

great systems of vessels : 1st, the branchio-cardiac, bringing (when the heart is contracting from the ventral towards the dorsal end) purified blood from the branchial sac to the heart by means of the ventral vessel ; 2nd, the cardio-splanchnic, conveying arterial blood from the heart to the viscera, and also to the test and mantle ; and 3rd, the splanchno-branchial system, conveying the impure blood, which has been circulating in the viscera and the mantle, to the respiratory organ by means of the dorsal vessel of the branchial sac. Besides these systems, there are series of anastomotic vessels, crossing from the branchial sac to the mantle, from the mantle to the test, and from the test to the branchial sac.

When the heart contracts from the ventral to the dorsal end it is purely systemic, and contains almost pure arterial blood, the only admixture of venous being the stream returning from the test (*v.t.*), which enters the branchio-cardiac vessel near its junction with the heart. When, on the other hand, the heart contracts from the dorsal to the ventral end, it is almost purely respiratory (not completely, as it supplies the test as well as the branchial sac), and contains impure blood returned from the viscera, the mantle, and the test. Hence the test receives a supply of pure blood from the heart only when that organ is contracting ventro-dorsally.

The blood in the Tunicata consists of a clear fluid plasma, in which float corpuscles. These are nucleated protoplasts of considerable size, and usually rounded in outline. Many are always clear and colourless, but generally a number are pigmented. The commonest colours are yellow, red, and brown, but white and blue have also been noticed.

The Reproductive Organs.

The Tunicata are hermaphrodite, though certainly in some and probably in many cases not self-fertilizing. The male and female glands are always situated together, but the closeness of their union differs in different groups. In some forms they do not attain maturity at the same time. In *Botryllus*, *Appendicularia*, &c., the ova are ripe long before the testis is fully developed.

In the Molgulidæ the ovaries and testes are united into two usually ovate, hermaphrodite genital masses, a right and a left, which are attached to the inner surface of the mantle. The right mass is placed in the centre of the right side anteriorly to the heart, and usually lies with its length placed transversely, and the genital ducts at the dorsal end. The left organ lies in the corresponding position on the left side and in front of the intestinal loop, except where the loop is so long as to make a secondary bend anteriorly, in which case the genital mass is bounded both in front and behind by the intestine.¹ In the genus *Eugyra* only this left genital gland is present.

In the Cynthiidæ we meet with a number of different arrangements. In *Culeolus* there

¹ As in *Molgula capiformis*, see Sorby and Herdman, Journ. Linn. Soc., Zool., vol. xvi. p. 527.