must be abandoned, however, as there is already a species of that name, and in the *Revue Mycologique* of January, 1885, I proposed to substitute the name *O. morrhuæ*. In the article of Saccardo and Berlese before mentioned, this species is said to occur in Algiers in company with *Clathrocystis* and *Sarcina*, and they consider it a *Torula* rather than an *Oidium*, adopting the name *T. pulvinata*. Patouillard also found on salted pork a fungus which he thinks probably belongs to the same species. As the specific description was originally given in the *Revue Mycologique* the following translation may be of service to those who do not have access to that journal: "Spores spherical, 3.5–5 $\mu$ in diameter, fuscous, attached in chains (average 12–15), arising from secundly fasciculate hyphæ, which are pulvinately compacted in scattered spots."

---

## 2.—PRELIMINARY NOTICE OF THE DEVELOPMENT OF THE TOAD-FISH, BATRACHUS TAU.

By JOHN A. RYDER.

The ova of this fish are large, and measure from 5 to 5½ millimeters in diameter. They are dirty yellow, almost amber colored, and adherent to the surfaces of submerged objects, especially the under sides of bowlders, under which the parent fish seem to clear away the mud and thus form a retreat in which they may spawn. The ova are attached to the roof of the little retreat prepared by the adults, where the eggs are found spread over an area about as large as one's hand in a single layer, hardly in contact with each other, and to the number of about 200. A discoidal area about 3 millimeters in diameter at the upper surface of each egg glues the latter firmly to the supporting surface (Fig. 4).

Fertilization of the ova probably occurs at the time of their extrusion by the female, which, like the female catfish, manifests no further interest in her offspring. The male at once assumes the care of the brood, and seems to remain in the vicinity until the young fish are hatched out and set free.

The germinal disk is developed at the under or inferior pole of the vitellus and opposite the point where the ovum is attached to the roof of the retreat by its adhesive membrane (Fig. 4). There are no oil globules in the yelk, the latter seeming to be remarkably homogeneous. It is therefore not very clear what it is that determines the inferior and inverted position of the blastodisk.

Equally remarkable is the fact that as development proceeds the young adherent embryos are found to have their heads directed towards the opening of their retreat and their tails towards its blind and dark extremity (Fig. 5). This appears to be invariably the case, and it would seem that the direction from which light comes in this instance, at least, has a great deal to do in determining the direction of the axis

of the body of the future embryo. This position of the young fishes is maintained as long as they are attached.

The development, as it advances, enables the young embryo within the egg-membrane to finally rupture the latter immediately over the back, which looks down and away from the surface to which the egg is attached. When the zona or egg-membrane is ruptured (Fig. 2) the young fish is, however, not set free at once, as in the case of other adhesive ova, but remains firmly glued to the inside of the zona over a part of the ventral surface of the yelk-bag. This adhesion of the yelk-bag to the zona takes place over about the same area on the inside of the latter as that which on the outside is adherent to the stone or other object, which affords support to the whole egg and embryo. It results in this way that the egg-membrane is not cast off from the embryo at once, but remnants of it continue to cover the sides and lower surface of the yelk some time after the embryo has ruptured the zona and commenced to respire from the surrounding water by means of its gills, but while still affixed to the surface to which the eggs were originally caused to adhere by the parent fishes (Figs. 1 and 2). Whether the substance which causes the yelk-bag to adhere to the inside of the zona is secreted at the time of oviposition, or whether it is secreted during a later stage of development has not been determined; but it is inferred that this adhesion is a secondary phenomenon, and takes place after the vitellus has been covered by the blastoderm, for the reason that the latter alone is adherent. In fact, if the vitellus were primarily adherent, the blastoderm could not grow around the vitellus and over the area where the former becomes adherent to the zona radiata.

While the embryos are still adherent, the tail is not kept constantly vibrating, but the pectoral fins are kept in motion so as to keep up currents of water and effect the constant change of the latter, needful for the respiration of the embryos.

For a considerable time the yelk-bag is almost pyriform, with its adherent base flattened and its upper narrowed end in relation with the embryo and its vessels and heart. Vessels are developed over the surface of the vitellus long before hatching. With the progress of development the vitellus suffers constriction (Fig. 1), so that it is divided into an upper portion, which is included by the down-growing myotomes of the body cavity, and a lower portion which is covered by the thinner epiblastic and mesoblastic covering of the inferior pole of the yelk. When the embryos are detached from the surface to which they adhere, the free, bulbous lower portion of the yelk-sack becomes wrinkled in consequence of the thin epiblastic and mesoblastic investment being thrown into narrow folds, which run horizontally around the yelk.

With the extension of the abdominal walls over the yelk, more and more of the yelk is finally taken into the abdominal cavity proper, and a transverse constriction around its middle is finally developed, so that it becomes hour-glass shaped. The upper bulb of this yelk mass is in-

tra-abdominal, and the lower bulb is invested by a thinner portion of the abdominal wall and adherent to the surface upon which the eggs were originally laid. The embryos apparently remain affixed by their yelk-bags until they reach the length of somewhat more than half an inch, when they present nearly the form of their parents. The same broad, flat, depressed head as seen in the adult is already well marked. They are also well pigmented by this time, four broad lateral and transverse bands of color showing on the nape and tail. By this time also the inferior bulb of the yelk-sack is becoming smaller, and it is apparent that the whole of its contents will become intra-abdominal. Soon after this the young become detached from the surface to which the egg adhered originally. Judging from the slowness with which the early stages are passed over, I infer that the fixed condition of the egg and embryo lasts for at least three or four weeks. The egg-membrane is ruptured in apparently about half that time. The period of incubation of this species is therefore somewhere about fifteen to twenty days, but the exact duration of its development was not determined, so that this period is only given as approximate.

In this species I have witnessed the origin of the pelvic fins from a pair of minute horizontal folds (Figs. 2 and 3), which grow out just behind the pectoral folds. They develop somewhat later than the pectoral folds and appear just about the time that the egg-membrane is ruptured over the back of the embryo or when the latter bursts the bonds imposed upon it by its covering. The original position of the pelvic fins behind the pectoral does not last long, however, for in three or four days one begins to notice that the pelvic fin folds are beginning to advance and are being apparently shoved forward below the pectorals into their permanent position. This is before the embryo is quite three-eighths of an inch long. By the time the young fish is a little over one-half of an inch in length the translocation of the pelvic fins is completed. They are then inserted in advance of the base of the pectorals (Fig. 1).

I have not made any sections of these embryos, but a dissection of the adult fish shows that the spinal nerves which pass out to the pelvic fins, arise behind those which pass to the pectorals but cross the nerves going to the latter and are inserted in advance of them into the translocated pelvic fin, which we saw arose originally in a position to the rear of the pectoral. The paired nerves going to the pectoral are given off from the spinal cord, and pass out just in advance of the first, second, and third vertebræ; those passing to the pelvic or ventral fins pass out in advance of the fourth and fifth thoracic vertebræ, and a twig seems also to be sent off from the third pair. We have therefore been able to trace the stages of development of the nerves which pass to the paired fins up to their completed state in the adult, and thus put beyond question the data upon which the doctrine of the translocation of the paired fins rests.

The development of the median fins of *Batrachus* is more direct than usual in young fishes; that is to say, the atrophy of certain portions of the fold are not extensive, because the median fins of the adult are almost continuous.

The larval integument, when sections of it are prepared, is shown to be very thickly covered with muciparous unicellular glands, similar to those observed in the salmon.

The lateral line system is very well developed and begins to show itself very distinctly before the embryo is half an inch in length. The portions continued over the head and lower jaw remain open until the young fish is about a half-inch in length; after that the edges of what were open grooves coalesce and in that way the closed canals over the head are formed. At short intervals, however, the edges of the grooves do not close, and these open spaces in the outer walls of the mucodermal or neuromastic canals form the pores which open into the lateral line system from the outside.

This system is not, as is usually the case in other fishes, prolonged backwards on either side of the body and tail of the Toad-fish as a single canal, but divides behind the hyomandibular into a ventral and a dorsal canal, each of which passes along nearly parallel close to the base of the dorsal and anal fins respectively. The upper one of these canals passes along above the insertion of the pectoral, and the lower one passes below the base of that fin.

In the adult the pores which open outwards from the system of lateral canals are not simple openings without defense of any sort; on the contrary, those on the head, body, and tail are always defended by a pair of strongly-developed papillæ, which almost completely conceal the pore opening between their bases. On the body one of the papillæ arises below the pore and another above it. These paired papillæ are best developed on the head and jaws, and they gradually become more and more rudimentary towards the tail. No evidence of the development of these papillæ can be found on any of the later larval stages in my possession, so that it is obvious that they are of post-larval origin.

The anterior nareal opening in the embryo of *Batrachus* is quite near the middle line, and is produced into a tubular prolongation before the young fish reaches the length of one-half inch. The posterior nareal opening, on the contrary, is a simple pore, and stands farther from the middle line than the anterior one.

Judging from the highly specialized character of the lateral line system of canals in *Batrachus*, and the pores connecting canals, papillæ, and nerves which pass to the apparatus, it is obvious that the latter is quite complex and must subserve some very important function. That its sole function is to secrete mucus is absurd on its own face, even if we had no direct experimental evidence to show that these organs are the instruments of a special sense. In mounted preparations of the skin of the larvæ, prepared for me by Professor Libbey, it may readily be

shown that the pores are joined together by a canal, and that a nerve probably extends along its whole length. In the adult the integument of the first ray of the ventral pair of fins is thrown into numerous narrow transverse folds. The distribution of the nerves to this structure or its histology I have not worked out, but I think it very probable that in it we have a specialized tract of the integument which may be highly sensitive as a tactile organ and be of service to the fish in finding its food on the bottom where it habitually lives.

I must take occasion here to express my obligations to Mr. Vinal N. Edwards for assistance in obtaining the materials upon which this notice is based. All of the materials were obtained under submerged stones and stumps in the eel pond at Wood's Holl during the latter part of July, 1885.

EXPLANATION OF THE PLATE.

FIG. 1. Advanced embryo of *Batrachus* or Toad-fish, still adherent; the pelvic fin has been translocated forwards. Enlarged about 12 times.

FIG. 2. An embryo Toad-fish, from the side which has recently ruptured the egg-membrane, a remnant of which still remains around the yelk-bag. The pelvic fin is shown as a small bud-like prominence just behind the pectoral fold.

FIG. 3. The same seen from above, showing the paired fin folds resting with their bases apparently upon the yelk, outward a little way from the sides of the body of the embryo.

FIG. 4. Egg of Toad-fish, with spreading blastoderm, in its natural position and adherent.

FIG. 5. A group of four developing eggs of the Toad-fish, adherent to a fragment of bark, to show that the heads of the contained embryos are all directed one way. Natural size.

---

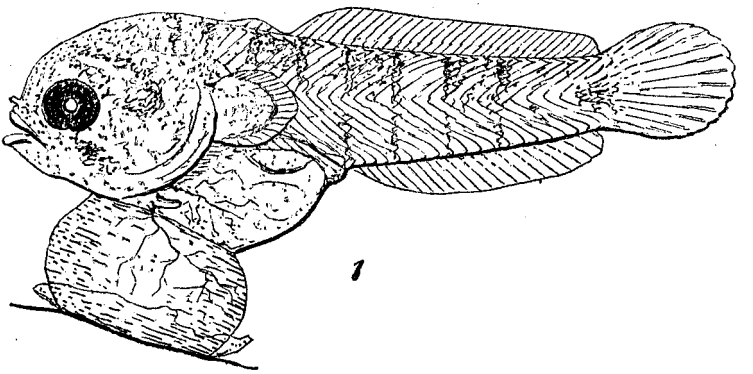
## 3.—ON THE EARLIER STAGES OF CLÆAVAGE OF THE BLASTODISK OF RAIA ERINACEA.

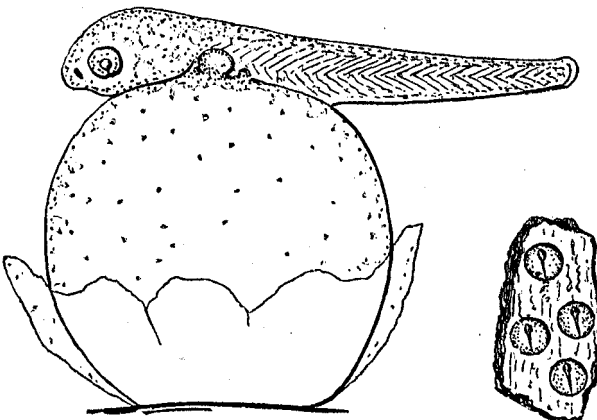
By JOHN A. RYDER.

In the oviparous Rays fertilization of the egg takes place while it is still within the oviduct, or possibly even before it enters the latter. In an egg taken from the cloaca of a female on the 11th of July, 1885, the blastodisk was already segmented into fifteen distinctly-marked cells. The mode in which these were arranged with reference to each other showed very plainly that the mode of segmentation, during the early stages at least, is very similar to that which occurs during the development of osseous fishes, though the cleavage becomes irregular somewhat sooner than in the latter. The sequence in which the segmentations occurred may be briefly described.

From a careful study of this disk, which was hardened in chromic acid, the case having first been carefully opened to allow the reagent access to the egg and disk, it is inferred almost with absolute certainty

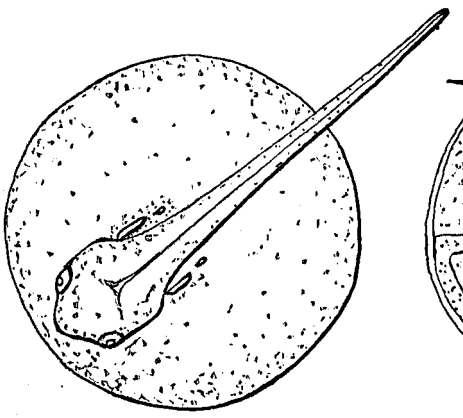
PLATE I.

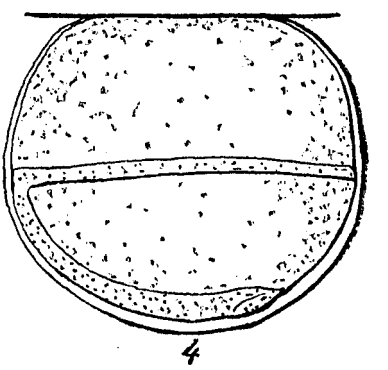









Development of the Toadfish.