

and the remaining side AC, may be determined. In the latter triangle, ACD, there will now be known the angles and the side AC; whence the sides AD, DC may be found.

It will be for practice to determine with what amount of rigour the indications of theory will require to be carried out. And it may be worth while to remark, finally, that the pencil, as emergent from the object-glass and incident on the prism, is not strictly parallel; but it would serve no useful purpose to take account of the slight amount of convergency it possesses.

NOTE on the OVICELLS of the CHEILOSTOMATOUS POLYZOA.
By the Rev. THOMAS HINCKS, B.A.

(Read at the British Association, September, 1861.)

MOST of the *Cheilostomatous Polyzoa* (Polyzoa furnished with a moveable lip, which closes the mouth) exhibit at certain seasons external capsules, of various forms, which are situated generally at the upper extremity of the cells, and overarch the orifice. It has long been known that in these ovicells ciliated embryos are matured, which, after making their escape and passing through a free existence of longer or shorter duration, become fixed and are developed into the perfect Polyzoan. A question has been raised, however, as to the birthplace of the ova which originate these motile embryos, and Professor Huxley has adopted the theory that they are produced within the cell itself, either in an ovarium attached to the side of the cell-wall (endocyst), or on the cord (funiculus) which in some species connects the body of the polypide with the bottom of the cell. He supposes (or did suppose in 1856, when his note on the subject was communicated to the 'Microscopical Journal,' vol. iv, p. 191), that the ova, after impregnation in the perigastric cavity, pass into the ovicell, and "there, as in a marsupial pouch," undergo their further development. In the same paper Professor Huxley remarks that "the general idea, that the ova are developed within the ovicells," is "wholly an assumption."

This very plausible conjecture has been virtually accepted as the true explanation of the function of the Polyzoan ovicells, and has not been challenged, so far as I am aware, in any published work. My object in this notice is to give a brief account of observations which I have made on the deve-

lopment of the ciliated embryo and its relation to the ovicell, and which are, I believe, conclusive against the marsupial theory.

I may remark, however, in the first place, that the common opinion could not be correctly represented as a mere "assumption," even when Professor Huxley's paper appeared. For as early as 1845 Professor Reid, in a communication to the 'Annals,' vol. xvi, p. 385 ("Anatomical and Physiological Observations on some Zoophytes"), had recorded the results of his examination of the ovicells of *Flustra avicularis* and the contained ova, and had clearly pointed out that the latter, in the first stage of their growth, "adhere to the upper end of the lining membrane of the capsule," and are enclosed in a sac formed by a reflection of this membrane. In his account of the structure of the Polyzoa in the 'British Zoophytes,' Dr. Johnston has referred to Professor Reid's investigations, and adopted his views.

My own observations, repeatedly made on several species, completely agree with Dr. Reid's, and leave no doubt that the ovum, which is ultimately developed into the ciliated



embryo, is produced within the ovicell, in an ovarian sac, which buds from the endocyst, at the upper extremity of the capsule.

I shall briefly detail the various points which have come under my notice, and trace the growth of the capsular ovum from its first appearance to its final exit.

The species upon which my observations have been made are *Bugula flabellata* (the *Flustra avicularis* of Reid), *B. turbinata*, and *Bicellaria ciliata*. In all these forms the ovicell is strengthened by the deposition of calcareous matter. The ovicell is a stony receptacle, lined by an extension of the endocyst or inner coat, which constitutes the wall of the perigastric cavity and encloses the body of the polypide. This lining membrane, according to Dr. Reid, "stretches across the aperture in the capsule."

The examination of a number of ovicells enables us to determine the following stages in the development of the ovum. It appears at first as a minute mass of granular substance, in contact with the endocyst, at the top of the capsule, and enclosed by a well-marked sac, formed by a reflection of the

lining membrane, stretching from side to side (fig. 1). At this stage the ovum has not attained any very definite form. It is simply a mass occupying the space between the endocyst and the wall of the ovarium. The first change which I have noticed seems to consist in a slight concentration of the matter at the centre of the nascent ovum. Gradually it assumes a circular form, and segmentation takes place, the mass being divided into four and afterwards into more numerous granules (figs. 2, 3). I have not detected a germinal vesicle. On the disappearance of the segmentation the ovum exhibits a marginal band of large and somewhat oblong cells, surrounding a central, opaque, granular mass, and changes its circular for a more or less oval figure (fig. 4). As the growth of the ovum proceeds the membranous partition which encloses it is pushed downwards, and the sac at last occupies a considerable portion of the oviceU, suspended, as it were, from the top, and reaching towards the aperture. Its wall is also thickened, and shows very distinctly. Indeed, from its first differentiation it may be detected without difficulty.

Subsequently the ovum increases in size until it nearly fills the cavity of the capsule, and the containing sac would seem to be ruptured and to disappear. Cilia are at last developed on the surface, and the embryo moves restlessly about the interior of the oviceU, and at last makes its escape through the aperture.*

I have never seen spermatozoa within the oviceU, and am unable to throw any light on the way in which impregnation of the capsular ova takes place.

Dr. Reid mentions having witnessed the division of an embryo into two portions, one of which immediately escaped from the capsule, the other remaining in it for the time, but nothing of the kind has occurred to me.

A word now as to the *ova*, which are produced within the *cells*, and which Professor Huxley supposed to make their way into the oviceU, for the purpose of accomplishing the later stages of their development.

They are commonly present in cells bearing capsules from which the embryos are being discharged. Professor Huxley has described them as they appear in *Bugula avicularia*, and has pointed out the respective positions of the ovary and testicle. They present one very distinctive character. They are never ciliated. No observer, I believe, has professed to detect cilia upon them at any stage of their development. Van Beneden

* I do not offer the foregoing as a complete account of the development of the ovum, but only as an enumeration of certain successive stages of it, which have come under my notice.

asserts that on one occasion he saw an ovum escaping through an orifice near the tentacular rim from the cell of *Laguncula*, but he distinctly states that it had no cilia. His observation, however, has not been confirmed. No such orifice as he supposes has, I believe, been detected by any other naturalist. On the contrary, these non-ciliated ova may very commonly be met with in the cells after the disappearance of the polypides, and everything seems to show that they are only liberated when the soft portions of the Polyzoa have quite perished. I have repeatedly found specimens in which the polypides had all disappeared, while in nearly every cell there was one of the red, circular bodies of which I have spoken. In the case of *Frustra foliacea*, Van Beneden remarks that the eggs (round, deeply-coloured bodies, and perfectly motionless) "appear to be hatched in the empty cells," for that he had seen very young individuals in the cells of adults.

It would seem, then, that we have in this class two kinds of reproductive bodies—the ciliated, actively moving embryos, produced in the ovicells, which are liberated in immense numbers, and diffuse the species far and wide; and the non-ciliated ova, produced in the cells, which are only removed from the polyzoarium after the death of the polypides, and may, perhaps, require a longer period for their perfect development.

It would be very interesting to know the complete history of the last-named bodies, and I trust the subject will receive the attention of those who may have the opportunity of continuous observation.

On the MOTIONLESS SPORES (STATO-SPORES) of VOLVOX GLOBATOR. By J. BRAXTON HICKS, M.D. Lond., F.L.S., &c.

I BELIEVE that the condition of the zoospores of *Volvox* have not been observed beyond the time when, in the autumn, the imperfectly or partially formed daughters in their early segmenting stage, or in their encysted state (testing spores), are set free by solution of the parent envelope. I shall, in the following lines, be able to show that there is yet another stage through which they pass.

These observations were made by keeping a large quantity of *Volvox*, gathered late in autumn, in water in a glass vessel for upwards of three months, watching very carefully and very frequently; after which time an accident unfortunately prevented my extending them further.