are easily absorbed by *matter*, and produce fluorescence on a fluorescent screen.

ALTAZIMUTH. Instrument for the measurement of the *altitude* and *azimuth* of heavenly bodies.

ALTERNATING CURRENT. A flow of *electricity* which, after reaching a maximum in one direction, decreases, finally reversing and reaching a maximum in the opposite direction, the *cycle* being repeated continuously. The number of such cycles per second is the *frequency*.

ALTERNATOR. A machine for producing electrical *alternating currents*.

ALTITUDE. 1. Height. 2. Altitude of the Sun, or other heavenly body, is its angle of *elevation*.

ALUDEL. See *udell*.

ALUM, potash alum. $K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$. Crystalline potassium, aluminium sulphate. The *compound* occurs naturally and is used as a *mordant* in dyeing, for fireproofing, and other technical purposes.

ALUMINA. Aluminium oxide, Al_2O_3 . Occurs naturally as *corundum* and *emery*, and in a *hydrated form* as *bauxite*. (See also *activated alumina*.)

ALUMINIUM. Al. Element. A.W. 26.9815. At. No. 13. Light white *metal*, S.G. 2.7, m.p. 659.70° C., ductile and malleable, good *conductor* of electricity. Occurs widely in nature in *clays*, etc.; extracted mainly from *bauxite* by *electrolysis* of a molten mixture of purified *bauxite* and

cryolite. The metal and its *alloys* are used for aircraft, cooking utensils, electrical apparatus, and for many other purposes where its light weight is an advantage.

ALUMINIUM BRASS. *Brass* containing small amounts of aluminium.

ALUMINIUM BRONZE. *Alloy* of copper containing 4%–13% aluminium.

ALUMS, the. Double *salts* of the general formula



where M is a *univalent metal* such as sodium, potassium, or ammonium, and R is a *trivalent metal* such as aluminium or chromium.

ALUM-STONE. See *alunite*.

ALUNITE, alum-stone. Natural *compound* of potassium and aluminium sulphate and aluminium hydroxide, $K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 4Al(OH)_3$.

Used as a source of potash *alum*.

AMALGAM. *Alloy* of mercury.

AMALGAMATION PROCESS for gold. Gold-bearing rock or sand, after crushing, is treated with mercury, which forms an *amalgam* on the surface of the gold. The amalgamated particles are allowed to stick to amalgamated copper plates, the rest of the ore being washed away; they are then removed, the mercury is distilled off in iron *retorts*, and the remaining gold purified by *cupellation*.

AMATOL. Explosive mixture of 80% *ammonium nitrate* and 20% *T.N.T.*

AMBER, succinite. A fossil *resin*, derived from an extinct species of pine. Obtained from mines in East Prussia, and found on seashores. Contains *succinic acid*. Yellow to brown solid, used for ornamental purposes.

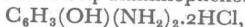
AMBERGRIS. Grey or black waxy material which occurs (probably as the result of disease) in the intestines of the sperm whale. Used in perfumery.

AMERICIUM. Am. *Transuranic element*, At. No. 95. *Radioactive*. Member of the *actinide series*. Most stable *isotope*, $^{243}_{95}\text{Am}$, has *half-life* of 8.8×10^3 years.

AMETHYST. Violet variety of *quartz*; impure crystalline *silica*, SiO_2 .

AMIDES. Group of *organic compounds* formed by replacing hydrogen *atoms* of *ammonia*, NH_3 , by *organic acid radicals*. E.g. *acetamide*, CH_3CONH_2 .

AMIDOL*. Hydrochloride of 2:4-diaminophenol,



used in *photography* as a developer.

AMINES. Compounds formed by replacing hydrogen *atoms* of *ammonia*, NH_3 , by *organic radicals*. Classified into primary amines of the type NH_2R ; secondary, NHR_2 ; and tertiary, NR_3 . See also *quaternary ammonium compounds*.

AMINO ACID. A *carboxylic acid* which contains the *amino group* $-\text{NH}_2$.

These acids are the units which link together into *polypeptide chains* to form *proteins*; they are therefore of fundamental importance to life. Some twenty different amino acids occur in nature, all of which have the general formula: $\text{R}-\text{CH}-\text{NH}_2-\text{COOH}$. See Table 3, page 333. 'Essential' amino acids are those which an *organism* is unable to

AMINO GROUP

synthesize and therefore has to obtain from its environment. There are eight 'essential' amino acids for man.

AMINO GROUP. The univalent group $-\text{NH}_2$.

AMINOPLASTIC RESINS. Synthetic resins derived from the reaction of urea, melamine, or allied amino compounds with aldehydes. Form the basis of thermosetting moulding materials.

AMMETER. Instrument for the measurement of electric current. In moving iron ammeters, a strip of soft iron is caused to move in the magnetic field set up by the current flowing through a coil; for the measurement of direct current, the more accurate moving coil instruments contain a permanent magnet between the poles of which is pivoted a coil carrying the current to be measured. In each type of instrument a pointer attached to the moving portion moves over a scale graduated in amperes.

AMMONAL. Mixture of ammonium nitrate, NH_4NO_3 , and aluminium. Used as an explosive.

AMMONIA. NH_3 . Pungent-smelling gas, very soluble in water to give an alkaline solution containing ammonium hydroxide, NH_4OH . Obtained synthetically from atmospheric nitrogen (see Haber process) and as a by-product of coal-gas manufacture. Used in refrigeration, and for the manufacture of explosives and fertilizers.

AMMONIUM CHLORIDE, sal ammoniac. NH_4Cl . White soluble crystalline salt, used in dry cells and Leclanché cells.

AMMONIUM HYDROXIDE. NH_4OH . Compound presumed to exist in aqueous solutions of ammonia; name is often applied to the solution.

AMMONIUM NITRATE. NH_4NO_3 . White soluble crystalline salt, m.p. 169.6°C ., decomposes on heating to form nitrous oxide, N_2O , and water. Used in explosives, e.g. ammonal, amatol.

AMMONIUM RADICAL. NH_4- . Univalent radical which has not been obtained free, but in compounds behaves similarly to an alkali metal, giving rise to ammonium salts.

AMMONIUM SULPHATE, sulphate of ammonia. $(\text{NH}_4)_2\text{SO}_4$. White soluble crystalline salt, obtained as a by-product of coal-gas manufacture, used as a fertilizer.

AMORPHOUS. Non-crystalline; having no definite form or shape.

AMPERE. Unit of electric current approximately equivalent to the flow of 6×10^{18} electrons per second. The absolute ampere, which is one-tenth of an ab-ampere (see ab-), is equal to 1.000165 International amperes. The International ampere was originally defined as the unvarying current which when passed through a solution of silver nitrate, deposits silver at the rate of 0.00111800 grams per second. Redefined in 1948 as the intensity of a constant current which, if maintained in two parallel, rectilinear conductors of infinite length, of negligible circular section and placed at a distance of one metre from one another in vacuo, will produce between the conductors a force equal to 2×10^{-7} M.K.S. units of force per metre of length.