THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

No. 58. OCTOBER 1882.

XXV.—*Embryogeny of the Bryozoa; an Attempt at a General Theory of their Development, founded upon the Study of their Metamorphoses.* By Dr. Jules Barrois *.

[Plate XIV.]

The present memoir is in continuation of my investigations upon the Escharina, already published †. All the great families of the Bryozoa have been in the same way subjected to observation from the point of view of the metamorphosis; and it is the general conclusions of these investigations that I now publish, in anticipation of the detailed memoirs which must follow that on the Escharina, and which will appear hereafter upon each of the families.

1. The documents published upon the development of the group Bryozoa have hitherto been completely silent upon an essential point of their embryogeny. We know well how the various free larvæ to which the egg gives birth are formed and developed, and we also know how, from the very simple stage which follows the destruction of these first states, the definitive cell is gradually fashioned; but all our knowledge proves

* Journal de l'Anatomie et de la Physiologie, 1882, pp. 1–34. Translated by W. S. Dallas, F.L.S., from a separate copy communicated by the author.

† Ann. Sci. Nat. 6e série, tome ix.

defective the moment we seek to approach the question of the relations of the larva to the adult form. In one word, we have precise documents upon the two extreme terms of the development; but between these two terms there exists a hiatus which no observer has succeeded in filling up.

From this it comes that, notwithstanding the minute investigations undertaken by many observers during the last few years, the embryogeny of the group Bryozoa has still remained in a comparatively backward state, at least as regards the conclusions. It is even still as impossible as at the beginning to apply our embryological knowledge to the appreciation of the adult organism. From not knowing the transition states which unite the two parts of the development, we still find it impossible to gather the fruit of the accomplished investigations.

Scarcely any of the observers of different periods but has been struck by the enormous importance of this particular point of embryogeny; and we find repeated attempts to get at a union of the two forms. As long ago as 1845 J. P. van Beneden tried to effect an approximation between the larva and the adult; next comes Smitt (1865), whose work is followed by a series of attempts made by Nitsche (1869), Metschnikoff (1869–71), Claparède (1871), Salensky (1874), and finally by Repiachoff and myself at the time of my memoir of 1877.

None of these various endeavours have been crowned with success; and we may even say that the most recent possess an entirely negative character: they assume that the larva becomes destroyed so as to be reduced to a sac in which we can detect nothing but a mass of globules in degenerescence—a stage entirely deprived of all trace of organs, and which would seem to render absolutely chimerical all hope of being able some day to follow the organs of the larva in their transformation into the definitive organs of the adult form.

2. It was at the laboratory of Concarneau, which is under the direction of MM. Robin and Pouchet, that, after many fruitless attempts, I for the first time succeeded in observing stages which have enabled me to fill up this gap, and to unite, organ by organ, a Bryozoan larva with its adult form. The first species with which I succeeded in attaining this result is *Lepralia unicornis*, which is abundant at Concarneau. The complete results of these first investigations have already been the subject of a special memoir published in the 'Annales des Sciences Naturelles' (sér. 6, tome ix.).

It is true that in the Chilostomata the larva in its transformations passes through stages in which the larval organs

are so much reduced and so little recognizable that one can understand how they should have hitherto escaped notice; but nevertheless there never exists a stage representing a *complete destruction of the organism*, leaving only the skin of the larva filled with globules of degenerescence. Such a barrier as this, absolutely separating the larva and the adult from one another, does not really exist at all; and what has led to the belief in it is the extreme simplicity of one of the intermediate stages of the metamorphosis, combined with the extreme rapidity of the transformation in the first stages after fixation: these characters, common to most metamorphoses, are exaggerated in the Bryozoa to a degree of which we possess few examples. Notwithstanding this, the passage from the larva to the adult may be followed in detail in the Bryozoa as completely as in the clearest cases, such as the Brachiopoda and the *Serpulæ*.

3. The possibility of the detailed investigation of the passage of the larva to the adult form being once demonstrated for a single species, it will be easily understood that I could not but desire to apply the experience acquired in my first researches to the study of the same stages in the principal groups, so as to construct from these new data a complete theory of the development in the whole class of the Bryozoa; and it is these new investigations, followed out since 1877 in different localities, of which I now give a brief exposition.

My subject naturally divides itself into three parts, viz.:—

The detailed study of a type of Entoprocta;

The detailed study of the types of Ectoprocta:—Escharina, Cellularina, Ctenostomata, Cyclostomata, Lophopoda;

Summary.

I. Entoprocta.

An Entoproct larva consists of:—

1. The *ectoderm*, divided into the oral and aboral surfaces,—the former flattened, margined by the ciliary circlet, and capable of sinking in to form the *vestibule*; the second much inflated, forming of itself nearly the whole of the skin of the larva, and capable of closing over the first-named.

2. The *digestive tube produced from the endoderm*. It possesses here a structure identical with that of the digestive tube of the adult animal, divided into œsophagus, rectum, and stomach; it is derived directly, except as regards its two branches of entrance and exit, from the endoderm of the gastrula.

3. An *organ superposed upon the mesodermic bands*. This organ, formed of two opposite lobes, is placed at the centre

of the oral surface and between the two orifices of the intestine, at the place occupied in the adult form by the cloaca with the incubatory sac. It is behind this organ that the cells representing the mesoderm are situated. This layer exists in the Entoprocta under the form of a special and well-defined trace, representing, as in so many instances, two kinds of germinal bands (*Keimstreifen*).

Accessory organs.—To omit nothing, we may further indicate two small appendages attached to the skin—one at the extremity of the body of the larva (caudal appendage), the other beneath the mouth on the aboral surface (subbuccal appendage); they are derived by gemmation from the two primitive layers. Certain authors ascribe very great importance to them; but they have none from a morphological point of view, and, in my opinion, they represent organs of sense belonging exclusively to the larval organism.

Metamorphosis *.

The phenomena are as simple as instructive, and differ much from what has been supposed.

The larva attaches itself by the *oral* pole; then we see the whole posterior portion of the vestibule (formed by the invaginated oral surface) gradually sink into the interior of the embryo.

This phenomenon is continued until the bottom of the vestibule (the whole of the portion which bears the apertures of the intestine), carrying with it the digestive tube, has changed its originally horizontal position for a vertical position (form *Loxosoma*) or a horizontal position in the opposite direction (form *Pedicellina*). During this movement the bottom of the vestibule becomes isolated and detaches itself gradually from its edges; and these become degenerescent to form globules, which for a moment fill the inner cavity of the peduncle. The circlet of cilia which formed the limit of these margins gives origin to the pedal gland.

In other words the essential portion of the vestibule quits its connexions with the oral surface, to enter into relations with the opposite surface, carrying with it the digestive tube. In this movement the posterior surface of the larva becomes the anterior surface of the adult, and the orientation becomes interverted.

While these two great phenomena (degenerescence of the inferior part of the vestibule and displacement of the superior,

* See 'Comptes Rendus,' June 27, 1881, p. 1527; 'Annals,' August 1881, p. 163.

carrying with it the digestive tube) are being effected, a narrow depression with thick lips is seen to originate towards the top of the anterior surface of the ectoderm ; this is what I call the *labial thickening*. This thickening advances to meet the polypide already formed in the interior, to constitute the aperture of the cell.

Thus these investigations confirm most of the broad homologies generally accepted between the two forms, the adult and the larva, in *Pedicellina*, which I reproduce in the following table :—

Digestive tube of the adult....	Digestive tube of the larva.
Intratentacular space	Vestibule.
Its median projection	Bilobed organ { Cloacal sac or pouch of the Ectoproct larvæ.
Ciliated canal opening into the cloaca (Hatschek)	Ciliated canal opening into the fissure.

On the other hand (and this is a most unexpected result) the *caudal appendage* does not at all correspond to the pedal gland of *Loxosoma*, and the different parts of the skin of the larva all have relations with the skin of the adult completely the reverse of what was supposed, since there has been in all a complete reversal, the top becoming the bottom and the anterior becoming the posterior surface.

Conclusion.—There is, in fact, a very complete passage of the organs of the larva to the organs of the adult; but this passage is not effected in a simple manner, and does not at all yield in complexity to the metamorphosis of the Ectoprocta ; in this respect there is no ground for maintaining the essential distinction that has been made between the two groups.

II. Escharina.

Larva.

The development commences, as in the Entoprocta, by the formation of a more or less epibolic gastrula, followed by the formation of two embryonic bands, each composed of three or four cells, and soon breaking up into not very distinct elements situated towards the oral surface.

1. *Ectoderm.*—The whole group of the Escharina is distinguished from the Entoprocta by an important character :—*The oral surface has lost the faculty of retracting itself to form a vestibule.* Further, we find that the cells of the circlet have greatly increased in the direction of the length, a change which becomes the source of many others.

Towards the aboral pole the cells rise up, carrying with

them a portion of the skin, so as to give origin to a circular fold formed by the cells of the circlet lined by a portion of the aboral surface. This fold forms a true *mantle*, which increases above the aboral surface, and finally covers it more or less completely.

This envelopment of the aboral surface by a *mantle* gives rise to the formation of a *pallial cavity*. In the Escharina the envelopment is never complete, and the extremity of the aboral surface, occupied by a special organ called the *hood*, always continues to project beyond this cavity. This hood, formed principally by a circle of radiating cells placed beneath the skin, is, in my opinion, by no means the homologue of the *caudal appendage* of the larvæ of the Entoprocta, but of the *labial thickening* which appears in the latter after fixation.

Towards the oral pole there is no elevation, and the sole effect of the elongation of the cells of the circlet is to reduce more and more the space at first occupied by the oral surface, which becomes depressed and becomes thinner in proportion. It is at first upon the anterior portion, furnished with the pyriform organ, that the whole reduction exclusively takes effect; it becomes slender, depressed, and thinner, and finally reduced to an elongated fissure edged on each side by the cells of the circlet.

Thus the oral surface is early divided into two distinct portions—a *free* portion of rounded form, and a *narrow portion enclosed in the circlet*. The former always coincides with the oral pole: it becomes reduced without interruption, to the profit of the second, in proportion as the encroachment of the circlet progresses; but in the Escharina it is still tolerably wide.

2. *Endoderm*.—The endoderm originating from the gastrula does not, as in the Entoprocta, give origin to a complete and well-formed digestive tube, but soon resolves itself into a compact mass of not very distinct elements—the *vitelline mass*, which for a long time occupies the interior of the embryo; in the larva we find it broken up into disseminated globules. We may regard the vitelline mass as representing the digestive tube, which is deficient in the larvæ of Entoprocta.

In a single species investigated by Repiachoff, the endoderm of the gastrula (formed, however, in the same manner as in the other larvæ of the group Ectoprocta) is seen to give origin to a complete digestive tube. This fact certainly possesses much interest, and places beyond dispute the homology that I have just indicated between the digestive tube of the

larvæ of Entoprocta and the vitelline mass of the larvæ of Ectoprocta.

3. Lastly, the cloacal sac of the Entoproct larvæ is here replaced by a kind of sac with very thick walls, similarly produced by an invagination of the exoderm, and placed near the centre of the oral surface. Very often a part of the wall of the sac rises up into a more or less elongated languette, which may be compared to the small pointed lobe placed at the side of the œsophagus in the Entoproct larvæ. In an *Alcyonidium* allied to *A. mytili* this languette becomes so long as to project beyond the aperture of the sac. In this state it may be compared to the small lobe of the Entoprocta, while the sac in which it is lodged would represent the great semicircular lobe bearing the anus, which, in the Entoprocta, already surrounds the small one.

These analogies are further comfirmed by the fact that in the larva of *Tendra zostericola* this sac, as in the Entoprocta, occupies the space included between the two branches of the intestine.

Accessory Organs.—1. Here again I must mention an elongated comma-shaped organ (*pyriform organ*), which occupies the front of the oral surface, and is composed of a small mass of glandular nature opening into the fissure of the anterior oral surface and surmounted by a group of radiating cells (those which serve as a base to the vibratile tuft). It has been supposed that in this organ we have the homologue of the *subbuccal appendage* of the Entoprocta. Following the ideas put forward by Hatschek with respect to *Pedicellina*, it has been regarded as a rudimentary bud, which would convert the Bryozoan larva into a compound form.

Upon this subject it will suffice for me to remark that the pyriform organ by no means occupies the same position as the *subbuccal appendage* of the Entoprocta: the latter is placed upon the *aboral surface*, *beneath* the mouth; the former is situated upon the *oral surface*, and *in front of* the buccal orifice. It would be well to name it the *prebuccal appendage*, in opposition to the name of *subbuccal*, which I apply to that of the Entoprocta.

According to my investigations, the *prebuccal appendage* of the Ectoproct larvæ disappears completely during the metamorphosis; and the same is the case with the *subbuccal* and *caudal* accessory organs of the larvæ of the Entoprocta. Hence I can only regard these accessory organs as belonging exclusively to the larval organism. The observation of facts by no means confirms the hypothetical views adopted with regard to them by the authors cited.

2. On the other hand, there exists in the Escharina a less apparent organ of great importance. Situated directly beneath the pyriform organ, this organ consists of two small ridges formed by simple thickenings of the skin. In the larvæ it easily escapes observation; and this explains why it has not hitherto been indicated. After fixation it is seen to increase to form a part of the adult organism; and it then becomes more easy to distinguish.

Metamorphosis.

In my memoir upon the metamorphosis of the Escharina I have already given a complete description of this, to which I may refer. I shall confine myself here to repeating the principal features.

1. *Fixation by the oral pole.*—The first phenomena of the metamorphosis consist in the devagination of the internal sac; the sac comes forth and becomes converted into a square lamina, by means of which the fixation is effected. Are we to say that for this reason we must regard the sac as being only an adhesive organ belonging truly to the larval organism? It would certainly be very rash to assert this; the function of securing the fixation may very well be performed by an organ originally destined to other uses and temporarily adapted to the function of a sucking-disk. In my opinion, the fact that I have just indicated proves nothing against the homology previously pointed out between the internal sac of the Escharine larvæ, the bilobate organ of the Entoproct larvæ, and the cloacal sac of the adult form.

However this may be, the oral surface is seen to sink down upon itself after the issue of the sac, so as to form a small more or less shrivelled tube which unites the adhesive lamina to the edge of the circlet.

2. *Reversal of the mantle.*—This fixation by the oral pole is accompanied, as in the Entoprocta, by a retreat of the vestibule into the interior of the embryo, but with a variation which depends solely upon the difference in structure of the larvæ.

In the Entoprocta the vestibule is fully formed, and its sinking into the interior of the embryo consequently does not necessitate any further change; but in the Escharina this is not the case. Here the aboral surface has lost the faculty of closing over the oral surface, and, further, the circlet has increased behind so as to surround the aboral surface with a kind of mantle, forming in this way a special cavity, playing the part of antagonist to the vestibule, and which I have called the *pallial cavity*.

We see therefore that the sinking of the oral surface into the interior of the embryo must here be preceded by a very important phenomenon, the *reversal of the mantle.* The larva suddenly quits the special arrangement which it affected among the Escharina, to revert to a form nearer that of the Entoprocta, and in which the aboral surface may again close over all the rest.

When the reversal of the mantle is effected the pallial cavity has completely disappeared; the larva then consists only of a simple sac entirely formed by the aboral surface, which has contracted around the edges of the adhesive lamina; in the interior is the cavity of the vestibule, margined by the circlet and the oral surface, the latter returning upon itself towards the centre, to be continued into a small tube which traverses the cavity of the vestibule and unites with the adhesive lamina.

3. *Formation of the polypide and of the opaque globules.*— The entire wall of the vestibule (including the circlet), the oral surface (including the prebuccal organ), and the upper part of the adhesive lamina are destined to fall into degenerescence, to form the thick mass of opaque globules which afterwards lines the whole base of the cell. The two small thickenings in the form of ridges situated towards the top of the vestibule in this stage alone escape the process of degenerescence; they increase while all the rest begins to be atrophied, and finally unite *above the vestibule* to form a single mass of increasing volume, and which afterwards passes towards the *superior and anterior* part of the future cell. At this point it meets with a second rudiment, originating from the invagination of the hood, and becomes confounded with it to form the polypide. In *Lepralia ciliata* the invagination of the hood gives origin to the whole of the internal epithelial layer of the polypide; the rudiment originating from the wall of the vestibule furnishes all that belongs to the external muscular layer.

It seems to me legitimate to see, in the two parts of the vestibule of the larvæ of Escharina (the rudiment which is detached from the upper portion, and the remainder of the wall destined to fall into degenerescence), parts corresponding to the two great divisions, *upper and lower*, of the vestibule of the Entoprocta, of which the former likewise forms the polypide, while the second breaks up into globules exactly comparable to the mass of globules of the young cells of the Escharina.

As to the invagination of the hood, I regard that as homo-

logous with the labial thickening of the Entoprocta. There is consequently a complete correspondence in all points.

Thus in the Entoprocta, as in the Ectoprocta, the polypide may be regarded as originating from the amalgamation of two distinct rudiments coming, one from the aboral surface of the larva, the other from the upper part of the vestibule of the larva, and which unite to form the polypide. In the Entoprocta the former (the labial thickening) is small, and gives origin only to the aperture of the cell, and the second, containing the entirely developed digestive tube, gives origin to nearly the whole of the polypide. In the Ectoprocta the reverse is the case: the former (the hood) is the more important, and it is this that forms nearly the whole of the polypide; the second is comparatively restricted, and gives origin only to the muscular connective parts of the future polypide. There is nothing very surprising in this variable intrusion of the two rudiments into one another; we have in the same way in the Tunicata an important portion, the *cloacal tubes*, placed at the boundary of the endoderm and ectoderm, and furnished sometimes by the one, sometimes by the other of those layers.

Lepralia Pallasiana.—In order to judge of the degree of constancy of the phenomena described in *Lepralia unicornis*, it will not be without interest to examine a second species of the same family before passing to other groups. The following are the results which I have obtained by the careful study of *Lepralia Pallasiana*, a species of the same family, but of a type very distinct from that of *L. unicornis*.

The sole differences that we could observe only commence at the close of the metamorphosis, at the moment when the skin removes from the internal organs to give rise to the square stage. We observe that in *Lepralia Pallasiana* the fatty mass, instead of retaining the horseshoe-shape more or less resembling that of the circlet, forms a square lamina, which surrounds the rudiment of the polypide. Moreover this rudiment, when once formed, does not separate again from the aggregation of globules with which it is in contact by its posterior part.

In *Lepralia unicornis* we have three stages:—

1. The two rudiments of the polypide unite so as to form a continuous cord from the aperture of the cell to the fatty mass.

2. They become concentrated into a small mass suspended from the skin.

3. The rudiment, definitively formed, has again become elongated as far as the fatty mass.

In *Lepralia Pallasiana* (and, I believe, in a good many other species) we pass directly from stage 1 to stage 3.

Such are the kinds of variations that we discover between the different types, when we do not go beyond the group Escharina. We will now pass to the more distant groups.

III. Cellularina (*Bugula avicularia*).

Larva.

The larvæ of the Cellularina belong to the same type as the larvæ of the Escharina; but in some species, such as *Bugula avicularia*, they differ therefrom by a greater elongation of the cells of the circlet. This elongation causes the *free portion* of the oral surface to be reduced to a degree of which we find no example among the Escharina; while the *enclosed* portion has acquired an extraordinary length, and occupies nearly the whole height of the young larva.

Moreover the skin of the larva, which in the Escharina may be regarded as composed half and half of each of the two surfaces (oral and aboral), is here formed chiefly by the circlet.

Metamorphosis.

Nevertheless the length of the cells of the circlet has not here any influence upon the metamorphosis, which takes place absolutely, as in the Escharina, by direct reversal of the mantle; it is necessary, however, to note particularly the peculiar form of the adhesive lamina and the aspect of the hood after fixation.

1. *Adhesive lamina.*—The adhesive lamina has no longer the same form that I have described in the Escharina. In the latter the internal sac of the larva contained two small symmetrical elevations, which, after fixation, only made more distinct the angles of the kind of lozenge formed at this period by the adhesive lamina; in the *Bugulæ* these two symmetrical elevations are replaced by a single more voluminous elevation, which fills nearly the whole cavity of the sac. After fixation this elevation forms a large mamilla at the bottom of the adhesive lamina, causing the latter to appear double, and formed of two superposed inflations, of which the inferior and smaller one originates from the interior projection of the sac, and the larger superior one from its wall.

2. *Hood.*—The hood, coloured by means of carmine, shows us, principally after fixation and very distinctly, its essential part composed of a circle of radiating cells situated beneath the skin of the aboral surface, and which I regard as the first

rudiment of the future polypide. It is here that I have seen most distinctly the superposition of the cells of the skin upon the circle formed by the radiating cells: the fact appears here so clearly as to cut short every doubt; and it is for this reason that I point it out.

3. *Of the second stage of the metamorphosis.*—The development appears to depart more from the type of the Escharina in the second stage of the metamorphosis at the period when the adhesive plate (composed of its two superposed inflations) becomes united with the skin of the aboral surface, to give origin to a *club-shaped stage*. We then see the whole of the hood sink into the interior in a very sudden fashion, and not gradually, as in the case of the Escharina; moreover it penetrates much more deeply than was seen in the preceding group. Before stopping, and even before reaching the opaque ring formed by the circlet, it traverses this ring, so that the rudiment of the polypide is soon situated beneath the ciliary circlet. Unfortunately I have not yet studied the changes which take place in the rudiment of the polypide during this passage across the ring formed by the cells of the circlet; it is probably at this moment that the phenomena take place which correspond to the meeting of the two rudiments which we have indicated in the Escharina.

It is not long after this club-shaped stage, in which the rudiment of the polypide is seen placed beneath the circlet and in the posterior part, that the cell begins to swell, to give origin to the stage described by authors. Here we fall in with known phenomena.

IV. Ctenostomata. (Pl. XIV. figs. 3 and 8.)

In the Ctenostomata, and especially in the species that I have taken as the type (*Serialaria lendigera*), the increase of the cells of the circlet is carried to the extreme point, and with it all the consequences which follow upon it. The cells of the circlet form ribs of great length, which occupy almost the whole surface of the larva; the oral surface is almost entirely *enclosed*; one of the two poles is occupied by an exceedingly reduced small hood, the other by a free portion of the oral surface reduced to quite rudimentary dimensions. Lastly, and this is especially the great fact characteristic of the larvæ of Ctenostomata, the internal sac is nearly atrophied; it no longer possesses an internal cavity, and is reduced to a small solid mass adherent to the inner surface of the residue of the oral surface.

Metamorphosis (fig. 8).

This latter character has a very great influence upon the metamorphosis of the larvæ of the Ctenostomata, inasmuch as the devagination of the sac observed in the Escharina and Cellularina is no longer met with, the whole being reduced to the reversal of the mantle.

Moreover the length of the cells of the circlet, which had no effect in the metamorphosis of the Cellularina, here has a great influence upon the course of the phenomena, and produces a kind of reversal of the mantle absolutely different from that we have seen, each of the large cells which constitute the circlet having to fold several times upon itself before penetrating to the interior of the embryo.

The phenomena in general occur as follows:—

The whole of the elongated band which, in the larva, forms the whole of the oral surface reduced by the circlet (that is to say, the free and rounded part which immediately surrounds the oral pole, together with the portion enclosed in the circlet), sinks into the interior of the embryo, producing a long fissure, over which the neighbouring parts close. These parts are here formed exclusively by the two symmetrical portions of the circlet which were included between the two free and enclosed divisions of the oral surface. When this last has buried itself in the interior, these two symmetrical prolongations of the circlet become inflated into two large lobes which bound the fissure and which are formed by the antero-inferior part of the cells of the circlet, the extremities of which are folded back upon themselves.

Here, in the absence of a special organ, it would seem that the rather sudden drawing back of the oral surface acts in the manner of a piston to produce fixation, which is effected by the projecting lobes which bound the median fissure above, and generally by their posterior part. The cavity V (fig. 8) to which this drawing back gives origin, and which is bounded by the two lobes in question, constitutes a first and important cavity concealed by the lobes L (fig. 8); it represents the vestibule here. A second cavity, peripheral to the lobes, is soon formed around the former one, and results from the reversal of the ciliary circlet which closes over the two lobes. This reversal does not take place at all in the same manner as in the larvæ of the Escharina and Cellularina: the cells of the circlet, instead of turning bodily, taking as their turning-point the line of junction with the oral surface, roll themselves up in their lower portion, in this way penetrating gradually into the embryo; while at the same time, at the upper part,

all the aboral surface unfolds itself in proportion, issuing by degrees from the pallial cavity. In other words, there is a gradual inrolling of the circlet inwards, accompanied by an unrolling of the aboral surface outwards; it is a peculiar kind of reversal of the mantle, which will terminate in the same results as the more sudden reversal of the Escharina, but by passing through absolutely different stages.

We see further that, in the Ctenostomata, the portion destined to break up into globules and formed chiefly by the cells of the circlet, will not, as in the Escharina and Cellularina, have the form of a hollow ring, a torus surrounding the whole cavity of the vestibule, but that it consists of two distinct parts, an *enveloping* portion and a portion *enveloped*, the latter alone enclosing the cavity of the vestibule. At first the enveloped portion really consists only of the two great lobes which bound the fissure of the oral surface; but later on, and in proportion as the enveloping portion increases by the rolling inwards of the great cells of the circlet, we see the portion of these same cells which has already penetrated to the interior and forms the bottom of the peripheral cavity, rolled up again, but in the opposite direction, so as to join themselves to the lobes of the centre, which in this way receive a great increase. Finally, the long ribs which formed the circlet become divided into two nearly equal parts—an enveloped part which is joined to the lobes, and an enveloping part formed by the upper parts of the circlet.

Thus all the cells of the ciliary circlet become folded upon themselves two or three times, giving the mass formed by their union a very complex aspect, which it is difficult to unravel.

At the close of this period of the metamorphosis the mass constituted by the whole of the invaginated circlet is situated towards the bottom of the cell, of which it occupies the posterior and inferior parts (retaining the same orientation as in the case of the larva); the entire embryo has the aspect of a rounded sac, not at all flattened as in the Escharina, but exceedingly uniform and nearly spherical; we can, however, still distinguish the point of closure of the aboral surface below, and the point occupied by the extremity of the hood.

It is in the space left free by the mass of the invaginated circlet—that is to say, in the *anterior* and *superior* portion of the embryo (orientation of the larva)—that the polypide will be formed. Unfortunately I have been unable here to investigate the important question of the origin of the polypide in the same detailed manner as in the Escharina; nevertheless I can establish an important point, namely that there is no

invagination comparable to the invagination of the hood of the Escharina and Cellularina. This is due, no doubt, to the very great reduction of this organ in the larva of the Ctenostomata—a reduction which continues during the first stage of the metamorphosis, so that at the moment when the circlet has penetrated into the interior we can scarcely indicate the position of the hood, which seems to have entirely disappeared.

Notwithstanding this, it has often seemed to me that, towards the superior posterior part of the mass of the circlet, at the place corresponding to the hood, there could be seen a cellular mass which I should be tempted to regard as proceeding from the cells which formed the central organ of the hood. This cellular mass seemed to me to form the essential part of the future rudiment of the polypide; nevertheless I have sometimes met with a second, smaller rudiment, forming, so to speak, a pendant to the former one, and situated at the inferior and anterior part of the aggregation of cells of the circlet. Perhaps we have here two parts comparable to the two rudiments described in the larvæ of Escharina. This part of my researches is still incomplete.

[To be continued.]

XXVI.—*Notice of a second Species of* Triprion.

By Dr. A. Günther, F.R.S.

Hr. Forrer, who has just returned from a collecting expedition in Central America, has brought with him three living specimens of a *Triprion*, which he found near Presidio, in Mexico, and which evidently belong to a species different from, and larger than, *T. petasatus*.

This species may be called *Triprion spatulatus*, having a longer and broader snout than *T. petasatus*; the bony ridges, especially the supraorbital and supratympanic ridges, and the canthus rostralis project in a much less degree; and the interorbital space is much less concave. The coloration is a uniform light olive, without any spots, changing in intensity of shade only; the upperside of the head is sometimes of a yellowish-bronze colour.

Other distinguishing characters may be found when the specimens are dead and more accessible to examination. At present, I may add only that the pupil is transversely oval when expanded, and subquadrangular when more contracted, but never vertical. It can be shut entirely.