

XI.—*The Reproductive Organs of Bdellostoma, and a Teleostean Orum from the West Coast of Africa.* By J. T. CUNNINGHAM, B.A.

(Read 5th July 1886.)

During a short visit I paid to Oxford in the month of June last I had the opportunity of examining, by the kind permission of Professor MOSELEY, a number of specimens of *Bdellostoma Forsteri*, which were some of a large number brought from the Cape by Mr ADAM SEDGWICK of Trinity College, Cambridge. This examination showed what, from the close affinity of the two forms, was naturally to be expected, namely, that the structure of the reproductive system and the development of the reproductive elements in *Bdellostoma* were very closely similar to the structure and development of the corresponding parts in *Myxine*. A short time ago I described before the Society some ovarian eggs of *Myxine*, obtained at the beginning of the present year, which were approaching maturity. In these eggs there were slight projections at the poles, and on the surface of the projecting parts a number of papillæ. The projections were caused by the growth of a number of threads from the vitelline membrane within the ovarian capsule, and the papillæ were the separate elevations produced by the threads. In one of the specimens of *Bdellostoma* which I examined at Oxford there were a number of ovarian eggs in an exactly similar condition. These eggs of *Bdellostoma* are of course much larger than those of *Myxine*; the eggs of the latter, in the condition I refer to, were 2·1 cm., those of the former are 3·5 cm. No one has seen the perfectly ripe eggs of *Bdellostoma* after their escape from the ovary, but the specimens I have described prove conclusively that the eggs of this species when shed are provided with a number of polar threads, which are processes of the vitelline membrane, exactly as in *Myxine*. I have not yet made a microscopic examination of the reproductive organs in *Bdellostoma*, but from what I could see by ordinary dissection, it is evident that all the peculiarities which exist in the reproductive system in *Myxine* occur also in *Bdellostoma*. A number of specimens possessed sexual organs, in the anterior part of which were minute ova, while the posterior part was evidently testicular tissue; and in one or two other specimens the whole organ seemed to be testicular. The small quantity of testicular tissue in a given specimen was also noticeable, as in *Myxine*. I found no specimens which showed indications of having recently discharged their eggs. I have ascertained from Mr SEDGWICK that his specimens were collected in August and September, and this fact shows that the breeding period

of *Bdellostoma* agrees with that of *Myxine* in falling within the coldest season of the year. *Myxine glutinosa*, in the North Sea, deposits its eggs in December, January, and February, and the two latter months agree in meteorological conditions with the months of August and September in the latitude of Cape Town.

The egg of *Bdellostoma* at the stage under consideration has a thicker and stronger vitelline membrane than the egg of *Myxine*. I found it impossible to strip off from preserved specimens of the latter the connective tissue and follicular epithelium without rupturing the vitelline membrane. In the eggs of *Bdellostoma* this could be accomplished with ease. The membrane, when exposed, was seen to be yellowish-brown in colour, and translucent. Round the micropylar end of the capsule formed by the membrane is seen a distinct thin line, forming a complete ring, and it is evident that the micropylar end forms an operculum which separates from the rest of the capsule along this line. STEENSTRUP has figured a detached operculum in the figure he gives of the ova of *Myxine*, but in the latter form I have not yet detected indications of the structure. There can be no doubt, from the appearance seen in the *Bdellostoma* ovum, that the escape of the embryo in the Myxinoids is effected by the removal of an operculum specially adapted for that purpose.

The Teleostean ova I have next to describe resemble in the character of the vitelline membrane the ova of the Myxinoids. Each ovum is spherical in shape, 1.5 to 1.6 mm. in diameter, and about one pole of the sphere is provided with a number of long thin flexible filaments springing from the vitelline membrane. Each filament commences at the attached base with a conical papilla, which is thicker than the filament itself. By the interlacing of the filaments a large number, many thousands, of eggs are connected together to form a cylindrical mass about an inch wide, and a foot or more in length. The felted filaments form a rope-like core to the cylinder, the eggs forming an external layer. Besides the long filaments, each egg shows a similar number of short filaments springing from the opposite pole. These are very slender, and only from 2 mm. to 1.5 cm. in length. In other respects they resemble the long filaments, of which they are evidently rudimentary representatives. They seem to have no function, being too small to afford any assistance in the process of attachment. It is probable, though I have not been yet able to demonstrate the fact, that the micropyle is situated in the centre of the region whence the long filaments arise. If this were so, the relations of the filaments and vitelline membrane in this Teleostean egg would be exactly similar to those which obtain in the ovum of the Myxinoids. And whatever be the position of the micropyle, it is interesting to note that the occurrence of a group of filamentous processes of the vitelline membrane at each

of the two opposite poles of the ovum is not peculiar to the Myxinoids. It is as certain as an inference from the unfertilised ovum can be, that the segmentation of the egg of the Myxinoids is meroblastic, as in Teleosteans, and thus in two points the Myxinoid ovum agrees with the Teleostean, and differs from that of Petromyzon, while in respect of the mass of the yolk the Myxinoids agree more with Elasmobranchs.

I have not succeeded in identifying the species of fish to which belong the eggs above described. The eggs of several species are known to be provided with filamentous processes. In the Scombresocidæ the filaments are equal in length to the diameter of the ovum, and are uniformly distributed over the surface of the membrane. The filaments in this family were first described by Professor HAECKEL.* JOHN A. RYDER gives a very clear and complete account of them in the *Bulletin of the U. S. Fish Commission*, 1881, vol. i., as studied in *Belone longirostris*. In Chirostoma, one of the Atherinidæ, RYDER found there were only four filaments attached at one pole of the egg close together. In this latter case the filaments were during development closely wound round the vitelline membrane in one equator of the sphere, so that the method of their formation differs from that of the Myxinoid filaments, which are perpendicular to the surface of the membrane throughout their growth in the follicle.

Filamentous processes of the vitelline membrane occur also in the family Pomacentridæ; they have been described by HOFFMANN in *Heliastes chromis* of the Mediterranean (see *Konink. Akad. d. Vetensk. Amst.*, vol. xxi.). Here they occur at one end only of the ellipsoidal ovum. They occur also in Gobius and Blennius, but in neither of these cases are two sets of processes present, situated at opposite poles of the ovum. It is thus impossible to say whether the ova described in this paper belong to a fish of the family Scombresocidæ among the Physostomi, of the family Pomacentridæ, or coral-fishes among the Pharyngognathi, of the family Gobiidæ, Blennidæ or Atherinidæ, or to a species of some other family whose eggs are altogether unknown. The ova were obtained on two occasions, each time a single cylindrical "rope," by Mr JOHN RATTRAY, F.R.S.E., in the Gulf of Guinea. Mr RATTRAY was on board a steamer called the "Buccaneer" last winter, in the capacity of naturalist, having been invited to accompany Mr J. Y. BUCHANAN, who was carrying out some hydrographical investigations off the coast of Africa. The eggs were obtained in the following manner:—A small conical buoy was attached at the end of a rope, and along the rope were fastened two or three muslin tow-nets. The whole was then thrown overboard in such a way that the mouth of the tow-net faced whatever current was flowing. The eggs were found entangled on the line when the apparatus was

* MULLER'S *Archiv*, 1855.

recovered. On the first occasion, March 12th of the current year, the position was lat. $1^{\circ} 17' N.$, long. $13^{\circ} 56' 6'' W.$ The depth at which the ova were caught by the line was 30 fathoms. The total depth of the ocean at the spot was 2725 fathoms. The other mass of eggs was taken in a similar way, not far off the locality just defined. Thus these eggs were in a pelagic condition, suspended in the water, and freely obeying the ocean current. Mr RATTRAY states they were very transparent.

P.S.—Since the above was written I have found that the meroblastic nature of the ovum of *Myxine* has been actually proved. Fertilised eggs, in which the blastoderm had already begun to spread over the yolk, were examined and described by W. MÜLLER several years ago (*Jenaische Zeitschrift*, Bd. IX.). These eggs were from the collection of the Göteborg Museum, and were obtained at Lysekil in Bohuslän in 1854. W. MÜLLER, however, did not give a correct account of the development of the vitelline membrane and polar threads.