Evolution of chordate was one of the most important event in the history of chordate as it was the beginning of evolution of more advanced chordates like bird and mammals. It is the story of origin from a primitive invertebrate like creatures to early chordates. Though first fossil of the first vertebrate the ostrachoderm was discovered from the Ordovician period but it might have originated in late Cambrian period. As early chordates were soft bodied, their fossil records are not preserved. Hence, to trace their ancestry, we have to find out the similarity among different deuterostomes to trace the origin of chordates. Some structural features shared by them such as bilateral symmetry, antero-posterior body axis, triploblastic coelomate condition, etc., may he because of their common ancestry.

TIME OF ORIGIN: Late Cambrian period

PLACE OF ORIGIN: Fresh water

THEORIES OF INVERTEBRATE ANCESTRY OF CHORDATES

Several theories have been put forwarded to explain the origin of chordates either directly from some invertebrate group or through the intervention of some protochordate. Almost every invertebrate phylum—Coelenterata, Nemertean, Phoronida, Annelids, Arthropods and Echinodermatashas been suggested. But these theories are far from being satisfactory and convincing and have only a historical value. Only the echinoderm theory has received some acceptance.

DIVISION OF BILATERIA

The Bilateria is divided into two major divisions (1) Protostomia and (2) Deuterostornia. This division is based on the differences in embryonic and larval developments. Protostomia includes from Annelida to Arthropoda while deuterostomia includes Echinodermata, Pogonophora and Chordate.

DEUTEROSTOME LINE OF CHORDATE EVOLUTION

Following common features of all Deuterostomes suggests strong evidence of a closer evolutionary relationship between the three principal deuterostome phyla – Echinodermata, Hemichordata and Chordata.

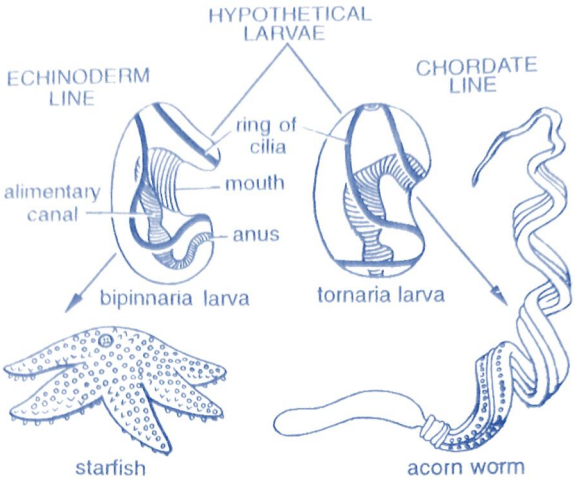
i) Early cleavage of zygote is indeterminate
ii) Blastopore of gastrula develops into anus

iii) Coelom (enterocoelous except vertebrates) is formed by the fusion of pockets developed from the endoderm of developing archenteron of the embryo

iv) Pelagic larvae of echinoderms and hemichordates have a close resemblance. Vertebrate does not have a floating larva.

v) Deuterostomes use creatine as phosphagen whereas inverteraates use arginine. Some hemichordates as well as echinoids use both.

1. ECHINODERM ANCESTRY



The hemichordate larva (tornaria) is strikingly similar to the larva (bipinnaria or dipleurula) of echinoderms. Both are small, transparent, free swimming and bilaterally symmetrical. Both have similar ciliated bands in loops, a dorsal pore, sensory cilia at the anterior end and a complete digestive system of ventral mouth and posterior anus. This striking larval resemblance led Johannes Muller and Bateson to suggest a common ancestry for the echinoderms and the hemichordates.

DISSIMILARITY & DOUTS: Presence of apical plate with eyespots in tornaria larva builds doubts about the common ancestry of echinodermates and hemichordates. Garstang and de Beer proposed the Neotenous Larva theoty suggesting that probably the auricularia larva of echinoderms became sexually mature and later this neotenic larva gave rise to the chordates. Cambrian and ordovician fossil records of Carpoid echinoderms lead Torsten and Gislen to assume that Carapoid echinoderms might have evolved from tornaria like creatures which have begun to settle down to lead sedentary life. The water vascular system might have developed out of ciliated grooves of these creatures. Besides this, it was also claimed that in the lower Silurian period, one carapoid echinoderm had the calyx perforated by a series of 16 small apertures. These apertures can be compared with the gill-slits of Branchiostoma. Some isolated biochemical studies (Needham, 1932 and Wihelmi, 1942 put some weight on the concept of diversion of chordates from echinodermates. Most of the nonchordates use arginine phosphate for the

transfer of energy but ophiuroides, cephalochordates, ascidians and vertebrates use creatine phosphate. On the other hand, hemichordates and echinodermates use both arginine and creatine phosphates as phosphate carrier. The descent of Chordata from the Echinodermata by the direct transformation of any echinoderm or its neotenous larva into a chordate is no longer accepted now-a-days. Instead they had a common an immediate ancestor.

2. **HEMICHORDATE ANCESTRY.**

There is a strong suggestive evidence that the early evolutionary stage of Deuterostomia was sessile or sedentary. The pharynx perforated by gill-slits is likely an adaptation to sedentary habit. No doubt, hemichordates are sedentary and have pharyngeal gill slits and a hollow dorsal nerve cord. Nevertheless, presence of a true notochord is doubtful and their adult body plan is quite different from vertebrates. Therefore, the prospects of some hemichordate as a likely ancestor of vertebrates seems to be impossible.

3. UROCHORDATE ANCESTRY.

The urochordate or ascidian theory of vertebrate origin was advocated by W. Garstang in 1928 and later elaborated by N.J. Berrill (1955) in his book, "Origin of Vertebrates", Romer (1959) and others. The adult tunicates reflect the primitive sessile, marine and filter feeding condition of the ancestral chordates. But, their body plans are so divergent that it is impossible to imagine a direct evolutionary transformation of an adult ascidian into a vertebrate. On the other hand, the ascidian larvae are tadpole-like, elongated, bilaterally symmetrical and free-swimming creatures with pharyngeal gill-slits, notochord, dorsal hollow nerve tube, and a muscular postanal tail. They represent only slightly modified living careature of the ancestral chordate that gave rise to the vertebrate line of evolution. According to this theory, certain of these larvae failed to metamorphose into adults, but became neotenous and later evolved into the cephalochordates and vertebrates. The sessile nature of the primitive chordate ancestory, hemichordates primitive pterobranch and echinoderms is considered by the workers resulting from common ancestry. However, the ascidian theory of chordate origin does not seem to be perfect. The principal drawback is that the theory considers sessile urochordates to be ancestral to chordates. Whereas, they are highly specialized because sessility is a specialized condition wherever it occurs in the Animal Kingdom.