AFFINITIES AND SYSTEMATIC POSITION

Cephalochordates (*Branchiostoma*) are unique in showing affinities with chordates as well as non-chordates. / Amphioxus

[I] Non-chordate affinities

Cephalochordates have been regarded to be phylogenetically related to several non-chordate groups at one time or other. Only those with more important groups are being summarized below. But these can be overlooked in favour of the more chordate-like characteristics of Cephalochordates.

1. Affinities with Annelida. Some of the common features are : (i) Body bilaterally symmetrical and metamerically segmented, (ii) metamerically arranged protonephridia with solenocytes (as in some polychaetes), (iii) well developed coelom, (iv) closed and similarly

disposed blood vascular system, and (v) filter feeding method in some polychaetes.

Objections. In cephalochordates, unlike annelids, metamerism is restricted only to myotomes and gonads. Coelom is enterocoelic and not schizocoelic as in annelids. The flow of blood in main blood vessels is in opposite directions in the two groups. Above all, the three basic chordate characters of Cephalochordata are not present in Annelida.

2. **Affinities with Mollusca.** It was Pallas (1778) who first described and named amphioxus as *Limax lanceolatus* considering it to be a slug. But the ciliary mode of feeding and respiratory mechanism through water current which are common features of the two groups may be due to similar mode of life. Their anatomy is completely different. Moreover, molluscs are unsegmented and their locomotory podium is also unknown in cephalochordates.

3. **Affinities with Echinodermata.** Echinoderms have asymmetrical body, enterocoelic coelom and similarly formed mesoderm. Perforations in the calyx of some fossil echinoderms look similar to gill-slits of amphioxus. As in *Branchiostoma*, ophiuroids have similar phosphagens (creatine phosphate). But all these similar features may be because of a very remote common ancestry of the two groups.

[II] Chordate affinities

Cephalochordata *(Branchiostoma)* shows the three basic chordate features, *viz.* the notochord, dorsal tubular nerve cord and pharyngeal gill-slits, in the most typical manner and there is no doubt about its chordate nature. However, it shows relationships with all the major groups of phylum Chordata, and its real status in the phylum remains uncertain.

1. **Affinities with Hemichordata.** Hemichordata and Cephalochordata resemble in having similar (i) pharyngeal apparatus with numerous gill slits and gill bars, (ii) filter feeding mechanism, (iii) respiratory mechanism, (iv) enterocoelic coelom, and (v) numerous gonads without gonoducts.

Objections. The muscles in Hemichordata are unsegmented, nervous system distinctly of non-chordate type, gill-slits dorsal in position instead of lateral, and a postanal tail is lacking. Moreover, inclusion of Hemichordata under Chordata is also uncertain because of doubtful nature of notochord. As such, Hemichordata, without question, are more primitive than Cephalochordata.

2. **Affinities with Urochordata** *Branchiostoma* (Cephalochordata) and *Herdmania* (Urochordata) are regarded to be very closely related because of (i) primitive ciliary feeding and respiratory mechanisms, (ii) large pharynx bearing numerous lateral gill slits, epipharyngeal groove, endostyle and peripharyngeal bands, (iii) an ectoderm-lined atrial cavity opening to outside through atriopore (atrial siphon), (iv) identical early stages (holoblastic cleavage, gastrulation by invagination) of development, and (v) the ascidian larva having a continuous notochord, above it a dorsal hollow nerve cord, and a post-anal tail with median caudal fin without fin rays.

Objections. The adult urochordates are extremely degenerate and sedentary animals having several features unrepresented in cephalochordates, such as (i) body unsegmented, (ii) covered by a test made of cellulose, (iii) with enterocoelic coelom, (iv) without notochord, and hollow nerve cord, (v) with a liver, (vi) a well-developed muscular heart covered by peritoneum, (vii) without nephridia, (viii) sexes united with hermaphrodite gonads and (ix) larva undergoing retrogressive metamorphosis to become the adult. These differences show that inspite of close similarities reflecting upon a probable common ancestry, the cephalochordates are better evolved than the urochordates.

3. **Affinities with Cyclostomata.** The Ammocoete larva of lamprey (Cyclostomata) and *Branchiostoma* show a striking similarity in many characters, such as : (i) elongated, slender fish-like body, (ii) continuous dorsal median fin, (iii) mouth surrounded by an oral hood and (iv) guarded by a velum, and (v) pharynx having endostyle and gill slits. Besides these fundamental chordate characters, their adults show metameric myotomes, persistent gill slits, velum and a postanal tail.

4. Affinities with other vertebrates. Besides cyclostomes, *Branchiostoma* also resembles other vertebrates in several ways, such a

(i) metamerically arranged myotomes, (ii) true coelom lined by mesodermal epithelium, (iii) postanal tail, (iv) midgut diverticulum comparable with liver, (v) well-formed hepatic portal system and (vi) similar arrangement of main longitudinal vessels with forward flow of blood in ventral and backward flow in dorsal blood vessel.

Objections. Cephalochordates differ from cyclostomes and other vertebrates in most of their primitive features already described, such as (i) lack of head, paired limbs, skull, vertebral column, muscular heart, red blood corpuslces, brain, specialized sense organs, gonoducts, etc., and (ii) in possessing nephridia, atrium, numerous gonads, asymmetry etc.