## **Origin of Chordates**

The chordates include organisms having a notochord, a dorsal tubular nerve cord and pharyngeal gill slits. The question of the origin of chordates remains unanswered and considerable controversy exists in this issue. The geological records established that the chordates originated prior to the **Cambrian period**, 500 million years ago.

Most of the scientists consider that the chordates have originated from invertebrates. Several theories have been proposed to explain the origin of chordates from nonchordate groups. Only the **echinoderm theory** has received some attention and acceptance and shall be considered and evaluated under the **deuterostome** line of chordate ancestry. The origin of chordates is available from the resemblance between the lower chordates and the invertebrates.

Some of the proposals for the origin of chordates are as follows:

- 1. **Coelenterate Theory**: According to this theory chordates were developed from coelenterates. Radial symmetry coelenteron, cnidoblasts etc, were lost and advanced characters were developed to give rise to chordates. This theory infers that chordates might have acquired higher characters independently. It is not correct and hence this theory is not acceptable.
- 2. Annelid Theory: This theory suggests that the chordates have evolved from an annelid. The annelids show bilateral symmetry, metamerism, head, closed circulatory system, haemoglobin, etc., like chordates. Haemoglobin is dissolved in the plasma in annelids but it is present in the red blood corpuscles in chordates. Annelid nerve cord is double, and, ventral in contrast to single, hollow, dorsal nerve cord of chordates. Some striking differences exist between the annelids and the chordates in their embryology. Hence it is difficult to accept this theory.
- 3. Echinoderm ancestry: The theory was given by Johannes Muller (1860) and is based on comparative studies of larval stages of echinoderms and hemichordates. Tornaria larva of hemichordates resembles echinoderm larvae such as Bipinnaria, Auricularia, Dipleurula and Doliolaria, which all possess ciliary bands and apical tuft of cilia. Garstang (1894) and DeBeers proposed that echinoderm larvae gave rise

to chordates by neoteny. Also, like chordates, echinoderms are **deuterostomes** and possess mesodermal skeletal elements.

- 4. **Hemichordate ancestry**: Romer (1959) suggested that ancestral deuterostomes were sessile or sedentary. Tornaria larva of hemichordates shows phylogenetic relationship with echinoderm larvae and hemichordates also show affinities with chordates.
- 5. Urochordate ancestry: W. Garstang (1928) and N.J. Berrill (1955) gave importance to the tadpole-like larva of urochordates which carries typical chordate characters, namely, a notochord in tail along with segmented myotomes, dorsal hollow nerve cord, sense organs and pharyngeal gill slits. Garstang (1928) suggested that chordates evolved from some sessile filter-feeding urochordate by the larval stage evolving into adult by **neoteny** and by losing the sedentary adult stage.
- 6. Cephalochordate ancestry: The theory of the origin of vertebrates from cephalochordates appears to be convincing. Chamberlain (1900) studied the primitive and advanced characters of cephalochordates and proposed that while extant cephalochordates possess all chordate characters. They possess the three basic chordate features: notochord, dorsal tubular nerve cord and the pharyngeal gill-slits. According to Colbert, the living Amphioxus possesses the logical structure of a model prevertebrate.
- 7. **Combined theory.** E.J.W. Barrington (1965) combined all the above theories and proposed that the common ancestor of echinoderms and chordates was a sessile ciliary arm feeder that lived in the plankton-rich environment of the Cambrian. The

hemichordates developed **pharyngotremy** which is a perforated pharynx with an internal food trapping mechanism. This resulted in the evolution of free-living hemichordates on one hand and the sessile urochordates on the other. According to **Garstang**, the larva of urochordate became elongated and increased in size. This



typical chordate larva became the ancestor of Cephalochordata and Vertebrates.