UG CBCS Semester-1
Phylum: Hemichordata

The hemichordates constitute a phylum of exclusively marine, benthic, bilaterally-symmetrical deuterostome invertebrates. They inhabit all sea bottoms of the world, from intertidal environments to abyssal depths. The phylum includes about 135 species, most of which are benthic burrowers known as acorn worms (or tongue worms) grouped in the class Enteropneusta. The remaining species belong to the class Pterobranchia-largely colonial forms of minute zooids superficially resembling bryozoans.

Characteristics

- Bilaterally symmetrical deuterostomes. body vermiform or saccate and fundamentally trimeric, with prosome, mesosome, and metasome, each with coelomic compartments; solitary or colonial; pterobranchs with mesocoelic extensions into the arms and tentacles
- With mesocoelic ducts and pores
- With pharyngotremy (communication of the gut to the exterior via ciliated pharyngeal gill slits and pores)
- Well developed, open circulatory system, unique excretory structure, the glomerulus, gonads extracoelic, in metasoma, complete gut and deposit or suspension feeders
- With buccal diverticulum or stomochord as supporting structure for the prosome; stomochord not homologous with the chordate notochord
- Circular and longitudinal muscles present in body wall of proboscis and collar of enteropneusts; pterobranchs with longitudinal muscles only
- Collagenous skeletal structures in the proboscis and gill bars of enteropneusts derived from basement membranes of adjacent epithelia
- Short, dorsal, mesosomal, occasionally hollow nerve cord (neurochord), probably homologous with chordate nerve cord
- Gonochoristic, with external fertilization and indirect development through a unique tornaria larva; some species with direct development; asexual reproduction common
- Cleavage radial, holob lastic, more or less equal. Although blastopore denotes posterior end of body, both the mouth and the anus form secondarily, subsequent to closure of the blastopore. Mesoderm and body cavities form by enterocoely.

Classifications

The classification presented herein follows the traditional division of the phylum into two classes, Enteropneusta and Pterobranchia.

Class I: Enteropneusta

Acorn, or tongue worms. Vermiform, with three body regions as proboscis, collar, and trunk; coeloms reduced by muscle development; gut elongate, straight; mouth ventral at anterior end of collar; long dorsolateral series of gill slits; dorsal, hollow nerve cord in the collar; anus posterior, terminal; marine, burrow in soft sediments or nestle under rocks or in algal holdfasts; largely intertidal although deep-water species are increasingly being discovered.

Example – Balanoglossus, Glossobalanus, etc., are marine, worm-like animals that usually live in shallow water and are found burrowing in muddy or sandy bottoms. Externally, three body regions are apparent: the proboscis, the collar, and the trunk.

The mouth is located ventrally, just beneath the proboscis and within the anterior border of the collar; the anus lies at the posterior tip of the trunk. The gill slits form a dorsolateral row of perforations on each side in the anterior region of the trunk, extending posteriorly for some distance. These perforations are passages from the cavity of the pharynx to the exterior. Near the middle of the trunk region, transverse ridges are produced by paired, glandular caeca which arise from the digestive tract. The digestive system includes a buccal region within the collar, a pharyngeal region marked by the gill slits, and an intestine which bears the caeca and leads to the anus. As the animal burrows through sand or mud, the proboscis is thrust forward, and the silt from which food is extracted enters the mouth and pharynx.

Excess water passes outward through the dorsolateral gill slits, aerating the blood in vessels lining their walls. The ingested silt, concentrated in a ciliated groove in the ventral region of the pharynx, is conducted posteriorly through the intestine, where usable food materials are digested and absorbed.

Coelomic spaces are found within proboscis, collar, and trunk, being derived from three pairs of primary embryonic coelomic pouches. The circulatory system consists of a median dorsal and a median ventral longitudinal vessel, interconnected by small lateral branches in the pharyngeal region and posteriorly. A so-called "heart" lies in the proboscis, but the blood is probably propelled chiefly by peristaltic contractions of the longitudinal vessels. A glomerulus, which has been considered an excretory organ, is connected with blood vessels in the proboscis.

The nervous system is composed of two principal nerve trunks formed as ectodermal thickenings in the median dorsal and median ventral regions of the trunk. These cords appear to represent specialized areas of a generally distributed subepidermal nerve net, or plexus layer. The cords are connected by a ring-like epidermal thickening in the collar, and the dorsal trunk proceeds anteriorly through the collar before dipping downward to enter the proboscis. The resemblance of this nervous system to the central nervous system of the typical chordate is not outstanding, although the nature of the dorsal nerve trunk in the collar region is somewhat suggestive of the chordate nerve cord.

A structure called the stomochord is present in the posterior part of the proboscis, arising as an anterior extension from the dorsal wall of the buccal cavity. This small supporting clement is probably homologous with the chordate notochord, but it is limited in its extent and of a very primitive nature.

The sexes are separate in the balanoglossids; the gonads are sac-like structures arranged serially on each side in the region of the genital ridges. When mature, each gonad establishes an individual, externally opening genital pore. The small eggs are fertilized externally, and development proceeds in the sea water. A pelagic, ciliated larva, the tornaria, occurs as a developmental stage in the life cycles of some species, but not in Saccoglossus.

The tornaria is so similar to the dipleurula-type larva of echinoderms that it was originally described as the larva of some unidentified echinoderm. This similarity may be interpreted as indicating an evolutionary relationship between echinoderms and hemichords, a relationship which is suggested also on the basis of certain biochemical similarities.

Class II: Pterobranchia

Pterobranchs. Body sacciform; with three body regions as preoral disc (= cephalic shield), tentaculate mesosome, and metasome subdivided as trunk and stalk; neurochord lacking; pharynx with one pair of gill slits or none; gut U-shaped; marine; generally small, aggregating, or colonial.

Example – *Cephalodiscus* and *Rhabdopleura*. These are small marine forms with the typical hemichord body regions of proboscis, collar, and trunk, the internal anatomy is comparable with that of the balanoglossids. In correlation with their generally sedentary mode of life, the gut is U-shaped, the anus opening near the mouth. The proboscis is modified into two or many arms, or tentacles, which in Rhabdopleura are retractable into the secreted test within which the animal lives.

Reproduction is both sexual and asexual, in Rhabdopleura new individuals are produced by budding from a horizontal stolon growing along the substrate. Individuals thus formed constitute a colony of zooids comparable with those of colonial coelenterates. The fossil remains of the extinct graptolites, long considered as either coelenterates or ectoprocts, have in the light of recent studies been interpreted as showing many similarities to the sessile and enclosed pterobranchs.

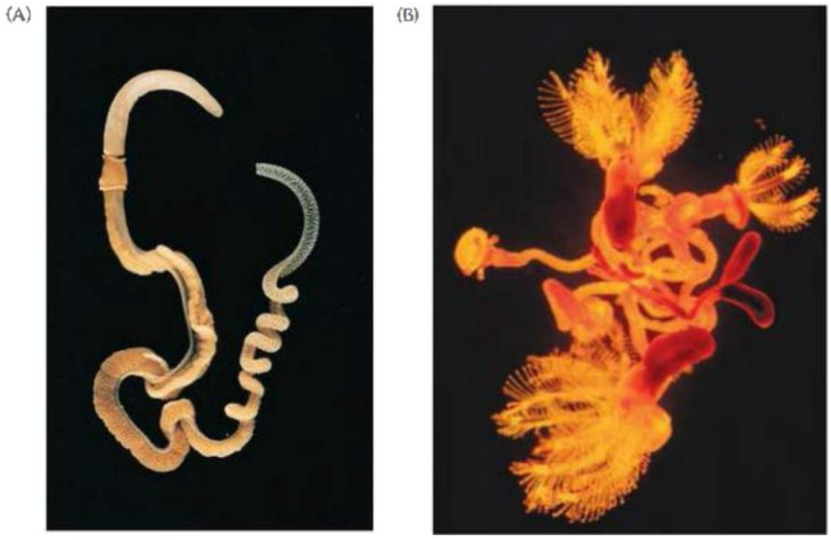

Figure 26 1 Representative hemichordates. (A) The acorn worm *Saccoglossus* (phylum Hemichordata. class Enteropneusta). (B) Port on of a *Cephalodiscus* colony (phylum Hemichordata. class Pterobranchia), showing sev eral individuals at d fferent stages of development.

Relationships of the Hemichordata

In the phyla Echinodermata, Chaetognatha, Hemichordata, and Chordata, the embryonic origin of the coelom is by the enterocoelous method, as in no other animal groups except the anomalous Brachiopoda. This common embryological feature is considered to indicate that these four groups are related by a common ancestry. Evidence from serological studies shows that the proteins of chordates resemble those of echinoderms and hemichords more closely than those of any other invertebrate group.

Further, biochemical studies on substances termed phosphagens, important in the functions of muscular tissues, also reveal significant similarities between these three groups.

The tornaria larva is suggestive of an evolutionary relationship between echinoderms and hemichords, and the presence in hemichords of visceral clefts, the stomochord, and rudiments of a dorsal nerve cord suggests affinities with the chordates. On the whole, the evidence may logically be interpreted as supporting the concept of a common evolutionary line of enterocoelous, deuterostomous organisms, possibly resembling the dipleurula or tornaria, from which by successive radiations the ancestors of the modern enterococlous groups arose. The hemichords would seem to have evolved from this ancestral line after the divergence of the ancient echinoderms and chaetognaths but before the rise of the true chordates. These evolutionary changes must have antedated the beginning of our fossil record and undoubtedly involved small forms lacking hard parts.