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## Glossary

This glossary provides explanations of the more important technical and arcane terms used in the introductions to the chapters and in the 'Highlights' and 'Conclusions'. These explanations do not pretend to be scientific definitions but are intended to help the general reader. Detailed stratigraphical terms are omitted as they are given context within the tables and figures. Systematic names for groups of organisms are given with the formal version followed by the informal plural suffix in brackets. This is followed by a vernacular translation of the Greek or Latin roots of the terms.

**Acanthodii (-ians):** 'spiny', a member of the extinct class of **Palaeozoic** (Silurian–Permian) primitive jawed fish, the so-called 'spiny sharks' with spine supported fins and a covering of small scales, which occupied both marine and fresh waters.

**Acanthomorpha (-phs):** 'spine form', a group of advanced spiny **neoteleosts** with true dorsal and anal fin spines.

**Acanthopterygii (-ians):** 'spiny fin', an advanced group of **neoteleosts** with spiny fins, ranging from the Upper Cretaceous(?) to the present, including living perch, mackerel, plaice etc.

**Achanolepid (-ids):** one of five types of **thelodont** scale, very small with no pulp cavity, a bulging base and crown made up of **dentine-type** tissue; regarded as the most primitive type.

**Acme:** 'prime', the high point attained by an organism or group of organisms, as measured by some aspect of **phylogenetic** success, e.g. number of species; in palaeontology this depends on relative abundance of preserved fossils in a body of strata.

**Actinopterygii (-ians): 'ray fin'**, (one of) the largest and most diverse of extant vertebrate groups, including many extinct forms and most living bony fishes; characterized by a hypermineralized cap to the teeth, and only one dorsal fin, although it may be subdivided; they also have **ganoid** scales, reduced pelvic girdles and usually paired fins with broad bases.

**Actualism:** a methodological approach to the interpretation of geological phenomena, based purely on an understanding of present processes on Earth.

**Aeolian:** 'of *Aeolus*, god of winds', sediments carried and deposited by the wind.

**Agnatha (-ns):** 'without jaws', a class of primitive jawless vertebrates, including a large number of extinct marine and freshwater groups but now reduced to two — the **hagfish** and **lampreys**.

**Albanerpetontidae (-ids):** 'alba reptile', an extinct and enigmatic group of freshwater salamanders.

**Ammocoete larva:** 'sand bed-mask', larval form of the **lampreys**.

**Ammonitina (-ites):** 'horn of (Ammon) Jupiter', an advanced group of **ammonoids**, characterized by the complexity of the sutures between septal chamber walls and the outer wall of the shell.

**Ammonoidea (-oids):** 'horn of (Ammon) Jupiter', members of an extinct group of marine cephalopods, whose nearest living relative is the *Nautilus*, and are generally characterized by a coiled shell, regularly partitioned into chambers (Devonian-end Cretaceous).

**Amniota (-otes):** 'foetal membrane', a group of **craniates** including reptiles, birds and mammals having an amnion (foetal membrane) around the embryo.

**Amphibia (-ians):** 'both life', a class of amniote **tetrapod** vertebrates with larval gills but adult lungs and a skin usually without scales; includes both living **Lissamphibia** — frogs, salamanders, etc.- and a large number of extinct fossil groups, whose characterization as amphibians is often problematic especially amongst early representatives.

**Anaerobic:** literally 'without air' or oxygen.

**Anaspida (-ids):** 'without shield', a group of extinct small **agnathans** with fusiform bodies and heads and bodies covered by small bony scales.

**Angiospermae (-erms):** 'vessel seed', a major division of the plant kingdom, commonly referred to as the flowering plants, with seeds developed in a closed 'vessel', the ovary.

**Anoxic:** literally 'without oxygen', synonymous with **anaerobic**.

**Anthracosauria (-aurs):** 'charcoal lizards', a group of '**labyrinthodont**' fish-eating tetrapods (early Carboniferous to Permian in age), some of which were terrestrial but others were aquatic; they may include the ancestors of the reptiles and are often referred to as reptilomorphs.

**Antiarchi (-archs):** 'against first', an extinct group of Devonian **placoderms**, whose bodies are covered in bony plates, with two median dorsal plates and in which the paired pectoral fins are replaced by long, jointed bony appendages.

**Anura (-ans):** 'without tail', a major group of living amphibians including the frogs and toads.

**Arachnida (-ids):** 'spider form', a large group of carnivorous chelicerate arthropods, mainly terrestrial, including the scorpions and spiders.

**Arenite (-aceous):** 'sand', a **clastic** sediment made of sand-sized particles.

**Argillite (-aceous):** 'clay', a fine-grained sediment made of silt, or clay-sized particles.

**Arthrodira (-ires):** 'jointed neck', a group of **placoderm** fishes (Devonian to Carboniferous), characterized by bony shields covering the head and thorax, which are articulated by a joint.

**Aspidin:** 'shield', an acellular bone-like material found in the bony plates and scales of some extinct jawless fish.

**Aspidorhynchidae (-ids):** 'shield snout', an extinct group of basal **teleosts** with long bodies and long pointed snouts.

**Astraspida (-s):** 'star shield', a group of extinct early **agnathans**, characterized by thick enameloid caps to the tubercles of the skin scales; the head armour is made of loosely linked polygonal plates.

**Autostylic:** 'self pillar', a means of jaw suspension whereby the mandibular arch is self-supporting and articulates directly with the skull.

**Avalonia:** 'Avalon Peninsula, Newfoundland', an early **Palaeozoic** crustal plate consisting of Newfoundland, England, Wales, south-east Ireland and part of western Europe, which was brought together with **Laurentia** at the end of the Silurian.

**Baltica:** 'Baltic', an early **Palaeozoic** crustal plate consisting of much of present day north-western Europe, including Scandinavia, European Russia and central Europe; the plate formed the south-eastern continental margin of the **lapetus** Ocean and collided with **Laurentia** to form the Caledonian mountain belt when the ocean was subduct-ed.

**Batoidea (-oids):** 'thorn bush', a group of **neoselachian elasmobranch** fishes (Jurassic-extant), such as the skates and rays, with dorso-ventrally flattened bodies, enlarged pectoral fins for locomotion and a reduced tail and other fins.

**Belemnite:** 'javelin form', a member of an extinct group of cephalopod marine molluscs related to the squids, having an internal solid calcium carbonate 'bullet-shaped' and posterior skeletal element (predominantly Jurassic-Cretaceous but with problematic earlier Carboniferous and Triassic forms and a later questionable Tertiary form).

**Benthic:** 'depths', living on or in the substrate.

**Benthosuchidae (-ids):** 'deep lizard', an extinct group of Triassic **stereospondyls** which may be paraphyletic and thus not a valid entity.

**Biocoenose:** 'life in common', a living community of organisms occupying a particular **biotope**.

**Biostratigraphy:** 'life layer writing', the subdivision and correlation of sedimentary strata based on their fossil content.

**Biota:** 'life', the flora and fauna of a particular place.

**Biotope:** 'life place', habitats within which the environmental conditions are relatively uniform and similar assemblages of inhabitants recur.

**Bioturbation:** 'life disorder', any physical disturbance of the substrate, such as burrows and feeding traces, by the organisms living on or in it. These traces are often preserved in ancient sediments.

**Biozone:** a stratigraphically restricted unit of sedimentary rocks defined by its fossil content, most usefully by species of narrowly defined temporal range, and named after a single characteristic species.

**Bloom:** a seasonal and often dramatic increase in numbers of **phytoplankton** due to simultaneous reproduction.

**Bone-bed:** a stratigraphically restricted sedimentary accumulation and concentration of bones, or other vertebrate remains such as teeth or scales, often worn by transport and associated with fluvial deposition, especially channel **lag** deposits or marine near-shore conglomerates. Bone beds may reflect a lack of other coarse grained sediment or a mass or catastrophic extinction event and occasionally are an economic source of **phosphates**. They represent an important source of palaeontological and geological information.

**Bowfms:** common name for the amiiforms, an extant group of primitive **neopterygians**, characterized by the living *Arnia*.

**Brachiopoda (-ods):** 'arm footed' a phylum of bivalved and lophophorate shellfish, superficially similar to the bivalved molluscs but distinguished by a different anatomy. Particularly common in the Palaeozoic seas but replaced by the molluscs as the dominant shellfish since Mesozoic times.

**Bradydonti (-onts):** 'slow toothed', a group of **holocephalan** fishes.

**Breccia:** a fragmental elastic sediment, characterized by angular grains.

**Caecilia (-ians):** 'blind', a group of limbless burrowing amphibians.

**Calcrete:** a deposit of a semi-arid region cemented by calcium carbonate, often referring to a superficial terrestrial soil.

**Caledonides:** 'of Caledonia', the **Palaeozoic** mountain chain extending in a northeast--south-west direction in Spitsbergen, eastern Greenland, Scandinavia, Scotland, northern Ireland, the Lake District of England, Wales and continued in Eastern Canada, which resulted from the closure of the **Iapetus** ocean.

**Capitosauridae (-ids):** 'head lizard', a member of a group of **temnospondyl labyrinthodont** amphibians with flattened skulls, some of which were 'crocodile-like' and reached considerable size (Triassic).

**Cartilage (-inous):** 'gristly', a strong elastic connective tissue, which is an important skeletal material in the vertebrates and the sole skeletal material in the **chondrichthyan** fishes.

**Caturidae (-ids):** 'of *Caturus*', a small group of extinct amiiform halecomorph **neopterygians**.

**Cenozoic:** 'recent life', the division of geological time which succeeds the Mesozoic and is characterized by the radiation of the mammals, flowering plants, insects, etc.

**Cephalaspida (-ids):** 'head-shield', an extinct group of **osteostracan** agnathans characterized by a solid bony head-shield and broad cornual processes.

**Cephalochordata (-ates):** 'head string', a group of primitive **chordates**, commonly called the lancelets and are thought to typify an ancestral form for the vertebrates; metamerically segmented, with an axial stiffening rod, the **notochord**, persisting in the adult and a perforated pharynx for feeding and respiration.

**Ceratodidae (-ids):** 'horn', an extant group of freshwater **lungfishes**.

**Ceratodontidae (-ids):** 'horn teeth', a group of extinct freshwater and marine **lungfishes**.

**Chimaeridae (-aeras):** 'monster shape', extant group of **durophagous holocephalans** with tooth plates, **holostylic** jaw suspension, an articulated dorsal spine, pelvic claspers and long narrowing tail (hence common name — rat-fish).

**Chondrichthyes (-yans):** 'cartilage fish', a major group of fish, commonly called the **cartilaginous** fishes, which have a cartilaginous endoskeleton, no lungs or air bladder and a spiral valve in the gut; typified at present by the sharks and rays.

**Chondrostei (-ians):** 'cartilage bone', a group of primitive **actinopterygians** with a **heterocercal** tail and a spiracle, typified at present by the sturgeons and paddlefish.

**Chordata (-ates):** 'string', major group of coelomate animals, characterized by a **notochord** and perforated pharynx at some stage in the life history and a dorsal hollow nerve cord.

**Chronostratigraphy (-ical):** 'time layer writing', the subdivision of geological time into a hierarchy of sequential units to which the layers (strata) of sedimentary rocks are allocated.

**Cladistic analysis:** 'branch analysis', an attempt to characterize natural groupings of organisms by means of a search for shared derived characters.

**Cladodont:** 'branch tooth', teeth with a prominent central cusp and smaller lateral cusps.

**Cladogram:** 'branch picture', a branched treelike classification diagram produced by **cladistic analysis**.

**Clastic:** 'broken in pieces', fragmental sediment composed mainly of particles derived from pre-existing rocks or minerals, including organic remains (designated as bioclastic).

**Cleithrum:** 'bar', the clavicular elements of some fish.

**Climatiidae (-lids):** '*Climatius* shape', a group of extinct **acanthodians** with two dorsal fins and a row of spines between the pectoral and pelvic fins.

**Clupeocephala (-ans):** 'herring head', an extinct group of Jurassic advanced **teleosts** derived from the **elopocephalans** and characterized by tooth plates fused with endoskeletal gill-arch elements.

**Clupeomorpha(-orphs):** 'herring form', a group of primitive **teleosts** ranging from the Jurassic to the present and including the living salmon and herring.

**Coccolith (-iths):** 'berry stone', a member of a palaeontologically important group of unicellular flagellate and planktic marine microorganisms producing a calcium carbonate skeleton made up of a series of plates. The Cretaceous **chalk limestone** is often **largely** made up of coccolith skeletons (Upper Triassic-Recent).

**Cocosteidae (-ids):** 'berry bone', an extinct group of **arthrodire** gnathostomes with an embayment in the central plate for the pre-orbital plate.

**Coelacanth:** 'hollow spine', a group of **sarcopterygians**, the actinistians with a reduced air bladder and no choana, characterized by the 'living fossil' coelacanth *Latimeria*.

**Coelolepida (-ids):** 'hollow scale', synonymous with **thelodont**, a group of extinct jawless **ostracoderms**, characterized by a covering of small **shagreen-like** scales, which can be used to identify them and are of considerable use in **biostratigraphy**.

**Conchostraca (-ans):** 'shelled shell', members of a group of freshwater crustaceans (the clam shrimps) in which the body is contained within a chitinous bivalved shell (Devonian-Recent).

**Conodonta (-onts):** 'cone teeth', an extinct group of small eel-like marine coelomates, characterized by assemblages of paired teeth made of bone-like material; recently considered to be chordates or possibly primitive **agnathan** vertebrates. The teeth have considerable use in **biostratigraphy**.

**Coprolite:** 'dung stone', petrified or fossil faecal material which may contain identifiable food remains and occasionally abundant enough to be a source of **phosphate**.

**Coquina:** 'of shells', a limestone deposit largely made of shells or their fragments.

**Cornstone:** a concretionary limestone deposit, characteristic of arid terrestrial environments.

**Cornua(-ates):** 'horn', a horn or horn-like projection.

**Cosmine:** 'order', a kind of **dentine** found in the cosmoid scales, which have an outer layer of enamel, then cosmine and an inner layer of bone; found in **crossopterygians** and early lungfish.

**Craniata (-ates):** 'skull', synonymous with **Vertebrata**, a major subdivision of the **chordates**, in which there is a high degree of cephalisation, producing a brain enclosed in a protective 'skull' and an endoskeleton consisting of a backbone, paired girdles and attached locomotory appendages.

**Creatine:** 'flesh', a biochemical found in all vertebrate muscle.

**Crinoidea (-oids):** 'lily form', a group of echinoderms, characterized by roots, stems, cups and arms made of jointed plates of calcium carbonate, hence the common name — 'sea lily'; the carbonate skeleton is readily fossilized and they were particularly common from the Middle **Palaeozoic** to **Mesozoic** but less so in more recent times.

**Crossopterygia (-ians):** 'tassel finned' an old classificatory term for a mainly extinct group of **sarcopterygian** fish which includes the living **coelacanth**.

**Cryogenic:** 'frost kin', produced by freezing.

**Cryptozoic:** 'hidden life', synonymous with Archean, the earliest phase of Earth history prior to 2600 Ma ago, during which life originated and from which only a few primitive organisms have been fossilized.

**Ctenacanthiformes (-orms):** 'comb thorn form', an extinct group of **elasmobranch** sharks, with flexible jaw systems and enhanced sensory apparatus, from which the **neoselachians** may have originated.

**Cyathaspida (-ids):** 'cup shield', an extinct group of **heterostracans**, characterized by a fusiform dorsal head-shield in a single plate, ornamented with longitudinal parallel **dentine** ridges and the body scales are relatively large.

**Cycloid:** 'circle form', scales with an evenly curved free edge.

**Cyclostomata (-omes):** 'circle mouth', a grouping of living **agnathans** without bone or paired fins, the **hagfish** and **lampreys**, on the basis of a number of shared characters such as the structure of the 'tongue'.

**Cyclothem:** 'circle laid down', a succession of sedimentary layers, representing a sequence of depositional events which tend to be repeated.

**Denticle:** 'little tooth', small tooth-like processes and scales.

**Dentine:** 'tooth', a hard material resembling bone, which makes up the greater part of teeth.

**Dermal bone:** 'skin bone', bony elements which develop within the skin and may be thickened into tough 'leathery armour-like' plates of varying size.

**Diachronous:** 'through time', relating to sedimentary or stratigraphical units where the environmental or facies boundaries cut across the time boundaries in the succession of deposition. Diachronism reflects the migration of a geological event through time so that the sediment produced by that event is not everywhere the same age.

**Diastrophism:** 'through turning point', large-scale movement and deformation of the Earth's crust.

**Dinoflagellate:** 'rotating whip', a member of a large and diverse group of aquatic unicellular micro-organisms, loosely placed with the algae, which swim by means of flagellae and some of which are covered with cellulose plates that can be preserved in the fossil record (Mid-Triassic-Recent).

**Diphycercal:** 'two-fold tail', a tail fin in which the vertebral column runs straight through to the tip and divides the fin into two symmetrical lobes.

**Dipnoi (-oans):** 'two times to breathe', a group of primitive bony fishes with both gills and lungs for breathing, hence the common name — lungfish.

**Dipteridae (-ids):** 'of *Dipterus*', similar to the lungfish *Dipterus*.

**Discoglossidae (-ids):** 'round flat tongue', a member of a group of primitive frogs (**anurans**) with a long fossil record (Upper Jurassic-Recent) and both aquatic and terrestrial representatives.

**Disconformity:** 'asunder with form', a break in time, during which no sediment is deposited or the sediment that is deposited is subsequently eroded before the succession of strata continues without angular discordance.

**Dolomite:** a carbonate mineral containing a significant amount of magnesium carbonate, forming extensive deposits, often as a result of secondary, post-depositional chemical changes to limestones.

**Durophagous:** 'hard to eat', consuming prey with hard parts, which need to be crushed, such as shellfish and crustaceans.

**Ecostratigraphy:** 'household layers, writing of', the study of the changing relationships between organisms, their evolution and their environments through time.

**Elasmobranchii (-anchs):** 'to draw out gills', a group of **chondrichthyans** with **placoid** scales, a spiracle and no operculum over the gills, such as the sharks, skates and rays; many forms have the two dorsal fins armed with large spines, which are amongst the few features that are fossilized.

**Elopocephala (-ans):** 'fish head', an extant group of advanced **teleosts** which gave rise to the **clupeocephalans**.

**Elopomorpha (-orphs):** 'fish form', a primitive group of **teleosts**, which includes the eels. **Embolomeri (-eres):** 'wedge part', in earlier classifications — an extinct group of primitive **labyrinthodonts**, originally thought to be characterized by a particular vertebral structure.

**Entopterygoid (-oids):** 'within wing form', a dorsal membrane bone behind the **palatine** in some fishes.

**Epeiric:** 'mainland', produced by large-scale uplift or subsidence of crustal rocks without the severe deformation associated with orogeny.

**Epicontinental:** 'upon continent', located on a continent or the surrounding continental shelf.

**Epilimnion:** 'upon lake', the upper layer of warm water, formed in summer, within a thermally stratified lake.

**Eriptychiformes (-orms):** 'very folded form', a poorly known extinct group of tessellated **heterostracans**.

**Erratic:** 'mistake', a rock which seems out of place within the sedimentary environment within which it is found, especially glacial erratics which have been carried great distances by glaciers or icebergs before being dumped wherever the ice melts.

**Eugenodontiformes (-orms):** 'well-born tooth form' an extinct group of **cladoselachian elasmobranchs**, some of which were large shark-like forms, characterized by a median series of large teeth on the lower jaw, which is scrolled into a tooth spiral in some, lacking anal and pelvic fins.

**Euramerica: 'Europe-America'**, continental mass of north-western Europe and North America, formed when the **Iapetus** Ocean was subducted during the **Caledonian** orogeny; also used to denote a biogeographical province.

**Eurypterida (-ids):** 'of *Eurypterus*, broad fern', an extinct group of large aquatic arthropods which superficially resemble scorpions.

**Euteleosta (-osts):** 'wide finished', the largest group of **teleosts**, which includes over 17 000 species, belonging to three main groupings ranging from pike to goldfish and salmon.

**Evaporite:** sediments and minerals grown from a saline solution by evaporation of the solvent — normally water, which may be marine or continental in origin. A wide range of mineral salts may be precipitated depending on the original composition of the solvent, e.g. carbonates, sulphates and chlorides, and mixed with other types of sediment, often finely laminated.

**Fish:** the common and convenient name for a wide range of aquatic vertebrates, which used to be united under the old classificatory term *Pisces*.

**Fissure-filling:** cavities, often formed by solution of limestone host rock, infilled with relatively younger deposits, which may be of particular interest when they contain fossils, especially **microvertebrates** that are not preserved elsewhere.

**Flash flood:** an infrequent and ephemeral flood, characteristic of semi-arid regions and often associated with storms. The water may evaporate and dump its sediment load before discharging into the sea.

**Flint:** a hard, glassy and non-crystalline mineral form of silicon dioxide (quartz), frequently found in carbonate sediments, where it has developed from dissolved silica derived from sponges.

**Flood basalts:** widespread layers of basaltic lava, generally derived from the relatively quiet fissure-type eruption of free-running basic lavas.

**Foraminifera (-ans):** 'carrying an opening a member of a group of small unicellular aquatic organisms which secrete a coiled shell of various materials; often very abundant in marine waters with representatives that are **benthic** and **planktic** (Cambrian-Recent).

**Gadiiformes (-orms):** '*Gadus* or cod shape' a group of **neoteleosts** with an air bladder and soft jointed fins, which includes cod, hake, mackerel and whiting.

**Galeaspida (-ids):** 'helmet shield', an extinct group of **agnathans** endemic to China and the surrounding region, characterized by their broad bony headshields, with a large median dorsal opening which connects with the

oralo-branchial cavity.

**Galeomorphii (-orphs):** 'of *Galus* form', the largest group of **neoselachians**, including the dogfishes and modern sharks.

**Ganoid: 'sheen', rhombic scales with outer** layers of **ganoine, cosmine** below and then lamellar bone.

**Ganoidei (-oids):** 'sheen form', a group of primitive **actinopterygians with ganoid** scales.

**Ganoine:** 'sheen', enamel-like material on the outside of ganoid scales, which are rhomboid in shape and have layers of ganoine, **cosmine** and lamellar bone; found in primitive **actinopterygians**.

**Gar:** 'spear', common name for the lepisosteids, a primitive group of **neopterygians**, characterized by the living pike-like *Lepisosteus*.

**Genotype:** 'race image', type species of a genus.

**Geochronometry (-etric):** 'earth time measure', the method of measuring geological time in years before present, commonly using the known decay rates of the daughter isotopes of radioactive minerals; mainly derived from igneous rocks.

**Glaucconite:** 'sea stone', containing the diagenetic (growing in place) mineral glauconite, a complex green-coloured hydrous potassium iron silicate which is sufficiently common in some shallow-water marine sediments to give them an overall green coloration e.g. Cretaceous greensands.

**Gnathostomata (-omes):** 'jaw mouth', a group of **vertebrates** with jaws, derived from the anterior gill-arches, and a considerable degree of cephalization.

**Gondwanaland:** a grouping of the major southern continental plates of Africa, Australasia, Antarctica, South America, India, several smaller plates and fragments of what are now parts of Mediterranean Europe, which formed a massive southern supercontinent in upper **Palaeozoic** times.

**Goniatite:** 'angle-like', an extinct group of upper **Palaeozoic ammonoid** cephalopods with coiled shells.

**Graben:** a linear block of crust downthrown between two parallel faults.

**Graptolithina (-lites):** 'writing stone', an extinct group of marine colonial hemichordates, which secreted a proteinaceous skeleton in the form of an interconnected series of cups to house and protect the zooids.

**Gymnophiona (-ones):** 'naked snake-like', synonymous with **caecilians** and apodans, a group of limbless burrowing amphibians, with an absent or reduced larval stage, a stoutly built skull, small calcareous **denticles** in the skin and an elongate trunk with up to 200 vertebrae.

**Gymnospermae (-erms):** 'naked seed', members of a major division of the plant kingdom, consisting of woody plants with alternation of generations and seeds produced on the surface of the sporophylls and not enclosed in an ovary, e.g. seed ferns and conifers (late Devonian–Recent).

**Hagfish:** common name for the living **myxinioids**, a marine group of the surviving **agnathans**.

**Halite:** 'salt-like', common salt, NaCl, a naturally occurring mineral particularly associated with **evaporite** deposits from sea water.

**Hardground:** a sediment surface preserved within a sequence of strata, which has hardened through early diagenetic processes and whose ecology has changed as it came to be occupied by different organisms.



**Hemicyclaspida (-ids):** 'half round shield', an extinct group of ateleaspid **osteostracans** distinguished by a distinct cornual angle and a rounded rostral angle to the headshield.

**Hercynian: ( = Variscan)** an upper **Palaeozoic** phase of mountain building following sub-duction of a WSW–ENE oriented ocean, from south-west England through Scania, central and southern Europe and the Iberian Peninsula.

**Heterocercal:** 'other tail', where the vertebral column terminates in the upper lobe of the tail, whose lobe is usually larger than the lower lobe.

**Heterostraci (-acans):** 'other shell', an extinct group of **agnathans**, with extensive head armour of large plates and a pair of common branchial openings on either side.

**Histology:** 'tissue discourse', the detailed study of plant and animal tissues.

**Holocephali (-ans):** 'whole head', a group of mainly fossil **cartilaginous** fish with **holostylic** jaws, gills covered by an operculum, narrowing whip-like tail and crushing teeth; includes the surviving **chimaeras**.

**Holoptychidae (-ids):** 'whole plate', an extinct group of porolepiform **sarcopterygians** with scales and dermal bones covered with **dentine** and **cosmine**.

**Holostei (-eans):** 'whole bone', a grouping of largely fossil **actinopterygians**, intermediate between the **palaeoniscids** and **teleosts**, which includes many **Mesozoic** taxa and the surviving **bow fin and gar pike**.

**Holostylic:** 'whole pillar', a type of jaw suspension in which the palatoquadrate bone is fused directly to the cranium, as found in the **holocephalans**.

**Holotype:** 'whole pattern', the single specimen selected to characterize a species. **Homocercal:** 'same tail', where the vertebral axis ends near the middle of the base and there are similar-sized upper and lower lobes.

**Horsetail:** common name for the **sphenopsid** pteridophytes with jointed stems and leaves in whorls; abundant in the upper **Palaeozoic** and surviving to the present day.

**Horst:** an upfaulted block of crustal rocks, often on either side of a **graben**.

**Hybodont:** 'hump tooth', a grouping of extinct **elasmobranchs**, characterized by their elongate and low hybodont teeth, ornamented with sinuous ridges and pierced by numerous nutrient canals, with **placoid** scales and calcified pleural ribs.

**Hypersaline:** 'above salt', when the salinity of water exceeds 40 parts per thousand; a condition which can only be tolerated by those halophilic organisms adapted to the conditions; the mean salinity of sea water is 35 parts per thousand.

**Hypochordal:** 'under cord', where the vertebral column descends into the lower lobe of the tail, which is generally larger than the upper one.

**Hypolimnion:** 'under lake', the layer of water below the **thermocline** in a lake.

**Iapetus:** a 'proto-Atlantic' ocean, which separated the Lower **Palaeozoic** crustal plates of **Laurentia** and **Baltica** and divided the present British Isles until the ocean floor was finally subducted in Ordovician-Silurian times.

**Ichnofossil:** 'track fauna', an assemblage of trace fossils that records life in sediments disturbed by the activity of organisms, e.g. worm burrows or foot prints (see **bioturbation**).

**Ichthyodectidae (-ids):** 'fish acceptable', an extinct group of important large predatory **teleosts** of the Jurassic and Cretaceous.

**Ichthyology:** 'fish discourse', the study of fishes.

**Ichthyostegidae (-ids):** 'fish roof', an extinct group of primitive **tetrapods**, which retain many fish-like characteristics such as a laterally flattened tail and lateral line system, which evolved from the **rhipidistians**.

**Index fossil:** a particular fossil species which characterizes a named **biozone** within a **biostratigraphical** subdivision.

**Inoceramid (-ids):** 'strong clay pot', a member of a large group of extinct pteroid marine bivalves, which have been used for **biostratigraphical** subdivision (Triassic-end Cretaceous).

**Intraclast (conglomerate):** 'within fragments', a carbonate fragment derived by erosion from local contemporaneous strata within the same depositional basin.

**Ischnacanthidae (-ids):** 'hip thorn', an extinct group of **acanthodians**, often with large teeth, two dorsal fins and no spines between the pelvic and pectoral fins.

**Kaolinite:** a mud rock consisting mainly of the potassium-rich clay mineral kaolin from which china clay is made.

**Katoprid (-ids):** one of five **thelodont** scales with a large open pulp cavity with extensions into dentine tubules.

**Kerogen:** a naturally occurring organic material which yields petroleum-like hydrocarbons on heating and distillation.

**Labyrinthine:** 'labyrinth', having an infolded structure such as the **dentine** of **labyrinthodont** teeth'.

**Labyrinthodont:** 'labyrinth tooth', traditionally one of three groups of stem **tetrapods** that included the first land vertebrates, and which are characterized by teeth with complex infolding of the **dentine**, large body size and compound vertebrae; no longer a valid entity as it is not monophyletic (late Devonian-Triassic).

**Lag (deposit):** a layer of larger or denser clasts, such as pebbles or bones, which have accumulated in the bottom of a channel during deposition.

**Lagerstätten (fossil):** a rock containing well-preserved fossils that are worth exploiting for their intrinsic interest; their nature implies some unusual circumstances of preservation.

**Laminites:** thin layers of generally fine-grained sediment, reflecting rapidly fluctuating, often seasonal, changes in sediment supply or environmental conditions; characteristic of lakes and other shallow basins of deposition where there is a restricted bottom fauna.

**Lamprey:** '*Lampetra*', common name for one of the surviving **agnathan** groups, the **petromyzontids**.

**Laurasia:** 'St Lawrence-Asia' the northern supercontinental mass formed in the early **Mesozoic** by the rifting of **Pangaea** with the opening of the **Tethys** and Atlantic Oceans; comprised of the amalgamated plates of North America, Greenland, Europe and Asia.

**Laurentia:** 'St Lawrence', North American crustal plate in lower **Palaeozoic** times, prior to the subduction of the **Iapetus** Ocean; comprised mainly of the ancient **Precambrian** core of the Canadian Shield and Greenland plus Scotland and north-west Ireland.

**Laurussia:** 'St Lawrence–Russia', the amalgamated plates of North America and Russia, following the subduction of the **Iapetus** Ocean.

**Lectotype:** 'chosen pattern', a specimen chosen from available **syntypes** to be the designated type of the species.

**Lepospondyli (-yles):** 'husk vertebrae', a traditional grouping of basal **tetrapods**, characterized by small size, simple tooth structure and spool-shaped vertebrae, which are formed as single structures, such as is found in the urodeles and apodans; **cladistic** analysis has shown that the group is not mono-phyletic, thereby undermining its validity.

**Leptolepidae (-ids):** 'slender scale', a group of halecostome **neopterygians** which show some early **teleost** characters, such as no enamel layer on the skull bones and a vertically keeled rostrum.

**Lingulida (-ids):** 'tongue', a group of extant brachiopod shellfish, which were much more abundant in the **Palaeozoic** than at present.

**Lissamphibia (-ians):** 'smooth both lives', a grouping which includes all the living and diverse amphibians with reduced or absent scales and skin respiration, i.e. **anurans** (frogs and toads), urodeles (newts and salamanders) and apodans (the limbless **caecilians**).

**Lithostratigraphy:** 'rock layer writing', the organisation and division of strata into units and their correlation based entirely upon their lithological (rock compositional) characteristics.

**Littoral:** 'seashore', the zone between high and low water marks on a shoreline.

**Loganellida (-ids):** 'Logan (Water)', a group of **thelodont** agnathans with a characteristic form of scale.

**Lungfish:** see **Dipnoi**.

**Maceration:** 'softening', the process of softening or isolating tissue and separating cells.

**Mastodonsauridae (-ids):** 'breast tooth lizard', an extinct group of freshwater Triassic **stereospondyls**.

**Maxilla:** 'jaw', part of the upper jaw behind the premaxilla.

**Mesoderm:** 'middle skin', the embryonic cell layer between the ectoderm and endoderm.

**Mesosauridae (-ids):** 'middle lizard', an extinct group of small Upper **Palaeozoic** fish-eating reptiles with elongate bodies, necks and long narrow jaws; they were the first known marine **amniotes**.

**Mesozoic:** 'middle life', the middle division of geological time with abundant life, after the **Palaeozoic**, before the **Cenozoic** and containing the Triassic, Jurassic and Cretaceous periods.

**Metamorphosis:** 'change of form', a significant change of structure and form undergone by an organism between the embryonic and adult stage, such as is found in insects and amphibians with a tadpole larva preceding the adult **tetrapod**.

**Micrite:** the fine-grained microcrystalline carbonate matrix of limestones, much of which is chemically precipitated as a lime mud but which may also include a significant proportion of organic-derived mud.

**Microvertebrate:** often referred to as 'Ichthyoliths', literally the small fossil remains of **vertebrates**, such as scales, teeth and bones, which may be barely visible with the unaided eye when disarticulated. They can be separated from many kinds of rock matrix by careful acid preparation and are then available for microscopic study. Although they have been known for over 150 years, their potential for revealing so much about the palaeontology of vertebrates and their use in **biostratigraphy**, has only been realized in the last decade Or so.

**Miospore (-ores):** 'less seed', a fossil plant spore less than 0.22 mm in diameter, for which the parent plant is often unknown.

**Molasse:** a terrestrial **clastic** deposit, generally of poorly sorted, immature sediment associated with the uplift and rapid erosion of newly formed mountain belts; often accumulating to considerable thickness in marginal or intermontane basins.

**Monophyletic:** a natural taxonomic group that includes all descendants of a single common ancestor, e.g. the **Aniniota** which include the reptiles, birds and mammals.

**Myriacanthoidea (-oids):** 'numberless spines' an extinct group of Palaeozoic **holocephalians** with loss of mandibular plates.

**Myxinoidea (-oids):** '*Myxine* — slime form', an extant group of marine **agnathans**, commonly referred to as the **hagfish**.

**Nasohypophysial:** 'nose under growth', a keyhole-shaped opening on the dorsal surface of the head in lampreys and the extinct osteostracans, which combines a single nasal opening with a blind hypophysial tube, allowing water to enter and leave the olfactory organ.

**Nautiloidea (-oids):** 'nautilus form', an almost extinct group of cephalopods with straight or coiled conical shells, which were more abundant in the Palaeozoic but survive in only one genus, *Nautilus*.

**Nekton:** 'swimming', those organisms which actively swim in water.

**Neocatastrophism:** the doctrine that the most important driving forces in Earth history and the evolution of life have not been those of gradual change, but a variety of catastrophic events, both internal and extra-terrestrial.

**Neopterygii (-ians):** 'new fin', a group of Recent **actinopterygians** characterized by an equal number of fin rays of the dorsal and anal fins and the reduction or loss of the clavicle; includes the ginglymoids, halecomorphs and teleosts.

**Neoselachii (-ians):** 'new sharks', a modern-type group which includes all extant **elasmobranchs**, characterized by enameloid on the teeth and scales and a septate **notochordal** canal.

**Neoteleosti (-osts):** 'new bone', an extant group of advanced bony fishes (**teleosts**).

**Neotype:** 'new pattern', a new or replacement type specimen taken from the original type locality.

**Neural crest:** '**nerve** crest', an ectodermal thickening of a dorsal groove, which gives rise in embryological development of the living **agnathans** and **cephalochordates** to the central nervous system.

**Neurocranium:** 'nerve skull', the **cartilaginous** or bony encasement to the brain and special sense organs.

**Nodule:** 'knob', a spherical or elliptical mineral concretion, generally grown post-depositionally within a sediment, as the result of the concentration of a particular mineral around a nucleus.

**Nomen nudum:** 'name naked', in taxonomy, an invalid name because the organism to which it is attached was inadequately described or illustrated.

**Notochord:** 'back cord', a stiff flexible rod of large vacuolated cells which acts as an anterior—posterior axis between the gut and dorsal nerve cord in **chordates**.

**Old Red Sandstone:** a classic term still applied to the terrestrial, largely **elastic** facies of the Devonian in Britain, characterized by conglomerates and red sandstones.

**Oolitic:** 'egg stone', a sedimentary rock, usually a limestone made up of small (1–10 mm) ovoid accretionary bodies cemented together. The ovoids resemble fish eggs but are formed by the precipitation of layers of calcium carbonate concentrically arranged around a nucleus, e.g. a sand grain, as it is rolled around on the sea floor by waves and currents, especially in shallow tropical and subtropical seas.

**Orobranchial:** 'mouth gills', in association with the mouth and gills as in orobranchial cavity.

**Orogeny:** 'mountain genesis' a process of mountain building during which the rocks and sediments of a particular area of a continent(s) are deformed and uplifted to form mountain belts. Although these processes take a long time, they can be distinguished as recognizable and discrete phases in Earth history and are named accordingly, e.g. **Variscan** orogeny.

**Ossiferous:** 'bone make', made up from bones or their fragments.

**Osteichthyes (-yans):** 'bone fish', all fishes whose endoskeletons are made from bone, usually having an air bladder and operculum covering the gills.

**Osteoglossomorpha (-orphs):** 'bone tongue form', an extant group of freshwater **teleosts**.

**Osteolepiformes (-orms):** 'bone scale form', an extinct group of **rhpidistian sarcopterygians** with **labyrinthine** teeth, long considered to be ancestral to the **tetrapods** because of the endoskeletal structure of the paired fins.

**Osteostraci (-ans):** 'bone shell', an extinct group of **agnathans** with both exoskeleton and endoskeleton of bone, characterized by median and lateral depressions on the surface of the dorsal head-shield, which has a 'horseshoe' shape and a pair of pectoral flap-shaped fins; also, generally there is a peculiar horizontal fin below the main tail fin.

**Ostracoda (-ods):** 'shell-like', members of a group of small crustaceans having a bivalved shell around the body. Throughout their long geological history (Cambrian–Recent) they have diversified into a wide range of aquatic ecological niches both on land and at sea.

**Ostracoderma (-erms):** 'shell skin', all those jawless **craniates** with an exoskeleton of **dermal bone**, i.e. the fossil **agnathans**.

**Otolith:** 'ear stone', a calcareous structure found in the otocyst capsule and used to maintain orientation in relation to gravity and balance; they are often the only structures to be fossilized from many **teleosts**, and individual otoliths can be identified specifically.

**Pachycormidae (-ids):** 'thick trunk shape', a group of **Mesozoic** basal **teleosts**, characterized by a mobile premaxilla and long swordfish-like jaws.

**Palaeocurrent:** a flow direction deduced from sedimentary structures associated with an ancient depositional or erosive event.

**Palaeoecology:** 'ancient household discourse', the study of the relationship between organisms and their environments in the past.

**Palaeokarst:** 'ancient karst', fossil solutional features associated with buried limestone topography.

**Palaeonisciformes (-orms):** '*Palaeoniscus* —ancient small form', a group of almost extinct early **actinopterygians**, typically carnivorous in habit with markedly **heterocercal** tails; traditionally regarded as **chondrosteian** grade but more recently as **neopterygians**, including the living sturgeons and paddlefish.

**Palaeoslope:** 'ancient slope', the orientation of an original inclined surface as determined from an ancient depositional or erosive event.

**Palaeosol:** 'ancient soil', a 'fossil' soil deposit characterizing a terrestrial environment.

**Palaeozoic:** 'ancient life', the first major division of geological time which is characterized by abundant life and which is preceded by the **Proterozoic** and succeeded by the **Mesozoic**; divided into six or seven periods from the Cambrian to the Permian.

**Palatine:** 'palate', in the region of the palate or roof of the mouth.

**Palinspastic:** 'again draw', restored to an original condition, or in the case of a map to represent original conditions or features.

**Palynology:** 'pollen discourse', the study of plant spores and pollen and their distribution, which has proved to be of considerable **biostratigraphical** use.

**Palynomorph:** 'pollen form', a microscopic, resistant, walled organic body found in paly-nological preparations, including both plant-derived bodies such as spores and pollen and also other acid-resistant remains such as acritarchs and chitinozoans.

**Palynozone:** 'pollen zone', a **biostratigraphical** subdivision characterized by an assemblage of pollen 'species'.

**Panderichthyida (-ids):** 'Pander's fish', an extinct group of thin streamlined **rhipidistean**s with long, dorso-ventrally flattened skulls and only paired pelvic and pectoral fins, without the midline paired fins of their relatives; they are now considered to be very close to the early **tetrapods**.

**Pangaea:** 'the whole Gaea', a supercontinent formed by ocean-floor subduction, plate collision and assembly of all continents in the late Permian.

**Paraphyletic:** 'beside tribe', arising from a single common ancestor but not including all descendants, e.g. Class **Reptilia** which does not include the descendant birds and mammals.

**Paratypes:** 'beside pattern', a specimen or specimens in the same series or collection from which the **holotype** has been selected.

**Pedocal:** 'ground calcium', an arid or semi-arid soil-type deposit, characterized by the presence of calcium carbonate, e.g. the '*Psammosteus Limestone*'.

**Peneplain:** 'almost plain', a landscape surface with greatly reduced features as a result of prolonged weathering and erosion.

**Perichondral bone:** '**around** cartilage — bone', ossification of **cartilage** from the outside.

**Perleidiformes (-orms):** '*Perleidus*-form', an extinct group of basal **actinopterygians**, of '**chondrostean**' grade, with **ganoid** scales, nearly symmetrical tail fins and small slender bodies, best known from the Triassic.

**Petalodont:** 'leaf tooth', an extinct group of Upper Palaeozoic **holocephalans**, known only from fossils of their leaf-shaped teeth.

**Petromyzontiformes (-orms):** '*Petromyzon* —rock suck form', an extant group of freshwater **agnathans**, commonly called **lampreys**, with a semi-parasitic mode of life, elongate eel-like bodies, no body armour or paired fins.

**Pharyngeal:** 'gullet', a structure or tissue associated with the gullet.

**Pholidophoridae (-ids):** 'bearing scales' an extinct group of Mesozoic neopterygian halecostomes, which show some characteristics of the primitive teleosts, such as cycloid scales and the loss of enamel from most skull bones.

**Phosphate:** a phosphorus salt associated with mineral **phosphate** in bone.

**Phylogeny:** 'race descent', the evolutionary relationships and history of a species or group of organisms.

**Phytoplankton:** 'plant wandering', free-living plants within an aquatic environment, often microscopic and with limited powers of locomotion, so mainly dispersed by wind and tide.

**Pineal:** 'of the pine', cone shaped, as in pineal gland — which is often externally visible in lower **vertebrates** and may have endocrine functions and be sensitive to light.

**Pituaraspida (-ids):** 'phlegm broad', a small group of poorly preserved **agnathans** only known from a few Devonian sandstone impressions in Australia.

**Placodermi (-erms):** 'plate skin', an extinct group of primitive **Palaeozoic** jawed fishes, with a dermal armour in two parts, one covering the head, the other the trunk, which are sometimes articulated, e.g. the **arthrodires**.

**Placoid scale:** 'plate form — scale', scales which are structured and formed similar to teeth and are characteristically found covering the **elasmobranchs** as **shagreen**.

**Planktonic:** 'wandering', belonging to the plankton; those generally small organisms which drift in water bodies and have limited powers of locomotion.

**Playa:** the flat dry bottom of a desert basin, often the bed of an ephemeral lake and underlain by **evaporites**.

**Pleuracanth:** 'side thorn', a small extinct group of Palaeozoic freshwater **elasmobranch** sharks.

**Point-bar:** a low bank of sediment on the inside bend of a river channel, consisting of material derived from the eroded outside **bank**.

**Precambrian:** 'before Cambrian', the first major division of geological time which includes the first 4 billion or so years of Earth history before abundant metazoan life capable of secreting skeletons had evolved; the top of the **Precambrian** is defined by the base of the Cambrian Period in the **Palaeozoic** Era.

**Prokaryote:** 'before nucleus', organisms such as blue-green algae and bacteria whose chromosomes are not surrounded by a nuclear membrane.

**Proterozoic:** 'former life', the younger subdivision of **Precambrian** time from 2.5 Ga ago until the beginning of the Cambrian at the base of the **Palaeozoic**; when primitive life had evolved and has been preserved as rare fossils of **prokaryotes** and soft-bodied metazoans in the youngest rocks of the division.

**Protobranch:** 'first gills', a member of a 'primitive' group of marine bivalve molluscs with a very long fossil record (Lower Cambrian-Recent) that commonly occupy mud substrates and feed by extracting organic material from the mud, e.g. the nuculids.

**Protochordata (-ates):** 'first string', a group of primitive **chordates**, which have 'tadpole-like' larvae with a perforated pharynx, **notochord**, hollow dorsal nerve cord and post-anal tail.

**Protopteraspidae (-ids):** 'first *Pteraspis* — wing shield', one of a number of extinct **pteraspid** groups, which retains some features of the **cyathaspids**, from which the pteraspids are thought to have originated; characterized by the supra-orbital canal passing through the **pineal** plate.

**Psammosteiformes (-orms):** 'sand bone form', an extinct group of large **pteraspidi-form heterostracans** with a secondary tuberculate ornamentation to the dermal armour and two orbital plates.

**Pteraspida (-ids):** 'of *Pteraspis* — wing shield', an extinct group **Palaeozoic heterostracans**, which had head-shields made of several large and independent bony plates, ornamented with concentric **ridges**.

**Pycnodontiformes (-orms):** 'dense tooth', a large extinct group of marine **neopterygians**, mostly deep-bodied forms, characterized by symmetrical (**homocercal**) tail fins.

**Pyrite:** 'fire stone', an iron sulphide mineral common within sediments, resulting from the biochemical action of bacteria within **anaerobic** environments.

**Pyroclastic:** 'fire fragments', the fragmentation of igneous rock materials during volcanic eruption, ranging from large rock bombs to pulverized rock dust and ash.

**Radio-isotope:** 'ray — equal place', the isotopes of radioactive elements which have the same atomic number but different atomic weights.

**Raffish:** see **chimaeras**.

**Red beds:** sedimentary deposits that are predominantly red in colour, generally as a result of abundant iron oxides, which often reflect deposition in an oxidizing situation, e.g. in an arid terrestrial environment and may be associated with **evaporites**.

**Regression:** referring to the retreat of the sea from land areas as a result of a fall in sea level or elevation of the landmass.

**Reptilia (-iles):** 'creeping animals', members of a large class of **amniote** vertebrates, having a long fossil history extending back to the Carboniferous, with a dry, waterproof horny skin of scales, plates or scutes, functional lungs, a four-chambered heart and laying eggs fertilized inside the female's body.

**Reptilomorph (-orphs):** 'creeping animal form', term applied to many early fossil **tetrapods** which are difficult to characterize as either reptile or amphibian.

**Rhipidistia** 'fan', an extinct group of Upper **Palaeozoic** 'lobe-finned' **sarcopterygian** fish which are considered ancestral to the **tetrapods**.

**Rhizodontidae (-ids):** 'root teeth', a poorly known extinct group of very large '**rhipidistians**' with thin and loosely attached skull bones, characterized by dermal fin rays with a long unsegmented portion, covered by rounded scales; the folded teeth are poly-plocodont like those of **osteolepiforms** and **tetrapods**.

**Rhizodontiformes (-orms):** 'root tooth form' an extinct group of poorly known, large **sarcopterygians**, probably effective predators, with thin and loosely attached skull bones and dermal fin rays with a long unsegmented portion.

**Rhythmic sequence:** a regularly banded vertical sequence of sediments, reflecting rhythmic changes in the supply of sediment often related to seasonal changes e.g. the **varved** couplets of silt and clay in glacial lakes.

**Rötliegendes:** 'red layers', a German stratigraphical term applied to the largely continental deposits of Lower to Middle Permian times, which are often reddened with iron oxide minerals.

**Rudist:** 'rough', a member of an unusual and varied group of extinct marine cemented bivalve molluscs (also known as hippuritoids), which flourished in the shallow tropical seas of the **Tethyan** area and in places formed reef-like clusters. Some had thick cone-shaped shells up to 1 m long, whilst others had coiled 'snail-like' shells (Upper Jurassic–end Cretaceous).

**Sabkha:** a halite-encrusted surface of salt flats, which are often developed just inland parallel to dry hot tropical coastlines, where periodic flooding by the sea is evaporated with precipitation of various **evaporite** minerals and laminae of dried algae.

**Sacculus:** 'small bag', lower part of the ear vestibule, which contain the **otoliths** of some **teleosts**.

**Sapropel:** 'rotten mud', **anaerobic** mud often enriched in bacteria.

**Sarcopterygii (-ians):** 'fleshy or lobe fin', a group of bony fishes, characterized by paired 'fleshy fins' and internal nostrils in some groups; includes the **crossopterygians** and **dipnoans**.

**Scale:** 'husk', a flat, plate-like protective structure for the skin, generally small and in rows to allow flexibility; may be either dermal or epidermal in origin.

**Scapherpetontidae (-ids):** 'boat reptile form', an extinct group of **neotonous** salamanders.

**Sclerite:** 'hard', an exoskeletal element in the form of spines or plates, often mineralized.

**Scolenaspidea (-ids):** 'worm broad form', one of five extinct groups of **cornuate osteostracans**, abundant in the Lower Devonian of Britain, Spitsbergen, North America and Podolia.



**Scorpionid (-ids):** 'scorpion', a group of arachnids which includes the scorpions.

**Sea-squirt:** common name for the **hemichordate** ascidians, marine organisms with a free-swimming larva and a sessile benthic adult.

**Selachii (-ians):** 'shark', a grouping of **elasmobranch** fishes, which includes fossil and living sharks and dogfish and ranges from the Devonian to the present; see **Neoselachii**.

**Semicircular canals:** the ducts of the ear labyrinth.

**Semionotidae (-ids):** '*Semionotus* — half-pointed dorsal fin shape', an extant and ancient group of basal **neopterygians**, with median neural spines, which includes the **gar** pikes and originated in Permian times.

**Serpulid (-ids):** '**small** snake', a small tubular fossil, mineralized with calcium carbonate and generally regarded as related to the living polychaete worms, which have similar form and encrusting habits.

**Shagreen:** common name for shark skin with its covering of many small overlapping dermal **denticles**.

**Siliciclastic:** 'hard stone fragments', a fragmental deposit, consisting mainly of grains of silica minerals, especially quartz.

**Somite (-ites):** 'body', the body compartments of metamericly segmented animals.

**Sphenopsida (-ids):** 'wedge shape', commonly referred to as '**horsetails**', a group of **pteridophyte** plants with jointed stems and leaves arranged in whorls; of considerable importance in the Upper **Palaeozoic**, when some grew to tree size, but now much smaller and fewer in kind.

**Squamata (-ates):** 'scaly', a member of a large group of lepidosaur reptiles that includes the lizards and snakes and whose inter-relationships are not clear (Upper Jurassic-Recent).

**Squamation:** 'scale', the arrangement of dermal scales.

**Squamosal:** 'scale nature', a membrane bone forming part of the side wall of the **vertebrate** skull.

**SSSI:** Site of Special Scientific Interest.

**Stegocephalia (-ians):** 'roof head', an extinct group of amphibians with salamander-like body form.

**Stem group:** in **cladistics**, an extinct and presumed ancestral group, defined on the absence of features of the presumed descendants.

**Stereospondyli (-yles):** 'solid vertebrae', an extinct group of **labyrinthodont** amphibians having fused vertebrae.

**Stratotype:** 'layer pattern', a sequence of strata at a particular location, which has been internationally recognized as the definitive section for a particular **chronostratigraphical** subdivision of geological time.

**Strike:** the trend of a geological surface measured at right angles to the direction of slope.

**Stromatolite:** 'bedded stone', layered structures built up by mats of blue-green algae, which trap fine sediment as they grow; typically found in shallow tropical seas and extend back as fossils for some 30 Ga.

**Subduction:** 'under lead', the descent of large slabs of relatively dense ocean floor crust below less dense continental crust rocks, as the result of the collision of two crustal plates, with the release of vast amounts of energy in the form of earthquakes and often accompanied by volcanicity.

**Sulphate:** a chemical compound containing sulphur and oxygen, which forms common sedimentary minerals with a variety of other elements, especially in **evaporite** deposits.

**Suture:** 'seam', the line of collision between two crustal plates following the subduction of any intervening crust.

**Symmoriiformes (-orms):** 'in proportion form', an extinct group of shark-like **elasmobranchs**, characterized by a very long rod in the pectoral fins and a peculiar arrow-shaped element in the dorsal fin supports.

**Synapomorphy:** 'joined together shape', a shared derived character(s) which defines a sister-group in **cladistic analysis**.

**Syntype:** 'with pattern', any one of a series of specimens which characterize a species when there are no designated **holotype** and **paratypes**.

**Taphonomy:** 'burial cutting', the study of the processes of death, decay and burial by which organisms become selected and recruited to the fossil record.

**Tectonism:** 'builder', the processes of crustal deformation, often associated with plate tectonics and mountain building.

**Teleostei (-osts):** 'end bone', an extant and major group of advanced **neopterygians**, which includes the majority of living bony **fishes**; characterized by an air bladder, loss of enamel layer on skull bones, **homocercal** tail and thin bony **cycloid** scales.

**Temnospondyli (-yles):** 'cut vertebra', an extinct group of Upper **Palaeozoic labyrinthodonts**, with flattened skulls.

**Terrane:** 'earth', a small crustal plate or fragment of a larger plate, with distinctive characteristics, which can be displaced considerable distances from its original site and added to another plate during plate tectonic movement.

**Tethys:** '*Tethys*, a mythical titaness and wife of *Oceanus*', an east-west-extending major ocean, which separated the southern supercontinent of **Gondwanaland** from **Laurasia** in **Mesozoic times**; subducted to form the Alpine-Himalaya mountain belt.

**Tetrapoda (-ods):** 'four footed', developmentally four-footed **vertebrates** including amphibians, reptiles and mammals.

**Thanatocoenose:** 'death common', an assemblage of fossil organisms which have been brought together by the processes of sedimentation, following their death, so that the assemblage may contain organisms that did not originally live near one another.

**Thelodonta (-onts):** 'teat teeth', an extinct group of **agnathans**, characterized by their shark-like dermal **denticles**, which are commonly fossilized as separate elements within the sediment.

**Thermocline:** 'heat swerve', a layer of water with fluctuating temperatures, which forms in summer and separates the **epilimnion** above from the **hypolimnion** below.

**Theromorpha (-orphs):** 'summer form', an extinct group of Upper **Palaeozoic** primitive mammal-like reptiles with a sprawling gait, including a group with heat exchange 'sailfins'.

**Thyestida (-ids):** 'pestle', an extinct group of **cornuate osteostracans** with an infra-orbital sensory line passing medially to the lateral fields.

**Transgression:** 'across walk', referring to the encroachment of the sea across a landscape as a result of either a rise in sea level or subsidence of the land.

**Tremataspida (-ids):** 'hole shield', an extinct group of **cornuate osteostracans** within the **thyestids**, which have lost their paired fins and cornual processes and have a 'tadpole-shaped' head.

**Trophic pyramid:** 'food pyramid', a layered subdivision of the food chain with the broad base of numerous primary producers at the base rising to the relatively few top carnivores at the apex of the 'pyramid'.

**Tuff:** volcanic ash, comprising rock and crystal fragments from an explosive eruption.

**Turbidite:** the deposit of a gravity-controlled turbidity current.

**Unconformity:** a break in the relationship between successive rocks in a sequence as a result of a variety of causes, from a lack of deposition to an intervening phase of **tectonism** and erosion; consequently the missing time interval may also vary enormously.

**Urochordata (-ates):** 'tail cord', a group of **protochordates** in which the chordate features are often only expressed in the larval stages; see **sea-squirts**.

**Uronemidae (-ids):** 'tail thread', one of five extinct groups of Carboniferous **dipnoans**.

**Variscan:** 'land of the Varisci or Vogtland', synonymous with **Hercynian**.

**Varved:** a **laminite** deposit in which the layers of sediment are graded and generally result from a seasonal influx of sediment-laden water into a low-energy water body such as a lake or lagoon.

**Vascular (plant):** 'small vessel', the major group of tracheophyte plants, in which there are special cells for the transmission of fluids.

**Vertebrata (-ates):** 'back bone', synonymous with **Craniata**, those metamerically segmented **chordates** in which the **notochord** is replaced by a backbone as part of an endoskeleton of **cartilage** or bone and with a high degree of cephalization.

**Viviparous:** 'live bearing', producing live young, as in the mammals, rather than eggs.

**Xenacanthiformes (-orms):** 'strange spine', an extinct group of shark-like **elasmobranchs** with a long dorsal spine on the head and diplodont teeth with a divergent crown and small median cusps.

**Zechstein:** a European stratigraphical name for Upper Permian deposits, including carbonates and **evaporites** of a shallow sea in northern Germany and the North Sea area.

**Zone:** a division of geological or stratigraphical time defined by fossil content, see **biozone**.

## [References](#)