

**27.—PRELIMINARY NOTICE OF THE DEVELOPMENT AND BREEDING HABITS OF THE POTOMAC CATFISH, *AMIURUS ALBIDUS* (LESUEUR) GILL.****By JOHN A. RYDER.**

A number of adult individuals of *Amiurus albidus* were brought from the Potomac River to the Armory building, at the instance of Lieut. W. C. Babcock, U. S. N., and Col. M. McDonald, and deposited in the large tank aquaria of that institution about the close of the shad fishing season of 1883. One pair of these have since bred or spawned in confinement, and thus afforded the writer the opportunity of observing and describing some of the more interesting phases of the development of this singular and interesting family of fishes. There has been hitherto little attention paid to the development of the *Nematognathi*, Siluroids or catfishes, probably from a lack of opportunity, and these notes may therefore prove of interest to naturalists. The literature of the subject is scanty; and besides a paper by Jeffries Wyman\* on the development of *Aspredo lavis* and *Bagrus*, I know of no separate essays on the development of this group, except some scattered notices in Günther's Introduction to the Study of Fishes and in his article Ichthyology, ninth edition of the Encyclopædia Britannica, on the development of *Arius*; an egg of this genus in an advanced state of evolution is figured, from which it appears that this form is very similar in its embryological features to *Ælurichthys*, some ova of which are in my possession, measuring three-fourths of an inch in their longest and five-eighths of an inch in their shortest diameter. *Arius* and *Ælurichthys* are marine forms, and the males have the habit of carrying the ova in the hinder part of the oral cavity or branchial region until the young are hatched, as redescribed by W. Turner.† The marine species, however, have only a few ova at a time as compared with the *Amiuri*, common catfishes or horned pouts of the Eastern United States.

Prof. Theodore Gill has been kind enough to aid me in determining the species of which I here sketch the development, and he refers it to the form with the name given in the title of this notice. Its habits of spawning and care of the young are probably common to all of the species of the genus, and are quite remarkable, as will appear from the subjoined account.

On the morning of the 13th of July, a little after 10 o'clock a. m., we

\* On some unusual modes of gestation. Am. Journ. Arts and Sciences, xxvii, 1859, pp. 5-13.

† A remarkable mode of gestation in an undescribed species of *Arius* (*A. Boaketti*) Journ. Anat. and Physiol., i, 1866, pp. 78-82.

noticed a mass of whitish eggs in one of our aquaria inhabited by three adult specimens of *Amiurus albidus*, two of which were unmistakably the parents of the brood, for the reason that they did not permit the third one to approach near the mass of eggs which one of them was watching vigilantly. One of the individuals remained constantly over the eggs, agitating the water over them with its anal, ventral, and pectoral fins. This one subsequently proved to be the male and not the female, as was at first supposed. The female, after the eggs were laid, seemed to take no further interest in them, the whole duty of renewing and forcing the water through the mass of adherent ova devolving upon the male, who was most assiduous in this duty until the young had escaped from the egg membranes. During all this time, or about a week, the male was never seen to abandon his post, nor did it seem that he much cared even afterwards to leave the scene where he had so faithfully labored to bring forth from the eggs the brood left in his charge by his apparently careless spouse. The male measured 15 inches in length, the female a fourth of an inch more.

The mass of ova deposited by the female in a corner and at one end of the slate bottom of the aquarium measured about 8 inches in length and nearly 4 inches in width, and was nowhere much over one-half to three-fourths of an inch in thickness. The ova were covered with an adhesive but not gelatinous outer envelope, so that they were adherent to the bottom of the aquarium and to each other where their spherical surfaces came in contact, and consequently had intervening spaces for the free passage of water, such as would be found in a submerged pile of shot or other spherical bodies. It was evident that the male was forcing fresh water through this mass by hovering over it and vibrating the anal, ventral, and pectoral fins rapidly. There were probably 2,000 ova in the whole mass, as nearly as could be estimated. All of those left in the care of the male came out, while about one-half of the mass which he had detached from the bottom of the aquarium on the third day, during some of his vigorous efforts at changing the water, were transferred to another aquarium, supplied with running water, and left to themselves. Those which were hatched by the artificial means just described did not come out as well as those under natural conditions. Nearly one-half failed to hatch, apparently because they were not agitated so as to force fresh water through amongst them and kept clean by the attentions of the male parent.

The eggs themselves measured about one-sixth of an inch in diameter a short time after oviposition, and after the large water space had been formed around the vitellus, between the surface of the latter and the egg membrane. The vitellus measured one-eighth of an inch in diameter. The germinal disk was formed at the upper pole of the vitellus immediately after oviposition, and gradually spread in the usual manner over the lower pole of the opaque granular vitelline globe. In the early part of the second day the body of the young fish was out-

lined, but the tail began to grow out before the embryo's body had embraced much more than one-fourth of the circumference of the vitellus. On the third day the tail of the embryo had acquired considerable length, and its free end was moved from side to side gracefully and rhythmically through the contents of the water-space.

The water-space from the first was filled with an immense number of free, refringent corpuscles, which made it difficult to make out the form of the embryo during the early stages. These corpuscles were not of the nature of blood-cells, and seemed to become less abundant towards the close of the period of development within the egg. Nothing of a similar character, as far as the writer is aware, has ever been encountered in the water-space of any other Teleostean egg. So abundant are these corpuscles at first, coupled with the opacity of the vitellus and the peculiar whiteness of the germinal matter, that even an experienced observer would be led to suppose at a first glance that all of the eggs were bad, having the "rice-grain" appearance of blasted shad eggs.

On the third day the vascular system begins to develop and the heart to grow forward under the head, down over the anterior end of the yolk. A pair of vascular arches (cuvierian ducts) are soon formed, just behind the rudiments of the pectorals, which grow outward and split up into vitelline capillaries and eventually join a median vitelline vessel which empties into the venous end of the heart. The mouth is widely open on the third day, and the branchial clefts are developed with a free circulation through the arches. The caudal part of the aorta and caudal vein is also developed at that time, and the intersegmental vessels are developed a little later, with loops running out into the mesoblast of the median natatory fold.

The eyes of the embryos were unusually small for young fishes, and reminded one during the early stages of the eyes of Ganoids and young Amphibians. The choroid fissure was prolonged obliquely far forwards. The eyes were pigmented on the fifth day.

The air-bladder became perceptible on the tenth day, far forwards, and as a dorsal outgrowth of the intestine, a little above and behind the level of the insertion of the pectoral fins, and as it grew more capacious the young fish commenced to swim higher in the aquarium. When first hatched, on the sixth to the eighth day, the young exhibited a tendency to bank up or school together like young salmon. They also, like young salmon, tended to face or swim against the currents in the aquarium, a habit common, in fact, to most young fishes recently hatched.

The development of the fins was somewhat similar in general character to that usually observed. On the second day the medial natatory fold began to grow out on the dorsal and ventral side and the end of the tail, but up to the fifth day no clearly-marked differentiation of any of the unpaired fins had occurred. The first of the paired fins to appear were the pectorals, which began to show themselves on either side of the body on the third day, a little way behind the ear, as a pair of low lon-

gitudinal folds. The first of the unpaired fins to be developed was the anterior dorsal, which was first marked off from the rest of the natatory fold on the fifth day by a slight emargination near the anterior end of the latter. Coincidentally with the development of the first dorsal the first rays of the caudal began to develop on the fifth day, just below the up-turned caudal end of the notochord, which terminated near the dorsal border of the tail, but no distinct embryonic caudal lobe was ever developed such as that described by A. Agassiz in the young of *Pleuronectes*. The development of the tail was in fact very similar to that of the salmon, even to the presence of a similar vascular plexus and a small but perceptible venous sinus. On the seventh day the mesoblast was perceptible in the anterior dorsal and in the anal, and the rays in these two fins had begun to develop. On the seventh day the caudal had assumed a clearly-marked fan shape. On the eighth day the anal was more apparent as a prominent expansion of a part of the ventral portion of the natatory fold, and its rays had become more distinctly visible. By the tenth day the rays in the first dorsal and the anal were distinctly developed, and both fins were sharply marked off from the rest of the fins developed from the natatory fold by deep angular emarginations. On the tenth day the adipose dorsal appeared as a separate lobe, which became progressively more distinctly developed. On the eighth day the ventrals budded out as a pair of folds above the hinder end of the yolk sack, at the lower edge of the body, just a little way in front of the vent. On the tenth day the caudal became distinctly lobed and posteriorly emarginated, the upper lobe being the longest, and on the eleventh day all of its rays were defined. By the thirteenth day the yolk had been absorbed, and the young fish were nearly ready to feed. By this time, too, the rays had appeared in the ventrals. By the fourteenth day the first hard spine of the anterior dorsal was developed, and the anterior spiny rays of the pectorals had been formed with two retrorse hooks on their hinder margins. By this time the young had practically passed through their larval condition, and began to bear a striking similarity to the adults, having by this time also become quite dark on the upper side of the body from the development of pigment cells in the skin.

On the fifteenth day after oviposition it was found that they would feed. While debating what should be provided for them, Mr. J. E. Brown threw some pieces of fresh liver into the aquarium, which they devoured with avidity. It was now evident that they were provided with teeth, as they would pull and tug at the fragments of liver with the most dogged perseverance and apparent ferocity. This experiment showed that the right kind of food had been supplied, and as they have up to this time (August 1) been fed upon nothing else, without our losing a single one of the brood, nothing more seems to be required with which to feed them.

It is worthy of note that when pieces of liver were thrown into the aquarium the parent fishes would apparently often swallow them, with numbers of young ones eating at and hanging to the fragments. I was soon agreeably surprised to find that the parent fishes seemed to swallow only the meat, and that they invariably ejected the young fish from the mouth quite uninjured, the parent fish seeming to be able to discriminate, instinctively, before deglutition occurred, between what was its proper food and what were its own young. As soon as the young began to feed they commenced to disperse through the water and to all parts of the aquarium, and to manifest less desire to congregate in schools near the male, who also abated his habit of fanning the young with his fins, as was his wont during the early phases of development.

The most interesting feature of the developmental evolution of the young catfishes is the early appearance of the barbels. The first pair which is visible is the maxillary at the angles of the mouth of the embryo. This pair of barbels grow out at either angle of the mouth, on the third day, as a pair of flat lobes, continuous anteriorly with the upper and anterior border of the mouth. By the fifth day the maxillary barbel becomes much prolonged and cylindrical, while the two pairs of chin barbels appear at the same time a little behind the outer margin of the lower jaw as two pairs of low fleshy papillæ. By the seventh day these, also, have grown considerably in length and become cylindrical. On the same day the nasal pair of barbels have been formed as papilliform outgrowths at the anterior margin of the posterior nostrils, the anterior and posterior nostrils being already separated by a pretty wide bridge of tissue. The early separation of the anterior and posterior nostrils by a bridge of tissue in the embryo catfish is a striking instance of the acceleration or precocious development of this structure, which is not usually formed so early. By the seventeenth day all of the barbels have acquired very nearly the same length in proportion to other parts of the body, as may be noted in those of the adults, but they are nearly transparent and appear to be thickly studded superficially with specialized end-organs, which are probably tactile in function. Their order of development is as follows: First the maxillary, then the outer, then the inner chin barbels, and lastly the nasal barbels are formed. The early and peculiar development of these cephalic appendages already distinguishes the embryos catfish on the third day from the embryos of all other forms of Teleosts.

The intestine is not prolonged far backwards beyond the posterior end of the yolk sack. On the thirteenth day the greenish secretion of the liver can be seen in its cavity. Nothing was observed of the development of the liver, but it is probable that a portion of the blood from the caudal vein passes through it and then passes through a vitelline network of vessels back to the heart.

Behind the vent, a distinct urinary duct could be seen by the sixth day, and by the tenth day an allantois or urinary vesicle was developed

in the usual position behind the anal end of the intestine. Transparent views showed that the segmental ducts were tortuous at their anterior extremities. Nothing was learned of the character of the pronephros, one of the features of development which may very properly be studied when we have once prepared sections from the material which has been preserved for the purpose.

On the 30th of June, or when the young were seventeen days old, it was determined to make an examination of the internal organs of both parents, which was done in the presence of Professor Gill, to learn which one of the parent fishes it was that had acted as nurse. Fortunately there was considerable difference between the two in color; the female had also lost a part of one maxillary barbel, so that it was easy to distinguish them apart. The darkest specimen, with the broadest head, we found was the male, and, as already stated, had acted as the nurse. Upon cutting him open and removing a portion of the milt or testes, they were found as a lobulated paired organ on either side of the mesentery, depending from the dorsal wall of the abdomen. The lobes of the testes were digitate. Upon compressing fragments of the testes under the microscope, active spermatozoa were pressed out. The spent roe or ovary of the female was a paired organ, the right and left sacs of which were joined together posteriorly. The ovarian lobes or leaflets were disposed transversely in the sacs.

The foregoing account of the development and breeding habits of *Amiurus albidus* is preliminary to a fuller one, accompanied by illustrations, taken from hardened and preserved material in the hands of the writer.

CENTRAL STATION, UNITED STATES FISH COMMISSION,  
Washington, August 1, 1883.

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**28.—ON RAINBOW TROUT REARED FROM EGGS BROUGHT FROM CALIFORNIA.**

**By ROLAND REDMOND.**

[From a letter to Prof. S. F. Baird.]

There are some Rainbow trout at the South Side Club, raised from a few eggs you sent them three years since, which show an extraordinary growth for their age, one being 22 inches long and weighing fully three pounds. They have begun to show a change in their spawning season, the eggs having become ripe about Christmas time.

Can you kindly spare us some more eggs this spring? The association is anxious to stock one of its ponds with this fish.

105 FRANKLIN STREET, NEW YORK, March 28, 1883.