BOSTON

# JOURNAL OF NATURAL HISTORY.

VOLUME VI.—NO. I.

---

## ART. I.—*On the Embryology of* Nemertes, *with an Appendix on the Embryonic Development of* Polynöe; *and Remarks upon the Embryology of* Marine Worms *in general.* By E. DESOR.

THERE is no group of animals the true affinities of which are more difficult to ascertain, than the so called white-blooded Worms. Not only the family, the order, but the class, and even in certain cases the department to which they belong is doubtful. Some light might therefore be expected from the study of their embryological development, according to the principle that each type in the animal kingdom follows, in this respect, a rule of its own. This consideration, together with the interest that attaches itself naturally to all inquiries in embryology, induced me to follow out the development of the Nemertes.

The Nemertes are marine worms of a very simple appearance, having no external gills, and no appendages of any kind.[1] Some of them are very long and ribbon-shaped, like Tænia;

[1] The anatomy of Nemertes has been investigated with great care, by the able French naturalist, M. De Quatrefages. (See Cuvier, Regne Animal illustré.) The species of the coast of Great Britain have been thoroughly described by Mr. Johnston in the Magazine of Zoölogy and Botany.

others are slender, like a thread ; but the greater number are small and similar in shape to the common earth-worm. Among the species of this type found on the shores of New England, there is one very similar to the *Nemertes olivacea* of Johnston. It is one and a half to two inches long, and has the same dark green color, but without the red head, wherefore I shall designate it under the name of *Nemertes obscura.* (Fig. 1.) It lives under stones and among sea grasses on the shore, between low and high water mark. Several specimens of this species were procured in East Boston, towards the end of January 1848 ; they were kept in a jar, where they lived several months in a very healthy state, care being taken to renew the water every day. On the 12th of February, there was observed at the bottom of the jar a yellowish gelatinous string, (fig. 2), which was found to consist of eggs. It had been laid during the night, and was remarkable as being almost as large as the parent animal. On examining it with a magnifying glass, (fig. 2*a*), I was struck with the irregular distribution of the yolk-spheres. Instead of being isolated and surrounded each by an independent albumen-like liquid, I found several of them collected together in transparent gelatinous bags, which seemed to be attached to a central string by a kind of neck or stalk, like a bunch of onions. The bags themselves are generally spherical, with the exception of the terminal ones, which are elongated and truncated at their base. The stalk by which they are attached is hollow, and the whole body bears a striking resemblance to a Florence oil flask, (fig. 3,) whence in future I shall call them *flasks.*

The number of yolks enclosed in a flask is generally three or four, seldom more than six or less than three. I have seen nevertheless, some containing ten and even as many as eleven, and on the other hand, some with no more than one, in which

[1] The same peculiarity is found in several species of Eolis, where there are commonly three or four yolks in one egg.

case the sphere is generally larger. Lastly some were found at the extremity of the string containing no yolk at all, but merely a transparent liquid. When crowded together, the yolks, which by themselves are spherical, become flattened at the points of contact, showing that they are of a soft consistence. The transparent liquid, with which the yolks are surrounded, is similar to that found in the eggs of molluscous animals, which is commonly called albumen, from its similarity to the white of eggs in higher animals. But physiologically speaking, it is in neither case a true albumen, though it may contain albuminous matter. It is nothing more nor less than the *mother liquid*, so to speak, which becomes transparent as the vitelline matter condenses, and which I propose to call *biogen liquid*, in consequence of its great importance in embryology.[1]

The germinative vesicle and germinative dot, which are so distinct in the ovarian egg,[2] have completely disappeared after its extrusion, at least I never was able to discern it after the egg had been laid; in place of it, we find in each yolk-sphere one or several clear or semi-transparent spots, not having a well defined outline, and which have been described by embryologists under the name of oil-drops, or clear dots. (Fig. 3–13.)[3]

[1] See Proceedings of the Boston Soc. Nat. Hist. 5th July, 1848.

[2] See Johnston, Miscellanea Zoölogica, in the Magazine of Zoölogy and Botany, Vol. I. Pl. 17, Fig. 2 and 6. According to Johnston, the eggs are found in little masses on each side of the alimentary canal.

[3] Considering the different opinions as to the nature and object of these spots, I have devoted myself with great care to their examination, hoping that they might throw some light on this difficult question. The following are the results of my observations.

On compressing the flasks, there are seen on the margin of the vitelline spheres little transparent vesicles like herniæ. (Fig. 4 *a* and 5 *a*.) Considering their sharp outlines I was tempted at first to consider them as vesicles, but seeing that on increasing the pressure they elongated their form, and that a large vesicle divided into a number of small ones having the same sharp outlines, (fig. 6 *b* and 7 *b*), my first impression was changed, and it seemed evident to me that it was a viscous liquid, which, from the cohesion of its particles, took these well defined forms, as we see in a drop of oil. In a second experiment made upon another mass of eggs, I ob-

The vitelline substance is not a homogeneous mass, nor simply granular, as it appears at first sight; on the contrary, it is composed of an accumulation of cells, which are distinctly nucleated, as may be shown by a magnifying power of only 150 diameters, and which is very plain in a power of 400 (fig. 8.) So long as the vitellus is entire, the cells being pressed against each other, have an angular form; but as soon as the vitellus is broken, they become spherical. Each cell contains, usually, but one nucleus, which also seems to be a cell; at least, it is transparent like the cell itself, (fig. 8.)

At this epoch of the development, that is to say, before the furrowing has began, there is no trace of a membrane to be observed around the yolk-spheres. It seems that the natural cohesiveness of the vitelline substance is sufficient to maintain it in a spherical form. The oily drop in the interior may even be forced out without breaking the vitellus. In order to break

served the following: A flask containing several vitelline masses was placed under the compressorium, and on compressing with great care, I succeeded in bursting, in a gradual manner, one of the vitelline masses in which the clear spot was very distinct. While the vitelline substance was escaping, the dot became isolated, (Fig. 8 *d*), and although I used a high power, (400 diam.) I could not perceive any trace either of a nucleus or any other body in it. Nevertheless, the vesicle could be moved in any direction with great ease, so that I even saw it escaping from the flask and rolling in the current of the vitelline substance. It had an extraordinary flexibility, bending and twisting itself against every obstacle which it met, assuming the most varied forms, as shown in Fig. 9–12. This extraordinary flexibility, taken in connection with the fact that I could not perceive any investing membrane, convinces me that it was a mere *drop of oily cohering fluid.*

Another vitellus having been crushed more rapidly, I could not perceive any large vesicle, but in place of it many small clear spots having the same limpid appearance, without any nucleus, from which I concluded that the large drop had been broken into many fragments, as in the case shown by Fig. 6 and 7.

These experiments I think authorize the conclusion, that the clear spot is formed by a transparent oily liquid, which assumes a spherical form, in consequence of its molecular cohesion. Moreover the impossibility of discovering any kind of membrane, and the fact that it may be broken into many smaller drops of similar appearance, without any previous appearance of partitions, seem to me sufficient to prove that at this early period at least, there is no envelop, and therefore that the oil-drop is not a true cell, as has been maintained by some authors. It remains for future investigation to make out what is its object and signification in the economy of nature.

it, it is necessary to compress it more or less, and then it will be seen torn open like a mass of jelly.[1]

The absence of a peculiar membrane surrounding the vitellus will not surprise us, if we consider that the transparent liquid contained in the flask is not similar to the albumen found in the eggs of higher animals, but belongs more properly to the vitellus itself; so that the membrane surrounding it is the true representative of the vitelline membrane, or chorion of the higher animals, and by no means the representative of the shell-membrane.

The furrowing of the vitellus begins as early as the third, and even sometimes the second day. The most striking appearance, as distinguishing this from other animals, is the great irregularity of the divisions. We find nothing of the almost geometrical progression and external regularity that exists in many mollusks and fishes. At first, we see a few folds form on the border of the vitellus, which divide it into irregular lobes, as seen in fig. 13. It is important to remark, that in this state the clear spot is undivided. It is plain, therefore, that the division of the yolk is in no way dependent upon the transparent spot; at least, that it is not occasioned by a previous division of the latter. In this respect, my observations confirm completely the results obtained by my friend Dr. Vogt, as to the development of the Actæon.[2]

The furrowing goes on gradually, till the whole mass is divided into a number of fragments of irregular size and shape, as seen in fig. 14, which shows one of the flasks on the fifth day. At this time each fragment shows a clear spot which is smaller than the single spot in an undivided yolk. Nevertheless, the sum of these spots seems to represent a larger mass than the primitive spot. Their form is spherical, as is ascertained by the following experiment. Having compressed the

[1] The vitelline granules being very cohesive in the Nemertes, it often happens, that when escaping, they adhere to each other and form balls, which might easily be mistaken for large cells.

[2] See Annales des Sciences Naturelles. 1846.

flask, (fig. 14,) I saw the yolk granules escape from one of the divisions, leaving untouched the clear spot, which now appeared as a well-defined drop, (*a*). At the same time, one of the three yolks broke, and I saw that the divisions, which till then were angular, assumed ovoid or spherical forms, (*b*.)

On the sixth day I found the divisions much farther advanced, and the yolks assuming the mulberry form, as shown in fig. 15. The yolks were still crowded together, especially in those flasks containing many yolks.

On the succeeding days, the subdivisions continued to progress, so that the yolks appeared to consist of small granules, fig. 16 representing a flask on the ninth day. A remarkable point about this flask was, that whilst the two upper yolks were exceedingly subdivided, the lower one, (*a*), was almost homogeneous, with a single large transparent spot, and had merely commenced its subdivision, showing that it had been arrested in its development. The simultaneous existence of this undivided yolk, having a single large clear spot, with two other yolks much subdivided, and having no single large spots but only the small ones in each granule, induced me at first to believe, that the small clear spots owed their origin to the subdivision of the large one, as is generally supposed; but having seen in other specimens the simultaneous existence of both kinds, (fig. 15,) I was convinced that this idea was not correct as applied to the Nemertes, and that there must be an increase of the transparent liquid during the development.

On applying pressure to the flask of fig. 16, the upper yolk burst, and I saw the granules escaping in the form of little spheroids, each having its clear spot, which appeared to occupy one-fourth, and sometimes one-third, of its bulk, (*b*.) The granules were now surrounded each by its own membrane, so that on the death of the egg the yolk decomposed into as many spheres as there are divisions.

It is not uncommon for small parts of the vitellus to separate from the mass, during the course of the development, and consequently we see, in most of the flasks, small bubbles floating about, as has been observed in many mollusks, and even in mammals. These bubbles seem to preserve a kind of separate life; at least, they do not decompose, and we find them even in those flasks whose embryos are far advanced, (fig. 18 and 20.) They are always surrounded by a distinct membrane, and contain a certain number of small granules; but I never saw them assuming any other form than that of simple vesicles, destitute of ciliæ.

At about the fourteenth day the yolks begin to move.[1] When observed with a high power, I found them covered with very minute ciliæ, their organs of motion, (fig. 17.) They move at first very slowly and irregularly, revolving about their own centre. The liquid in which they revolve does not seem to offer much resistance, from the apparent ease with which they push about the little bubbles contained in their enclosure with them. When a flask is broken and the yolks have escaped, they continue to agitate their ciliæ, and to move as well in the water as they did in the liquid contained in the flask. This is a sufficient proof that this motion depends upon inherent power, and is not the result of mere external influences, such as difference of density.

About this time the yolks, which until now had seemed quite homogeneous, begin to change their appearance. We perceive in the interior a very transparent spot, lying transversely, and which must not be confounded with the clear spots heretofore spoken of, from which they may easily be distinguished by their peculiar shape and sharper outlines, (fig. 18.) Upon the application of pressure, the crescent becomes larger, and very distinct, (fig. 19.)

We now also perceive two separate zones in the embryo, the external one being clear, and the internal more opaque. The external zone becomes more and more distinct, so as to

[1] In one flask, taken from another mass of eggs, I found motion by the twelfth day.

be recognized even when not compressed, as seen in fig. 20, representing a flask on the 18th day. The crescent-like spot is enlarged, the ciliæ are more distinct, and the embryos revolve more rapidly than before.

Some days after, when compressing the yolks, I noticed the existence of a third zone, that was interposed between the two others, (fig. 21) ; so that there were now three distinct layers in each yolk. The external one, being quite wide, showed very distinctly the subdivisions of the yolk substance, with the clear spot in each granule ; the second was the most transparent, and there were seen in it very small and delicate transparent cells ; the third or interior one, being the most opaque, with a quite distinct granular structure similar to that of the external zone, but more dense.

The embryo remained in this state until about the 24th day, when I noticed a most unexpected and extraordinary change, which, like a ray of light, made clear to me the signification of the different zones above alluded to, and at the same time revealed to me a new kind of development, hitherto unknown to embryologists. On putting some flasks under the microscope, I was astonished to see that in one of them there was, besides two yolks revolving in the usual manner, a third body, that had quite a different motion, elongating and contracting spontaneously, sometimes advancing and sometimes retreating. (Fig. 22 *a.*) It was surrounded with ciliæ as the others, but had only two zones, the external one being wanting, and in the place of the crescent, there was seen a lanceolate spot, conforming in its longest diameter to that of the yolk. There were also observed in the flask several irregular fragments of yolk-like substance, which I had not noticed before, and which, judging from their appearance, could be nothing else than the remains of the external zone, which was no longer to be seen around this embryo, whilst it was distinct around the others.

How had this disengagement taken place? Was it the normal result of the development, or was it only accidental?

On turning my attention to the other two yolks, these questions were at once answered. Having compressed them so as to force them out from the flask, I saw distinctly the three zones above described, (fig. 25) ; but the external zone was separated from the next zone by an empty space, (*a*), and I could see distinctly that there was an internal motion and contraction quite independent of the revolving of the whole yolk. On looking more closely, I could see, farther, that the margin of the second zone was covered with very minute ciliæ, (*b*). From this moment I no longer doubted that this internal motion was made by the animal itself, and that the external zone was nothing but an envelop, which is cast off by the animal when it approaches the completion of its embryonic development. I saw it indeed burst under the pressure, and fragments of it fall off, as represented in fig. 26. In another instance I saw, and had the good fortune to show to several of my scientific friends in Boston, the embryo trying to escape from this envelop, (fig. 27), which it succeeded in doing after a while, and was then seen dragging after it the fragments of the external zone, as is represented in fig. 28.

The various zones are not only distinct in their external appearance, but moreover composed of very different tissues, as will be seen by fig. 31, representing, on a large scale, a transverse section of the embryo of fig. 27, according to the line *a b*. The outer zone, (*m*), which is rather dense, is composed of large cells, apparently irregular, but becoming spherical on being isolated, (*x*), each of them having a transparent centre. These cells are nothing but divisions of the yolk, as I have already described and figured them in fig. 16. It seems therefore that this part of the yolk has undergone no visible change since that epoch, except the appearance of ciliæ on its surface.

Within this outer coat we find an empty space, narrow, but nevertheless sufficiently large to allow the embryo to move. Inside of it is seen a transparent zone, (*n*), covered with ciliæ, this being the real body of the animal. It contains clear cells of different sizes, but all spherical and nucleolated. The margin of this part only is bordered with angular epithelial cells, to which are attached the ciliæ. Inside of this is another large mass of cells, (*o*), similar to those of the outside, being without doubt the residue of the vitellus destined for the support of the animal. When isolated, (*z*), they are spherical, and contain likewise a clear spot, which nevertheless is less distinct than in the cells of the outer coat, and is sometimes completely wanting.

As soon as the animal leaves its envelop, it moves with great ease in all directions, bending and contracting itself as it pleases. When elongated, (fig. 22 *a*), there is seen, as we have already stated, a longitudinal clear stripe, extending upwards from the inside yolk, (*c*). If the animal contracts itself, (fig. 24), this stripe becomes so much shorter as to appear transverse instead of longitudinal. This fact convinced me at once that this stripe was nothing more nor less than the crescent-like spot, formerly spoken of, in an elongated state, being *the first appearance of the alimentary canal.*

The animal moves with as much ease when taken out of the flask and placed in water as before, showing that the change of medium has no effect upon it. It appears perfectly master of its movements, and on seeing it swimming about, and striking against different objects, one might suppose it endowed with a certain amount of curiosity. Sometimes, also, I saw them shake themselves convulsively, as if they had a chill.

Commonly, the embryo does not leave the flask immediately after having freed itself from the envelop; on the contrary, it remains there sometimes for days. The changes which now take place, on about the thirtieth day, concern principally the internal parts. The residue of the yolk not only diminishes in volume, but becomes less and less opaque; the intestine likewise becomes more distinct; it assumes now the appearance of a proper tube, which extends from the vitellus to the upper part of the body, and is seen even to enter into the vitellus, (fig. 29.) A few days later, the yolk residue is nearly transparent; the part of the intestine seen in it generally appears bent; and, besides this, there is seen near the posterior extremity a large clear spot, which indicates probably the anus, (fig. 30.)

My observations were here brought to a close, it being impossible to pursue the further development of the young Nemertes, when escaped from the flasks, in consequence of their small size, and the difficulty of preserving them alive.

### RECAPITULATION.

The main point in these researches is the fact, that a large portion of the yolk is transformed into an envelop, which surrounds the embryo during the first phases of its existence, and which is then cast off by it when it becomes able to move by itself. This liberation of the embryo from the envelop must not be confounded with the casting off of a mere external membrane, like the shell membrane, or like the placenta of the mammalia. Indeed, the placenta, as we know, is formed of a combination of the chorion or vitelline membrane with the maternal organs. The envelop of which we speak is not the product of the vitelline membrane; it is an integral part of the yolk itself.[1]

The liberation from this envelop is by no means a substitute for the process of hatching, which takes place as regularly in the Nemertes as in any other animal. Indeed the embryo which throws off its envelop is not hatched by this process. We have shown, on the contrary, that it continues to remain for some time after its liberation in the common egg, which has been designated under the name of ***flask***, and it is only when leaving it, that we can consider it as hatched.

Consequently the presence of an envelop forming an

[1] One might be induced to compare this liberation from the envelop with the moulting of caterpillars; but it is to be remembered, that in moulting, it is the skin that is concerned; that is to say, a portion of the animal composed of organized tissue, whilst the envelop of the Nemertes has not yet arrived at this state, but seems to be merely yolk substance.

integral part of the vitellus, and being for a time the seat of a peculiar motion, should be considered as a peculiar evolution of animal life, which though unnoticed until now, deserves none the less to be taken into serious consideration.

Another point of no less importance is the existence of *two kinds of ciliary motion*, distinct from each other, and which, though simultaneous, are independent. While the vitelline sphere, as a whole, *revolves*, the embryo within is endowed with a peculiar motion performed by means of ciliæ, similar in their appearance to those of the envelop, and which continue the same motion after the animal is hatched. Therefore, there can be no doubt that this motion is a true *voluntary motion*. The ciliæ of the envelop in this respect are essentially different, and their motion may be considered as *merely organic*, similar in some respect to that of mucous membranes.

Ciliary motion ought therefore no longer to be considered as a peculiarity of certain classes of animals, neither ought we to look at it as being exclusively connected with certain functions. It is a general motive agency that nature adapts to all sorts of functions, particularly to locomotion among the lower animals, and also among many higher animals in the embryonic periods of their life.

## ON THE DEVELOPMENT OF POLYNOE.

Extraordinary as the development of Nemertes may appear, it is not without some analogies in other Worms. We would especially refer to *Polynöe squamata*, an Annelid very common on both shores of the Atlantic. To my friend M. Lovèn are due the first investigations of the development of these worms.[1] His observations have lately been completed by M. Sars, the distinguished Norwegian embryologist,

[1] Several specimens were exhibited by Prof. Agassiz before the American Academy, in this state.

who has taken up the history of these animals from the first period of their development,[1] showing that at the spawning season, the eggs fill nearly the whole cavity of the animal, being of a purplish tint, and showing distinctly the germinative vesicle. When laid, the eggs are found deposited under the scales of the back, where they are kept in place by an adhering membrane. There they pass through the first stages of their growth, namely, the subdivision of the yolk, which is followed by the first appearance of the germ, both of which take place in a very regular manner. After a while, ciliæ appear on the surface of the yolk, which enable the eggs to move by jerks. These ciliæ grow rapidly, while the embryo changes its color from pink to green. When they have arrived at this stage, the embryos leave their retreat simultaneously, and begin to swim freely in the water.

It is at this period that I found, last February, thousands of little green spots moving with great rapidity in a jar, where there were several Polynöe kept. Having examined them with the microscope, I was struck, like M. Sars, to see that they had not the least resemblance to their parents. They were small spherical bodies, surrounded with a ring of long threads, (fig. 36,) by means of which they spun round, all the time changing their places, sometimes starting in a straight line in one direction, sometimes describing parabolic lines, and then stopping short and spinning round like tops.[2] Sometimes also, instead of spinning on their own axes, they turned somersets, and then it was easy to perceive that the threads formed a regular ring, (fig. 37.) When the spheres spun around, I saw at the base of each thread an enlargement, which is simply a fold of the membrane to which the threads are attached, as is plainly shown in the enlarged sketch of fig. 39. The movement of the threads resembles that of a whip-lash, the middle part bending first.

I was surprised to find such rapid and extraordinary motion in the progeny of an Annelid, and though it appeared quite

[1] Wiegman, Archiv. 1836. [2] Wiegman, Archiv. 1846.

spontaneous, nevertheless it seemed to me different from the motion of any embryo with which I was acquainted. Their manner of moving was abrupt and jerking, somewhat unlike voluntary motion, but which reminded me strongly of the motion of the sporules of Confervæ, which I had formerly observed at Neuchatel, and described in the Proceedings of the Helvetian Society.[1]

The motion of the embryos seems to be incessant, as long as they have plenty of water to swim in, but the rapidity is variable.[2] On placing them on the glass so as to leave them nearly dry, I succeeded in stopping them for a moment. What was my astonishment when I saw that the two red spots, which are visible very early, (fig. 36), were not situated on the surface, but belonged to an embryo that was lodged inside of this moving sphere, (fig. 38), and had an independent motion. With the help of the two red spots I could easily ascertain the real position of the embryo. The next day the embryo was more defined, (fig. 40), and I could distinctly see it contracting itself inside of the sphere,[3] like the embryo of the Nemertes in its envelop.

The embryos remained in that state for several days, when I saw that their motions were more sluggish; some of them remained even motionless at the bottom of the vase. On examining them in that state, I found that the envelop was torn, the threads were hanging down, and there was a swelling like a large hernia projecting, (fig. 41.) I soon perceived that it was the embryo about to escape. This operation is not performed without some difficulty, if we may judge by the amount of time that is necessary for the embryo to disengage itself, (sometimes 5 and even 10 minutes.) It is worth notic-

[1] Actes de la Société Helvétique des Sciences Naturelles, 1838.

[2] M. Sars also saw the vitelline spheres move by means of their long threads, but as he did not distinguish the external envelop from the embryo in the interior, he considers these threads as belonging to the embryo itself, and compares them with the *cirrhi* that surround the head of the embryo in the Nudibranchiate mollusks, whereas the real ciliæ of the animal inside are considered by him as simple vibratile ciliæ.

ing that the embryo always escapes tail foremost, this being completely free, whilst the head and eyes are within the envelop, (fig. 42.) Around the embryo are seen opaque grains of yolk, which remain in the envelop when it is cast off, (fig. 43 *a*.) As soon as the embryo is completely free, (fig. 43), it begins to creep, but its motions are very sluggish when compared to those of the envelop.[1]

I could not succeed in prosecuting the inquiry farther, since the embryos fell a prey to a species of Infusoria (Leucophrys), which is very voracious, and was at that time very numerous.

CONCLUSION.

It follows, from the above statements, that the embryonic development of Polynöe agrees with that of the Nemertes in the very point we have considered as the most prominent, viz. the fact that there is an envelop which, after having for a time protected the progeny, and afforded to it the means of revolving, is cast off, thus allowing the embryo to become entirely free. And as this mode of development is quite different from that observed in the other classes of Articulata, especially the Insects and the Crabs, we may fairly expect that when more extensively investigated, the embryology of the worms will afford us the means of a better and more natural classification than that which is derived merely from the anatomy and external features of the full grown animal.[2]

This is not the place to discuss any of the general questions to which these investigations into the embryology of the lower animals give rise, if considered in a philosophical point of view, especially in regard to animal individuality. Hith-

[1] A somewhat similar development has been observed by M. Siebold in the embryology of an intestinal worm (*Monostomum mutabile.*) There the progeny, when hatched, is likewise surrounded by an envelop covered with ciliæ, (fig. 33,) by means of which it moves about. By-and-by this envelop is cast off, giving birth to a sluggish worm of a quite different appearance, (fig. 32 and 33.) But there is this difference, that the envelop seems to be more highly organized, having even eyes (*a*) that are thrown off with it.

[2] Thus we shall have occasion to show, in a future paper, that Planaria, which is generally ranked by the side of the Nemertes, is totally different in its embryology.

erto, independent motion has generally been considered as the strongest criterion of animal life, and in order to sustain this view, naturalists have attempted to establish various arbitrary distinctions between animal motion and that of certain seeds, especially the sporules of Confervæ. Now we have here vitelline spheres that move in a manner of their own, different from that of the animal within, and, as it seems, under the influence of a power quite independent of the control of the animal, though the means by which this motion is performed are similar, that is to say, by ciliæ, like those of the animal itself. We may, therefore, conclude that this is a motion, which, though dependent upon life, does not belong essentially to the individual.

The foregoing investigations were made in East Boston during the months of February and March, 1848, with a microscope belonging to Professor Agassiz, with whom I had the pleasure of discussing several of the results obtained. An abstract was communicated to the Boston Society of Natural History at the session of the 5th of July, 1848. To my friends, Dr. S. Cabot and Elliot Cabot, Esq., I am highly indebted for many valuable suggestions, and also for having had the kindness to revise the proof of this paper.

---

## EXPLANATION OF THE PLATES.

(*The magnifying power is* 50 *diameters when there is no higher power indicated.*)

PLATE I. FIG. 1. *Nemertes obscura.* Desor. Nat. size.

FIG. 2. String of eggs of Nemertes obscura. Nat. size.

FIG. 2. *a.* The same 10 times magnified, to show the disposition of the flasks.

FIG. 3. A single flask, with four yolks. 50 diam.

FIG. 4 and 5. Single yolks compressed, showing the oily liquid in form of a hernia, *a*, on the margin.

FIG. 6 and 7. The same yolks more compressed, so as to divide the herniæ into several small drops (*b*).

FIG. 8. Portion of a flask 400 times magnified, showing the cellular

structure of the yolk granules and the oil drop (*d*) inside, being isolated by pressure.

Fig. 9–12. The oil-drop isolated in various shapes, showing its elasticity.

Fig. 13. A flask on the third day, showing the beginning of the division, the oil-drop being still undivided.

Fig. 14. A flask 5 days old. The division is more advanced. When a yolk breaks (*b*), each division is an independent sphere, having a clear spot inside.

Fig. 15. A flask 7 days old. The division is still more advanced; the yolks are flattened at their points of contact. In one of them the primitive oil drop is preserved (*a*).

Fig. 16. A flask 9 days old. The yolks are so divided as to assume the mulberry form. One of them (*a*) is retarded in its development, showing merely the beginning of the division with the entire oil drop (*a*).

Fig. 17. A flask 12 days old. The embryos are surrounded with little cilia, by means of which they revolve.

Fig. 18. A flask 15 days old. The embryos have inside a clear crescentic spot, the first indication of the intestinal tube.

Fig. 19. One of the embryos compressed, showing that it is composed of two zones.

Fig. 20. A flask 18 days old. The difference of tissue is obvious in all the embryos.

Fig. 21. A single embryo from another flask of the same age, compressed, showing three distinct zones.

Plate II. Fig. 22. A flask 24 days old. The external envelop has fallen off in one of the embryos, allowing it to move freely in the flask.

Fig. 23. An embryo, after having escaped from the flask, in an expanded state, showing the crescentic spot (*c*) in an elongated form.

Fig. 24. The same embryo contracted.

Fig. 25. An embryo inside of its envelop, the cilia being distinctly visible inside.

Fig. 26. An embryo whose envelop is falling off.

Fig. 27. An embryo at the moment when it escapes from its envelop. (80 diam.)

Fig. 28. The same dragging its envelop after him. (80 diam.)

Fig. 29. An embryo 30 days old; showing the intestinal tube running along the body. (80 diam.)

Fig. 30. An embryo 34 days old. The intestinal tube is bent inside of the yolk residue, which becomes more and more transparent. (80 diam.)

Fig. 31. Section across the embryo of fig. 29, in order to show the structure of the different zones, (400 times magnified); *m*, external envelop;

*n*, body of the animal; *o*, the residue of the vitellus; *x*, single cell of the outer envelop; *z*, single cell of the yolk residue.

FIG. 32 – 35. Monostomum mutabile, after Siebold.

FIG. 32. The embryo enclosed in the egg; *a*, the external membrane of the egg; *b*, the envelop; *c*, the embryo inside; *d*, the eyes.

FIG. 33. The embryo surrounded by its envelop.

FIG. 34 and 35. The embryo, after having left the envelop 34, in profile; 35 in front.

FIG. 36 – 43. Embryos of Polynöe squamata, (50 times magnified.)

FIG. 36. The embryo immediately after being hatched; showing the ring of long cilia.

FIG. 37. The same seen in profile.

FIG. 38. An embryo of the second day after being hatched.

FIG. 39. Portions of an embryo, showing the form and the motion of the cilia (80 diam.)

FIG. 40. An embryo three days old.

FIG. 41. An embryo four days old, when ready to cast off the envelop.

FIG. 42. An embryo at the moment when it casts off its envelop.

FIG. 43. An embryo after having cast off the envelop.

FIG. 43. *a*. Remains of the envelop.

---

## ART. II. — *Descriptions and Figures of the Araneides of the United States.* By NICHOLAS MARCELLUS HENTZ, Tuscaloosa, Alabama.

[Continued from Vol. V. page 479.]

### Tribe IV. MAMMULOSÆ. *Abdomen with various projections.*

#### 31. EPEIRA ? PENTAGONA.

Plate III. Fig. 1.

*Description.* Varied with yellowish and whitish, marked with black spots; cephalothorax elongated, external eyes separated; abdomen with four tubercles; feet 1. 2. 4. 3., the first and second much the longest.

*Observations.* This may constitute the type of a new