The echinoderms, especially their larval forms, attract the attention of many Zoologists due to the presence of many striking similarities between themselves and between different other groups of animals.

**Relationship with Annelida:**
A number of early workers have established affinities between the trochophore larva of annelids and some echinoderm larvae on the basis of the presence of similar ciliated bands and some other superficial similarities.

But these affinities are not based on any scientific ground because cleavage pattern is spiral in annelida but radial in echinoderms; coelom formation is schizocoelic in annelids but enterocoelous in echinoderms.

**Relationship with Brachiopoda:**
Some superficial similarities are also noted in between the early developmental stages of Brachiopoda and Echinodermata.

**The similarities are:**
1. Cleavage is holoblastic,

2. Blastula is a coeloblastula,

3. The coelom is enterocoelous in the members of the class Articulata of phylum Brachiopoda,

4. The members of class Articulata have free-swimming larval stage. However, these affinities are only superficial.

**Relationship with Chordata:**
The most convincing affinities are noted between the echinoderms and the chordates. Hence many workers regarded the echinoderms to be the nearest group to the chordates. However, modern workers do not support the contention and they hold that the echinoderms and the chordates diverged separately from a common basic ancestor.

**The affinities are discussed below:**
1. Mesodermal skeletal substance is present in both.

2. Presence of infra-epidermal nervous system in hemichordata.

3. The perforations on the calyx of carpoid echinoderms are compared with pharyngeal gill-slits of Amphioxus.

4. Needham (1932) has tried to show a relationship between these two groups by analysing biochemical evidences. Invertebrates have the phosphogen in the form of arginine phosphate whereas chordates usually have creatine phosphate. But the echinoids among echinodermata and hemichor-dates among Chordata have both arginine phosphate and creatine phosphate.

5. Wilhelmi (1942) has shown similarities between the two groups by serological tests as well.

6. Cleavage is radial, holoblastic.

7. Blastopore changes into anus.

8. Enterocoelous mode of coelom formation.

9. The similarities between adult echinoderms and chordates are very few, but the affinities between the larval forms are highly notable.

**Metschnikoff (1869) tried to show the following affinities between the torn aria larva of Balanoglossus and the bipinnaria and auricularia larvae of the echinoderms:**

1. free-swimming and bilateral symmetrical larvae in both,

2. transparent body with similar ciliated bands,

3. enterocoelous coelom with similar disposition,

4. similar location of mouth and anus,

5. the madreporic vesicles in bipinnaria are thought to be homologous with heart vesicle of Balanoglossus.

**Significance of echinoderm larvae:**

Bather (1900) claimed common ancestry of hemichordates and echinoderms from the dipleurula larva. The genealogical tree given in 1957 by Anderson and Guthrie and the phylogenetic tree given in 1948 by L. H. Hyman in collaboration with Prof. YV. K. Fischer who also supports the same idea, (vide the phylogenetic trees (Figs. 21.40 and 21.41).

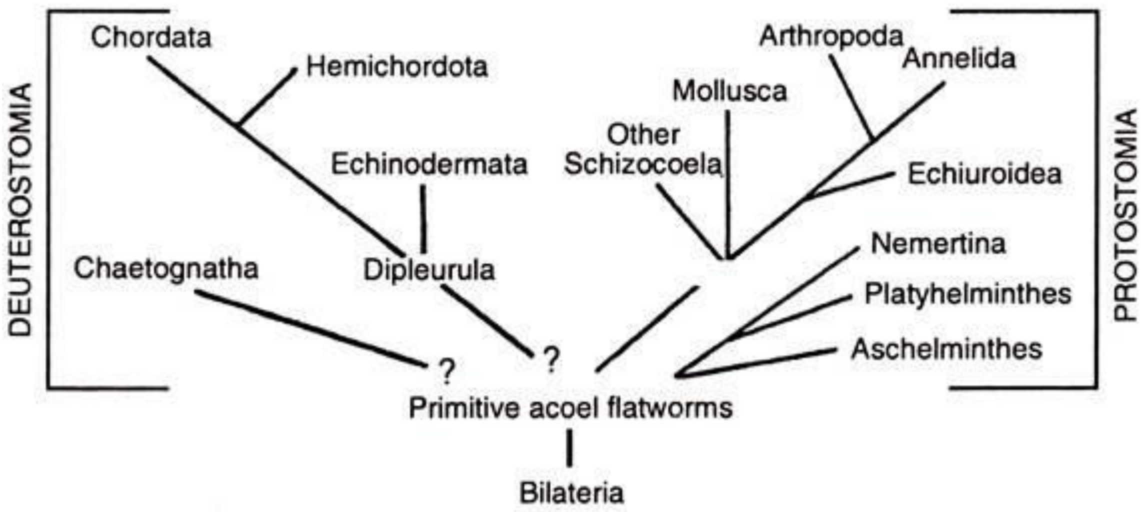


**Fig. 21.40:** Phylogeny of chordate (L. H. Hyman's view).

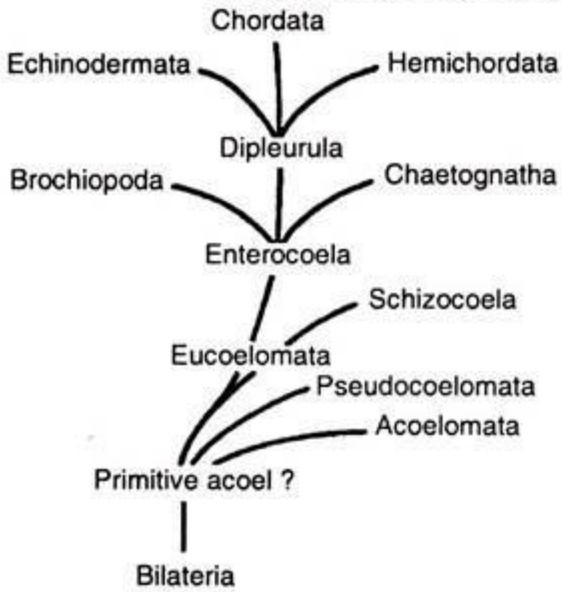


**Fig. 21.41:** Phylogeny of chordates (Guthric and Anderson's view).

Muller and Bateson again claimed that the tornaria larva and dipleurula larva had evolved form a common ancestral source.

De Beer and Garstang hold that the tornaria larva, the dipleurula and pluteus larvae are living relics from a very remote period when the echinoderms and chordates were not diverged.

The neotenous theory propounded by Garstang in 1894, 1928 holds that the chordates arose from some neotenous form of auricularia larvae. The sequence is—Auricularia larva (Echinodermata) → Tornaria larva (Hemichordata) → Tadpole (Ascidia) → Neoteny → Free swimming Chordates.

The adoral ciliated band of auricularia presumably functions to convey food particles in the oral aperture, and for this it has been converted to the floor of the pharyngeal cavity. Garstang suggests that endostyle was derived from this loop of the adoral band of the auricularia larva.

An atrium was developed in course of time to protect the gills. The fishlike swimming larva of tunicates is held by him to be formed from the development of muscles along the sides of the elongated body.

The ciliary bands were then pushed upwards and subsequently rolled up with the underlying nerve plexus to form the neural tube. Fig. 21.42 shows Garstang's idea of derivation of the protochordate from echinoderm larva.

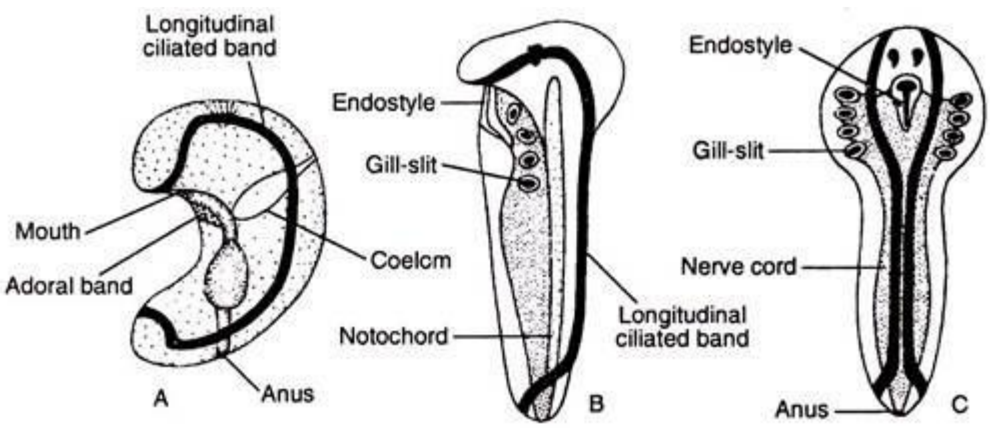


**Fig. 21.42:** Showing the sequences of derivation of the protochordate from echinoderm larva, possibly the auricularia (after Garstang). A. Auricularia larva (side view), B–C. Protochordate. B. Side view, C. Dorsal view.

Most of the modern workers like Berrill (1955), Bone (1979) have supported the main theory of Garstang but deny the origin of todpole. The tornaria larva of Hemichordate is much more similar to the larvae of echinoderms but differs in its mode of origin and its structure. Young (1981) supported the neotenous larval theory of Garstang.

Therefore, from the above discussion it may be concluded that the phylogenetic relationship between echinoderms, hemichordates and chordates is more convincing, and chordates may have evolved from non-chordates, probably the echinoderms.

But Fell (1963), Pawson and others deny the ancestry of chordates from any form of echinoderms arid they also deny the relationship between the tornaria larva and the echinoderm larvae. Many counter-arguments have been put forward by them.

1. Protocoel is unpaired in Balanoglossus, but paired in echinoderms.

2. Extant echinoderms lack pharyngeal gill-slits.

3. Bipinnaria larva lacks telotroch.

4. The tornaria larva has a characteristic apical plate with eye-spots.

Fell and many others hold that the affinities between tornaria and echinoderm larvae are not based on any phylogenetic relationship but are merely due to larval convergence for similar mode of life.

In Fell's own words "It therefore follows that within the phylum (Echinodermata), larval similarities do not indicate taxonomic affinities. Extrapolating beyond the phylum, so as to deduce taxonomic affinities on the basis of resemblance between auricularia and tornaria is, therefore, inadmissible. The unreliability of larval structure in the echinoderms as a guide to phylogenetic affinity is further illustrated by the occurrence of divergent patterns of development within related groups (e.g., Asterozoa, Echinozoa, Crinozoa)."

The presence of similar biochemical substances may not necessarily speak of any phylogenetic relationship and may be due to convergence for similar modes of physiological activities. Moreover, creatine phosphate has been found to occur also in other animals phylogenetically remote from the chordates, such as in sponges (Robin, 1954/ and in many polychaetes (Hobson and Recs 1955).

The study of larval forms and adults of echinoderms reflects a case of retrogressive metamorphosis because the adult echinoderms possess many primitive features than the larval forms.

The features of adults are comparable with lower invertebrates (e.g., Cnidaria), such as radial symmetry, lacking of distinct head, absence of anterior and posterior sides, etc. and the advanced larvae of echinoderms metamorphose into primitive adults. Hence it is an example of retrogressive metamorphosis.

**Views regarding the larval phylogeny:**

**MacBride (1914):**

Dipleurula larva was of fixed type and gave rise to the free-swimming forms of Antedon or Yolk larva.

**Hyman's synthetic view (1955):**

Dipleurula was remotely related non- echinoderm forms for their bilateral symmetry and went through a sessile stage of radial forms to reach the echinoderm status. This radial form Pentactula stage where reorganisation took place and gave rise to free- swimming and attached forms parallely (Fig. 21.43).

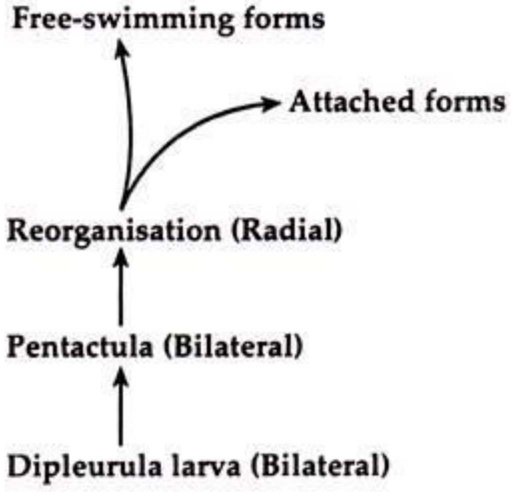


Fig. 21.43: Hyman's suggestion (1955).

**H. B. Fell (1963):**

Supports free-swimming origin of echinoderm larvae and their phylogenetic correlation through Vitellaria.

**Parker and Haswell (1972):**

Dipleurula larva was free-swimming, gave rise to the free-swimming forms through the free-swimming Antedon on one hand and to the fixed type through the fixed Antedon forms, on the other.

Barrington has summarised the work of other workers like Berrill (1955), Bone (1960), Carter (1957), Marcus (1958) and Whitear (1957) and has proposed that the echinoderms, the pogonophores, the hemichordates and the rest of the chordates arose separately but directly from a common bilaterally symmetrical sessile or semi-sessile ancestor with tripartite body and coelom, ciliated larval stage and ciliary mode of feeding from external source (Fig. 21.44).

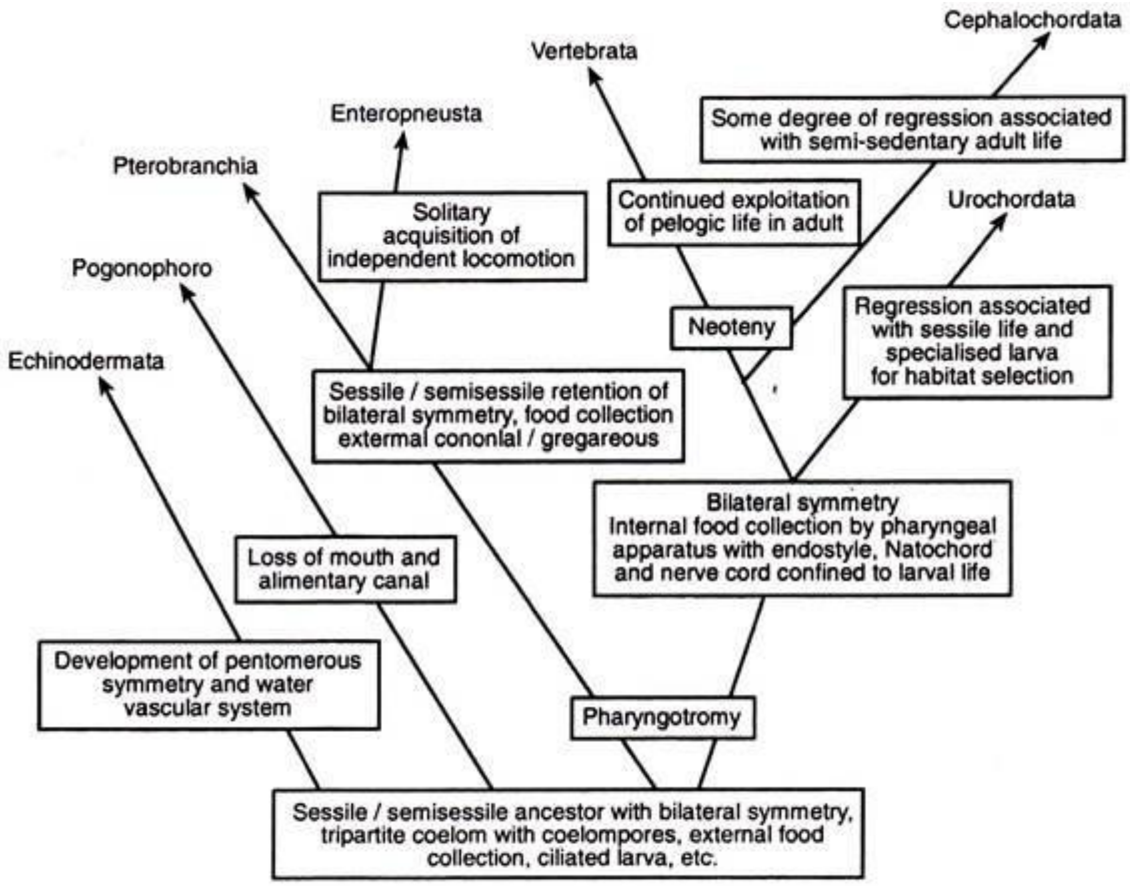


**Fig. 21.44:** Showing the phylogenetic relationship of Deuterostomia (after Barrington, 1965).