D, *nec).* Previous to this stage some of the hypoblast cells at the front edge of the blastopore and forming part of the dorsal wall of the archenteron (fig. 10, C, *ch)* have become separated off, and then arranged to form an elongated band, two cells wide, underlying the posterior half of the neural canal (fig. 10, D, E, *ch*.). This is the origin of the notochord. Outgrowths from the sides of the archenteron give rise to laterally placed masses of cells, which are the origin of the mesoblast. These masses show no trace of meta­meric segmentation. The cavities (reproductive and renal vesicles) which are formed later in the mesoblast represent the cœlom. Consequently the body-cavity of the *Tunicata* is a modified form of enterocœle. The anterior part of the embryo, in front of the notochord, now becomes enlarged to form the trunk, while the posterior part elongates to form the tail (fig. 10, E). In the trunk the anterior part of the archenteron dilates to form the mesenteron, the greater part of which becomes the branchial sac ; at the same time the anterior part of the neural canal enlarges to form the cerebral vesicle, and the opening to the exterior at the front end of the canal now closes. In the tail part of the embryo the neural canal remains as a narrow tube, while the remains of the wall of the archenteron—the dorsal part of which becomes the notochord—are converted into lateral muscle bands (fig. 10, G) and a ventral cord of cells, which eventually breaks up to form blood corpuscles. As the tail grows longer, it becomes bent round the trunk of the embryo inside the egg-membrane. About this period the epiblast cells begin to form the test as a cuticular deposit upon their outer surface. The test is at first devoid of cells and forms a delicate gelatinous investment, but it shortly afterwards becomes cellular by the migration into it of test cells formed by proliferation from the epi­blast.@@1

The embryo is hatched about two or three days after fertilization, in the form of a tadpole-like larva, which swims actively through the sea by vibrating its long tail. The anterior end of the body is provided with three adhering papillæ (fig. 10, F, *adp)* in the form of epiblastic thickenings. In the free-swimming tailed larva the nervous system, formed from the walls of the neural canal, becomes considerably differentiated. The anterior part of the cerebral vesicle remains thin-walled (fig. 10, F), and two unpaired sense organs develop from its wall and project into the cavity. These are a dorsally and posteriorly placed optic organ, provided with retina, pigment layer, lens, and cornea, and a ventrally placed auditory organ, consisting of a large spherical partially pigmented otolith, attached by delicate hair-like processes to the summit of a hollow *crista acoustica* (fig. 10, F, *au).* The posterior part of the cerebral vesicle thickens to form a solid ganglionic mass traversed by a narrow central canal. The wall of the neural canal behind the cerebral vesicle becomes differentiated into an anterior thicker region, placed in the posterior part of the trunk and having a superficial layer of nerve fibres, and a posterior narrower part which traverses the tail, lying on the dorsal surface of the notochord, and gives off several pairs of nerves to the muscles of the tail. Just in front of the anterior end of the nervous system a dorsal involution of the epiblast breaks through into the upturned anterior end of the mesenteron and thus forms the mouth opening. Along the ventral edge of the mesenteron, which becomes the branchial sac, the endostyle is formed as a narrow groove with thickened side walls. It probably corresponds to the median portion of the thyroid body of *Vertebrata.* A curved outgrowth from the posterior end of the mesenteron forms the alimentary canal (oesophagus, stomach, and intestine), which at first ends blindly. An anus is formed later by the intestine opening into the left of two lateral epiblastic involutions (the atria), which rapidly become larger and fuse dorsally to form the peribranchial cavity. Outgrowths from the wall of the branchial sac meet these epiblastic involutions and fuse with them to give rise to the first formed pair of stigmata, which thus come to open into the peribranchial cavity ; and these alone correspond to the gill clefts of *Amphiοxus* and the *Vertebrata.*

After a short free-swimming existence the fully developed tailed larva fixes itself by its anterior adhering papillæ to some foreign object, and then undergoes a remarkable series of retrogressive changes, which convert it into the adult Ascidian. The tail atro­phies, until nothing is left but some fatty cells in the posterior part of the trunk. The adhering papillæ disappear and are replaced functionally by a growth of the test over neighbouring objects. The nervous system with its sense organs atrophies until it is re­duced to the single small ganglion, placed on the dorsal edge of the pharynx, and a slight nerve cord running for some distance pos­teriorly (Van Beneden and Julin). Slight changes in the shape of the body and a further growth and differentiation of the branchial sac, peribranchial cavity, and other organs now produce gradually the structure found in the adult Ascidian.

The most important points in connexion with this process of development and metamorphosis are the following. (1) In the Ascidian embryo all the more important organs *(e.g.,* notochord, neural canal, archenteron) are formed in essentially the same

manner as they are in *Amphioxus* and other *Chordata.* (2) The free-swimming tailed larva possesses the essential characters of the *Chordata,* inasmuch as it has a longitudinal skeletal axis (the noto­chord) separating a dorsally placed nervous system (the neural canal) from a ventral alimentary canal (the archenteron) ; and therefore during this period of its life-history the animal belongs to the *Chordata.* (3) The Chordate larva is more highly organized than the adult Ascidian, and therefore the changes by which the latter is produced from the former may be regarded as a process of degeneration (*31*). The important conclusion drawn from all this is that the *Tunicata* are the degenerate descendants of a group of the primitive *Chordata* (see below p. 618).

Classification and Characters of Groups.

Order I.—LARVACEA.

Free-swimming pelagic forms provided with a large locomotory appendage (the tail), in which there is a skeletal axis (the urochord).

A relatively large test (the “Haus”) is formed with great rapidity as a secretion from the ectoderm ; it is merely a temporary structure, which is cast off and replaced by another. The branchial sac is simply an enlarged pharnyx with two ventral ciliated openings (stigmata) leading to the exterior. There is no se­parate peribranchial cavity. The nervous system consists of a large dorsally placed ganglion and a long nerve cord, which stretches backwards over the alimentary canal to reach the tail, along which it runs on the left side of the urochord. The anus opens ventrally on the surface of the body in front of the stig­mata. No reproduction by gemmation or metamorphosis is known in the life-history.

This is one of the most in­teresting groups of the *Tuni­cata,* as it shows more com­pletely than any of the rest the characters of the original ancestral forms. It has un­dergone little or no degen­eration, and consequently corresponds more nearly to the tailed-larval condition than to the adult forms of the other groups. The order includes a single family, the Appendiculariidæ, all the members of which are minute and free-swimming. They occur on the surface of the sea in most parts of the world. They possess the power to form with great rapidity an enormously large investing gelatinous layer (fig. 11), which corresponds to the test of other groups. This was first described by Von Mertens and by him named “Haus.” It is only loosely attached to the body and is frequently thrown off soon after its formation. The tail in the *Appendiculariidæ* is at­tached to the ventral surface of the body (fig. 12), and usually

@@@1 Some of the first test cells are also probably derived from the epithelium of the egg follicle.