

3. Observations upon an American Species of *Perichæta*, and upon some other Members of the Genus. By FRANK E. BEDDARD, M.A., Prosector to the Society.

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(Plates IV. & V.)

Some weeks since Mr. C. Bartlett brought me two living earthworms, which he had found in earth surrounding the roots of an orchid, received from South America. One of these was a very small example of a *Lumbricus*, which I have not yet identified; the other was a *Perichæta*, which is illustrated in the accompanying coloured sketch (Plate IV. fig. 1). There are so very few coloured figures extant of foreign earthworms<sup>1</sup> that I have considered it desirable to put on record the coloration of this species, which appears to be *P. indica*. The worm is remarkable for its extreme activity, as has been already noted by Baird (1) and by Perrier (18) in other species of *Perichæta*, studied in the living condition. Another curious characteristic of the worm is its method of progression; many *Oligochæta* seem to make use of the mouth in locomotion, attaching themselves firmly by it, while the following segments are moved forwards; in the present species a considerable portion (? the whole) of the buccal cavity is everted whenever the animal moves, so that the head has a remarkably leech-like aspect. I have attempted to illustrate the appearance of the anterior end of the body during locomotion in the accompanying drawings (Plate IV. figs. 2, 3). I never observed the worm in motion without this alternate eversion and inversion of the buccal cavity.

As will be seen, the colour of the worm is a rich brown, somewhat darker upon the clitellum, with a whitish line in the middle of each segment. The colour appears to be caused by at least two distinct pigments; one or more of these is dissolved out by alcohol, leaving the worm colourless, except for a dark bluish-brown area along the back (which resists the action of the spirit), and is recognizable in sections as black granules lying in the epidermis and in the circular muscular layer. I lay particular stress upon this fact, for the reason that in other specimens of *P. indica* (see no. 5), which I received from New Caledonia and which were sent to me *in alcohol*, the brown coloration and the whitish line in the middle of each segment are preserved. It is interesting to find that *P. indica*, which has been already recorded from the East Indies and from New Caledonia, occurs also in South America. There are not many species which have so wide a distribution; *P. affinis*, *P. houlleti*, and *Urochæta corethrurus*, however, are forms which inhabit the tropics of both the

<sup>1</sup> The only coloured figures known to me (taken from life) are several of *Perichæta* and *Hypogæon* by Schmarda (20), and of *Microchæta rappii* in a paper by myself upon the anatomy of this worm (3); Schmarda's figures lose some of their value from the fact that they are not accompanied by any description of the internal characters, and cannot, therefore, be easily identified.



Old and New World, while *Eudrilus* has been recorded from South America and the West Indies and from New Caledonia, and it also occurs in New Zealand.

I take this opportunity to put together a few notes upon other species of *Perichæta*.

*Proposed Subdivisions of the Genus Perichæta, Schmarda.*

The genus was instituted by Schmarda (20), who, however, only directed attention to the numerous setæ forming a row round the middle of each segment, and to the form of these setæ. Vaillant (22) subsequently described the internal anatomy of *Perichæta*, and pointed out the important differences which distinguish the type from *Lumbricus*. In the next year Baird (1) called attention to the identity of this genus with *Megascolex*, which was described by Templeton (21) twenty years before the publication of Schmarda's work. The reason which, apparently, caused these two genera to be regarded as distinct was a misunderstanding of Templeton's original description. I have directed attention myself (2) to the fact that both Schmarda and Vaillant misquoted Templeton's original description, making him responsible for the statement that setæ are *only* present on the dorsal surface of the body of *Megascolex*; Templeton himself defined the species as having "each ring in the middle of its length dilated into a ridge, which carries on it, *except in the mesial line of the back*, minute conical mamillæ, 100 in number, each surmounted with a minute bristle." These inaccuracies on the part of Schmarda and of Vaillant have been also pointed out by Horst in a paper published (15) about the same time as my own.

Perrier, in his most important paper (18) upon the anatomy of Earthworms, retains, in spite of Baird, Schmarda's name of *Perichæta*; but the value of his opinion in the matter is greatly discounted by the fact that, like his predecessors, he entirely misunderstood and misquoted Templeton's description of *Megascolex cæruleus*, probably taking his information from Schmarda, Vaillant, or Grube.

The synonymy of the genus was, I regret to say, somewhat confused by my own paper (2) upon a large Ceylon worm, which I described under the name of "*Pleurochæta moseleyi*." I was led to describe this form, which I afterwards (4) recognized as identical with Templeton's *Megascolex cæruleus*, as belonging to a new genus, on account of the inaccuracy and incompleteness of Templeton's description. In a subsequent paper (8), dealing partly with the nomenclature of the genus, I proposed to retain the name *Megascolex* for "those worms which are characterized by (1) the presence of a continuous ring of setæ upon the segments of the body, (2) the possession of a clitellum occupying segments 14-16 inclusive, (3) the position of the two male generative apertures upon the eighteenth segment behind the clitellum . . . .; while the name *Perichæta* might be applied to certain other forms which present a fundamental resemblance to the above-mentioned groups, but differ



in one or both of the following characters:—(1) in the ring of setæ upon each segment being discontinuous at one or more points; (2) in the clitellum occupying more or fewer segments of the body than three."

Rosa has lately pointed out (24) that my distinctions are valid, but that the names should be reversed. I am now quite prepared to agree with him; at the time when I wrote I was inclined to consider that Templeton's *Megascolex* was identical with *Perichæta*, even to the extent of having a *continuous* circle of setæ in each segment, inasmuch as Baird (1), who had examined the type in the British Museum, stated that he could find no difference between it and *Perichæta*. Taking for granted the accuracy of Baird's observations, it appeared to me necessary to use the name *Megascolex* for the worms which Schmarda termed *Perichæta*; strictly speaking I should have allowed the name *Perichæta* to drop, but it was proposed to retain it for *perichæteous* worms with a dorsal and ventral interrupted line &c.

When I discovered (4) that my *Pleurochæta* was identical with Templeton's *Megascolex cæruleus*, it seemed necessary to restrict the generic name to that form, and to group all the other known *perichæteous* forms under the genus *Perichæta*; it will be seen that the definition of *Perichæta* appended to that paper includes such forms as *P. armata*, though I omitted to state in so many words that it was proposed to drop the generic distinction between *Megascolex affinis* and *Perichæta armata*, since the differences between *Megascolex cæruleus* and any other *perichæteous* worm are rather more important than those which differentiate the latter species among themselves.

Rosa (24) has, as already stated, proposed to divide *Megascolex* from *Perichæta* by the distribution of the setæ and the presence or absence of intestinal cæca; the genera are thus defined by him:—

*Megascolex*. Line of setæ interrupted; no intestinal cæca.

*Perichæta*. Line of setæ continuous; intestinal cæca present.

Fletcher (17, III.) has proposed a similar division, but also (17, II.) has pointed out that in the typical *Perichæta*, with continuous row of setæ and cæca, the gizzard is situated further back than in *Megascolex* and occupies two segments, the mesentery between them having vanished<sup>1</sup>.

This distinction, although it applies to so large a number of species, falls to the ground before the Indian species described by Prof. Bourne<sup>2</sup>; *Perichæta hulikalensis* (Bourne, 11. p. 668) has dorsal and ventral gaps, but possesses intestinal cæca in the usual position.

<sup>1</sup> I had previously directed (6) attention to this difference between certain species of *Perichæta*, though mistaken in supposing that in *P. newcombei* the gizzard occupied three segments; I have since convinced myself the gizzard is really in segment 6; in any case this species does not fit in very accurately with the proposed subdivision of *Perichæta*.

<sup>2</sup> This paper was overlooked by Rosa, as he mentions in a postscript (24. p. 11).



If Rosa's definition of the two genera be slightly altered, it will be possible to arrange most of the species of "*Perichæta*" as follows:—

MEGASCOLEX. Line of setæ interrupted; clitellum occupying more than three segments.

PERICHÆTA. Line of setæ continuous; clitellum consisting of three segments only.

There are, however, other species which present more important differences among themselves than those above mentioned. Prof. Bourne (11) calls attention to the fact that there are anatomical differences, to which considerable weight must be attached, between several of the forms described by him.

*Perichæta novæ zelandiæ* (Beddard, 7) differs from all other species in the following combination of characters:—No dorsal pores; nephridia paired; atria tubular.

*P. bakeri* and *P. barronensis* of Fletcher agree in their nephridia and atria, but have dorsal pores.

A number of species described by Fletcher (17), viz. *P. attenuata*, *P. enormis*, and *P. coxii*, agree to differ from others in the very remarkable fact that the setæ in the anterior segments are eight in number to each segment, increasing in the posterior segments to 20-30.

In both these cases the different geographical area occupied by the species is, perhaps, a further argument in favour of separating them.

Then *Perichæta stuarti* has four pairs of atria, as in *Acanthodrilus*; they open on to the same segments as in that genus, and appear to be similar in structure; the diverticula of the spermatheca also appear, from Bourne's description (11. p. 667), to be more like those of *Acanthodrilus* than of most *Perichæta*. *P. ceylonica* (Beddard, 9) has two distinct pairs of atria, but they open both of them on to the same segment, the 18th; at present I am not inclined either definitely to unite this form, generically, with *P. stuarti*, or definitely to separate it; further information as to its structure is first needed.

If these various types be accepted by zoologists as of generic value, it must still be admitted that they cut off very small corners from the mass of species (about sixty in number) of which the family consists. At present, however, it does not seem easy to make any further alterations, and I am not satisfied that *Megascolex* has the same value, as a generic type, that *Aporochaeta* has.

The following is a definition of the family Perichætidæ and its various genera as advocated in this paper.

#### Fam. PERICHÆTIDÆ, Claus.

Earthworms with a continuous circle of numerous setæ round all the segments of the body (with the occasional exception of a few of the most anterior); clitellum commencing with the thirteenth or



fourteenth, and extending over three to six segments. Gizzard always present and single; intestines frequently provided with a pair of conical cæca. Nephridia generally diffuse. Spermathecæ nearly always<sup>1</sup> furnished with one or more diverticula; atria (prostates) always present, and sometimes penial setæ.

(1) Genus *PERICHÆTA*, Schmarda.

Setæ numerous, and forming a continuous or nearly continuous row round all the segments of the body<sup>2</sup>. Nephridia diffuse, with many external pores in each segment. Atria (prostates) branched and lobate. Dorsal pores present (? always). Penial setæ sometimes present.

*Distribution.* World-wide, especially tropics of Old World and Australia.

Subg. 1. *PERICHÆTA* (Beddard).—Line of setæ continuous; clitellum consisting of 3 segments only (14–16). One or more pairs of intestinal cæca. Gizzard posterior to 7th segment, occupying 2 segments, the septum between which has disappeared.

Subg. 2. *MEGASCOLEX*<sup>3</sup> (Beddard).—Line of setæ interrupted; clitellum occupying more than 3 segments. Cæca generally absent. Gizzard usually situated in, or in front of, segment 7; occupying only one segment.

(2) Genus *PERIONYX*, Perrier.

Setæ forming a continuous row round each segment; generative pores closely approximated in middle ventral line; atria (prostates) lobate; nephridia paired; dorsal pores present.

*Distribution.* India and Burmah.

(3) Genus *DIPORCHÆTA*, gen. nov.

Setæ forming a continuous row round each segment; atria tubular; nephridia paired.

(For *P. novæ zelandiæ* and perhaps *P. bakeri*.)

*Distribution.* Australia and New Zealand.

(4) Genus *ANISOCHÆTA*, gen. nov.

Setæ 8 in number per segment anteriorly, afterwards increasing up to 30; nephridia diffuse; atria lobate.

(For *P. attenuata*, *P. enormis*, and *P. coxii*.)

*Distribution.* Australia.

<sup>1</sup> The only exception appears to be *Megascolex cæruleus*; but this matter requires reexamination.

<sup>2</sup> Except of course the peristomial segment.

<sup>3</sup> N.B.—These divisions will not do unless Prof. Bourne finds, as he has thought possible, that such species as *P. burliarensis* and *P. hulikalensis* should be separated as distinct genera.



## (5) Genus HOPLOCHÆTA, gen. nov.

Setæ forming a continuous row round each segment ; atria tubular, two pairs opening on to segments 17 and 19.

(For *P. stuarti*, Bourne.)

*Distribution.* India.

## PERICHÆTA INDICA (Horst).

'Eine *Perichæta* von Java,' Horst, Nederl. Arch. f. Zool. iv. p. 3.

*Megascolex indicus*, Horst, Notes Leyden Mus. vol. v. p. 186.

*Perichæta indica*, Beddard, Proc. Zool. Soc. 1886, p. 298 ; Horst, Midden-Sumatra, Vermes, p. 4.

This species is already pretty well known, and I have not much to add to our knowledge of it beyond the appearance of the living worm, which has been already described (p. 52) and which is illustrated in the accompanying coloured drawing (Plate IV. fig. 1). Horst remarks (15. p. 189) that probably some of the specimens of *P. cingulata* described by Vaillant (22) are identical with this species ; Perrier has suggested that several species are included under the name of *P. cingulata*. In view of these difficulties it seems to be reasonable to adopt Horst's name of *P. indica* and to drop the name of *P. cingulata* altogether.

On the first few segments of the body there are two specially large and distinct pairs of setæ, situated at almost equidistant intervals on the ventral side of the body. I did not refer to them in my earlier paper upon *P. indica* ; the condition of the setæ is a step in the direction of those very remarkable Perichætous worms described by Mr. Fletcher, which I have ventured to include in a distinct genus. These facts have an important bearing upon the general question of

*The Distribution of the Setæ in Chætopods.*

The paired setæ of *Lumbricus* and other Oligochæta are usually compared to the parapodia of the marine Chætopods ; and it has been supposed that four distinct parapodia and four pairs of setæ represent the typical arrangement of the locomotor organs of these two divisions of the Chætopoda. Deviations from this arrangement, the extremes of which are shown in the Capitellidæ and in the genera *Perichæta* and *Perionyx*, are regarded by perhaps the majority of naturalists as secondary modifications. There is, however, a certain amount of evidence which seems to point the other way, indicating that the complete circle of setæ, which characterizes the family Perichætidae, is the primitive arrangement ; in this case the paired setæ of *Lumbricus*, *Acanthodrilus*, &c., will be due to reduction, and the comparison with the four seta-bundles of Polychæta will fall to the ground. Among Polychæta the nearest approach to the Perichætous condition is found in the Capitellidæ ; but Eisig (13) argues with considerable force against regarding the almost continuous circle of setæ found in some Capitellids as the primitive



condition. The summary which Eisig gives of our knowledge respecting the structure and development of the parapodia and their setæ in other Polychæta does not permit of a decisive answer as to the original condition of these organs; the "diplostichous biremal" form may have been evolved from a "monostichous uniremal," or the reverse. The former alternative is more in accord than the latter with the derivation from a continuous circle of setæ.

Among the Oligochæta there is more evidence; and this seems to favour the supposition that the continuous circle of setæ is the archaic condition.

(1) The continuous circle of setæ characterizes the genera *Perichæta* and *Perionyx*; of these the former is the most widely distributed and the most abundant of all Earthworms. There are more species of *Perichæta* than of any other two genera; that is, of course, well described species. There is, moreover, a large amount of structural variation in the species of this genus; so much so, that were it not for the fact of the agreement among the species in the very striking character of the setæ, they would probably have been more subdivided into genera; this I have attempted to do. Such forms as *P. intermedia*, *P. stuarti*, *P. ceylonica*, and *P. affinis* differ from each other quite as much as do such genera as *Urochæta*, *Diachæta*, and *Urobenus*. Accordingly when the existence of some 18 or 20 genera possessing only 8 setæ in each segment is contrasted with the two genera above-named as an argument in favour of the more prevalent "biremal" condition, it must be discounted by these considerations. Even with regard to the number of species, *Perichæta* and *Perionyx* are probably not far behind the remaining genera of Earthworms taken together, though it is difficult to make an estimate<sup>1</sup>.

(2) The Perichætidæ show in many respects a type of structure which is less specialized and more primitive than that of other Earthworms. The continuous network of nephridia with numerous irregularly disposed internal and external apertures is, so far as our knowledge goes, confined to that genus and found in nearly all its species. In other genera which have a diffuse nephridial system (*Megascolides*, *Typhæus*, some species of *Acanthodrilus*, and *Cryptodrilus*, *Deinodrilus*, *Trigaster*, and *Dichogaster*) there appears to be generally some modification—such as loss of funnels, specialization of part of nephridial network, restriction of network to segments, &c.—which can be best explained on the hypothesis that it has been derived from a condition like that of *Perichæta*.

(3) In most (? all) Perichætidæ the buccal lobe does not divide the buccal segment; this appears from the nature of the case to be a primitive condition. Most *Perichæta* have dorsal pores, the presence of which may fairly be regarded as typical for the terrestrial Oligochæta: it is worthy of note that some forms, in which these pores are absent, show signs of degeneration; for example the absence of dorsal pores in *Acanthodrilus georgianus* and in *Pontodrilus* is correlated with

<sup>1</sup> About 60 species of *Perichæta* to about 120 of other genera; but the differences between individual species of *Lumbricus* and *Allolobophora* (comprising 50 out of the 120) are often very small.



the feeble development of the gizzard. The subnervian vessel, commonly believed to be absent from *Perichæta*, is found, at least in some species. The reproductive organs, although not presenting any specially archaic characters, are not at any rate more modified than those of other Earthworms. In short it cannot be urged that the organization of the Perichætidæ, as a whole, is opposed to the view that these are the most primitive Oligochæta; while the structure of the excretory system in my opinion favours the supposition.

(4) The most striking evidence, however, in favour of the derivation of the paired arrangement by a gradual reduction of a continuous circle of setæ, is afforded by the structure of *Deinodrilus*. This genus is a native of New Zealand, and is in many respects intermediate between *Perichæta* and *Acanthodrilus*. It is at present the only Oligochæte known which possesses *more than 8 setæ in each segment*<sup>1</sup> and yet has not the continuous circle of setæ of *Perichæta*. *Deinodrilus* has 12 setæ in each segment, disposed at approximately equidistant intervals; it therefore furnishes a connecting link between the continuous circle of setæ and the paired setæ. *Deinodrilus* has diffuse nephridia, more like those of certain species of *Acanthodrilus* than those of *Perichæta*; the nephridia of a few of the anterior segments are more concentrated, as also are the corresponding nephridia of *Trigaster lankesteri* (Benham),\* a species which, in the opinion of Horst, should be referred to the genus *Acanthodrilus*, and which is at any rate closely allied to that genus; this concentration reaches its extreme in *A. multiporus*, where the nephridia of these segments are metamorphosed into a gland opening into the buccal cavity. The reproductive organs are exactly like those of *Acanthodrilus*, but the clitellum, which occupies segments 14–16, and is developed continuously round the body, is like that of *Perichæta*. There is, therefore, a strong case for believing that *Deinodrilus* represents a stage in the evolution of *Acanthodrilus* from *Perichæta*, or of *Perichæta* from *Acanthodrilus*. The question is, which of these two alternatives is the more probable? The species of *Acanthodrilus* which come nearest to *Deinodrilus* are evidently those which have a diffuse nephridial system, i. e. *A. multiporus*, *beddardi*, *schlegelii*, *büttikoferi*, and *antarcticus*; all these species furthermore agree with *Deinodrilus* in having an incomplete prostomium (not dividing buccal lobe) and dorsal pores, while the first and last have the persistent double dorsal vessel of *Deinodrilus*. The species which are furthest away from *Deinodrilus* are such forms as *A. dissimilis*, where the prostomium completely divides the buccal segment, the nephridia are paired, and the dorsal pores have commenced to disappear. These extremes are connected by *A. annectens*, which has the incomplete prostomium and paired nephridia, but the anterior pair of nephridia are much specialized and open into the buccal cavity, as in *A. multiporus*. There are, moreover, other intermediate forms. The question is really intimately connected with the development of the nephridia; if the

<sup>1</sup> The statement that *Hypogæon* has 9 setæ in each segment requires verification.



presence of a single pair of these organs in each segment is the archaic condition, then *Perichæta* will be a modification of *Acanthodrilus*; but this view is confronted with two serious difficulties—(1) the apparent specialization of a part of the nephridial network to form a series of paired nephridia in *Megascolex armata* and in *Megascolides australis* (Spencer) will require explanation; and (2) the connection of the vasa deferentia with the atria (=prostates) will have to be regarded as having been derived from a condition in which these organs are independent of each other (*Acanthodrilus*). These structural peculiarities are capable of an intelligible explanation if we assume that *Deinodrilus* is an intermediate stage in the evolution of *Acanthodrilus* from *Perichæta*.

The remarkable arrangement of the setæ in certain Australian *Perichætæ*, which I have in the present paper associated together in the genus *Anisochæta*, and the commencing reduction of the setæ in *P. indica* must be considered in relation to this question. It is noteworthy that in these cases it is the anterior segments only which differ from the posterior in the reduction of the setæ. The formation of a "head" is also brought about by specialization in the alimentary and excretory systems, and by a partial obliteration of the cœlom and loss of internal segmentation. These facts tend to show that the reduction in the number of the setæ is also secondary; and this reduction is very general in *Perichætidae*, though not anywhere so apparent as in *Anisochæta*. It is true that, as Perrier first pointed out, the hindermost segments of *Perichæta* may also show a reduction in the number of setæ; but this fact may be in accord with the views here advocated, inasmuch as the nephridial system in *Megascolides* begins to be specialized in the posterior region of the body. I would, however, rather insist upon the increase in length produced by the addition of new segments at the end of the body, and explain the few setæ of these segments as due to their recent formation and consequent imperfect development.

If we were acquainted with a species of *Lumbricus* in which the anterior segments were provided with a larger number of setæ than ordinarily, it would certainly be set down to "cephalization;" there is therefore nothing unreasonable in regarding the converse change, which actually occurs, as due to the same cause. These facts, therefore, are at least not contrary to the assumption that the "*perichætos*" condition is the more primitive. Among the species of *Anisochæta* which show the reduction to 8 setæ per segment, some have more segments modified in this way than others; there is, therefore, evidence of a gradual change in this direction which lends more weight to the arguments here advanced than if all were modified to exactly the same extent. In the latter case the facts could be referred only to a modification affecting the "head" and comparable for example to the loss of the setæ in some of the first few segments in *Chaetogaster*; as it is the facts appear to point to a gradually advancing reduction of the setæ commencing in the most modified region of the body.



*Nephridia.*

In describing the remarkable nephridia of a New-World *Perichæta*, *P. aspergillum* (10), I pointed out that probably all *Perichætæ* with irregular diffuse nephridial tufts—that is to say, all the species belonging to *Perichæta*, *Anisochæta*, and *Megascolex*, as these genera are defined in the present paper,—would prove to possess a nephridial system of the same kind as that which characterizes *P. aspergillum*. The pores upon the cuticle often render it possible to predict of a given Earthworm that the nephridia will be found to be dysmetameric; after finding upon the cuticle of *P. houlleti* numerous pores which could be referred to no other known structure than to the apertures of nephridia, I ventured to predict that this species would be found to agree in all essentials of its excretory system with *P. aspergillum*. Unfortunately I have not been able to put this prediction to the proof, as the specimens of *P. houlleti* which I have are not in a sufficiently good state of preservation for sectionizing. The specimen of *P. indica*, however, I carefully preserved, and the examination of transverse, and particularly of longitudinal, sections shows that it agrees with *P. aspergillum* in the minute structure and in the relations of the nephridia. A dissection of the worm shows that the nephridia do not present the regular paired condition of such forms as *Lumbricus*; they are represented only by minute tufts attached to the ventral body-wall, especially to both sides of the intersegmental septa. This condition of the nephridia would lead to the assumption that a microscopic investigation of the nephridia would prove the presence of numerous irregularly-disposed external pores and cœlomic funnels. I made a number of longitudinal sections in the hinder region of the body, and found that the nephridial tubes were in places perfectly continuous from segment to segment through the septa; the external pores also had that irregular arrangement of a large number of pores per segment which is apparently to be now regarded as a very prevalent condition among Earthworms.

*Spermathecae.*

The structure of the spermathecae is illustrated in the accompanying figures (Plate V. figs. 4, 5, 6, 8). As appears to be always the case in Earthworms, the diverticula have a different histological structure from the pouch. The epithelium lining the pouch (see fig. 6) is tall and columnar. In the diverticulum, on the other hand, the structure not only differs from that of the pouch itself, but also from that of the diverticula of other species of *Perichæta*; but these differences are very possibly due to immaturity in the present specimen. The diverticulum was filled (see fig. 5) with a perfectly homogeneous fluid, slightly stained by the colouring reagent used; the epithelium lining the pouch was formed of very low cells, not in the least columnar, and hardly to be distinguished from the muscular fibres which make up the very thin walls.

*Glycogenic Organs.*

*Perichæta indica* is furnished with a series of curious glandular-



looking bodies in most of the posterior segments of the body; these are attached, close to the middle line on either side of the dorsal vessel, to the posterior side of the septa. They were perfectly recognizable both in transverse and longitudinal sections, though naturally their relations to the septum were better shown by the latter, their position with reference to the dorsal vascular trunk by the former series of sections.

Structurally these small white bodies consist of a mass of cells continuous with the peritoneal epithelium and probably formed by a local proliferation of its cells; in the interior of each were a few muscular fibres; there was no trace whatever of a central cavity, which occurs in the corresponding bodies of the allied genus *Acanthodrilus*. These "septal glands" were in *Perichæta indica* solid throughout.

As to *Acanthodrilus* the observations recorded in this paper were made upon some examples of *Acanthodrilus georgianus* (Michaelson, 26), which were collected for me in the Falkland Islands by Dr. Dale, at the request of Mr. Coleman, Secretary to the Falkland Islands Company.

This worm differs from all other species of the genus, which I have examined, in possessing a series of sac-like organs connected with the septa. These have the appearance of white solid bodies attached to the septum close to the nephridium—a pair to each segment; they commence at about the 20th segment and continue to the end of the body; the first three or four pairs are commonly larger than the rest. These organs are not really solid bodies, but sac-like outgrowths of the septa depending freely into the interior of the segments; they are, in fact, exactly similar to the sperm-sacs and egg-sacs of the same and other Earthworms in their early stages of development; and their absence in the anterior segments of the body, where the sperm-sacs and egg-sacs are found, may possibly be due to their homology with those structures.

Each sac has a somewhat racemose appearance owing to the irregular bulging of its walls; the walls are muscular with a thick coating of peritoneal cells, which are larger and more numerous than those on the adjoining surface of the septum; the interior of the sac has a delicate lining of peritoneum and communicates with the segment in front by a pore.

The only structures with which I can compare these septal sacs are the oval aggregations of peritoneal cells described by Claparède (26) in the common Earthworm. Claparède figures and describes these bodies as consisting of a mass of peritoneal cells enclosing a few muscular fibres; the presence of muscles suggests that the bodies may really be sacs, and not solid proliferations of the peritoneum. Vejdovsky (29) has recorded the presence of similar sacs in *Rhynchelmis* and in *Tubifex*; but inasmuch as in *Tubifex* they were only found in a few cases and in the posterior younger segments, Vejdovsky regards them as connected with the growth of the septa.

In *Acanthodrilus georgianus*, as already mentioned, they commence in the anterior region of the body; and as they were found



in both specimens (sexually mature) dissected, the probability is that they are definite organs and not temporary outgrowths of the septum caused by its rapid development.

The cells covering the septal sacs, when these organs were treated with a weak solution of iodine in potassium iodide, were stained a deep mahogany-brown. This colour disappeared on warming the slide and reappeared on cooling; it seems therefore to be due to the presence of glycogen.

Glycogen was first discovered in the tissues of the Earthworms by Claude Bernard, and its presence in that animal has been lately reaffirmed by Barfurth (30). The last-mentioned author particularly states that it occurs in the muscular tissue. As far as concerns the muscles of the septa, I do not find myself able to agree with Barfurth. In preparations of the septal sacs it was distinctly the peritoneal cells and *not* the muscular tissue which showed the glycogen reaction; the muscles were stained *yellow*; and this colour did not disappear on warming, unless the tissue was exposed for some time to a temperature of 60° C., when the colour disappeared but did not return on cooling.

The glycogen reaction was not confined to the peritoneal cells covering the septal sacs, but was found also in the peritoneal cells covering the surface of the septum and elsewhere.

The large size of the peritoneal cells upon the septal sacs and their abundant granular contents, combined with their very dark staining, seems, however, to indicate that these cells are specially concerned with the formation of glycogen. The septal gland is so far analogous with the vertebrate liver in that it "has more glycogen than other organs; it is not an organ *sui generis*, but only *primus inter pares*" (Barfurth).

The formation of glycogen in the peritoneal cells is interesting, since in the Mollusca the formation of this substance has been shown by Blundstone (31) to occur in the "vesicular connective tissue," which is apparently the lining membrane of the much reduced cœlom of these animals.

I may take this opportunity of mentioning that I have found glycogen in the peritoneal cells of *Æolosoma*, in which worm the presence of glycogen has never yet been recorded.

#### PERICHÆTA BISERIALIS, E. P.<sup>1</sup>

*Perichæta biserialis*, Perrier, C. R. t. lxxxii. (1875), p. 1043.

Some years ago I received from Manila, through the kindness of Mr. H. E. Barwell, several species of a *Perichæta* which I refer with some little doubt to the above-named species. M. Perrier has as yet only given a very short preliminary account of this species, which cannot be regarded as sufficiently defined.

The most marked external characters are the peculiar ventral

<sup>1</sup> M. Vaillant (23 A) proposes subgeneric rank for this species under the name of *Perriera*, on the grounds that there is a median and ventral line devoid of setæ. *P. luzonica* is referred to the same subgenus. I have already (53) discussed this question; but these species are *not* the only two with ventral gaps.



setæ and the genital papillæ; and it is precisely these characters which lead me to identify the present species, at least provisionally, with *Perichæta biserialis*.

The *prostomium* is small and does not divide the circumoral segment.

The *setæ* form a continuous row round each segment; on the ventral side a single pair, one on either side of the median line, are very much enlarged, being three or four times as large as the rest. On the anterior segments of the body two or three setæ on each side are thus enlarged; posteriorly there is only a single pair of these setæ.

The *clitellum* occupies segments 14–16 inclusive and is developed all round the body. There are *no setæ* on the clitellum<sup>1</sup>.

The *male generative pores* are upon segment 18.

The five succeeding segments each have a pair of *genital papillæ*, which are placed in positions exactly corresponding with the male pores some distance on either side of the median line; these papillæ as well as the male pores are situated just in front of the ring of setæ (Plate V. fig. 4).

The *oviducal pore* is single and median upon the 14th segment.

No *spermathecal pores* could be detected.

*Dorsal pores* are present, but I am not able to state at which segment they commence.

Concerning the internal anatomy I am not able to say much, as none of the specimens examined by me were in a sufficiently good state of preservation for section-cutting.

The *nephridia* show the usual characters which are found in the genus *Perichæta*; they present a series of minute tufts attached to the body-wall; in some of the anterior segments they form immense masses completely occupying the cavity of the segment.

There are only three *mesenteries* which are specially thickened; these lie between segments 6–7, 7–8, 8–9; of these three mesenteries the last two are considerably thicker than the first.

The *gizzard* lies behind the last thick mesentery and occupies at least two segments.

The most remarkable fact about this species is that *there are apparently no spermathecæ*. I have only been able to examine two specimens, and there was not the slightest indication of spermathecæ in either of these. I cannot of course state positively that these structures are absent, which seems unlikely seeing that in all other species of *Perichæta* they are present; but the fact remains that they were undoubtedly absent in two examples, the only complete examples which I possess<sup>2</sup>.

<sup>1</sup> The presence or absence of setæ on the clitellum is characteristic of a given species and should always be carefully noted. It serves, for example, to distinguish *P. indica* (where they are absent) from *P. affinis* (where they are present).

<sup>2</sup> Since writing the above I have received Rosa's paper (27) in which he refers to the absence of spermatheca in *Lumbricus eiseni* and *Allolobophora constricta*, besides *Criodrilus*.



## PERICHÆTA FORBESI, n. sp.

I possess two specimens of this *Perichæta*, which were collected by Mr. H. O. Forbes in New Guinea and given to me; I have great pleasure in associating the name of this new species with Mr. Forbes.

Both examples are of an almost exactly similar size. The length is about 9 inches, the breadth nearly half an inch. The colour of the spirit-preserved specimens is a dark greyish brown, darker upon the clitellum.

The *prostomium* is very small, and does not extend over a large portion of the peristomial segment.

The *setæ* form a continuous row round the middle of each segment.

The *clitellum* occupies the usual number of segments, *i. e.* 3 (segments 14–16); but the glandular tissue, instead of being, as is usually the case, continued as far as the posterior boundary of segment 16, appeared in both specimens to end at the *setæ* of that segment.

As in *Perichæta affinis*, *setæ* are developed upon the ventral side of the clitellum.

The *male generative pores* occupy the usual position, *i. e.* upon the 18th segment.

The 17th segment and the 19th, 20th, and 21st have each a pair of genital papillæ occupying a position corresponding to that of the male pores, and situated like them just in front of the circle of *setæ*. The number and arrangement of the genital papillæ of this species serve to distinguish it from *Perichæta biserialis* (*cf.* Plate IV. figs. 4, 5).

The *oviducal pore* is single and median upon the 14th segment.

*Dorsal pores* are present and commence between segments 12 and 13.

The arrangement of the *specially thickened mesenteries* is very distinctive of *P. forbesi* (*cf.* Plate IV. fig. 6). The mesentery separating segments 7 and 8 is thickened and then there is a considerable interval consisting of three segments which are apparently undivided by any mesenteries at all; in this space lies the *gizzard*. The 10th segment is separated from the 11th by a very thick mesentery, and the 11th from the 12th; these two are much thicker than the mesentery between segments 7 and 8, especially the first of the two.

The *spermathecae* present a character which is, so far as my experience goes, unique among Earthworms, and that is their marked asymmetry.

In the 8th and 9th segments are a pair of these organs; each is a somewhat pear-shaped pouch with a single small sessile diverticulum. In the 8th segment, on the left-hand side of the body, was an additional spermatheca placed close to the other one and of exactly similar structure. This duplication occurred in both specimens, but in the second specimen it affected the spermatheca of the 9th segment. It is of course possible that this structural peculiarity



is merely an abnormality of no special interest; on the other hand it occurred in *both* specimens, the only ones which I possess of this species. If a structural peculiarity is found in two specimens selected at random, there is, as it appears to me, considerable probability in favour of the structure being a normal one; at the same time an asymmetry of this kind is most surprising in so typically a bilaterally symmetrical worm as *Perichæta*. I mention the fact therefore for what it is worth, without venturing to commit myself to a definite opinion as to whether it is normal or abnormal<sup>1</sup>.

The *sperm-sacs* in both examples were limited to a single pair of large greyish kidney-shaped bodies attached to the anterior mesentery of segment 12, the last of the three specially thickened mesenteries. Lying upon each of these (again in both specimens), but attached separately to the mesentery, was a pedunculated sac (Plate V. fig. 7) of a brownish colour entirely filled with Gregarines. I am not at present able to say whether this sac is a part of the sperm-sac pathologically altered by the presence of these parasites or not.

The *ovaries* are large and situated in the usual position in segment 13.

In the next segment are a pair of bodies of similar shape and occupying an exactly corresponding position, which I regard as *receptacula ovarum*.

#### PERICHÆTA VAILLANTI<sup>2</sup>, n. sp.

Of this new species I only have a single example; like *P. biserialis* it comes from Manila, and was collected near that town by Mr. Herbert Barwell, to whom my thanks are due for a large number of Earthworms collected in Luzon.

The colour (in alcohol) is a yellowish brown, the yellow tint being particularly marked upon the clitellum.

The *prostomium* is small and does not extend far over the peristomial segment.

The *setæ* form a continuous row round each segment.

The *male generative pores* are upon the 18th segment.

There are no *genital papillæ*.

The *clitellum* occupies segments 14–16 inclusive, and as in other species of *Perichæta* is developed all round the body; there are *no* setæ upon it.

The *oviducal pore* is single and median upon segment 14.

*Dorsal pores* are present.

The *apertures of the spermathecæ* are very conspicuous on the interspaces between segments 5–6, 6–7, 7–8, 8–9.

There are *no* specially thickened mesenteries at all.

The *nephridia* form, as in other *Perichætæ*, a series of scattered tufts.

<sup>1</sup> In a preliminary note in the 'Zoologischer Anzeiger,' Bd. xii. no. 318, I erroneously stated that the doubling of the spermatheca affected that of the 8th segment in both cases.

<sup>2</sup> Named after M. Leon Vaillant.



The *spermathecæ*, 4 pairs, present nothing remarkable in their structure; each is a small pear-shaped pouch with a single small stalked diverticulum.

The *sperm-sacs* have a somewhat peculiar structure which is illustrated in fig. 10. In segments 11 and 12 are a pair of oval sacs; those of each side of the body are connected with each other, but there is no contact between the sacs of the right and left sides ventrally; from each of the oval sacs is a small projecting tube-like outgrowth (*x*, Plate V. fig. 10), which in the dissected worm appeared to be broken off at its extremity. I am inclined therefore to suppose that there is a connection above the intestine between the two sperm-sacs of each segment by means of these outgrowths; if so, there is a striking resemblance in this particular between *Perichæta vaillanti* and *Dichogaster*, in which worm I have figured and described (10) an almost identical arrangement.

The *ovaries* are in segment 13, attached to the anterior mesentery of this segment.

The *oviducts* are perfectly normal.

The *atrium* is again rather unusual in its structure; as a general rule that portion of it which lies nearest to the external orifice has thickened muscular walls and is curved upon itself like a horseshoe; its calibre gradually increases towards the external orifice.

In *Perichæta vaillanti* the terminal portion of the atrium abruptly widens to form an oval, thick-walled sac, as in *P. indica* (Horst, 16), into which the thin tube-like proximal part of the atrium opens.

The only species with which the present could be confounded is *P. modigliani* (Rosa, 25); but it differs from that species in having no thick mesenteries and apparently in the structure of the sperm-sacs. There is no knowing whether *P. vaillanti* is the same as *P. juliana* (Perrier, 19); the only fact known about the latter species is that it has four pairs of spermathecæ.

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## EXPLANATION OF THE PLATES.

## PLATE IV.

- Fig. 1. *Perichæta indica*, nat. size; drawn and coloured from a living specimen.  
 2, 3. Anterior segments of *Perichæta indica*, to show protrusion of buccal cavity.  
 4. Anterior segments of *Perichæta biserialis*.  
 5. Clitellar and following segments of *Perichæta forbesi*.  
 6. *Perichæta forbesi*; segments 7-12, dissected, to show position of spermatheca and thickened septa.  
 7. — *biserialis*; corresponding dissection of segments 6-10 to show thickened mesenteries.

## PLATE V.

- Fig. 1, 2, 3. Variations in position of genital papilla in *Perichæta affinis*, fig. 2 being the normal.  
 4. *Perichæta indica*; transverse section through duct of spermatheca.  
 5. — — —; transverse section through spermathecal appendix.  
 6. — — —; a portion of a transverse section of wall of spermatheca.  
 7. — *forbesi*; portion of sperm-sac modified by presence of gregarines.  
 8. — *indica*; spermatheca.  
 9. — — —; longitudinal section through intersegmental septum to show attachment of "glycogenic" organ (*gl*); *d.v.*, dorsal blood-vessel; *mes*, septum; *i*, epidermis.  
 10. Genitalia of *Perichæta vaillanti*; *v.s.*, sperm-sacs; *x*, process of ditto, which appears to meet that of its fellow in the dorsal median line; *ov*, ovary; *od*, oviduct; *n*, nerve-cord; *m*, intersegmental septa.  
 11. Anterior segments of *Perichæta affinis*; *pr*, minute prostomium.  
 12. *Perichæta houlletii*; dissection to show increase in size of seta near ventral median line; *s*, seta; *n*, nerve-cord; *m*, intersegmental septum.

4. Notes on the Habits and Oviposition of *Xenopus lævis*.

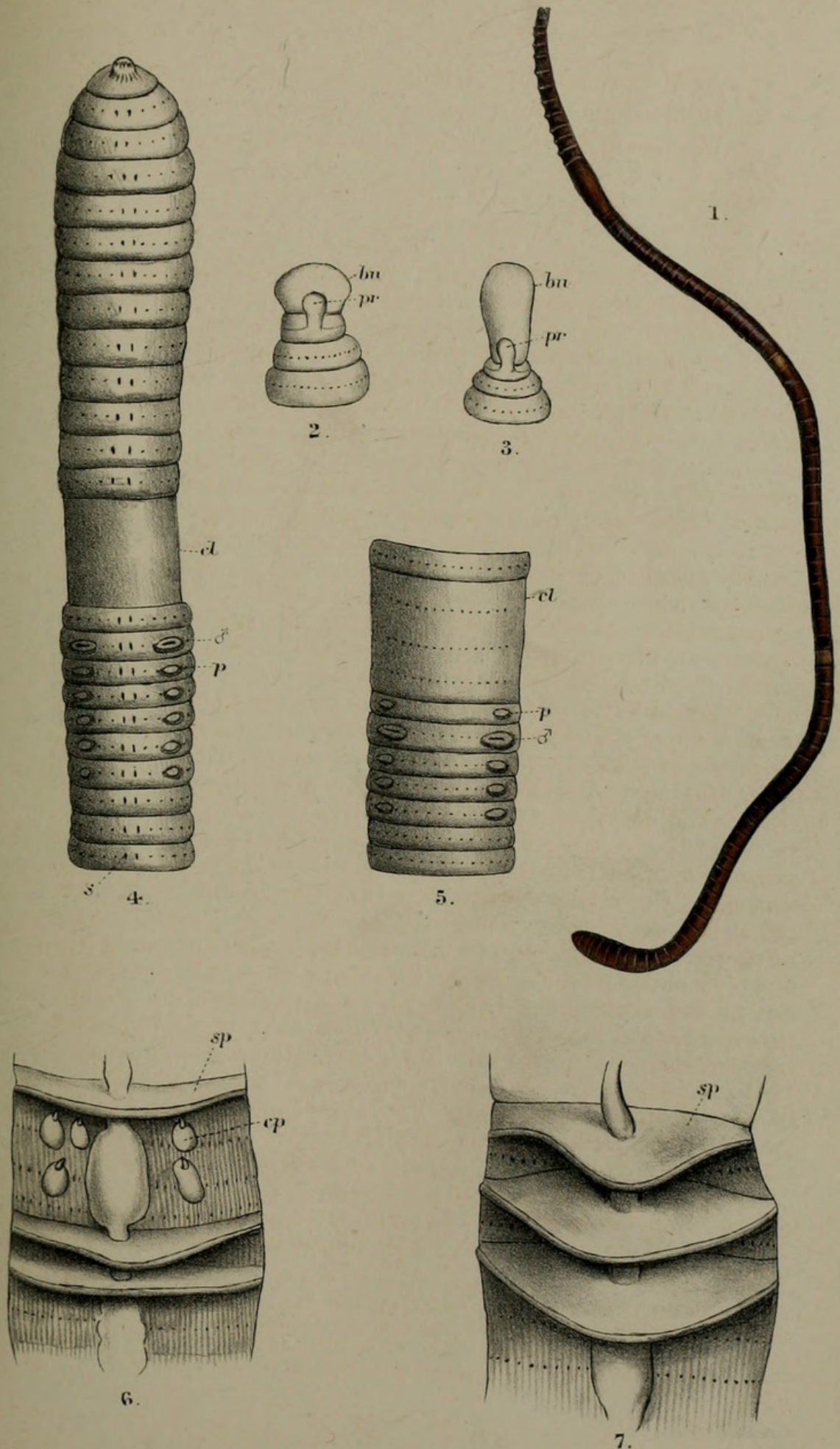
By J. M. LESLIE, F.Z.S.

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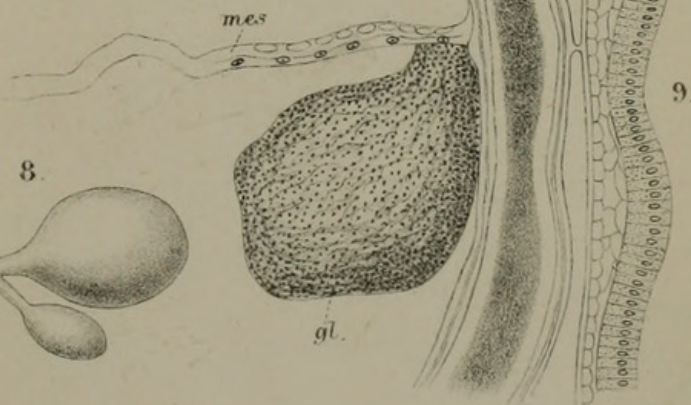
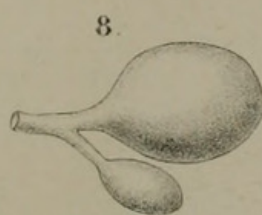
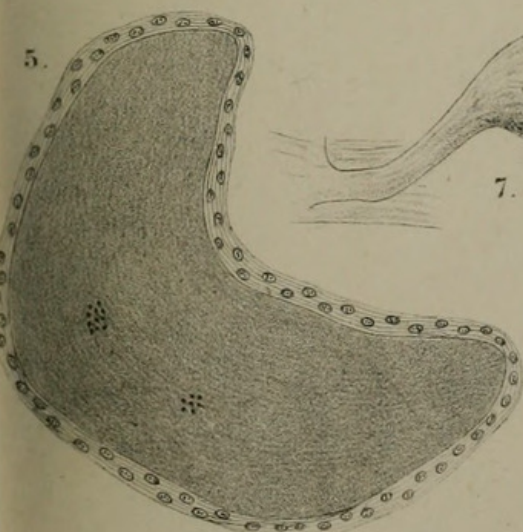
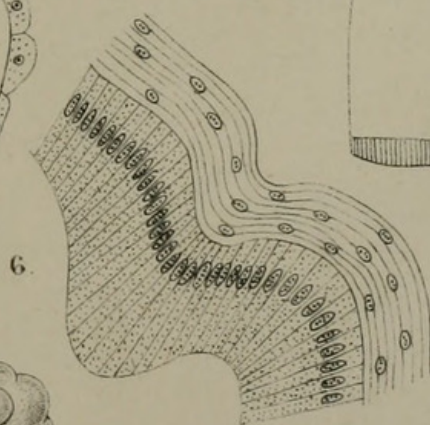
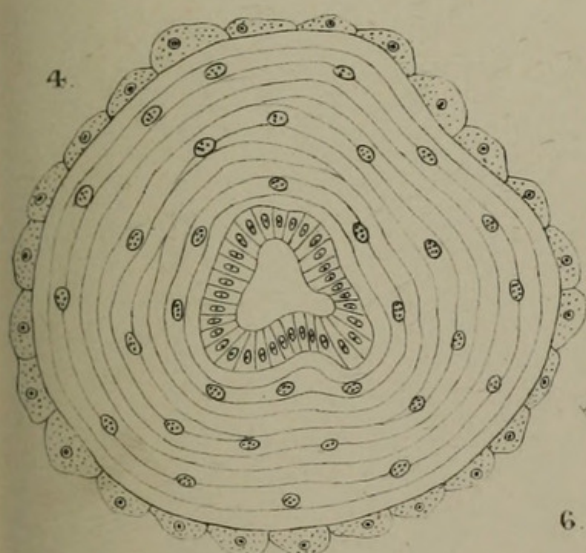
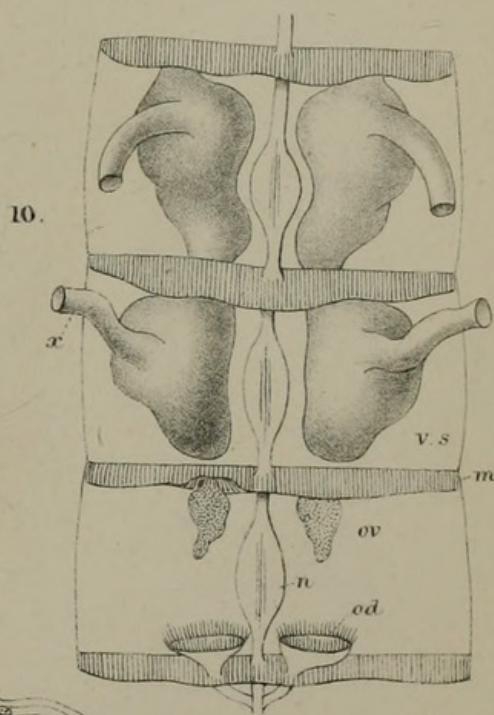
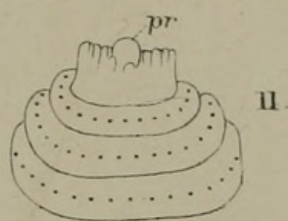
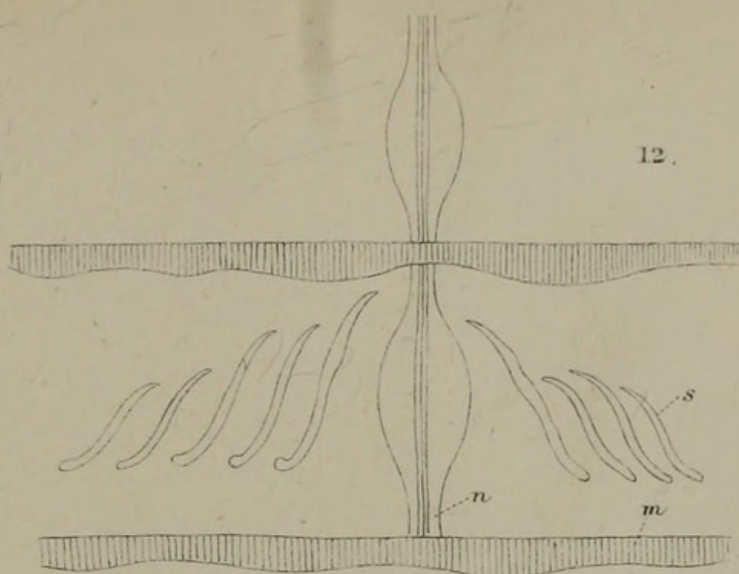
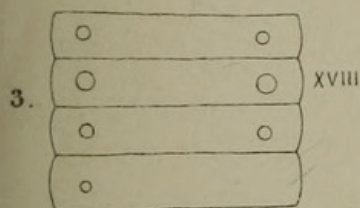
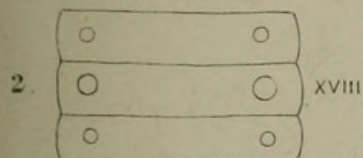
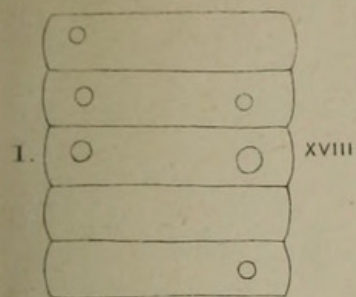
At the suggestion of Mr. Boulenger<sup>1</sup> I have, for the last two years, been investigating the life-history of the Clawed Aglossal Frog, *Xenopus lævis*, Daud., which is common here at Port

<sup>1</sup> [Mr. Leslie's observations on the oviposition of *Xenopus lævis* fill up a desideratum of long standing. The development of *Pipa* being of an ultra-specialized type, we have to fall back on the only other genus of *Aglossa* for information on this head. What we know of the structure of the *Aglossa* shows













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