

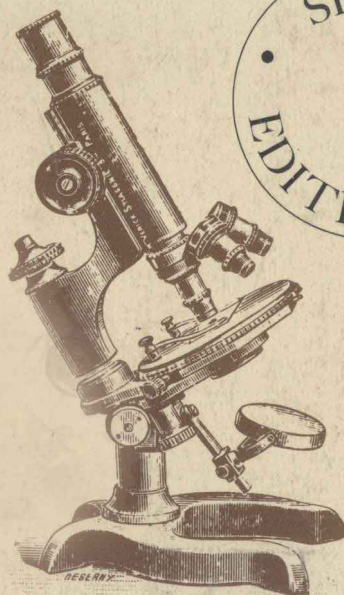
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The Penguin Dictionary of

BIOLOGY

SEVENTH
EDITION



THE PENGUIN DICTIONARY OF
BIOLOGY

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AUTHORS' NOTE

THOUGH not all those who talk about scientific jargon believe it, technical terms are an absolute necessity for scientific communication. Quite apart from the million or more named organisms, with which this dictionary is not concerned, there are huge numbers in biology. Many biological terms, however, are used in very restricted circles, and many are transitory; we have attempted to select some three thousand of the more stable and the more widespread, providing not merely definitions but some information bearing on the likely context of the terms.

Apart from choosing what seem to us the commoner and more stable terms, we have adopted a few other policies. Because they have not yet left the literature, we have put in some terms which may seem somewhat archaic. With the more chemical and biochemical terms and concepts, we have restricted ourselves to regrettably crude and superficial entries, though we have tried to deal with the two great generalizations of our time, those of energy transfer and of protein reproduction. The relevant chemical and biochemical terms will be found in *The Penguin Dictionary of Science* by Uvarov, Chapman and Isaacs.

We should make clear that our dictionary does not presume to say how terms should be used, but only how we find them being used – it is descriptive, not prescriptive. The descriptions of usage may seem somewhat dogmatic, but there is room for no more than what seem to be the received opinions of time.

M. A.
C. J. H.
M. L. J.

USING THE DICTIONARY

MANY unfamiliar terms, especially the rarer ones, are defined with the help of other technical terms, perhaps equally unfamiliar. This is unfortunately necessary to keep the dictionary within bounds, and may often require that several terms have to be followed up before reaching an entirely intelligible definition. Every biological term used in a definition is, we hope, itself defined elsewhere in the dictionary; except that some semi-technical terms, which can be found in any English dictionary, are omitted. Terms that are not strictly biological will usually be found in the *Dictionary of Science* (Penguin Reference Book).

The letters (q.v.) after a word that occurs in a definition indicate that the entry under this word adds important information to the subject under discussion. The letters Cf. are intended to point out a contrasting term.

(Bot.) or (Zool.) before a definition means that what follows applies only to plants or to animals respectively. It is not used where the limitation is obvious.

(Adj.) means that the term defined is an adjective, when this is not clear from the definition.

A

- A-BAND (A-DISC).** One of the two kinds of band visible under certain conditions in a striped muscle fibre; the alternation of the two kinds produces the cross-striations of striped muscle. The other kind is the *I-band*. The A-(anistropic) band, unlike the I-band, contains the myosin filaments.
- ABAXIAL (Dorsal).** (Of a leaf surface), facing away from the stem. Cf. *Adaxial*.
- ABDOMEN.** In vertebrates: region of the body containing the viscera other than heart and lungs (i.e. intestine, liver, kidneys, etc.); in mammals, but not in other vertebrates, bounded anteriorly by diaphragm. In arthropods: posterior group of segments similar to each other, but different from the more anterior thorax and head.
- ABDUCENS NERVE.** Sixth cranial nerve of vertebrates. Almost entirely motor, supplying external rectus eye-muscle. See *Eye-muscles*. A ventral root.
- ABIogenesis.** Spontaneous generation (q.v.).
- ABSCISIC ACID (ABSCISIN, DORMIN).** Growth-inhibiting plant hormone (a sesquiterpene). Present in a variety of plant organs - leaves, buds, fruits, seeds and tubers. Promotes senescence and abscission of leaves, induces dormancy in buds and seeds. Antagonizes influences of growth-promoting hormones. Believed to act by inhibiting nucleic acid and protein synthesis.
- ABSCISSION LAYER.** Layer at base of leaf-stalk in woody dicotyledons and gymnosperms, in which the parenchyma cells become separated from one another through dissolution of the middle lamella before leaf-fall.
- ABYSSAL.** Inhabiting deep water (roughly below 1,000 metres).
- ACANTHODII.** Group of fossil fish, the earliest known gnathostomes, mainly Devonian, 350 to 400 million years ago, but lasted from Silurian to Permian. Bony skeleton. Spines at front margin of fins, and a row of spines between pectoral and pelvic fins. Heterocercal tail.
- ACARINA (ACARIDA).** Order of Arachnida including mites and ticks. Body not segmented or divided into abdomen and prosoma. Larvae usually with three pairs of legs; adults have four. Extremely abundant animals, found almost everywhere. Economically the most important arachnid order; many species are parasitic on man or domestic animals, e.g. *Sarcoptes* causing scabies, cattle tick carrying redwater fever.
- ACCESSORY NERVE.** Eleventh cranial nerve of tetrapod vertebrates. Really a branch of the vagus, clearly separate only in mammals. Contains motor nerve fibres to throat and neck, and to viscera.
- ACCLIMATION, ACCLIMATIZATION.** Slow change in the physiology of an organism, as a result of its exposure to a changed environment (e.g.

ACCOMMODATION

a lowered temperature), which improves its ability to maintain homeostasis in the new conditions. (Sometimes 'acclimation' is used for response to changes in a single feature, e.g. temperature or salinity, such as usually occur only in laboratory experiments; and 'acclimatization' for response to, e.g. seasonal changes, involving many factors, e.g. temperature, light, nature and availability of food.)

ACCOMMODATION. Changing the focus of the eye. In man and a few other mammals occurs by changing curvature of lens; at rest, lens is focused for distant objects; it is focused for near objects by becoming more convex with the contraction of the ciliary muscles in ciliary body (q.v.) (see Fig. 3, p. 111). Few mammals can accommodate. Most birds and reptiles accommodate by changing curvature of the lens; in fish and amphibians, lens is moved backwards and forwards in relation to retina (as in focusing a camera).

ACELLULAR. (Of an organism), not divided into separate cells. Many organisms consisting of one cell are quite complex in structure and in function and, in contrast to the term unicellular, 'acellular' emphasizes the biological equivalence of such organisms to the whole of a multicellular organism rather than to one of its cells.

ACETABULUM. Cup-like hollow on each side of hip girdle into which head of femur (thigh bone) fits, forming hip joint, in tetrapod vertebrates.

ACETYLCHOLINE (ACh). Substance (neural transmitter (q.v.)) secreted at the ends of many nerve fibres (cholinergic fibres) when nerve impulses (action potentials) arrive there. Where such a nerve fibre ends at a synapse e.g. in a sympathetic or parasympathetic ganglion of vertebrates, ACh is the agent which stimulates the contiguous nerve cell and hence in effect 'passes the impulse on'; and similarly where the fibre connects with an effector, e.g. at the nerve-muscle junction of vertebrates. The released ACh combines with receptor molecules in the membrane of the post-synaptic cell, and there starts a new action potential. Curare blocks this combination. After secretion ACh is very rapidly destroyed by the enzyme cholinesterase, being broken down into acetate and choline. It is the acetyl ester of choline (q.v.). See *Synaptic Vesicle*.

ACETYL COA. See *CoA*.

ACHENE. Dry, one-seeded fruit formed from a single carpel, with no special method of opening to liberate the seed; may be smooth walled, e.g. buttercup; feathery, e.g. traveller's joy; spiny, e.g. corn buttercup; or winged (*samara*), e.g. sycamore.

ACHLAMYDEOUS. (Of flowers), lacking petals and sepals, e.g. willow.

ACID DYES. Dyes consisting of an acidic organic grouping of atoms (anion) which is the actively staining part, combined with an inorganic cation, e.g. eosin. Stain particularly cytoplasm and collagen. Cf. *Basic dyes*.

ACOELOMATE. Having no coelom (e.g. the phyla Coelenterata, Platyhelminthes, Nemertea, Nematoda).

ACOUSTIC. Concerned with hearing. *A. nerve*, Auditory nerve (q.v.).

ACOUSTICO-LATERALIS SYSTEM. Lateral line system (q.v.).

ACQUIRED CHARACTERISTICS, INHERITANCE OF. Transmission to offspring of variations, which appeared in the parents as responses to environmental influences. E.g. exposure to sunlight causes darkening of the skin of white human beings, compared to others less exposed: an acquired characteristic. If this acquired characteristic were inherited, offspring of the darker parents would then tend even if only very slightly, to be darker than offspring of the lighter parents, when both groups of offspring are reared in equal sunlight. The view that such inheritance occurs is commonly known as Lamarckism (q.v.) or Neo-Lamarckism. Since the rise of modern genetics, it is not widely thought that such inheritance is of importance in organisms reproducing sexually. When an acquired variation occurs, the genes in the gametes are not usually affected in such a way as to reproduce these variations in the offspring. It has however been shown that natural selection (q.v.) acting on mutations (q.v.) may change successive generations of a population so that a characteristic at first acquired only in response to the environment may come to develop independently of the environmental stimulus (*genetic assimilation*). The change therefore imitates Lamarckism, but depends on mutation. Organisms reproducing asexually may, of course, hand on to their offspring part of the body complete with its acquired characteristics.

ACRANIA (CEPHALOCHORDATA). Sub-phylum of Chordata containing only species of amphioxus, all marine. Unlike Vertebrata they have no brain, skull, or cartilaginous or bony skeleton; but they have typical chordate dorsal tubular nerve cord with double nerve roots, gill-slits, muscle blocks (myotomes) and a notochord (which however contains muscle cells); and they have an unexpected feature, found in no other chordate though in many invertebrates - nephridia with flame cells, presumably excretory organs. They may be closely related to early ancestors of vertebrates.

ACRASIALES. Cellular or communal slime moulds. Group (order) characterized by aggregation of amoebae by chemotaxis towards each other, to form a cellular, sometimes motile, *pseudoplasmodium* which then forms a fruiting body containing spores. The transition from scattered amoebae to spore formation has been a favourite subject for the study of differentiation. Affinity uncertain. See *Myxomycophyta*.

ACROPETAL. (Bot.). Development of organs in succession towards apex, the oldest at base, youngest at tip, e.g. leaves on a shoot. Also used in reference to direction of transport of substances within a plant, i.e. towards the apex. Cf. *Basipetal*.

ACROSOME. Part of head of animal sperm, usually forming a cap over

ACTH (CORTICOTROPIN)

the nucleus. It contains enzymes concerned in penetration of the egg coverings and perhaps fusion with the egg during fertilization.

ACTH (CORTICOTROPIN). Adreno-cortico-tropic hormone, a polypeptide secreted by anterior lobe of pituitary, controlling the growth and secretory activity of adrenal cortex, particularly the secretion of glucocorticoids. Its own rate of secretion is controlled by a polypeptide hormone liberated from the hypothalamus.

ACTIN. Protein that, in conjunction with myosin (q.v.), provides the contractile mechanism in muscles, and in other cells. The actin molecule normally occurs in filament form (F-actin) made up of two strings of globular units (G-actin) wound round each other.

ACTINOMORPHIC. (Of flowers), regular; capable of bisection vertically in two or more planes into similar halves, e.g. buttercup. Also known as *radially symmetrical*, a term used to describe animals having a similar organization, e.g. jellyfish. Cf. *Zygomorphic*.

ACTINOMYCETE. Member of order of gram-positive bacteria (Actinomycetales) with cells arranged in hypha-like filaments. Mostly saprophytes, some parasites. Source of streptomycin.

ACTINOMYCIN. Antibiotic that combines with DNA, thus preventing transcription.

ACTINOPTERYGII. A class of fish (or often regarded as a sub-class of the class Osteichthyes); includes all common living fish except sharks and skates. Characterized by bony skeleton; absence of a central skeletal axis in paired fins, their skeletal support being like the ribs of a fan; no opening of nostrils into mouth; air-bladder. Ganoid scales (q.v.) in primitive species. Cf. *Chondrichthyes*, *Crossopterygii* and *Dipnoi*, the other three classes of living fish. Appear first in Devonian (350 to 400 million years ago); originally freshwater, but later colonized the sea.

ACTINOZOA (ANTHOZOA). Sea anemones, corals, sea pens, etc. Class of Coelenterata (of sub-phylum Cnidaria). Body is a polyp, and there is no medusa stage; polyp more complexly organized than that of other Coelenterata; mouth possesses an intucking of ectoderm into coelenteron (stomodaeum or pharynx); vertical partitions in coelenteron (mesenteries). May have an external calcareous skeleton forming coral. Divided into two orders, Alcyonaria and Zoantharia. Cf. *Hydrozoa*, *Scyphozoa*.

ACTION POTENTIAL. Of a nerve impulse; a localized change of electrical potential between the inside and outside of a nerve fibre, which marks the position of an impulse as it travels along the fibre. In the absence of an impulse the inside is electrically negative to the outside (the resting potential); and during the passage of an impulse past any point on the fibre it changes momentarily (for about 1/1000 second) to positive. This wave of potential change is the most easily detectable and measurable aspect of an impulse. A similar action potential occurs in a muscle fibre when it is stimulated.

ACTION SPECTRUM. Wavelengths (λ) that are active in promoting or

inhibiting a particular reaction, e.g. action spectra for photosynthesis show maximum absorption and activity in blue and red parts of visible spectrum.

ACTIVATED SLUDGE. Material consisting largely of bacteria and protozoa, used in, and produced by, one method of sewage disposal. Sewage is mixed with some activated sludge and agitated with air; organisms of the sludge multiply and purify the sewage, and when it is allowed to settle they separate out as a greatly increased amount of activated sludge. Part of this is added to new sewage and part disposed of.

ACTIVE CENTRE (SITE). The part of an enzyme molecule that combines with the substrate. A relatively small number of the atoms of the enzyme molecule is involved.

ACTIVE TRANSPORT. Transfer of substance from region where its concentration is low to where it is high, especially through a membrane; accomplished by means of expenditure of energy from metabolism. Probably all cells can do this.

ACTOMYOSIN. Complex of two proteins, actin (q.v.) and myosin (q.v.), forming a major constituent of muscle.

ADAPTATION. (1) Evolutionary. Any characteristic of living organisms which, in the environment they inhabit, improves their chances of survival and ultimately of leaving descendants, in comparison with the chances of similar organisms without the characteristic; natural selection therefore tends to establish adaptations in a population. An adaptation to a particular feature of the environment means a characteristic which is an adaptation because it reduces destruction by that particular feature. An adaptation to a particular *activity* of an organism (e.g. to flying) means simply a characteristic which makes possible or improves performance of that activity without necessarily being measured in terms of survival, though usually that is implied. (2) Physiological. Change in an organism as a result of exposure to certain environmental conditions which makes it react more effectively to these conditions. (3) Sensory. Change in excitability of a sense-organ as a result of continuous stimulation such that a more intense stimulus becomes necessary to produce the same response. E.g. contact of an object with the skin at once excites the touch receptors; but if contact is simply maintained the touch receptors quickly cease to respond, though they will respond again to a more intense stimulus. Different receptors differ much in the extent of their adaptation.

ADAPTIVE (INDUCIBLE) ENZYME. Enzyme formed by an organism in appreciable amounts only in response to the presence of its substrate or of a structurally similar substance. Bacteria especially are known to adjust their enzyme make-up in this way. Cf. *Constitutive Enzyme*.

ADAPTIVE RADIATION. Evolution, from a primitive type of organism, of several divergent forms adapted to distinct modes of life. E.g. at beginning of Tertiary the basal stock of placental mammals radiated

ADAXIAL

into many forms adapted to running, flying, swimming, burrowing, etc.

ADAXIAL. (Of a leaf surface), facing the stem. Cf. *Abaxial*.

ADENOHYPOPHYSIS. See *Pituitary Body*.

ADENOSINE TRIPHOSPHATE. ATP (q.v.).

ADH. Antidiuretic hormone (q.v.).

ADIPOSE TISSUE. Fatty tissue. Connective tissue, the cells of which contain large globules of fat.

ADP (ADENOSINE DIPHOSPHATE). The acceptor of phosphate, forming ATP (q.v.). See *Phosphorylation*.

ADRENAL (SUPRARENAL) GLAND. An organ of hormone secretion in vertebrates. There is a single pair, one near each kidney, in man and other mammals, but there are multiple adrenals in many other vertebrates. In all tetrapods each gland has two components, distinct in function but closely fused together. (a) Medulla, the inner part of the gland in mammals, embryologically derived from nervous tissue (neural crest), secreting adrenaline and noradrenaline. Its activity is controlled by cholinergic (preganglionic) nerve fibres of the sympathetic nervous system. Medullary tissue seems to have largely an emergency function, secreting its hormones when the animal is driven to fight or flee; it is not essential for a quiet life. (b) Cortex, the outer part of the gland in mammals, embryologically derived from the lining of the coelom. It secretes various steroid hormones, which fall into three classes, though there is some overlapping of function: glucocorticoids, especially cortisol and corticosterone, which promote carbohydrate formation from amino acids and fatty acids, and have other effects; mineralocorticoids, especially aldosterone, which control the salt and water balance of the body; and, of minor importance, sex hormones, notably, in both sexes of mammals, androgens. Glucocorticoid secretion is controlled by a pituitary hormone (see *ACTH*). The adrenal cortex is indispensable for life. Medullary (= chromaffin) tissue and cortical (= interrenal) tissue are variously arranged within the adrenal of non-mammalian vertebrates; in many fish they are separated into distinct organs.

ADRENALINE (ADRENIN, EPINEPHRINE). Hormone secreted, together with closely related noradrenaline, by the medulla of the adrenal gland (q.v.). Both substances are also secreted at many postganglionic 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 relative amounts of adrenaline and noradrenaline secreted vary between different species of vertebrate. The two hormones have similar but not identical action. Both occur in some invertebrates. Adrenaline is

- amino-hydroxyphenyl-propionic acid, a catecholamine. See *Beta-blocker*.
- ADRENERGIC.** Of a motor nerve fibre, secreting at its end noradrenaline or (less usually) adrenaline when nerve-impulse arrives there. These substances stimulate the effector innervated by the nerve fibre. Many vertebrate sympathetic motor nerve fibres are adrenergic. Cf. *Cholinergic*. See *Beta-blocker*.
- ADRENOCORTICOTROPIC HORMONE.** ACTH (q.v.).
- ADVENTITIOUS.** Arising in abnormal position; of roots, developing from part of plant other than roots, e.g. from stem or leaf cutting; of buds, developing from part of plant other than in axil of leaf, e.g. from root.
- AERENCHYMA.** Tissue of thin-walled cells with large, air-filled intercellular spaces, found in roots and stems of some aquatic and marsh plants.
- AEROBIC RESPIRATION.** Respiration (q.v.) requiring free (i.e. gaseous or dissolved) oxygen. Cf. *Anaerobic respiration*.
- AESTIVATION.** (1) (Bot.). The arrangement of the parts in a flowerbud. (2) (Zool.). Dormancy during summer or dry season; it occurs e.g., in lung-fish (Dipnoi). See *Hibernation*.
- AFFERENT.** Leading towards, e.g. of arteries leading to vertebrate gills; or of nerve fibres conducting impulses towards central nervous system (sensory fibres). Cf. *Efferent*.
- AFTER-RIPENING.** Refers to dormancy (see *Dormant*) exhibited by certain seeds, e.g. hawthorn, apple, which, although embryo is apparently fully developed, will not germinate immediately seed is formed. Embryo will not grow even when removed from seed coat and provided with favourable conditions but has to undergo certain chemical and physical changes before it is capable of growth. Possibly associated with delay in production of required growth-promoting hormones or with gradual breakdown of growth inhibitors.
- AGAMOSPERMY.** All types of apomixis (q.v.) in which embryos and seeds are formed by asexual means; excludes vegetative reproduction.
- AGAR.** Mucilage (mixture of polysaccharides, some sulphated) obtained from certain seaweeds; forms a gel with water, melting at a higher temperature than it solidifies at; is used to solidify culture media on which micro-organisms are grown.
- AGGLUTINATION.** Sticking together, e.g. of bacteria (one of the effects of antibodies); or of red blood corpuscles (as when blood of incompatible blood-groups is mixed).
- AGGLUTININ.** Substance producing agglutination, usually antibody or lectin; and see *Blood-group*.
- AGNATHA.** Class of vertebrates (sometimes made a sub-phylum, the other vertebrate classes then being grouped as the sub-phylum Gnathostomata). Represented now by very few species (order Cyclo-

AGONISTIC BEHAVIOUR

stomata, i.e. the lampreys and hagfishes). Aquatic, fish-like in many respects, but without jaws, and the two pairs of fins or legs characterizing nearly all other vertebrates are absent (though there may be one pair). The earliest fossil vertebrates known belong to this group; these are the Heterostraci, which first appear in the Ordovician, 450 to 500 million years ago.

AGONISTIC BEHAVIOUR. Aggressive behaviour towards another member of the same species, involving threat or fighting.

AIR-BLADDER. Swim-bladder (q.v.) or lung (q.v.) of fish.

AIR-SACS. Of birds: thin-walled, air-filled extensions of the lungs, lying in abdomen and thorax, and extending even into some of the bones.

Of some insects: thin-walled diverticula of tracheae. Compression and expansion assist ventilation of the respiratory system.

ALBINISM. Failure of development of skin pigments. In mammals, including man, commonly due to an autosomal recessive gene.

ALBUMEN. Egg-white of birds and some reptiles. A solution of glycoprotein with some salts in water, between the ovum (the yolk) and the shell membranes. Secreted by the oviduct. An important store of water, it is eventually absorbed by the embryo.

ALBUMIN. A protein that is without a prosthetic group, and is soluble in water and in dilute salt solution. The main protein constituent of blood serum in vertebrates. Cf. *Globulin*.

ALCYONARIA. Soft corals, sea pens, etc.; an order of Coelenterates, class Actinozoa. Have eight pinnate tentacles and eight mesenteries. The polyps are colonial, with body wall and coelenteron continuous between them. Skeleton, often calcareous, within the mesogloea. Cf. *Zoantharia*.

ALDOSTERONE. See *Adrenal gland*.

ALEURONE GRAINS. Granules of protein occurring in storage regions of plants; common in seeds.

ALEUROPLAST (ALEURONE-PLAST). Colourless plastid (leucoplast) storing protein; found in many seeds, e.g. brazil nuts.

ALGAE. Simple, photosynthetic plants with unicellular organs of reproduction. Plant body (thallus, q.v.) unicellular; or multicellular, filamentous or flattened, ribbon-like, with relatively complex internal organization in higher forms but non-vascular. Aquatic plants, marine or freshwater, or plants of damp situations, e.g. damp walls, tree trunks, in soil.

Algae has been abandoned as a formal taxon in recent classifications, component groups being now considered as sufficiently distinctive to merit recognition as divisions. These are based on structure, pigments, chemical nature of cell wall, flagella, assimilatory products; and comprise Bacillariophyta, Charophyta, Chlorophyta, Chrysophyta, Cryptophyta, Cyanophyta, Euglenophyta, Phaeophyta, Pyrrophyta, Rhodophyta, Xanthophyta.

ALIMENTARY (ENTERIC) CANAL. The gut; a tube concerned with digestion and absorption of food. In some animals it has one opening only (Coelenterates, flatworms), but in most it has an opening (mouth) into which food is taken and another (anus) from which unassimilated material is ejected.

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.

ALLANTOIS. Sac-like outgrowth of ventral side of hinder part of gut present in embryos of amniote vertebrates; represents a large and precocious development of urinary bladder. Allantois grows during development so that it extends right outside the embryo proper, to lie in wall of yolk-sac of birds and reptiles, or under chorion of mammals. It is always covered with connective tissue containing a rich network of blood-vessels, communicating with embryonic circulation. In reptiles and birds, respiration takes place via these blood-vessels, which lie immediately under outer layer of yolk-sac which itself is pressed close against inside of shell; excretory products are stored in allantoic cavity (see *Uricotelic*); and the greater parts of allantois is left behind in the shell at hatching. In placental mammals the allantoic blood-vessels supply blood to placenta (q.v.) serving not only for respiration but for nutrition and excretion; cavity may be large and accumulate urine, but is often very small; most of allantois and its blood-vessels are detached from embryo at birth. See Fig. 9, p. 236.

ALLELES (ALLELOMORPHS). Two or more genes (q.v.) are said to be alleles (of each other), allelic or allelomorphic (to each other) when they (1) occupy the same relative position (locus) on homologous chromosomes, and, when in the same cell, undergo pairing during meiosis (q.v.); and (2) produce different effects on the same set of developmental processes; and (3) can mutate one to another. Several genes allelomorphic to each other are called an allelomorphic series; not more than two members of a series can simultaneously be present in a normal diploid cell.

ALLOGAMY. (Bot.). Cross-fertilization.

ALLOGENEIC (ALLOGENIC). With a different set of genes. Cf. *Isogenic*, *Syngenic*.

ALLOGRAFT. Graft from a donor with a genetic constitution different from that of the host.

ALLOGROOMING. Grooming a conspecific.

ALLOPATRIC. (Of the geographical relationship of different species or sub-species), not occurring together, i.e. having different areas of distribution. Cf. *Sympatric*.

ALLOPOLYPLOID. A polyploid (q.v.) organism to which two different

ALL-OR-NONE LAW

species have each contributed one or more sets of chromosomes. Cultivated wheats are probably allopolyploids. See *Allotetraploid*. Cf. *Autopolyploid*.

ALL-OR-NONE LAW. Statement about certain irritable tissues, that they have in standardized conditions only two possible reactions to stimuli of whatever intensity; either no response, or response of a strength that cannot be varied by varying the strength of the stimulus. Applies to nerve cells in the generation of an impulse and to many muscle fibres in the generation of contraction.

ALLOSTERIC. Of a protein molecule, carrying (at least) two different chemical groups combining specifically with different molecules, combination at one group influencing combination at the other. E.g. an enzyme (q.v.) may have one group ('active site') which reacts with substrate in the usual way; and another group (allosteric site) which reacts with a specific inhibitor substance which stops the enzyme activity. See *End-product Inhibition*.

ALLOTETRAPLOID (AMPHIDIPOID). Allopolyploid (q.v.) which arises when an ordinary hybrid between two different species, containing a set of chromosomes from each parent, doubles its chromosome number. An ordinary hybrid is usually sterile because its chromosomes cannot pair during meiosis. But if it becomes an allotetraploid it solves this difficulty because each chromosome then has a homologue with which it can pair. An entirely new species is thus immediately created. Tobacco probably originated in this way. Since interspecific hybridization and successful polyploidy (q.v.) is rarer in animals than in plants, allotetraploidy is known at present only in plants.

ALS. Anti-lymphocytic serum. Serum containing antibodies to lymphocytes.

ALTERNATION OF GENERATIONS. In life cycle (q.v.), alternation of a generation having sexual reproduction with a generation having asexual reproduction. The sexually and asexually reproducing forms are often very different from each other. Occurs among animals in, e.g. the Cnidaria (q.v.), the tapeworms; in these both generations are diploid. In plants seen most clearly in, e.g., ferns where the two generations are independent. The fern plant is a diploid *sporophyte* and reproduces asexually by formation of haploid spores following meiosis. Germination of the spores initiates the *gametophyte* generation, a small prothallus (q.v.), which reproduces sexually. Male and female gametes fuse together to form a zygote which develops into a new fern plant.

Great differences exist between the plant groups with respect to the relative prominence and degree of independence shown by gametophyte and sporophyte generations. In many members of the Thallophyta, spores are not produced by the diploid generation, which cannot therefore be termed 'sporophyte'. Nevertheless, one can recognize, as in all sexually reproducing plants, an alternation between haploid and diploid phases in the life history. The mycelium of many Phycos