UG CBCS Semester-II

Retrogressive Metamorphosis in *Herdmania*

Introduction:

Metamorphosis is a change from the juvenile to adult stage in which larval stage is quite different from the adult stage. In retrogressive metamorphosis the larva possesses advanced characters which are lost during the development. The adult is either sedentary or degenerated with primitive characters.

Urochordate adults, being sedentary show degenerative characters while the free-swimming tadpole larva shows advanced chordate characters which are lost during metamorphosis. Retrogressive Metamorphosis in *Herdmania* is peculiar types of metamorphosis which occurs in the life history during development, certain characters of the advanced grade of organisation found in the larva completely disappear in the adult. It is probably due to the sedentary mode of life of the adult.

Retrogressive Metamorphosis in *Herdmania*

Metamorphosis (Gr., meta = after + morphe = form + osis = state) is the shape change in form during post-embryonic development and in many cases, signals a dramatic change in habitat of the animal such as pelagic to benthic existence.

Fertilization: Although, *Herdmania* is hermaphrodite and cross fertilization is a rule because the female gamete mature earlier than sperm which is discharged into sea. Fertilization takes place in the sea water. The larva which develops is the Ascidian Larva.

Metamorphosis of the ascidian larva is unique. It involves transformation of an active non-feeding, pelagic, lecithotrophic (i.e., that feeds on its own yolk reserves) and tailed larva having many advanced features such as axial notochord, dorsal neural tube and special sense organs, into an inert, sedentary or sessile, simple (primitive) and plankotrophic filter feeding adult with only a phaynx with stigmata and endostyle, both indicating the chordate features of adult ascidian.

This type of metamorphosis which shows degenerative or retrogressive changes from larva to adult is called retrogressive metamorphosis

Habit and Habitat:

- Just after hatching, the larva is photopositive and geo-negative.
- It cannot feed because its mouth is still closed by test.
- After a short active free-swimming existence lasting about 3 to 4 hours, the larva becomes geo-positive, photonegative and sluggish.
- It sinks to the bottom, attaches itself upside down to a suitable hard substratum by adhesive papillae and undergoes rapid degeneration or retrogressive metamorphosis to attain adulthood.
- According to Berril (1955) the selection of a suitable habitat is essential as the larva may not survive on any other habitat or may get suffocated by the bottom mud and detritus.

The advanced Chordate characters of the larva (larval Stage)

i. The tadpole is an elongated somewhat cylindrical in shape and measures about 1.5 millimetres in length and 0.3 millimetres in width

ii. There is a rod-like notochord in the tail to which are attached muscle bands for swimming.

iii. There is a dorsal hollow nerve cord which is enlarged to form brain at the anterior end.

iv. A photoreceptor ocellus and a balancing organ, the statocyst are attached to the brain.

v. There are only two pairs of gill slits in pharynx but the mouth is closed by a membrane and intestine is rudimentary.

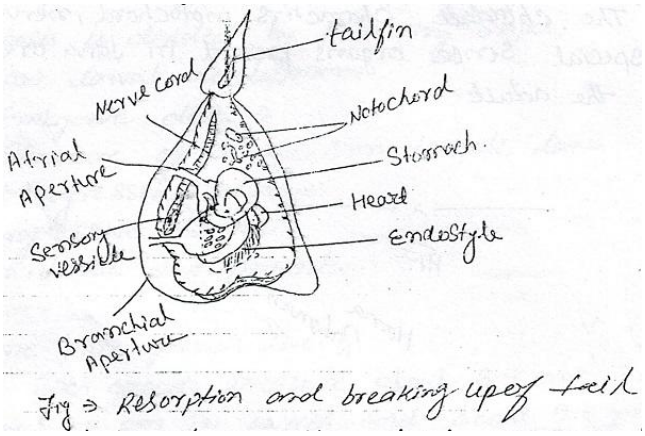

Fig ⇒ Resorption and breaking upof tail

vi. Endostyle presenton the ventral side of pharynx is very well-developed which functions like thyroid gland and helps in metamorphosis.

vii. Heart is on the ventral side of gut but is non-functional.

viii. The larva possesses on the anterior end three ectodermal adhesive papillae which help in firm attachment on the substratum.

Changes during metamorphosis

I. Larva attaches to the substratum with the help of chin warts, head downward and tail up.

II. Rapid growth takes place between the chin warts (adhesive papillae) and mouth and almost no growth on the opposite side of body.

III. Due to rapid growth on one side, body starts rotating in such a way that mouth gradually migrates to the upper side.

IV. Meanwhile pharynx enlarges and stigmata increase in numbers.

V. Intestine becomes functional and atrial opening is formed on the opposite side of oral aperture.

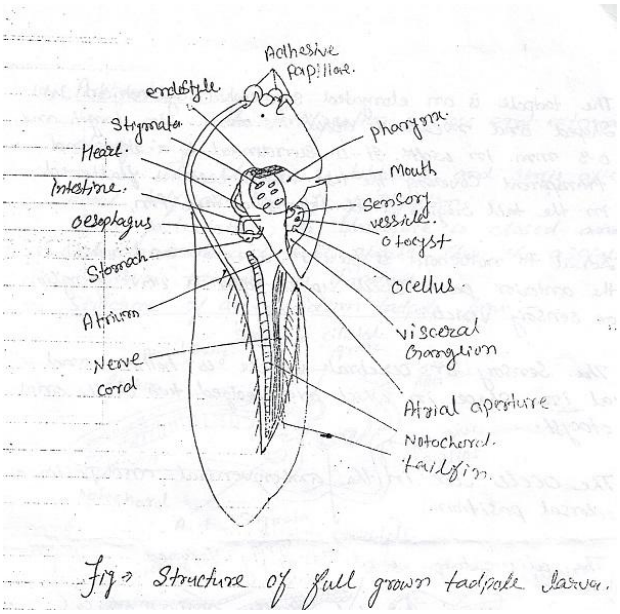

Fig ⇒ Structure of full grown tadpole larva.

VI. Both tail and notochord are gradually absorbed in the body during metamorphosis.

VII. The hollow nerve cord is reduced into a solid nerve ganglion on the dorsal side.

VIII. Sense organs, namely ocellus and statocyst are lost.

When the metamorphosis is over, *Herdmania* is transformed into a bag-like sedentary animal attached to the rock by a foot and having branchial and atrial openings for inlet and outlet of water respectively. Pharynx becomes enormously enlarged with a large number of stigmata

for filter feeding and digestive system becomes well developed. However, other advanced chordate characters of the larva are degenerated into simple structures, due to which it is called retrogressive metamorphosis.

Embryological Significance of Ascidian Tadpole:

The presence of a tadpole larva in the life history of *Herdmania* and other ascidians is significant in the following ways:

a. **Taxonomic Significance:**

- The tadpole larva possesses true chordate characters such as notochord and dorsal tubular nerve cord, which are lacking in the adult.
- Thus, the ascidian larva provides the clue for including the ascidian under the phylum Chordata.
- Without tadpole larva, the true nature and taxonomic position of degenerate sedentary adult ascidians would have remained uncertain.

b. **Phylogenetic Significance:**

On the basis of recapitulation, the ascidian larva possessing the chordate features is considered as the relic of the free-swimming ancestral vertebrates.

c. **Dispersal:**

The adult ascidians being sedentary, the free-swimming habit of the larva provides the only means of dispersal of the species. It also provides chances of selecting better sites regarding food and protection, thus, ensuring survival of the race.

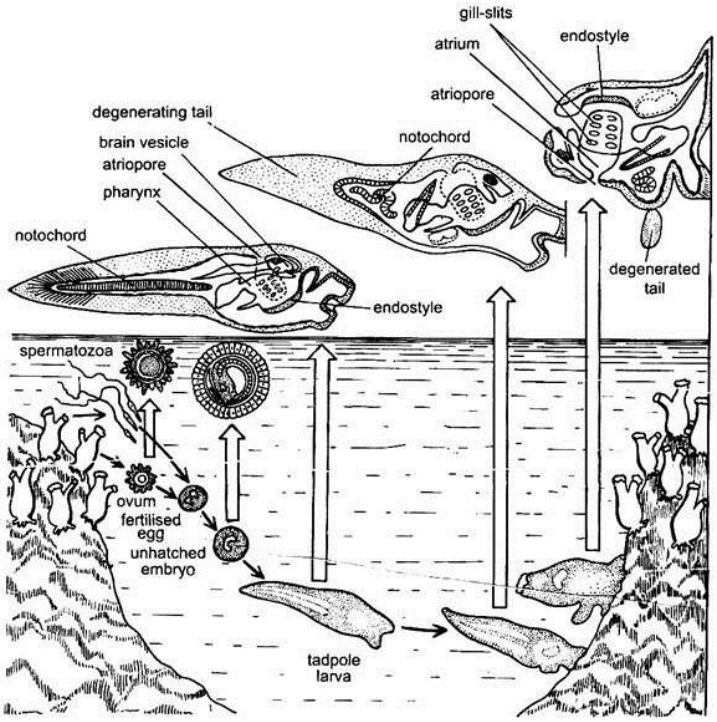

Fig. 35.4. Life cycle of a simple ascidian, showing retrogressive metamorphosis of tadpole larva, later its attachment with the solid substratum.