METAMORPHOSIS IN Ascidia

METAMORPHOSIS

- The term metamorphosis customarily denotes the sequences of structural and physiological changes undergone by the larvae to reach the adult stages.
- Metamorphosis is the transformation in the mode of life with radical changes in form, structure and physiology.
- There are broadly two types of metamorphosis:
 - **A. PROGRESSIVE METAMORPHOSIS**
 - **B. RETROGRESSIVE METAMORPHOSIS**

RETROGRESSIVE METAMORPHOSIS

- Retrogressive metamorphosis is a process in which animals show degenerative changes in the scale of evolution .
- It is a peculiar event seen in some Urochordates. Example: Ascidia
- Retrogressive metamorphosis is the process by means of which the active free swimming tadpole larva of *Ascidia* with complex organs of special senses and provided with a notochord and well developed nervous system is metamorphosed into fixed inert adult in which most characters indicative of affinities with the chordates have been aborted, except the gill slits, endostyle and other parts of the feeding mechanism.

Ascidians

Adult ascidians lack a notochord and there is only a sing ganglion in place of the dorsal nerve cord.

Of the five characteristics of chordates adults possess only two: pharyngeal gill slits and an endostyle, both of which they use in filter feeding.

HENCE THE METAMORPHOSIS IS REFERRED TO A RETROGRESSIVE METAMORPHOSIS

SALIENT FEATURES OF TADPOLE ARVA OF ASCIDIA

- Larva is free swimming and very active.
- It does not take any food. Post pharyngeal portion of the gut is rudimentary.
- Tail with a caudal fin is continuous with dorsal and ventral fins marked with striae.
- Three adhesive papillae is present (helps in anchorage to substratum during settlement).
- Cerebral vesicles contains lens cells and visual cells, and a single statocyst cell containing an otolith. A sensory vesicle with an unicellular otolith (balancing organ) and a multicellular ocellus are present at the anterior end of tubular nerve cord.

SALIENT FEATURES OF TADPOLE LARVA OF ASCIDIA (continued)

- The ocellus consists of 3 lens cells associated with a pigmented cup formed by about a dozen pigmented sensory retinal cells.
- The tail is supported by a notochord extending from beneath the posterior wall to the tip.
- On either side of the notochord run three rows of muscle cells derived from the mesoderm
- Gut is not well developed. The pharynx is however already equipped with an endostyle in its ventral floor. A single pair of gill slits open into an atrium.
- The heart is present in the pericardial region
- Nervous system consists of a hollow dorsal nerve chord extending to the tail and enlarge in front to form cerebral vesicle.

FIGURE: T&DPOLE L&RV&



SETTLEMENT OF T&DPOLE L&RV&

- The larva is very active soon after its hatching. Larval stage usually lasts for a few hours.
- In the first part of the larval life, the tadpole is positively phototactic and negatively geotactic
- Later it becomes positively geotactic and negatively phototactic.
- The active larva soon becomes sluggish.
- Upon contact with a substratum the larva finds suitable ,the tadpole attaches to the suitable substratum with the help the adhesive papillae. The larva assumes an inverted posture after settlement.
- Soon metamorphic changes set in.
- Note: Berrill has given much importance to habitat selection of Ascidia

Ascidian metamorphosis

- After fixation the larva undergoes metamorphosis and is transformed into adult
- The metamorphosis undergoes fast degenerative changes accompanied by a few progressive changes.
- During metamorphosis the notochord disappears, the nerve cord is reduced to a single nerve ganglion and a couple of nerves.
- The larva has all the three chordate features. Most of these chordate characters degenerate as the active larva metamorphoses. Hence it is referred to as retrogressive metamorphosis

RETROGRESSIVE CHANGES DURING METAMORPHOSIS

- The tail along with its cuticular fin and striae and the myomeres regresse and finally degenerate.
- Mouth opens about 90 degrees upward from the point of attachment, due to rapid growth of the region between adhesive papillae and mouth and also due to retardation of growth at original dorsal side.
- The nerve cord gradually degenerates and is represented by a solid fusiform nerve ganglion in the adult.
- Notochord becomes coiled , disorganized and finally degenerates.
- **Ocellus and otocyst degenerate.**
- Muscle bands degenerate due to phagocytosis as well as atrophy.

PROGRESSIVE CHANGES DURING METAMORPHOSIS

- Although retrogressive changes are significant yet some progressive changes are evident which are required for survival of the adult stage.
- Pharynx gets enlarged and number of gill slits increase.
- Progressive development and differentiation of post pharyngeal portion of the gut.
- **Atrium becomes extensive**
- Velum and velar tentacles develop around mouth.
- **Tunic gets more developed.**
- Gonads and gonoducts arise from mesoderm.
- Urinary vesicles formed by mesenchymal cells.

THUS FROM AN ACTIVE FREE SWIMMING LARVA WITH COMPLEX ORGAN OF SPECIAL SENSE AND WITH A WELL DEVELOPED IOTOCHORD AND NERVOUS SYSTEM, THERE IS A RETROGRESSION TO A FIXED, INTER-ADULT IN WHICH ALL THA CHORDATES FEATURES HAVE BECOME ABORTED ACCEPTING THE GILL SLITS.



SIGNIFICANCE OF TADPOLE LARVA

A. EFFECT OF TADPOLE LARVA ON DISTRIBUTION-

- The muscular chordate tail serves as the organ of locomotion and helps in directing the tadpole towards its preferred attachment site during the final phase of the free swimming period.
- Berrill has emphasized on the very great importance of habitat selection in the life history of Ascidians.
- Larva's short life in the chordate stage is sufficient to ensure distribution.

SIGNIFICANCE OF TADPOLE LARVA (continued)

B. PHYLOGENETIC SIGNIFICANCE-

Tadpole larva can be regarded as a relic of the ancestral free swimming Chordate. According to Berrill, the tadpole larva is the actual source from which the Vertebrates evolved in space and time. So by the study of larva we see the evolution of non Chordate to Chordate

SIGNIFICANCE OF TADPOLE LARVA (continued)

C. TAXONOMIC SIGNIFICANCE-

- Adult Ascidians are highly degenerative organisms without notochord and hollow nerve cord.
- The position of these structures of the tadpole larva thus ascertains the Chordate nature of Ascidians.
- Systematic position of the Ascidians remain disputed for a long period due to the absence of essential Chordate characters in adult.
- This dispute was resolved after the life history of Ascidia was described (All essential Chordate characteristics were found in the larva).
- With this discovery the Ascidians were placed under Chordate with certainty in spite of the curious adult anatomy.

SIGNIFICANCE OF TADPOLE LARVA (continued)

D. EMBRYOLOGICAL SIGNIFICANCE-

- Egg development shows basic Chordate plan.
- Segmentation is Chordate like.
- Gastrulation occur by invagination as in Chordates.
- **Coelom formation is enterocoelic type, which is a basic Chordate feature.**
- The larva is a basic Chordate with all 3 vital Chordate characters and a post anal tail.