

systems support such a comparison. *Limulus* has in each ventral ganglion two sets of transverse commissures, four or five bundles below the remnant of the median furrow, and two above it. Thus a rudimentary 'canalis centralis' is formed in the adult with commissures on either side of it. The entire set of neural commissures in the hind-brain of *Limulus* probably represent the beginnings of the cerebellum. In the fore-brain region of *Limulus* are three main systems of commissures, having the same general relation to the brain that the superior, middle and inferior commissures have in Vertebrates.

*Life History and Sexual Relations of the Entoconchidæ.* N. R. HARRINGTON.

The *Entoconchidæ* are a very rare degenerate type of molluscs, first observed by Johannes Müller. Since that observation, in 1852, but one contribution to their morphology has appeared. From the discovery of a new genus of this family, living under new conditions, the following facts may be observed :

1. Ontogenetically these forms do not pass through a Thyca or Stilifer stage, as has been suggested by recent hypothesis. They are ejected through the cloacal wall (as are the Cuvierian organs), or else are eviscerated, escaping from the sac by dehiscence.

2. The larva is free swimming and enters the new host with the water taken into the respiratory system, penetrating either the walls of the latter or those of the alimentary tract.

3. The adult sac is produced by the enormous outgrowth of the genital organs and subsequent degeneration of head parts.

4. For the first time in these degenerate shellless molluscs, separate sexes are observed. The males carry spermatophores. This observation takes *Entoconcha* from the evidence employed to show that Hermaph-

roditism is simpler and more primitive than Gonochorism in the Mollusca.

*Budding in Clavilinidæ.* G. LEFEVRE.

The only genera of this family of compound Ascidians whose bud development has hitherto been described are *Clavilina* and *Perophora*, but the following is a brief account of the process as it occurs in another genus, *Ecteinascidia*. The material was obtained in Jamaica and belongs to the species *E. turbinata*, Herdman. Although in external appearance the zooids resemble those of *Clavilina*, as they are quite elongated and the two siphons are at the anterior end, the species shows a closer similarity to *Perophora*, both in the structure of the adults and the mode of development of the buds. It differs from the former and agrees with the latter in the total absence of an epicardium and abdomen, but is distinguished from these two forms by the presence of perfect internal longitudinal bars in the wall of the branchial sac. There is nothing like the displacement or rotation of the inner vesicle of the bud rudiment, which has been described for *Perophora*.

The ectoderm of the bud is directly derived from that of the stolon and the inner, or 'endodermal,' vesicle from the stolonian septum, which, however, is not a flat partition, but a tube enclosed within the ectoderm and bathed on all sides by the blood. The bud is connected with the stolon at its posterior end, and its long axis is perpendicular to that of the stolon, as in *Clavilina*.

The pericardium is usually the first organ to appear, and is formed by cells which wander out from the wall of the inner vesicle far back on the right side.

The dorsal tube has a similar origin, but arises at the extreme anterior end of the vesicle, while the ganglion is differentiated out of the dorsal wall of the tube.

The sexual organs are also formed from cells which are given off from the wall of

the inner vesicle, but near the point where the digestive tract is growing out.

It is quite probable that free cells of the blood also take part in the formation of all these organs, as appearances strongly indicate such an occurrence, but these cells themselves are derived from the inner vesicle, which is clearly seen to give them off into the body space, especially at very early stages.

The ectoderm, therefore, is not actively concerned in the bud development, but the duty of providing the material for the formation of all the internal organs devolves solely upon the inner or 'endodermal' vesicle.

*Notes on the Structure and Development of the Type of a New Family of so-called Social Ascidians from the Coast of California.* W. E. RITTER.

In its superficial characters the new form closely resembles *Clavelina*. Studied in detail, however, its affinities are found to be much closer with the *Polyclinidae*, e. g., with the genus *Amaroucium*, than with *Clavelina*. The acidizoids are wholly distinct from one another, excepting for their attachment to a common basal stolon, as in *Clavelina*, and in form, size and color they closely resemble the zooids of some species of this genus, e. g., *C. savigniana* M. Edw.

They are flute-shaped, the attachment being at the small end. Their average length is about 3 cm. The colonies usually contain many zooids closely crowded together, as in *Clavelina*. But beyond this the distinctively clavelinian characters cease. The general features of the individual zooids are distinctly those of the *Polyclinidae*. The body is divided into three well-defined regions: viz, the thorax, containing the branchial sac; the abdomen, composed mainly of the intestine; and the post-abdomen, containing the gonads and the heart.

In *Clavelina*, on the other hand, the

gonads are situated within the intestinal loop, and the heart along side of it—in other words, *Clavelina* has no post-abdomen.

Now it will be noted that the *Polyclinidae* are entirely typical ascidiæ compositæ; i. e., not only does reproduction by gemination take place, but the blastozoids thus produced become closely crowded together and all wholly embedded in a common testicular mass.

This brief comparison will suffice to call attention to the fact, which becomes much more striking when the comparison is carried out in detail, that in the new form we have an ascidian which in the relation of the blastozoids to one another in the colony is strictly a so-called social ascidian, while in the structure of the individual zooids it is as strictly a compound ascidian.

Another illustration is thus produced of the artificiality of a classification of the tunicata which attempts to base primary subdivisions on the condition of the blastozoids of the colony as regards a common test-mass.

The characters which prevent the form from being admitted to the family *Polyclinidae*, and make necessary the establishment of a new one for it, are founded in the structure of the gonads and the oviduct; the relations of the epicardiac tubes; and in the arrangement of the branchial tentacles.

The study of the embryology is still quite incomplete. The embryos are developed in a long expanded proximal portion of the oviduct which may properly be called a uterus. About a dozen embryos are found in each uterus, these being placed in a single row, usually with the oldest farthest forward and the youngest nearest the ovary, or farthest back.

The larval stage is much abridged, the metamorphosis of the nervous system being nearly complete before the larva leaves the parent. It is doubtful if there is any free-swimming tadpole stage at all.