Retrogressive Metamorphosis in Herdmania

(1) What is retrogressive metamorphosis

The series of changes undergone by various animals during post-embryonic development as for example, the transformation of a larva into an adult, is called Metamorphosis.

A metamorphosis resulting in degeneration or loss of many larval characters and formation of a less complex adult is called 'Retrogressive Metamorphosis'

Herdmania is the simple ascidian found in Indian ocean. It is a solitary and sessile animal and remains attached to some hard substance by its foot. It offers a very good example of this phenomenon (= Retrogressive metamorphosis). From an active, free-swimming ascidian tadpole larva, with complex organs of special sense, notochord and nervous system, there is a retrogressive to the fixed, inert-adult in which all the parts indicative of affinities with the chordates (except gill slits, endostyle and part of feeding mechanism) become aborted.

(2) Retrogressive Metamorphosis in Herdmania

Herdmania is a sessile and hermaphrodite urochordate with a pair of gonads, ~~each consisting of 10-25 lobes~~ (the right one is on the dorsal side of the heart and the left gonad lies in the loop of the intestine) each consisting of 10-25 lobes, arranged in pairs in 2 parallel rows with genital ducts in between them. Each lobe has an outer testicular and inner ovarian zone, which produce sperms and ova respectively.

A mature ovum (0.3 mm in diameter) containing yolk and nucleus is enveloped by a vitelline membrane, an outer chorion and inner chorion. Between the chorion layer lies Perivitelline fluid. The outer chorion is covered by a layer of vacuolated follicle cells which help in its floatation in water.

Herdmania is protogynous. Fertilization is external and as a rule cross fertilization occurs in the animal. Holoblastic cleavage of the zygote results in a blastula with a small blastocoel. Gastrulation is effected partly by epibaly and partly by invagination

with the above changes the egg hatches into a larva called ascidian tadpole larva. which start swimming within 2-3 days.

Ascidian tadpole Larva

As the larva resembles the tadpole larva of a frog, it is called Ascidian tadpole larva. It is characterised by having the following structure:-

1. The 1.2 mm long body can be divided into two parts
   - (a) egg shaped trunk (0.3 mm)
   - (b) long, flat-tail (0.9 mm)
2. Body covered with test secreted by outoderm.
3. Anterior part of the trunk has three adhesive papillae secreted by ectoderm. One is on the dorsal side and the other two are above lateral in position to fix the larva on a hard substratum.
4. Tail is with tail fin formed from the test. It has oblique striations resembling fin rays.
5. A notochord in the axis of tail. It is a rigid cylindrical rod composed of a single row of vacuolated cells.
6. A band of striated muscles on either side of notochord.
7. Lying above the notochord is a hollow dorsal nerve cord which dilates to form a visceral ganglion in the trunk and further forward expands into an oval sense vesicle.
8. The sense vesicle contains 2 ocelli (eye spots) and a ventral pigmented otocyst.
9. Alimentary canal includes branchial sac, oesophagus, stomach and intestine. The mouth is formed by the invagination of anterodorsal ectodermal cells. Mouth is covered with the test and so it is functionless and the larva cannot feed.
10. pharynx is enclosed by an atrial cavity which opens dorsally to the outside through atrial aperture
11. Anus opens into atrium on the left side.
12. Pericardium and heart are formed by the diverticulum of the stomach.
13. Mesodermal cells found scattered all over tadpole body beneath the ectoderm and forming a thick mass just behind endoderm of the trunk.

the ascidian tadpole larva swims in water for a few hours and then fixes itself upside down on a solid substratum (rock, log of wood etc) with the help of its adhesive papillae and undergoes a retrogressive metamorphosis during which the following changes occur; —

~~It undergoes metamorphosis and becomes adult. During metamorphosis~~

(many well developed larval structures degenerate or are lost.)

(1) Tail is reduced in length by breaking and due to phagocytosis is absorbed in the body.
(2) With the tail, the contained notochord, nerve cord of tail muscles are lost.
(3) The sense vesicle with its contained sense organs disappears.
(4) The anterior left extremity of the nerve tube gives rise to neural gland.
(5) The trunk ganglion is very much reduced and forms the visceral nerve. The adult nerve ganglion is formed as a result of proliferation from the nerve tube and the trunk ganglion.
(6) The three adhesive papillae (slowly) also disappear.
(7) Alimentary canal and viscera develop further. Atrium & pharynx enlarge; the no. of stigmata in pharynx increases; stomach and intestine increase in length and become curved.
(8) Mesoderm forms mesenchyme, muscles, gonads and other ducts.
(9) The primordium of heart separates off from the pharynx and forms the pericardium and heart of the adult.
(10) Test thickens and tough appears.
(11) The region between mouth and point of fixation grows rapidly, causing the body to rotate by about 180° degrees. The result is that mouth and atrial aperture are brought opposite to the fixed end.

In this way, the free swimming, tailed ascidian tadpole larva changes into a sedentary and fixed adult by an retrogressive of many larval characters, which prove it to be a chordate.