

considers that this body may be regarded as the representative of the glandular portion of the organ of Bojanus.

In some of the Molgulidæ (the genus *Lithonephrya* of Giard) this renal organ is always found occupied by a single large concretion, which almost entirely fills its cavity.

In many of the Ascidiidæ we find another kind of renal apparatus. A large number of huge clear-walled spherical vesicles are aggregated together in a mass lying around the intestine, and in the thickness of the mantle (fig. 9, *r.o.*, p. 40), while a number of small blood-vessels and sinuses ramify through the mass. As in the case of the Molgulidæ, there is no excretory duct, and the elimination products are stored up in the thin-walled vesicles in the form of spherical concretions concentrically laminated, and sometimes having shells of different tints of yellow and brown, and are usually covered by a thickish coating of a pure chalky white. These concretions contain a considerable amount of uric acid.

Finally, as has been stated above, E. van Beneden and Julin have shown strong grounds for the belief that the neural gland is a renal organ, especially devoted to the nerve ganglion. If this be the case, then this gland differs totally from the other renal organs in the Tunicata, inasmuch as it possesses a duct by which the eliminated substances are excreted either into the branchial sac or the peribranchial cavity.

Blood-Vascular System.

The heart in the Tunicata is a simple sac or fusiform tube, from the two ends of which vessels are given off. It is enclosed in a delicate membranous sac, the pericardium, formed, according to Hancock, of a fold of the lining membrane of the peribranchial cavity, to which it is attached along one side from end to end.

In all Tunicates in which the matter has been investigated, the periodic reversal of the blood current, first noticed by Kuhl and van Hasselt in the case of *Salpa* has been found. The heart, after contracting for a certain time in one direction, stops, and then the waves of contraction begin to pass along it in the opposite direction, consequently the blood is propelled from the dorsal and ventral ends of the heart alternately. In the young *Ascidia virginea* there are usually from 35 to 40 contractions in one direction at a time, and this takes from 1 min. 30 sec. to 2 min., while the pause between the two series of contractions is usually 7 or 8 seconds in duration, and thus equals three ordinary contractions.

The heart varies considerably in position in different forms. In the Molgulidæ it is placed on the right side, and adheres to the inner surface of the mantle immediately anterior to the renal organ.

In the Cynthiidæ, as a general rule, it lies in close relation to the stomach or the first portion of the intestine, but in the curious *Culeolus*, it is situated on the right side of the body, close to the endostyle, and attached to the inner surface of the mantle.