VIVEKANANDA COLLEGE

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NAAC ACCREDITED 'A' GRADE

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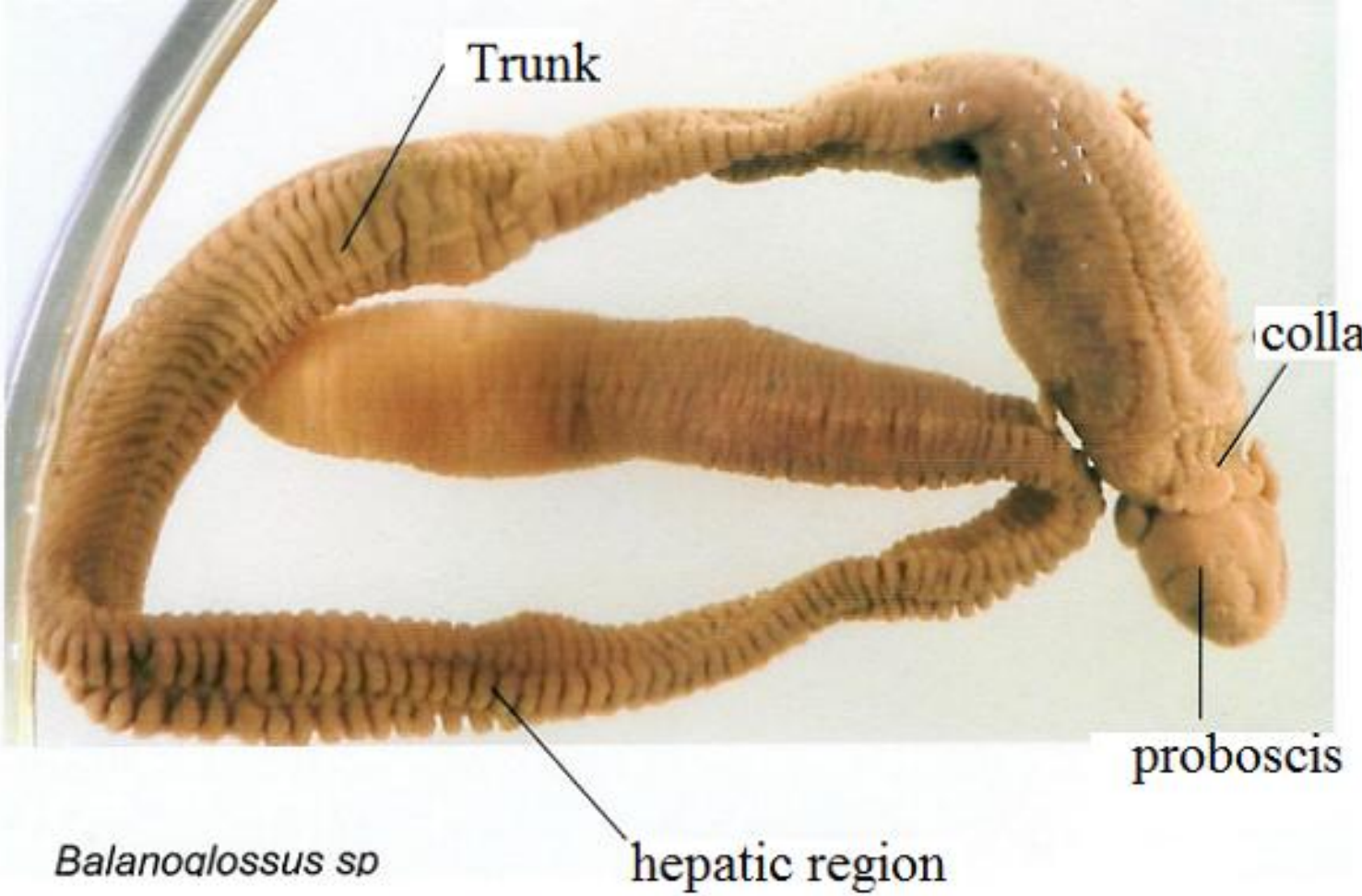

HEMICHORDATES

Dr. Shaoli Majumder

GENERAL CHARACTERS OF HEMICHORDATA:

1. Solitary and colonial, mostly tubicolous, exclusively marine.

2. **Body** soft, fragile, vermiform and **divisible into proboscis, collar and trunk**.

3. Body wall with a single-layered epidermis.

4. Coelom enterocoelous, divisible into protocoel, mesocoel and metacoel.

5. **Buccal diverticulum**, earlier considered as notochord, **present in the proboscis**.

6. **Digestive tract** complete; **in the form of straight or U-shaped tube**.

7. **Gill-slits, when present, are paired and one to numerous**.

8. Circulatory system simple and well developed; closed type; usually with a contractile heart vesicle and two longitudinal vessels, one dorsal and one ventral, interconnected by lateral vessels and sinuses.

9. Excretion by a single glomerulus situated in the proboscis.

10. Nervous system primitive comprising mainly of an intra-epidermal nerve plexus.

11. Reproduction mostly sexual. Sexes separate or united. Gonads one to several pairs.

12. Fertilisation external. Development mostly indirect through a free swimming **tornaria larva**. Direct development is also found in some forms.

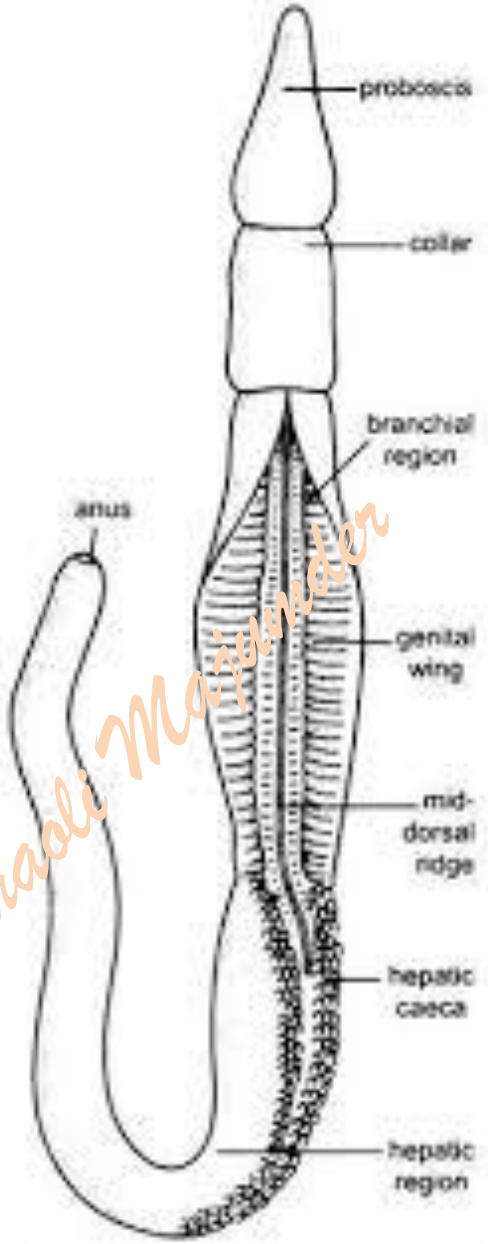

Fig. 2.2. *Balanoglossus*. External features in dorsal view.

AFFINITIES OF HEMICHORDATA:

The position of Hemichordata, in the scheme of classification of animals, has been controversial. In 1814, Sedgwick and Huxley suggested the affinities of Enteropneusta (Hemichordata) with the vertebrates and in 1885 Bateson considered this group as a subphylum of the phylum Chordata.

But on the basis of general organisation, some recent workers, such as Van der Horst (1939), Dawydoff (1948), Marcus (1958) and Hyman (1959) have thought it proper to remove this group from phylum Chordata to give it the status of an independent invertebrate phylum. The name "Hemichordata" is, however, retained for the group because it suggests that its members are related to chordates, i.e., they are "half or "part" chordates, a fact that is undisputed.

1. Affinities with Chordata:

Bateson (1887) included Hemichordata in phylum Chordata, since then a close relationship has been acknowledged between hemichordates and chordates.

Resemblances:

The phylogenetic relationship of hemichordates and chordates is based on the supposed presence of the three fundamental chordate characters in both groups, viz., a notochord, central nervous system, and pharyngeal gill-clefts. The structure and function of pharynx and branchial apparatus are similar to those of Cephalochordata and Urochordata. Origin of coelom is similar in both Hemichordata and Cephalochordata, it is enterocoelous.

❑ **The buccal diverticulum or stomochord of hemichordates has been regarded as the equivalent of a notochord since the time of Bateson.**

➢ **Objections:**

1. The buccal diverticulum is a hollow evagination of the anterior wall of the buccal cavity, and it is not definite whether it is endodermal or ectodermal in origin, whereas the notochord is a long solid rod formed from the roof of the archenteron.

2. The buccal diverticulum is generally made of ordinary epithelial cells, while the notochord of vertebrates consists of large vacuolated cells.

❑ **There are certain resemblances between the nervous system of hemichordates and chordates, such as its position, and formation of the dorsal nerve cord from the dorsal epidermis, and the collar cord which often has a neuropore and is comparable with the brain of vertebrates.**

But there are major differences, such as:

(i) Its superficial position in contact with the epidermis,

(ii) Possession of a main ventral nerve cord, and

❑ **The chief link between the hemichordates and chordates lies in the pharynx and its gill- clefts.** The details of the branchial apparatus having tongue bars, M-shaped skeletal rods and synapticula are exactly like those of Amphioxus. But the endostyle and epibranchial groove are absent from the pharynx of hemichordates. Such similarity can be only due to common ancestry, and phylogenetic relationship of hemichordates and chordates cannot be denied.

The inclusion of hemichordates in phylum Chordata cannot be justified on the basis of a few similarities which are more than outweighed by important differences.

The main differences are:

1. Chordates do not have the body and coelomic regions corresponding to those of hemichordates.

2. The circulatory and nervous systems of hemichordates are like those of invertebrates.

3. There is no post-anal tail in hemichordates.

4. Chordates are metamerically segmented animals; this segmentation is clearly shown by the muscular, nervous, circulatory and excretory systems, whereas there is a total absence of segmentation in hemichordates.

2. Affinities with Annelida:

Spengel (1893) first suggested the relationships between hemichordata and Annelida.

Resemblances:

The main resemblances of Hemichordata with Annelida are as follows:

1. The general body form and burrowing habit of tubicolous forms such as Balanoglossus are alike and mud is ingested in burrowing. It is passed out from the anus as castings.

2. The collar of Balanoglossus resembles with the clitellum of earthworm.

3. The proboscis of Balanoglossus and prostomium of earthworm are similar and both are pre-oral.

The differences are as follows:

The differences between two groups are so great that there can be no phylogenetic relationship between them.

1. Pharyngeal gill-slits, buccal diverticulum and dorsal tubular nerve cord found in Balanoglossus.
2. Paired ventral nerve cord present in annelids is absent in Balanoglossus.
3. Nephridia found in annelids are absent in Balanoglossus.

3. Affinities with Echinodermata:

➢The adult hemichordate and adult echinoderm are so different that one cannot suspect any relationship between them the only anatomical similarity between them is their nervous system which in both cases consists of nerve net lying near the surface embedded in the epidermis.

➢But there is a strong affinity between the two phyla on embryological evidence, the method of formation of the gastrula and the coelom is very similar in the two phyla and for years the tornaria larva was considered to be the larva of an echinoderm. The tornaria larva shows a very striking resemblance with the auricularia larva and specially with bipinnaria of Asteroidea.

Resemblances:

1. The ciliated band is identical and follows the same course in the tornaria and the auricularia and bipinnaria, though the telotroch and eye spots of the tornaria are absent in echinoderm larvae.

2. The alimentary canal has the same shape and the same divisions into foregut, stomach and intestine in hemichordate and echinoderm larvae.

3. In both groups the blastopore becomes larval anus.

4. The greatest and the most convincing resemblance lies in the method of formation and arrangement of coelomic cavities. In both the coelom is of enterocoelous origin and it divides into three antero-posterior parts, which in hemichordates are called proboscis coelom (protocoel), collar coelom (mesocoel), and trunk coelom (metacoel), while in echinoderms the three parts of the coelom are axocoel, hydrocoel, and somatocoel. Moreover, the proboscis coelom and collar coelom of hemichordates open to the exterior by pores through short hydroporic canals, as does the hydrocoel in echinoderms.

Differences:

1. Eye spot present in tornaria is absent in bipinnaria.
2. The apical plate and telotroch present in tornaria are absent in bipinnaria.
3. The protocoel is paired in echinoderms, while unpaired in tornaria larva.

The many embryonic resemblances between hemichordates and echinoderms are merely due to convergent evolution due to similar mode of habits and habitat.

The only infallible conclusion is that the two groups are closely related and that they arose from a common ancestor. Echinoderms have deviated greatly from the ancestral type, while hemichordates are closer to it. The common ancestor gave rise to echinoderms as a blind side branch, while the main line of evolution produced the hemichordates and chordates.

CONCLUSION:

The close affinities of Hemichordata, Echinodermata and Chordata, etc., have led to the conclusion that they have common ancestor from which they have arisen independently. Probably the common ancestor was dipleurula larva. Recently Barrington (1965) expressed that Echinodermata deviated greatly from the ancestral stock and formed a blind branch. Hemichordata also did not stand on the direct line of ancestory but formed a divergent offshoot from the main line of chordate evolution. Thus, it may be suggested that Balanoglossus and other chordates are running on the same field but not on the same track. Since the hemichordates arose from the ancestral line after the divergence of the ancient Echinodermata but before the rise of true chordates, they are often called prechordates.

It appears most reasonable to place them in the invertebrates as an independent phylum which has arisen from an ancestral stock that has given rise, on the one hand, to echinoderms and, on the other hand, to hemichordates and chordates.

THANK YOU