

The RESTON
Encyclopedia
of Biomedical
Engineering
Terms

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George J. Whalen

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Preface

Growing interest in the field of biomedical engineering has brought technology increasingly closer to its ancient and fundamental mandate: to harness and utilize the forces of nature in the service of mankind. And yet, this hybrid, interdisciplinary field has long been burdened by the weight of two languages: that of the *physician* and that of the *engineer*. For medicine and engineering have evolved as separate arts, only recently converging because necessity has dictated an increased understanding between the two disciplines. Perhaps the greatest barrier to understanding between medical personnel and engineers has been the language which each uses when communicating with his peers. Physicians are trained to communicate with physicians; engineers, to communicate with engineers. Not surprisingly, the interface between these arts has often proven to be a gulf of misunderstanding.

Progress in biomedical engineering requires that health care specialists and technical personnel learn to speak each other's language. For, in the unhindered exchange of ideas, concepts, problems, and solutions between these two important disciplines, exciting new breakthroughs will become possible, leading the way to better health care for us all.

This book, then, is dedicated to the task of improving communications between the provider of health care and the technologist. It expresses the language of biomedical engineering in the tongues of both the physician and the engineer, with painstaking emphasis on simplifying the definitions of specialized words from both disciplines. Our objective has been to write definitions of terms which are satisfyingly faithful to present understanding within each discipline, while being simple enough to allow the meaning of each term to cross over to the reader in the other discipline. In effect, we



have attempted to provide a *common* reference work for medical and technical personnel, to aid in the transfer of information between these two great disciplines.

In preparing this work, we have been very fortunate to have had the aid, advice, and encouragement of countless sources in the fields of medicine and technology. The contributions of these sources are gratefully acknowledged, as are the meritorious efforts of Mrs. John J. Dillon, whose skills at the typewriter first made this work a reality.

Rudolf F. Graf
George J. Whalen

A

abducens nerve The sixth cranial nerve, arising in the pons and innervating the musculature of the eye.

abduct To move a part of the body away from the midline.

ablation Removal or detachment of a part.

-able Suffix meaning capable of.

abnormal morphology A significant difference in shape or appearance of an oscillographic or graphic trace from the norm or expected waveshape. Typically, an electrocardiographic waveform in which an irritable focus causes myocardial contraction, rather than the sinoatrial node, thus giving rise to an ECG complex of abnormal appearance in the clinical electrocardiogram.

ABO grouping Term descriptive of the types of human blood: A, B, AB, and O. An individual's blood type is determined by the presence or absence of identifiable constituents. For example, the agglutinogens, A and B can be absent, or present, or one can be missing. Many distinct sub-

groups have been identified in the Standard or Universal grouping, after the system devised by Landsteiner.

abortion The termination of a pregnancy before fetal viability has been reached.

abrasion An area of the body rubbed bare of skin or mucous membrane.

abscess A collection of pus in a cavity formed by the disintegration of tissue.

absolute address 1. An address used to identify work in a program with respect to its location in storage, but without regard to its position in that program; it may be either symbolic or nonsymbolic. 2. A binary number that is permanently assigned as the address of a storage location in a computer.

absolute coding Coding written in machine language. It does not require processing before it can be understood by the computer.

absolute pressure A measurement of pressure with respect to true zero pressure. It is the sum of the atmospheric (barometric) and gauge pressures.

absolute-value computer

absolute-value computer A computer that processes all data expressed in full values of all variables at all times. Contrasted with incremental computer which handles changes in variables as well as absolute values.

absorbed dose 1. Energy imparted by any ionizing radiation absorbed by a unit mass of material at a particular point of interest. 2. The portion of an administered medication which is not excreted by the body.

absorbed dose rate The dose per unit of time, measured in rads per second, minute, or hour.

absorptiometer An instrument for quantitative analysis of liquids or gases by measurement of radiation absorbed by a sample.

absorption 1. The process by which a medication or radiated energy is taken into the body. 2. The process by which the number of particles or photons entering a body is reduced by interaction of the particle or radiation with the matter. Similarly, the reduction of the energy of a particle while traversing a body of matter. 3. Penetration of a substance or pathogen into the body of another.

ac Abbreviation for alternating current.

acapnia The absence of carbon dioxide from the blood. In cases of hyperventilation, too much CO_2 may be lost from the bloodstream, inducing syncope (fainting).

ac bias The alternating current, usually of a frequency several times higher than the highest signal frequency, that is fed to a magnetic recording head, in addition to the signal current. This ac bias serves to linearize the magnetic recording process.

accelerated life test Any set of test conditions designed to reproduce in a short time

the deteriorating effect obtained under normal service conditions.

accelerators 1. Machines that accelerate either protons or electrons to high energies. Types of accelerators are: betatrons, cyclotrons, Van de Graaff devices, linear accelerators, and other newer machines, the energy limits of which range between 10 million and several billion electron volts. Accelerators are used medically in the treatment of various types of malignant tumors. 2. An agent used to hasten a reaction, to reduce curing, or hardening time of a thermosetting resin, by entering into the reaction. The term *accelerator* is often used interchangeably with the term *promoter*. An accelerator or promoter is often used along with a catalyst, hardener, or curing agent.

access In data processing, the act of summoning data from, or placing data in, storage.

accessory nerves See *cranial nerves*.

access time 1. The time it takes a computer to locate data or an instruction word in its memory or storage section, and transfer it to its arithmetic unit where the required computations are performed. 2. The time it takes to transfer information which has been operated on, from the arithmetic unit to the location in memory where the information is to be stored. Also called *waiting time*. 3. The time interval between the instant at which data is to be stored and the instant at which storage is completed (i.e., the *write time*).

accident prone Special susceptibility to accidents due to psychological causes.

ac coupling Signal transfer from one circuit to another circuit through a capacitor or other device which passes the desired signal, but not the static characteristics of an electrical signal.

accretion Growth, accumulation, or enlargement.

accumulator 1. Register and associated equipment in the arithmetic unit of the computer in which arithmetical and logical operations are performed. 2. Main computational register of a computer. 3. Unit in a digital computer where numbers are totaled—that is, accumulated. Often the accumulator stores one operand, and upon receipt of any second operand, it forms and stores the result of performing the indicated operation on the first and second operands. Related to adder. 4. Means of storing energy or electric power with such techniques as lifted weights and chemical changes.

accuracy 1. The ability of a measurement system to determine the true level or state of a variable in terms according to standards of reference. 2. That property of a well-described measurement process that sets forth the proximity of a given output of the process to a true value, agreed upon by workers in the field. 3. The limit of an electrical indicating instrument usually expressed as a percentage of rated full-scale value, which the errors inherent in a meter will not exceed when used at reference conditions. These errors include full-scale error, balance error, scale error, and magnetic panel error. While accuracy is the composite effect of these errors, not all of these errors are necessarily present in every meter. 4. The measure of a meter's ability to indicate a value corresponding to the absolute value of electrical energy applied. Accuracy is expressed as a percentage of the meter's rated full-scale value. 5. The maximum angular difference between the shaft angle input to an encoder and the indicated shaft angle as read from the code output. Accuracy includes both transition error and quantizing error. 6. The ratio of

the error to the full-scale output, or the ratio of the error to the output expressed as a percent.

acetone A colorless liquid with a pleasant ethereal odor. It is found in small quantities in normal urine and is used as a solvent for fats and resins.

acetylcholine A chemical agent which aids in the transmission of nerve impulses across junctional synapses between nerves and muscles.

achalasia 1. An inability to relax the muscles of a hollow organ. 2. A spasm; typically, of the esophageal musculature at the entrance to the stomach, bringing about an uncomfortable sensation of fullness.

achlorhydria An abnormally low hydrochloric acid level in the stomach, resulting from a disease state or from the process of aging in some cases.

acid A chemical substance that, in solution, releases hydrogen ions. Acids taste sour, turn blue litmus red, unite with bases to form salts, and in general have chemical properties opposed to those of alkalis. Many thousands of acids are known to chemistry; hundreds are useful to medicine and scores are present in the human body.

acid-base balance Balance between acidic and basic component which determines the pH of the body fluids.

acid-fast In bacteriology, a term applied to certain bacteria which retain the red carbo-fuchsin stain after the application of an acid solution. Other organisms are decolorized. Tubercle bacilli are acid-fast.

acidophils Those cells situated in the anterior pituitary gland which secrete hormone directly influencing growth.

acidosis A tendency toward a higher acid reaction in the blood stream and usually

a lower alkaline reaction. The body's alkaline reserve is depleted. This condition occurs in advanced diabetes or under other circumstances, such as prolonged diarrhea, in which the body loses sodium bicarbonate. Retention of carbon dioxide in the blood, as occurs in drowning, when the lungs are underventilated, also induces acidosis. Patients with severe acidosis may gasp for breath, go into a coma, even die. This is because the carbon dioxide content of the blood importantly regulates the breathing process.

acne An inflammatory disease of the sebaceous glands.

acoustic impedance The degree of resistance to transmitted sound imparted by the characteristic elasticity of a given substance.

acoustic nerve The eighth cranial nerve, arising in the pons. This paired nerve innervates the sensory components of the ears and is associated with hearing and the state of balance.

acoustic shock The physical pain, dizziness, and sometimes nausea caused by hearing a sudden loud sound. The threshold of pain is about 120 dB.

acoustic telemetry The utilization of sound energy for the transmission of information. It differs from others in that information derived from the received signal is encoded by the transmitting source.

ac set and reset inputs See *synchronous inputs*.

actin The major component of the thin filaments of living muscle tissue. It is a protein which acts with other components of the muscle structure to bring about contraction.

actino electricity Electricity produced by

the action of radiant energy upon crystals.

actinometer An instrument that measures the intensity of radiation by determining the amount of fluorescence produced by that radiation.

actinotherapy A treatment method involving exposure of the body to ultraviolet light rays or infrared radiation.

action current 1. A brief and very small electric current flowing in a nerve following stimulus. 2. The local flow of current into the depolarized region of the cell membrane during generation of the action potential. Since the cell membranes involved are normally those of nerve or muscle, they are polarized until the flow of action current, whereupon a state of depolarization is attained.

action potential The voltage variations that occur when a nerve or muscle cell is excited or fired by an appropriate stimulus. After a brief interval, the cell recovers its normal *resting potential*, which is typically about 80 millivolts. The interior of the cell is negative with respect to the outside.

active 1. Elements which control flow of energy from a separate supply, 2. The general class of devices that requires a power supply separate from the control source.

active circuit Any network or electric circuit which requires an energy source for its operation and is characterized by its production of an output derived by controlling the flow of energy from that source. Amplifiers, oscillators, and switching circuits are *active*. Resistive, capacitive, and inductive circuits are typically classified as *passive*.

active component An electrical or electronic element which can control voltages or currents to produce gain or switching

action in a circuit (e.g., transistor, diode, IC, vacuum tube, or saturable reactor). Also called *active device* or *active element*.

active computer When two or more computers are installed, the active computer is the one that is on-line and processing data.

active device See *active component*.

active electric network Electric network containing one or more sources of energy.

active element A device which modifies or amplifies the input and contains one or more sources of energy. Example: ICs, transistors, vacuum tubes, relays, ferro-magnetic cores and saturable reactors. See also *active component*.

active network An electrical network which includes a source of energy.

active pull-up Similar to a pull-up resistor, except that a transistor replaces the resistor connected to the positive supply voltage. This allows low output impedance without high power consumption.

active RC filter A filter which uses both negative and positive feedback, provided by solid-state amplifiers, to enhance its characteristics. Excellent selectivity can be provided at very low frequencies.

active substrate A substrate for an integrated component in which parts of the substrate display transistance. Examples of active substrates are single crystals of semiconductor materials, within which transistors and diodes are formed, and ferrite substrates, within which flux is steered to perform logical, gating, or memory functions. For other functions, it can also serve as a passive substrate.

active transducer A transducer whose output waves receive their power from a separate power source, controlled by the input waves to the transducer (e.g., strain-

gauge pressure transducer, thermistor, or photo-sensitive resistor).

acuity Sharpness or clearness, especially of the visual sense.

acute exposure Term used to denote radiation exposure of short duration.

acute myocardial infarction A condition resulting from diminished or blocked flow of oxygenated blood to a region of the myocardium, owing to occlusion of a vessel supplying that region. Atherosclerotic deposits are the usual cause and necrosis of the tissue, the usual result. The condition is life-threatening, because spontaneous ectopic beats (either stimulated by the ischemic tissue, or caused by conduction delay) can disrupt normal cardiac contraction and bring on fibrillation. Prompt counteractive drug therapy can reduce the possibility of this occurrence, although other steps must also be taken. The condition requires immediate, intensive, and highly skilled treatment, and modern practice has scored resounding successes in defusing the lethal nature of this once major killer.

ad Prefix meaning to or toward.

adapter A device for connecting two parts of an apparatus, which would not be directly connectable because of incompatible dimensions, terminations, voltages, currents, frequencies, etc.

adaptive communications Communications system capable of automatic change to meet changing inputs or changing characteristics of the device or process being controlled. Also called *self-adjusting communications* or *self-optimizing communications*.

adaptive system A system which provides reliability and stability by sensing the environment and controlling the mechanism through proportional feedback.

adaptometer Instrument for measuring time required for the retina to adapt; indicates night blindness, deficiency of vitamin A.

adc See *A/D converter*.

A/D (analog-to-digital) converter A circuit that translates an analog signal to a digital code which is representative of the value of the signal, usually at a given instant. Many digital codes may be generated at different times.

adder Switching circuits which combine binary bits to generate the *sum* and *carry* of these bits. Takes the bits from the two binary numbers to be added (*addend* and *augend*) plus the carry from the preceding less significant bit and generates the sum and the carry.

addiction The state of being given to some habit; the habitual use of drugs.

Addison's disease A cortisone deficiency which disrupts the working of the circulatory and digestive systems. Skin discoloration is a manifest symptom, as is the abnormal activities of the skeletal musculature.

address 1. An identification, as represented by a name, label, or number, for a register, location in storage, or other data source or destination. See also *tag*. 2. Loosely, any part of an instruction that specifies the location of an operand for the instruction.

address field The portion of an instruction which specifies the location in a computer memory where a particular piece of information is located.

adduct To move a part of the body toward the midline.

A/D encoder Analog-to-digital encoder for changing an analog quantity to equivalent digital representation.

adenine An amino purine base important for the synthesis of nucleic acids.

adenine flavine dinucleotide A cofactor in the electron transport system associated with the biochemical pathways of respiration.

adenoids Spongy lymphoid tissue masses located on the upper surface of the palate in the floor of the nasopharynx.

adenoma A tumor, usually benign, of epithelial cells.

adenopathy Effects of any of several glandular diseases, most particularly involving morbid enlargement or swelling of the lymph nodes.

adenosis Any disease of the glands, particularly one involving the lymph nodes.

adenoviruses A group of viruses capable of causing adenoidal, conjunctival, and pharyngeal infections, often with pneumonia. They average 80 millimicrons in diameter, are icosahedral in shape, and comprise a DNA core surrounded by capsomeres.

adhesion The abnormal joining of two surfaces, especially after surgery.

adipose tissue Fatty tissue found beneath the skin and within the abdomen. The cells contain fat globules.

adjustable speed/torque drive system An adjustable drive system consisting of a drive unit and a control unit. The drive unit may be a motor or gearmotor while the control may be encased or the chassis type. The units work together through a closed loop feedback circuit to control speed and torque electronically.

adolescence Between the age of puberty and adulthood.

ADR Abbreviation for air dose rate.

adrenal glands A pair of endocrine

adrenalin
glands, also called suprarenal glands, situated adjacent to the upper pole of each kidney. They consist of two regions, the cortex and the medulla.

adrenalin (adrenin, epinephrine) Hormone secreted, together with closely related noradrenalin, by the medulla of the adrenal gland. Both substances are also secreted at many nerve endings of sympathetic nervous system, and this accounts for similarity of the action of adrenal medullary hormone to the effects of massive stimulation of sympathetic system (increased work of heart, blood pressure, and blood-sugar; dilation of blood vessels of muscles, heart and brain, and contraction of those of skin and viscera; widening of pupil; erection of hair, etc.). The two hormones have similar but not identical action. Adrenalin is amino-hydroxyphenylpropionic acid.

adrenal nerves Cholinergic, preganglionic sympathetic nerve fibers supplying the adrenal medulla. Stimulation causes the release of adrenalin into the circulation.

adrenergic Of a motor nerve fiber, secreting at its end adrenalin and noradrenalin when nerve-impulse arrives there. These substances stimulate the effector innervated by the nerve fiber. Many sympathetic motor nerve fibers are adrenergic.

adrenocorticosteroids More than 20 synthetic adrenal hormones and their chemical derivatives. They are used primarily in the treatment of collagen diseases (e.g., rheumatoid arthritis and various forms of allergy), and in the suppression of certain inflammatory diseases or immunological processes.

adsorbent Substance causing adsorption.

adsorption The property possessed by certain porous substances, e.g., charcoal, of taking up other substances.

adynamic ileus An obstruction of the intestine resulting from inhibition of bowel motility, usually following abdominal surgery. Electrical stimulators have been applied to the intestinal musculature in an attempt to increase intestinal motility in cases of adynamic ileus.

aeroembolism The formation of gaseous bubbles in the blood and other body tissues consisting primarily of nitrogen, carbon dioxide and water vapor. This occurs at altitudes where release of gases from the body tissues form bubbles in accordance with Henry's Law.

aerosol Very fine particles of liquid or solid substances suspended in air or other gas.

afferent In neurology, referring to the direction of an impulse which is traveling toward a specified center, such as the cell body of a neuron.

afibrinogenemia The absence of fibrinogen from the blood. This substance plays a vital role in blood clotting. Thus, its lack can result in excessive bleeding from small wounds. It is possible to infuse fibrinogen into the blood to control this abnormality. Also called *hypofibrinogenemia*. May be found in obstetrics if thromboplastins are absorbed into the bloodstream from the damaged placenta or retained blood clot. The clotting mechanism of the blood is impaired and there may be uncontrollable hemorrhage.

afterglow Persistence of luminosity in a gas-discharge tube after the voltage has been removed or on the screen of a cathode-ray tube after the electron beam has moved. In many types of monitors, this property is exploited to trace a representative waveshape of a physiologic event (e.g., ECG, blood pressure, carotid pulse or peripheral pulse), so that the briefly persisting

image of the wave on an oscilloscopic screen can be studied by an observer.

afterpotential A relatively slow variation of membrane potential following the spike.

agammaglobulinemia An inherited or acquired deficiency of the important substance, gammaglobulin. Presence of this protein in the blood is essential to the functioning of the body's immune response. Thus, where it is lacking, the power of the individual to resist or overcome infection is seriously impaired.

AGC Automatic gain control. A circuit which stabilizes a large variation in the strength of an incoming signal. A circuit function in a tuner or receiver which maintains the mean amplitude of the modulated signal at almost a constant level. AGC is also used to describe the audio compression system employed in automatic tape recorders, in which the recording signal level is adjusted to compensate for widely differing sound levels.

agglutination The sticking together of cells, e.g., red blood cells, or bacteria, due to an alteration of surface charge. Usually brought about by the effects of antibodies.

agglutinins Antibodies such as those found in the blood serum of persons suffering from typhoid or paratyphoid fever. They have the property of causing bacteria to clump together or agglutinate. See also *blood grouping*.

agnosia A disease of the perceptive faculties through which people and objects are recognized. It may be optical, auditory, tactile, or involving the senses of smell and taste.

-ago Suffix meaning disease.

-agra Suffix meaning seizure, catching, or rough.

air dose X-ray or gamma ray dose expressed in roentgens delivered at a point in free air. In radiologic practice, it consists of the radiation of the primary beam and that radiation scattered from surrounding air.

air gap 1. Airspace between two objects which are electrically or magnetically related. 2. A small gap left in the magnetic circuit of a closed-core transformer which increases the magnetic reluctance and prevents saturation of the core.

airway resistance A measurement encountered in pulmonary function studies, usually made by pneumotachography. The measurement reveals the degree of opposition offered by the major components of the respiratory system (i.e., trachea, bronchi, bronchioles and alveoli) to the flow of air.

-al Suffix meaning pertaining to.

albuminuria The presence of protein in the urine in the form of leukocytes.

aldolase Enzyme in muscle concerned in the conversion of glycogen to lactic acid.

aldosterone A hormone secreted by the cortex of the adrenal glands; a mineralocorticoid.

alexia Inability or difficulty in understanding the written or printed word, owing to a lesion of the brain.

algae A family grouping of simple, photosynthetic plants with unicellular organs of reproduction. Pond scums and most seaweeds are algae. More precise taxonomy is now based on structure, pigments, and chemical character of cellular wall.

-algia Suffix meaning pain.

algorithm 1. An ordered sequence of mathematical steps that always produces the correct answer to a problem, though the solution may be more lengthy than

necessary. 2. A series of equations, some of which may state inequalities which cause decisions to be made and the computational process to be altered based on these decisions.

algorithmic Pertaining to a constructive calculating process usually assumed to lead to the solution of a problem in a finite number of steps.

algorithmic language An arithmetic language by which numerical procedures may be precisely presented to a computer in a standard form. The language is intended not only as a means of directly presenting any numerical procedure to any suitable computer for which a compiler exists, but also as a means of communicating numerical procedures among individuals. The language itself is the result of international cooperation to obtain a standardized algorithmic language. The International Algebraic Language is the forerunner of ALGOL.

algorithm translation A specific, effective, essentially computational method for obtaining a translation from one language to another.

align 1. To adjust the tuning of a multi-stage device so that all stages are adjusted to the same frequency, or so that they work together properly. 2. To adjust relative positions of optical components in a system. 3. To adjust two or more components of a system, so as to gain synchronism in their functions, or so that they work properly with one another.

alignment 1. Process of adjusting the tuned circuits of an electronic device so that the device will be properly responsive to a given frequency or range of frequencies. 2. Process of adjusting two or more components of a system so their functions are properly synchronized.

alimentary Pertaining to the absorption of nourishment. The alimentary canal is the whole digestive tract, extending from the mouth to the anus.

-alis Suffix meaning pertaining to.

alive 1. Energized. 2. Connected to a source of electrical voltage. 3. Charged so as to have an electrical potential different than that of the earth. 4. Reverberant, as a room in which sound reflects and echoes.

alkali The opposite of acid; a chemically basic substance (base) that forms hydroxyl ions (OH) when in solution and turns red litmus blue. Among the alkalis are potassium (potash), sodium, and ammonia. Mixed with fatty acids, alkalis form soluble soaps.

alkaline battery Any of several types of primary or storage batteries which use an alkaline electrolyte, as opposed to an acid electrolyte. The alkaline electrolyte is usually a solution of potassium hydroxide.

alkaloids Group of nitrogen-containing, basic organic compounds present in plants of a few families of Dicotyledons (e.g., Solanaceae, Papaveraceae); possibly end-products of nitrogen metabolism. Of great importance because of their poisonous and medicinal properties, e.g., atropine, cocaine, morphine, nicotine, quinine, strychnine.

alkalosis An excess of alkali in fluids and tissues of the body. It is the opposite of acidosis. It may occur after excessive consumption of acid-neutralizing substances, such as sodium bicarbonate.

all-diffused monolithic integrated circuit Microcircuit consisting of a silicon substrate into which all of the circuit parts (both active and passive elements) are fabricated by diffusion and related processes.

See also *compatible monolithic integrated circuit*.

alligator clip A test clip having long, narrow, serrated jaws.

allocate To assign storage locations in a computer to main routines and sub-routines; hence, fixing the absolute values of symbolic addresses.

all-or-none law The principle that the response to a stimulus is either a full-sized impulse or no impulse, no intermediate response being possible.

alloy A substance made up of two or more chemical elements, of which at least one is a metal, possessing metallic properties, and combined in such a way that its ingredients are not readily identifiable with the unaided eye.

alloy junction A junction produced by alloying one or more impurity metals to a semiconductor. A small button of impurity metal is placed at each desired location on the semiconductor wafer, heated above its melting point, and cooled. The impurity metal alloys with the semiconductor material to form a P or N region, depending on the impurity used.

all-purpose computer A computer combining the specific talents heretofore assigned solely to a general-purpose or special-purpose computer, scientific or business.

alnico An alloy of iron with aluminum, nickel, and cobalt used to make permanent magnets.

alpha Brain wave signals, detectable in the EEG having frequencies of approximately 8 to 13 Hz. The associated mental state is relaxation, heightened awareness, elation, and in some cases, dreamlike.

alphameric A contraction of the term alphanumeric.

alphanumeric Pertaining to a character set that contains both letters and digits and usually other characters such as punctuation marks. Synonymous with *alphameric*.

alpha particle Nucleus of a free helium atom which contains two neutrons and two protons (an electronic charge of 2 and a mass number of 4). The particle gives up a large quantity of energy during interaction scattering electrons which in turn results in a high density of ionization.

alpha rays A stream of fast-moving alpha particles (each having two protons and neutrons) which produce intense ionization in gases through which they pass, are easily absorbed by matter, and produce a glow on a fluorescent screen. The lowest in frequency of the radioactive emissions. Alpha rays have little penetrating capability (a 1 MeV alpha ray will penetrate less than a millimeter of air).

alpha rhythm A slowly changing bioelectric component of the electroencephalogram (EEG) associated with a state of physical and mental relaxation, usually with the eyes closed. Alpha frequencies range from 8 to 13 Hz and their origin is thought to be the visual cortex of the brain.

alpha wave detector A device that detects the 8 to 13 Hz alpha wave content of brain wave output. Used in biofeedback. Also called *alpha wave meter*.

alpha wave meter See *alpha wave detector*.

alternating current (ac) 1. Electric current, the flow of which reverses (or alternates) at regular intervals. Two current reversals are termed one cycle. The number of complete cycles per second is the frequency. (Most American homes are supplied with alternating current with a frequency of 60 cycles per second.) 2. Current

that is continually changing in magnitude and reversing in polarity. 3. A periodic current, the average value of which over a period is zero, and the plot of which, over time, is a sine wave.

alternation One-half of an alternating current cycle. The complete rise and fall of a current traveling in one direction, from zero to maximum and back to zero.

alveolar oxygen pressure The oxygen pressure in the alveoli (typically, 105 mmHg).

alveolus 1. An air cell of the lungs formed by the terminal dilations of the bronchioles. 2. A small cavity or pit, resembling a honeycomb cell. 3. The socket into which a tooth is set.

ambulating Walking.

ambulatory Relating to walking; moving about. The ambulatory treatment of fractures enables the patient to remain up and at work. The limb is immobilized in plaster of Paris.

ameboid cell See *leukocyte*.

amenorrhea Absence or abnormal cessation of menstruation.

amino acids A variety of organic compounds containing one, or more than one, of the basic amino groups, and one or more of the acidic carboxyl groups, polymerized to form proteins and peptides.

ammeter Instrument for measuring the strength of an electric current in amperes. The type usually employed consists of a pivoted coil placed between the poles of a permanent magnet. Current to be measured flows through the coil and creates a field which interacts with the field of the permanent magnet pivoting the coil within the magnet's field. A pointer is attached to the movable coil and registers amperes

on a calibrated scale which is fitted to the face of the instrument.

amnesia Loss of memory.

amnion A thin membrane forming a closed sac surrounding the embryo. It contains a thin, watery fluid, the amniotic fluid, in which the embryo is immersed.

amniotic See *amnion*.

A-mode (amplitude mode) A method of echographic data presentation in which the horizontal axis of the oscilloscope trace represents time (interpreted as depth), while the vertical axis displays amplitude of the echo field.

amp Abbreviated form of ampere.

amperage The rate of current flow in a circuit, expressed in amperes.

ampere 1. A unit of electrical current or rate of flow of electricity. One volt across one ohm resistance causes a current flow of one ampere. A flow of one coulomb per second equals one ampere. Also the unvarying current, through an aqueous solution of silver nitrate of standard concentration at a fixed temperature, that deposits silver at the rate of .001118 gram per second. Equivalent to the passage of 6.25×10^{18} electrons per second through a given point in a circuit. 2. The constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular sections and placed 1 meter apart in a vacuum, will produce between these conductors a force equal to 2×10^{-7} newton per meter of length.

ampere-hour The quantity of electricity represented by a current of one ampere that flows for one hour.

ampere-hour capacity Number of ampere-hours that can be delivered by a storage battery or other battery under specified conditions.

ampere-turn A term used to express the magnetomotive force surrounding a coil. The total force is derived by multiplying the number of turns of wire around a coil by the current (in amperes) flowing through the coil and expressing the product in ampere turns.

amp-hr Abbreviation for ampere-hour(s).

ampicillin A broad-spectrum semisynthetic penicillin used in the treatment of many types of meningitis and severe intestinal, respiratory, and other disorders.

amplification 1. Increase in signal magnitude from one point to another, or the process causing this increase. 2. Of a transducer, the scalar ratio of the signal output to the signal input.

amplification factor The symbol used to signify this is μ . It is the measurement of amplification in a circuit usually in voltage or current terms calculated by dividing the output by the input. This figure is often converted to *decibels* (which see).

amplifier Device which enables an input signal to control power from a source independent of the signal and thus to be capable of delivering an output which bears some relationship to, and is generally greater than, the input signal. Amplifiers are both linear and nonlinear. Linear types are frequently used for increasing a low-level signal without appreciably distorting its waveform. Nonlinear types are most often used to secure greatest power output where distortion of the signal wave is of secondary importance. Typical amplifying elements are transistors, integrated circuits, electron tubes, and magnetic circuits.

amplitude The magnitude of a simple wave or the simple part of a complex wave. It is the largest value measured from zero.

amplitude distortion The distortion of a

signal by the undesirable influence of a circuit or component and takes place when there is a change of amplitude in part of the input signal bringing about harmonic distortion and intermodulation distortion. This part is expressed as a percentage of the whole waveform at any given period of time.

amplitude-frequency distortion The distortion which occurs when the various frequency components of a complex wave are not amplified, attenuated, or transmitted equally well.

amplitude modulation A process whereby the amplitude of a single-frequency carrier wave is varied in step with the instantaneous value of a complex modulating wave. In amplitude modulation, two *sidebands* are created, one consisting of the sum of the carrier and modulating frequencies (upper sideband), and the other consisting of the difference between the carrier frequency and the modulating frequencies.

amplitude response The maximum output amplitude obtainable at various points over the frequency range of an instrument operating under rated conditions.

ampoule A sealed phial containing a drug or solution sterilized ready for use.

amyotonia A lack of muscular tone, often congenital in origin.

an Prefix meaning absence of.

anabolism The phase of metabolism associated with the building up (synthesis) of material by biochemical reaction in living tissue.

anacrotic Refers to the upstroke ascending limb of a tracing of pulse wave.

anaemia Diminished oxygen-carrying capacity of the blood, due to a reduction in the numbers of red cells, or in their content of haemoglobin, or both.