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

that the disk changes form somewhat in the same way as does the segmenting blastodisk of a Teleostean ovum. This conclusion is supported by the following data: The disk of an apparently unfertilized egg removed from a recently-captured female, was perfectly discoidal, whereas the disk of the nearly completed 16-celled stage was elongated and had a decidedly squarish outline when viewed from above. The latter measured 1.71 millimeters in width and 2.37 millimeters in length. Its thickness in the center was about .6 of a millimeter, and thinned out at the margin into a very thin layer of protoplasm which is obviously homologous with the periblastic layer of the Teleostean egg.

Judging from the arrangement and depth of the segmentation furrows, the first one, *I*, divided the disk into two halves, and in the process of segmentation the disk became narrowed at right angles to the plane of the first cleavage. This modification seems to have influenced the character of the subsequent cleavages, as the next furrow, *II*, is about at right angles to the first, and traverses the middle of the disk through its longest diameter. The disk is now segmented into four large cells. The next cleavage furrows, *III*, *III*, cut through the disk transversely across its least diameter, and the two of them divide the four cells resulting from the first and second cleavages into eight. These are arranged in two parallel rows of four each and embrace the long diameter of the disk, just as in the blastodisk of the Teleostean egg at the end of the third cleavage. Some irregularity now becomes apparent upon the advent of the fourth cleavage upon one side, as a result of which it is clear that the disk will soon lose its oblong, subquadrate form and become discoidal in the same way in which this happens in the eggs of bony fishes. On the right side of the blastodisk of *Raia*, the furrow, *IV*, of the fourth cleavage is quite regular, on the left very irregular, as shown in the figure.

Sections through the disk display the relation of the segmentation spheres to the vitellus. The furrows do not appear to cut quite through the less granular protoplasm of the disk, so that probably a thin periblastic stratum is left underlying the latter and immediately overlying the yelk, the coarse granules and corpuscles of which are apparent just below. The marginal cells in section have a thin border, and the outer twelve cells are wider than the four central ones when viewed from above. The thin borders of the marginal cells are directly continuous with the thin periblastic envelope which invests the vitellus.

The nuclei are relatively small, and contain rather dense single, but somewhat irregular, masses of chromatin.

Somewhat more advanced stages show the disk divided irregularly into cellular areas; the whole disk is also more nearly discoidal in form.

No later stages were observed in which the number of cellular layers had multiplied, or where the disk showed two or more superimposed strata of cells; and in none of those examined by me did I find any evidence of the presence of a developing cleavage cavity, nor was it

observed in the 16-celled stage, originating in the manner described for the Teleostean egg by Whitman. The time of the appearance of that cavity, however, seems to vary somewhat even in different species of the latter.

The striking similarity of the early stages of segmentation in the blastodisk of *Raia* to those observed in the blastodisks of Teleosts is significant, and shows that the pattern of the furrows up to the fourth cleavage, in such an extremely meroblastic (teleplasmic) type of egg, need not necessarily resemble those developed on the blastodisk of the equally extreme type *Aves*, if Coste's figures are correct. The figures of the very early cleavage patterns of the blastodisk of the bird's egg given by Coste cannot, however, be reconciled with the more recent views as to the possibly intimate relation which may subsist between the future axis of the embryo and the first cleavage plane. The detection of the essentially right-angled relation between the first four cleavage planes which segment the blastodisk of *Raia* opens up the question whether such a method of cleavage does not also take place in the blastodisk of the bird's egg. If that is the case, then the subject of the very early stages of cleavage of the *Avian* blastodisk needs reinvestigation.

A continuous series of sections was cut of the Ray's blastodisk, above described, with a Cambridge rocking microtome. In this series it was possible to follow out the cells and furrows shown in the accompanying diagram. This series of sections was prepared by cutting the disk transversely. The hardening of the disk here described was accomplished as it lay upon the subjacent yelk undisturbed. After remaining in that position for twenty-four hours in the acid, the acid was gently poured off, the egg carefully washed, and the disk loosened with the greatest care from the underlying yelk. The changes wrought by the acid in the relative positions of the cleavage furrows were too slight to be noted, as was shown by a careful examination of the surface of the blastodisk both before and after hardening.

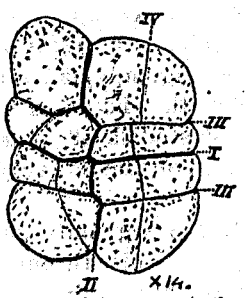

FIG. 1.—Diagram of the cleavage planes in the blastodisk of *Raia erinacea*.

4.—FISH KILLED BY POISONOUS WATER.

By A. H. GLENNAN.

[Letter to J. B. Hamilton, M. D., Surgeon-General of the Marine Hospital Service.]

Large shoals of dead fish have been met with between Egmont Key Light and Charlotte Harbor, off the mainland, and vessels have been several hours in passing through them. A few weeks ago the fishing schooner City of Havana, Capt. John Curry, lost two loads of live