Paleontology material

Unit 3

Phyllum Hemichordata

Morphology

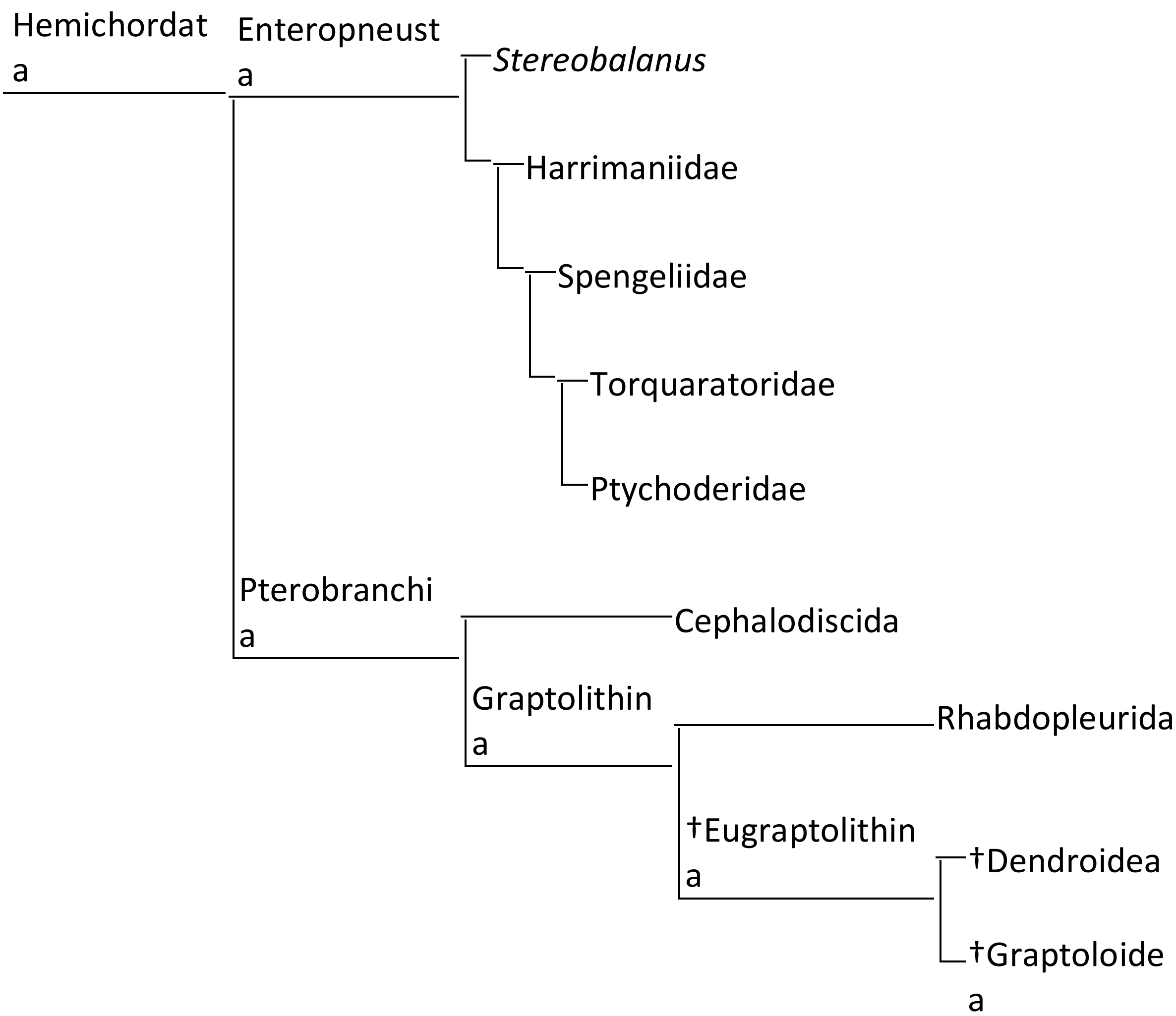
Hemichordata is a phylum of marine deuterostome animals, generally considered the sister group of the echinoderms. They appear in the Lower or Middle Cambrian and include two main classes: Enteropneusta (acorn worms), and Pterobranchia. A third class, Planctosphaeroidea, is known only from the larva of a single species, *Planctosphaera pelagica*. The extinct class Graptolithina is closely related to the pterobranchs.

Acorn worms are solitary worm-shaped organisms. They generally live in burrows (the earliest secreted tubes) and are deposit feeders, but some species are pharyngeal filter feeders, while the family Torquaratoridae are free living detritivores. Many are well known for their production and accumulation of various halogenated phenols and pyrroles. Pterobranchs are filter-feeders, mostly colonial, living in a collagenous tubular structure called a coenecium. The body plan of hemichordates is characterized by a muscular organization. The anteroposterior axis is divided into three parts: the anterior prosome, the intermediate mesosome, and the posterior metasome.

The body of acorn worms is worm-shaped and divided into an anterior proboscis, an intermediate collar, and a posterior trunk. The proboscis is a muscular and ciliated organ used in locomotion and in the collection and transport of food particles. The mouth is located between the proboscis and the collar. The trunk is the longest part of the animal. It contains the pharynx, which is perforated with gill slits (or pharyngeal slits), the esophagus, a long intestine, and a terminal anus. It also contains the gonads. A post-anal tail is present in juvenile member of the acorn worm family Harrimaniidae

Classification

Hemichordata are divided into two classes: the Enteropneusta, commonly called acorn worms, and the Pterobranchia, which may include the graptolites. A third class, Planctosphaeroidea, is proposed based on a single species known only from larvae. The phylum contains about 120 living species. Hemichordata appears to be sister to the Echinodermata as Ambulacraria; Xenoturbellida may be basal to that grouping. Pterobranchia may be derived from within Enteropneusta, making Enteropneusta paraphyletic. It is possible that the extinct organism *Etacystis* is a member of the Hemichordata, either within or with close affinity to the Pterobranchia.



Geological and Stratigraphic importance.

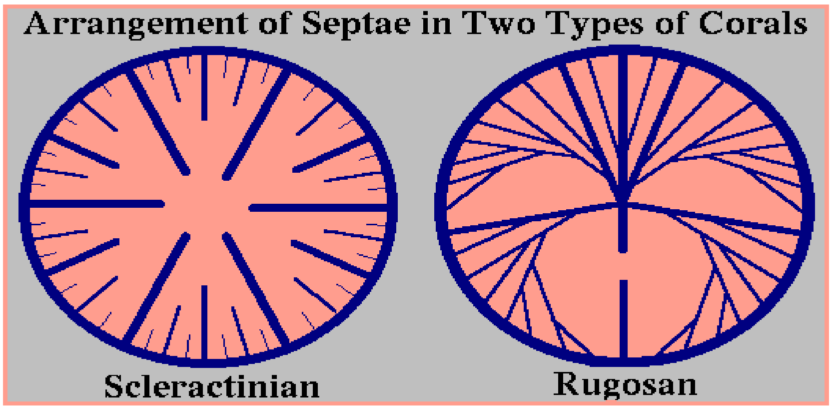
Hemichordates are known as fossils from at least the earliest mid-Cambrian Period (ca. 510 Ma) and are well represented in the fossil record by the graptolithinid pterobranchs (“graptolites”), which include the most abundantly preserved component of Paleozoic macroplankton . However, records of the soft tissues of fossil hemichordates are exceedingly rare and lack clear anatomical details . *Galeaplumosus abilus* gen. et sp. nov. from the lower Cambrian of China, an exceptionally preserved fossil with soft parts, represents by far the best-preserved, the earliest, and the largest hemichordate zooid from the fossil record; it provides new insight into the evolution of the group. The fossil is assigned to the pterobranch hemichordates on the basis of its morphological similarity to extant representatives. It has a zooidal tube (coenecium) with banding throughout comparable to that in the extant pterobranchs and a zooid with paired annulated arms bearing paired rows of annulated tentacles; it also displays a putative contractile stalk. *G. abilus* demonstrates stasis in pterobranch morphology, mode of coenecium construction, and probable feeding mechanism over 525 million years.

Phyllum Coelenterata

Class Anthozoa-corals

Morphology

Anthozoans completely lack a medusa stage; they are *polyps* throughout their life cycles. An anthozoan individual has a saclike body divided by radial partitions known as *septa*; these septa can easily be seen in corals, and their arrangement is an important character for classification.



Above is a diagram of the septal arrangement in two types of corals. On the left is a scleractinian (extant stony coral) showing hexagonal symmetry. The extinct rugose corals of the Paleozoic seas had a very different arrangement, diagrammed on the right; they were once called tetracorals (four-sided corals), but the arrangement is actually bilateral. Compare the above diagram with the corals shown below, *Tubastraea*, on the left, and *Lithostrotionella*, on the right.

Corals are an ancient group having a simple, radially-symmetrical body with a single opening that serves as both a mouth and anus. The body is made up of two layers of cells, separated by a jelly-like layer with no internal organs. Corals possess specialised stinging cells called nematocysts on their retractable tentacles that are used to catch food.

Body Shape

A coral polyp is a tubular sac-like animal with a central mouth surrounded by a ring of tentacles. The end opposite the tentacles, called the base, is attached to the substrate.

Size

Depending on the species, coral polyps may measure less than an inch to several inches in diameter (a few millimeters to several centimeters). One of the largest corals, Fungia (mushroom coral), is a solitary coral that can extend 10 in. (25 cm) in diameter. Colonial coral polyps are much smaller and average 0.04 to 0.12 in. (1-3 mm) in diameter.

Coral colonies also vary in size. Some corals form only small colonies. Others may form colonies several feet (a few meters) high. Star coral (Montastrea annularis) colonies reach an average height of 10 to 13 ft. (3-4m).

Color

Natural pigments in coral tissue produce a range of colors including white, red, orange, yellow, green, blue, and purple. Colored calcareous spicules (needle-shaped structures) give some octocorallians their colors. Algae that live within the tissues of some corals may make the coral appear brown, green, or orange.

Tentacles

Tentacles are for defense and for moving food to the mouth. Depending on the subclass, a coral polyp's tentacles are arranged in multiples of six or eight. The tentacles contain microscopic stinging capsules called nematocysts. A nematocyst is a bulbous double-walled structure containing a spirally folded, venom-filled thread with a minute barb at its tip. A tiny sensor projects outside the nematocyst. When the sensor is stimulated physically or chemically, the capsule explodes and ejects the thread with considerable force and speed. The barb penetrates the victim's skin and injects a potent venom.

Classification

Anthozoa is subdivided into three subclasses: Octocorallia, Hexacorallia and Ceriantharia, which form monophyletic groups and generally show differentiating reflections on symmetry of polyp structure for each subclass. The relationships within the subclasses are unresolved.

Anthozoa are a class in the phylum Cnidaria. It includes the sea anemones and the corals. It is a monophyletic clade, one of two in the Cnidaria. The other is the Medusozoa.[1]

The class does not have a medusa larval stage in its development, unlike the rest of the phylum. Like all Cnidaria, their food-catching and defense are done by nematocysts, which are extremely effective stinging cells. Over 6,100 species have been described.[2][3]

There are three subclasses:

- Ceriantharia: the tube-dwelling anemones or cerianthids
- Hexacorallia: 4,300 species of colonial polyps, usually with 6-fold symmetry. This includes all of the stony corals, which are vital for coral reef formation, and all sea anemones, and zoanthids.
- Octocorallia: 3,000 species of colonial polyps with 8-fold symmetry.[1] It includes the blue coral, soft corals, sea pens, and gorgonians (sea fans and sea whips).

Though a coral polyp looks like a plant, it's really an animal, or rather, a colony of animals, and is classified into the Phylum Cnidaria (also called Phylum Coelenterata). Phylum Cnidaria is further subdivided into three classes: the jellyfish (Class Scyphozoa); the hydrozoans (Class Hydrozoa); and the corals and sea anemones (Class Anthozoa). The most common type of reef is the fringing reef. This type of reef grows seaward directly from the shore. They form borders along the shoreline and surrounding islands. When a fringing reef continues to grow upward from a volcanic island that has sunk entirely below sea level, anatoll is formed. Atolls are usually circular or oval in shape, with an open lagoon in the center.Barrier reefs are similar to fringing reefs in that they also border a shoreline; however, instead of growing directly out from the shore, they are separated from land by an expanse of water. This creates a lagoon of open, often deep water between the reef and the shore.

Coral reefs are important because they bring in billions of dollars to our economy through tourism, protect coastal homes from storms, support promising medical treatments, and provide a home for millions of aquatic species.

NOAA's Coral Reef Conservation Program works to protect coral reefs through research, education, and preservation programs. Many reefs, such as the Virgin Islands Coral Reef National Monument, are housed in NOAA's system of marine protected areas.

Geology and stratigraphy

The origins of the Anthozoa lie in the Precambrian, but concrete evidence is sketchy. A number of the Vendian, or latest Precambrian, soft-bodied "medusoids" are now thought to represent benthic polyp-like organisms. Some of the frondlike fossils of the time could represent colonial anthozoans similar to living "sea pens," *Eoporpita* is one such Vendian fossil that could be a single anthozoan polyp, and *Charnia* is a frondlike fossil that in the past has been linked with "sea pens" or soft corals. However, this issue has not been resolved to everyone's satisfaction, although some well-preserved frondlike fossils of the genus *Charniodiscus* from Australia may show spicules and individual polyps (Jenkins 1989). In any case, there is molecular evidence to suggest that the Anthozoa are the earliest branch of the phylum Cnidaria (Bridge et al. 1992).

Cambrian-age localities with soft-bodied organisms preserved also include some soft-bodied sea anemones and "sea pens," such as *Mackenzia* and *Thaumaptilon* from the Burgess Shale and *Xianguangia* from the Chengjiang biota of China. A few of the Cambrian "small shelly fossils" are *spicules* — nearly microscopic, mineralized, needle-like pieces — that appear similar to the spicules of living octocorals

Corals first appeared in the Cambrian about 535 million years ago. Fossils are extremely rare until the Ordovician period, 100 million years later, when rugose and tabulate corals became widespread. Paleozoic corals often contained numerous endobiotic symbionts.

Tabulate corals occur in limestones and calcareous shales of the Ordovician and Silurian periods, and often form low cushions or branching masses of calcite alongside rugose corals. Their numbers began to decline during the middle of the Silurian period, and they became extinct at the end of the Permian period, 250 million years ago.[48]

Rugose or horn corals became dominant by the middle of the Silurian period, and became extinct early in the Triassic period. The rugose corals existed in solitary and colonial forms, and were also composed of calcite.

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