have of late years been the subject of several very import­ant memoirs. The researches of Todaro, Brooks (*25*), Salensky (*26*), and others have elucidated the embryology, the gemmation, and the life-history of the *Salpidæ ;* and Grobben, Barrois *(27*), and more especially Uljanin (*28*) have elaborately worked out the structure and the details of the complicated life-history of the *Doliolidæ.* Finally, in an important work published in 1886 on the morpho­logy of the *Tunicata,* E. van Beneden and Julin (*30*) have, mainly as the result of a close comparison of the embryo­logy of Ascidians with that of *Amphioxus* and other *Chordata,* added considerably to our knowledge of the position and affinities of the *Tunicata,* and of the exact relations of their organs to the corresponding parts of the body in the *Vertebrata.*

Anatomy.

As a type of the *Tunicata, Ascidia mentula,* one of the larger species of the Simple Ascidians, may be taken. This species is found in most of the European seas, generally in shallow water on a muddy bottom. It has an irregularly ovate form, and is of a dull grey colour. It is attached to some foreign object by one end (fig. 1). The opposite end of the body is usually nar­row, and it has a terminal opening surrounded by eight rounded lobes. This is the mouth or branchial aperture, and it always indicates the anterior end @@1 of the animal. About half-way back from the anterior end, and on a rounded projection, is the atrial or cloacal aperture— an opening surrounded by six lobes—which is always placed upon the dorsal re­gion. When the Ascidian is living and undisturbed, water is being constantly drawn in through the branchial aperture and passed out through the atrial. If coloured par­ticles be placed in the water near the apertures, they are seen to be sucked into the body through the branchial aperture, and after a short time some of them are ejected with consider­able force through the atrial aperture. The current of water passing in is for re­spiratory purposes, and it also conveys food into the animal. The atrial current is mainly the water which has been used in respiration, but it also contains all excretions from the body, and at times the ova and spermatozoa or the embryos.

The outer grey part of the body, which is attached at or near its posterior end and penetrated by the two aper­tures, is the “test.” This is a firm gelatinous cuticular secretion from the outer surface of the ectoderm, which is a layer of flat cells lining its inner surface. Although at first produced as a cuticle, the test soon becomes organized by the migration into it of cells derived from the ectoderm (see fig. 2). These test cells may remain as rounded or fusiform or stellate cells imbedded in the gelatinous matrix, to which they are constantly adding by secretions on their

surfaces ; or they may develop vacuoles in their proto­plasm, which become larger and fuse to form a huge ovate clear cavity (a “ bladder cell ”), sur­rounded by a delicate film of protoplasm and having the nucleus still visible at one point ; or they may form pigment gran­ules in the pro­toplasm ; or, lastly, they may deposit carbonate of lime, so that one or several

of them together produce a calcareous spicule in the test. Only the unmodified test cells and the bladder cells are found in *Ascidia mentula.* Calcareous spicules are found chiefly in the *Didemnidæ,* amongst Compound Ascidians ; but pigmented cells may occur in the test of almost all groups of *Tunicata.* The matrix in which these structures are imbedded is usually clear and apparently homogeneous ; but in some cases it becomes finely fibrillated, especially in the family *Cynthiidæ.* It is this matrix which contains tunicine. At one point on the left side near the posterior end a tube enters the test, and then splits up into a num­ber of branches, which extend in all directions and finally terminate in rounded enlargements or bulbs, situated chiefly in the outer layer of the test. These tubes are known as the “vessels” of the test, and they contain blood. Each vessel is bounded by a layer of ec­toderm cells lined by con­nective tissue (fig. 3, *B),* and is divided into two tubes by a septum of con­nective tissue. The septum does not extend into the terminal bulb, and conse­quently the two tubes com­

municate at their ends (fig. 3, A). The vessels are formed by an outgrowth of a blood sinus (derived originally from the blastocœle of the embryo) from the body wall (mantle) into the test, the wall of the sinus being formed by con­nective tissue and pushing out a covering of ectoderm in front of it (fig. 2, *s*'). The test is turned inwards at the branchial and atrial apertures to line two funnel-like tubes, —the branchial siphon leading to the branchial sac and the atrial siphon leading to the atrial or peribranchial cavity.

The body wall, inside the test and the ectoderm, is formed of a layer (the somatic layer of mesoderm) of connective tissue, inclosing muscle fibres, blood sinuses, and nerves. This layer (the mantle) has very much the shape of the test outside it, but at the two apertures it is drawn out to form the branchial and atrial siphons (fig. 4). In the walls of these siphons the muscle fibres form powerful circular bands, the sphincter muscles. Throughout the rest of the mantle the bands of muscle fibres form a rude irregular network. They are numerous on the right side of the body, and almost totally absent on the left. The muscles are all formed of very long fusiform non-striped fibres. The con­nective tissue of the mantle is chiefly a clear gelatinous

@@@1 Some writers use a different nomenclature of regions ; see (*17*).