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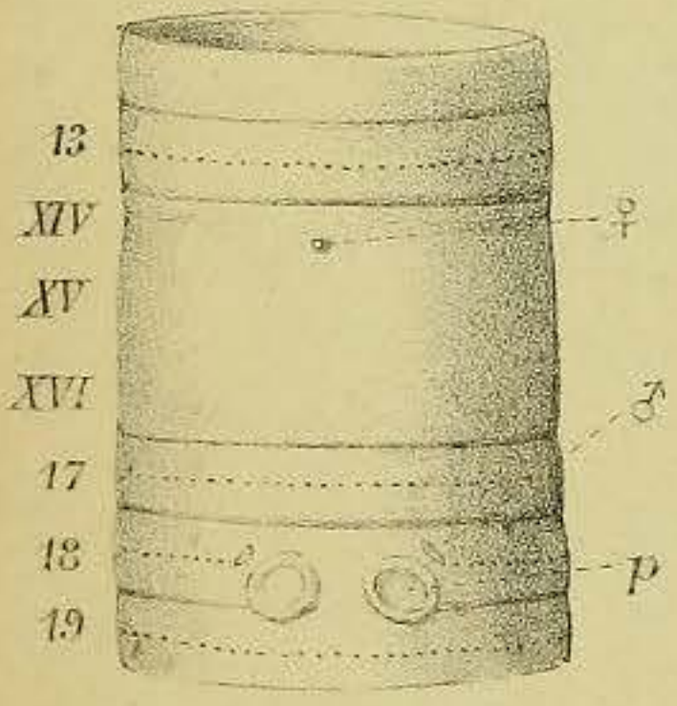

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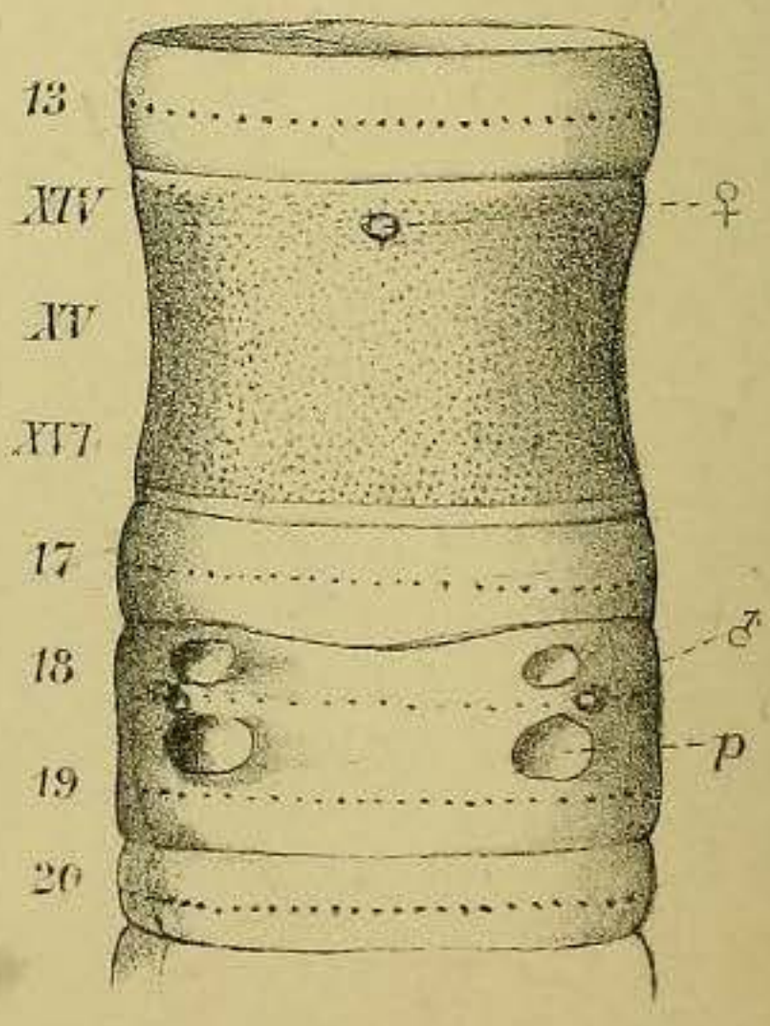

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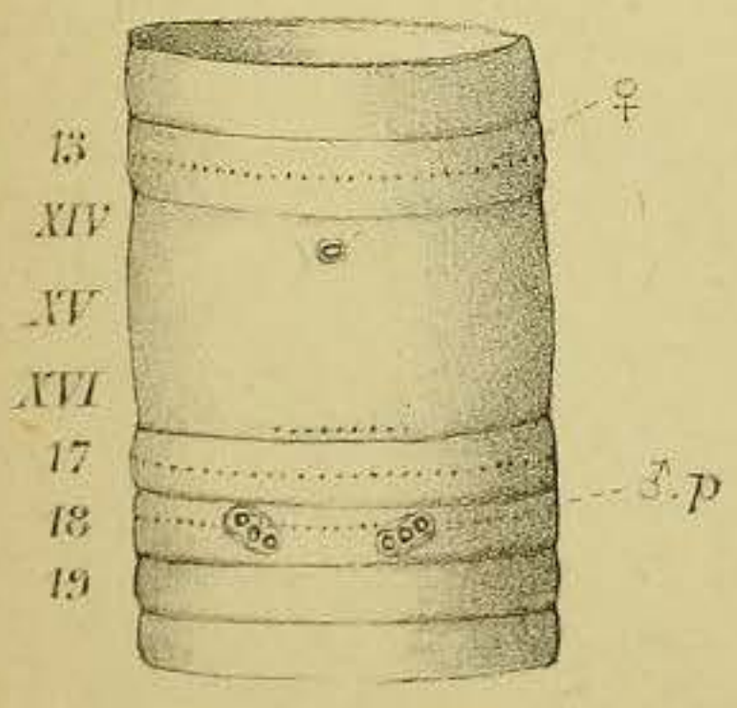

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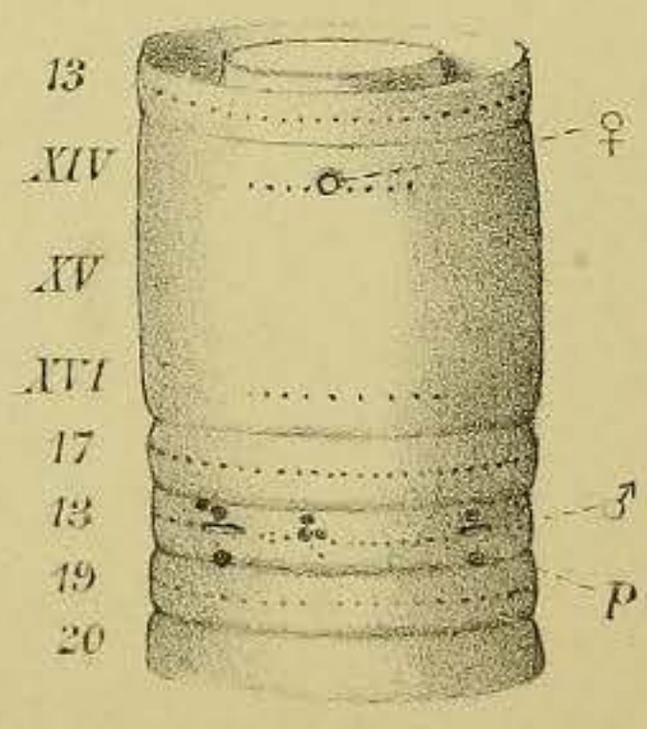

F. E. B. del. J. Smit lith.

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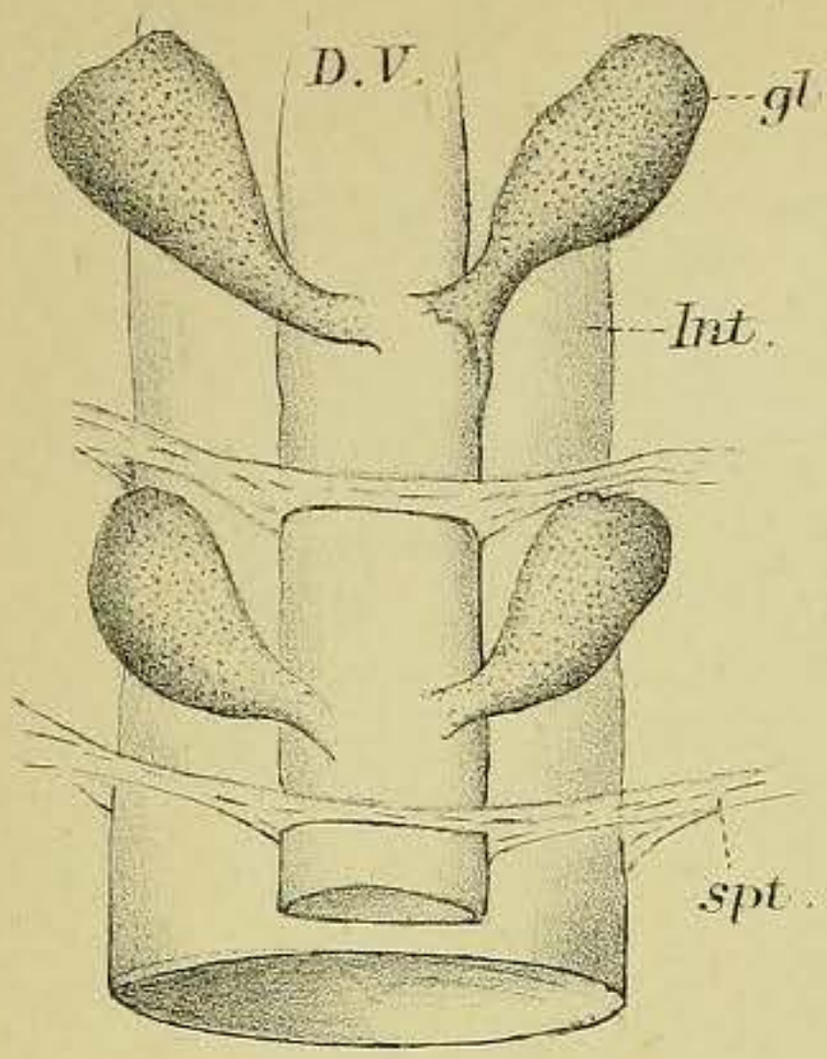
SPECIES OF PERICHÆTA.



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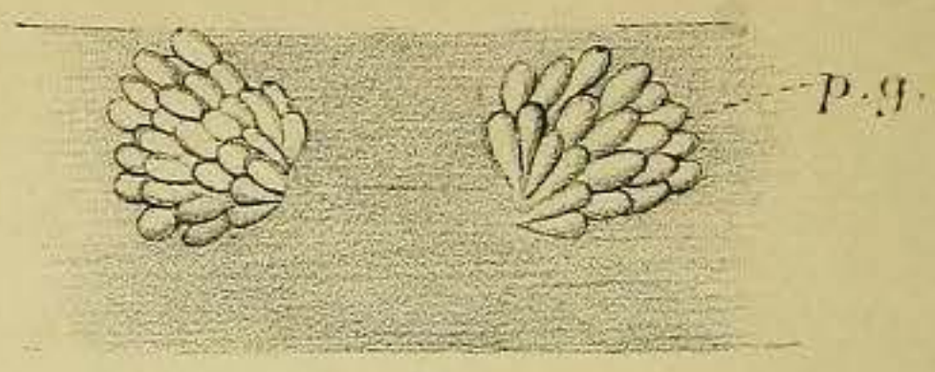

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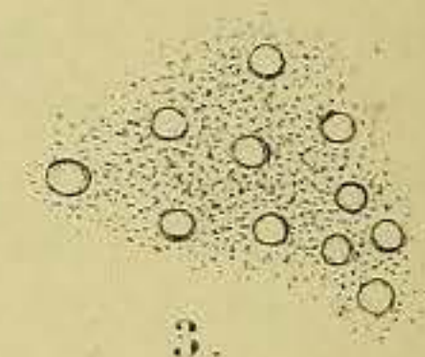

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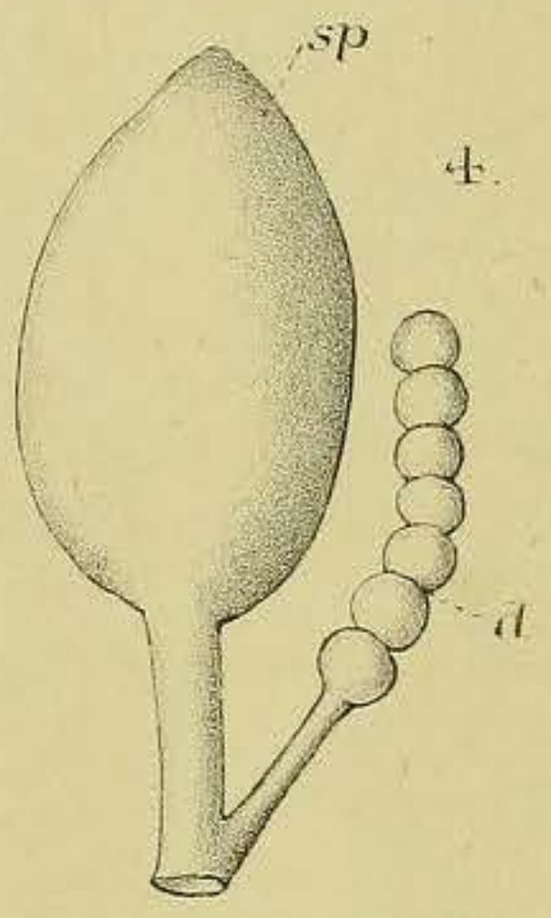

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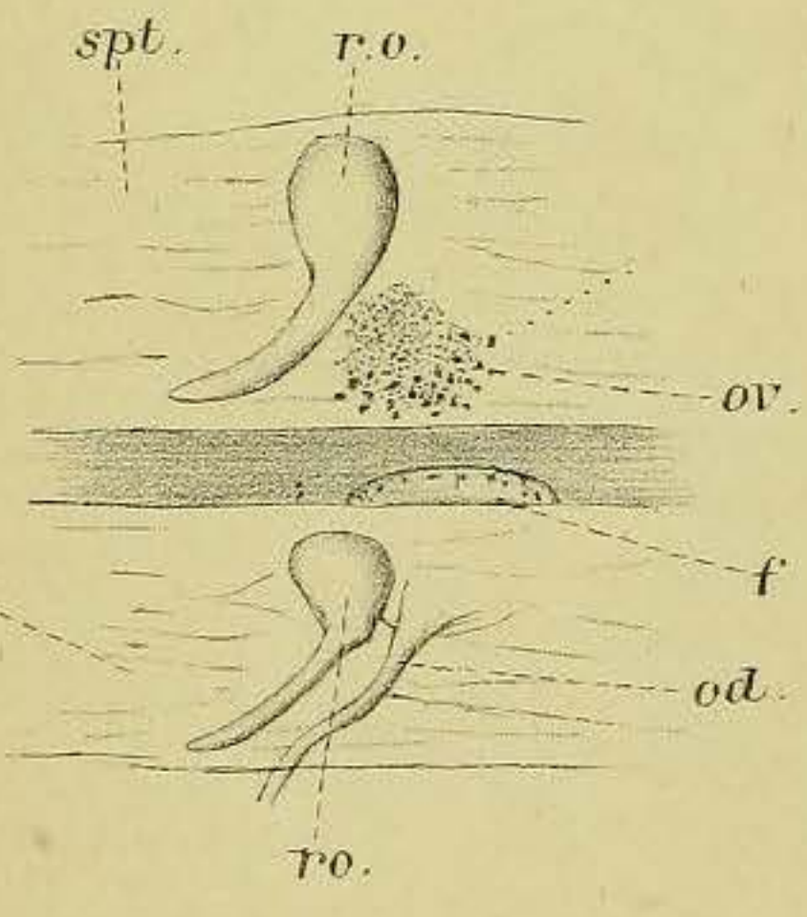

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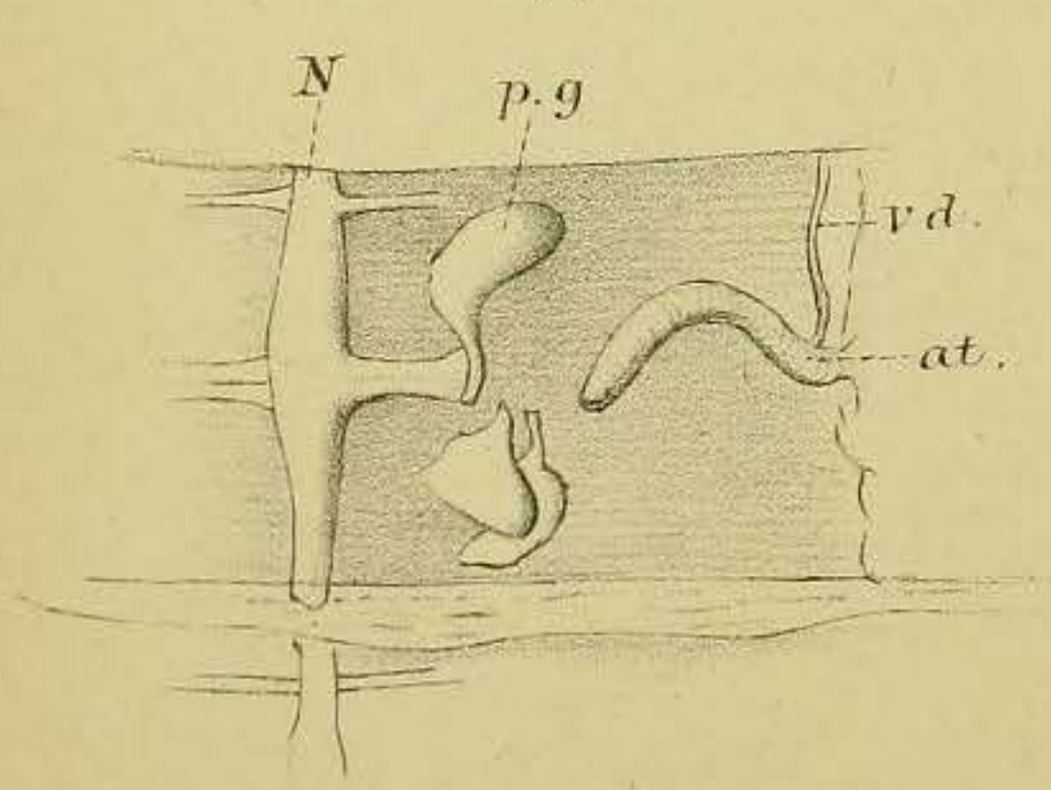

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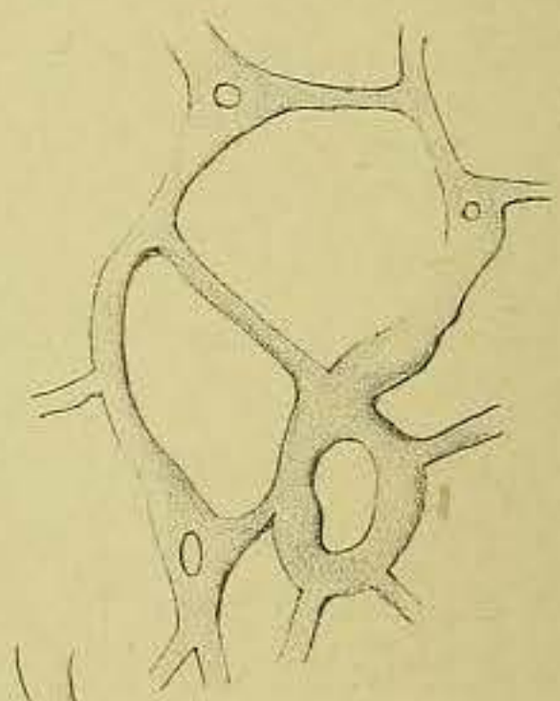

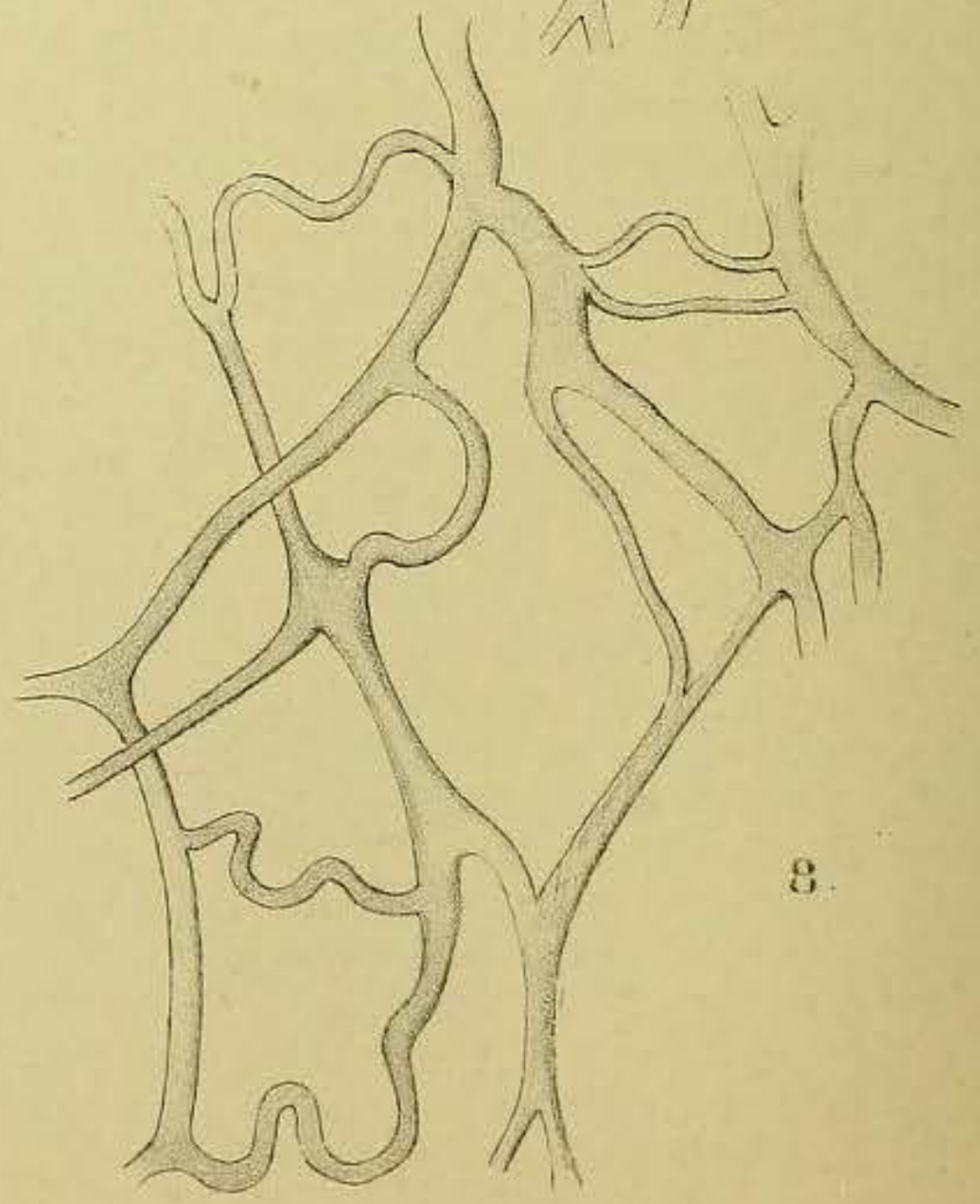

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ANATOMY OF PERICHÆTA.

4. On some Species of the Genus *Perichæta* (*sensu stricto*).

By Frank E. Beddard, M.A., Prosector to the Society.

[Received February 5, 1892.]

(Plates IX. & X.)

I have already communicated to this Society [1] some observations upon the family Perichætidæ and upon the generic types which may be recognized in it. In the present paper I propose to describe some species of *Perichæta* (*s. s.*). I regard those Perichætidæ as referable to the genus *Perichæta* in the strict sense in which the setæ are disposed in a perfectly continuous circle round each segment, being generally (? always) disposed along a distinct ridge in the middle of the segment; this gives to the species of the genus a very different feel from either *Megascolex* or *Perionyx*, since the setæ necessarily project more and thus produce a roughening of the skin, very perceptible when the worms are handled.

My experience of living Earthworms of the genus *Megascolex* is limited to the examination of a specimen (as yet unidentified) from the Seychelles. These worms are far more lethargic in demeanour than the extremely active *Perichætæ*, and it is quite possible that this difference may be general.

Another distinguishing character of the genus is the presence of a pair of cæca [2] projecting forwards from the intestine in the xxvith segment. The gizzard, moreover, lies in segments viii.–x. and the septa are wanting which should divide those segments. No true *Perichæta* is known in which the spermatheca have more than a single diverticulum apiece [3]. The clitellum never consists (with one exception, *P. fecæ*) of more than three segments (xiv.-xvi.), and the oviducal pore is generally, if not always, single and median [4].

Most naturalists who have described species of *Perichæta* have mentioned the number of setæ on the segments; but a segment has generally been selected at random, and frequently no mention has been made of the particular segment chosen. Prof. Bourne points out that it is desirable to count the setæ upon more than one segment, and he selects segments v., ix., & xxv.; he finds "that the

[1] "Observations upon an American Species of *Perichæta*, and upon some other Members of the Genus," P. Z. S. 1890, p. 52.

[2] I refer later on in this paper (p. 165) to one exception to this rule.

[3] The second "diverticulum," in the form of a pear-shaped pouch, which occurs in *Perichæta houlleti* does not belong to the same category as the true appendix of the spermatheca; this I have pointed out elsewhere [Q. J. Micr. Sci. vol. xxx. p. 462].

[4] Fletcher has described and figured an Earthworm ("Notes on Australian Earthworms: Part II."; Proc. Linn. Soc. N. S. W. ser. 2, vol. i. pl. 13. fig. 6 ♀, and p. 962), *Perichæta queenslandica*, which has the internal organization of a true *Perichæta*, but "interrupted" setæ and paired oviducal pores; *Perichæta darnleiensis*, described on p. 966 of the same memoir, appears to be in every respect a true *Perichæta*, but has also paired oviducal pores. This matter, however, requires looking into again, as Mr. Fletcher suggests a slight doubt as to whether the said apertures are really separate.

relation of these numbers to one another varies with other important characters rather than the actual numbers themselves."

Prof. A. G. Bourne[1] considers that in all true *Perichætæ* there are setæ between the male pores. So far as my own experience goes I agree with Prof. Bourne. The only possible exception that occurs to me is *Perichæta taprobanæ* described in the present paper (on p. 163). That species has setæ between the male pores, but differs from *Perichæta* in a few other points to which I direct attention. Another point which appears to me to be of importance is the size of the setæ upon the anterior as contrasted with the posterior segments; in all the species of *Perichæta* described in the present paper the setæ of the eight anterior segments are very much larger than those upon the segments which follow; there is an abrupt break at the end of segment viii.; up to this point the setæ get gradually larger upon successive segments. In *Perichæta taprobanæ*, which may perhaps be a distinct genus, there is no such marked difference between the segments in front of and those behind the eighth. Although there is a sudden diminution in size of the setæ there is not always a corresponding increase in their numbers, but there generally is an increase.

So much, then, for the generic distinctions of *Perichæta*.

As to the species there exists already some little confusion, and I am not prepared to guarantee absolutely the novelty of the species described in the present paper. When there were only a very few species of the genus known, their discrimination was a much easier matter than it is now; at the time that Perrier wrote his first descriptions of *Perichætæ* it was a nearly sufficient definition to state merely the number and position of the spermathecæ. There are therefore a good many points, now known to be of systematic importance, which are omitted or not clearly set forth in some of the papers which record new species of *Perichætæ*. So far as we know at present, the following are the principal external features which are of systematic importance:—

(1) Whether the ventral setæ are larger than the rest.
(2) The number of setæ upon the segments.
(3) Whether the clitellum includes the *whole* of segments xiv.–xvi.[2]
(4) Whether the setæ are present or absent from some or all of the clitellar segments; and if present whether they are modified (as, for instance, in *Perichæta houlleti*).
(5) The number and arrangement of the anterior and posterior genital papillæ.
(6) The position of the atrial pores upon the xviiith segment, *i. e.* whether they are more lateral or ventral.
(7) Colour and size (including number of segments).

I should like to take this opportunity of calling attention to the importance of illustrating these and other Earthworms by accurate

[1] "On *Megascolex cæruleus*, Templeton, &c.," Q. J. Micr. Sci. vol. xxxii.
[2] My attention was directed to the importance of this point by Prof. Bourne's paper upon *Megascolex cæruleus* (Q. J. Micr. Sci. vol. xxxii. p. 49).

coloured figures. The species of *Perichæta* generally (so far as my experience goes, *always*) show characteristic differences of colour which it is difficult to express in words so as to convey a sufficiently accurate idea. The characters, moreover, which separate the species of *Perichæta* are not always available ; some species are separable by very well-marked characters, but others again hardly differ, except in the number and position of the genital papillæ with which are associated peculiar glands, and *in their colour* ; immature specimens often want the papillæ, and, in the absence of coloured figures for reference, new species may be described which have no existence or important facts in distribution may be ignored. At present there are only two coloured figures of Perichætidæ extant on which any reliance can be placed : these are Bourne's figure of *Megascolex cæruleus* and my own of *Perichæta indica* [1]. Several coloured figures accompany Schmarda's descriptions of *Perichætæ* in his 'Neue wirbellose Thiere,' but these are not so useful as they would be if the descriptions were sufficiently full to render identification of the species possible [2].

The chief internal characters which show variations are the spermathecæ and the atria. The number and position of the spermathecæ, and perhaps the relative size of the spermatheca and its diverticulum, offer useful characters ; but they are rather difficult to make use of, as the quantity of sperm in the diverticulum is responsible for considerable variations in its form, as I point out in the case of *Perichæta sinensis* (see p. 159). The atrium is sometimes furnished at its point of opening with a dilated sac, the presence or absence of which is very characteristic of a given species. The extent of the glandular part of the atrium is perhaps often a valid specific distinction, especially in such forms as *Perichæta taprobanæ*, where it is extraordinarily small. The intestinal cæca are also subject to some variation, which is, however, not common ; in two species only are they absent, and in two others there are six pairs instead of the normal one pair. There seems also to be some variety in the position of the specially thickened intersegmental septa ; but this character is one which is best appreciated in large species such as *Perichæta forbesi*, and is not always so clearly marked in the smaller forms.

Whether the receptacula ovorum really vary from one to two pairs is a matter which requires further investigation. At present I am almost inclined to think that the existence of the two pairs of these structures placed in segments xiii. and xiv. will prove to be characteristic, not of particular species, but of the genus itself.

? PERICHÆTA SUMATRANA, Horst.

Megascolex sumatrana, Horst, Notes Leyden Mus. vol. v. p. 189.
Perichæta sumatrana, Horst, Midden-Sumatra, Vermes, p. 5.

I have examined five or six specimens of this species, which has a

[1] Vaillant's figure of "*Megascolex diffringens*" may be *Perichæta indica*.

[2] Since the above was written I have received, through the great kindness of Prof. Claus, these worms for identification.

very conspicuous coloration, illustrated in Plate IX. (fig. 4). The specimens were all received alive from Kew Gardens; they were brought to Kew in Wardian cases from Barbados and from Hong Kong; it may be that the specimens from the two localities were accidentally mixed, but the fact that each box contained another and a distinct species in each case is against the supposition that there had been an accidental transference of specimens from one box to another. The occurrence of the same species of *Perichæta* in two such widely-separated regions of the World is interesting, but it is not the only instance seen in this genus; both *Perichæta indica* and *Perichæta houlleti* have been recorded from the tropics of both the New and the Old World.

The accompanying drawing (Plate IX. fig. 4) illustrates the coloration of the species, which varies somewhat in individuals, preserving, however, the same general plan. The body is markedly ringed as in our own *Allobophora fœtida*; there are alternate bands of olive-brown and pale brownish yellow; in the individual figured the darker bands are of a more distinctly green colour than in other specimens.

When treated with Perenyi's solution the green, both of the greener and browner individual, became very much brighter and more distinctly green, and was finally dissolved out when the worms were transferred to alcohol. This change of colour appears to be due to the acid in the Perenyi's fluid, as it was not produced by alcohol alone.

This species is extremely strong and active and it is most difficult to catch; the buccal cavity is protruded when the animal is moving, as in all other species of the genus that have been examined in the living condition. The length is 70 mm. by 4 mm. in breadth [1].

Number of segments 86.

The *clitellum* occupies the usual three segments, beginning and ending sharply. There are no setæ upon it.

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

The *atrial pores* are not prominent; they are transversely elongated slits upon the xviiith segment.

There are *no genital papillæ*.

The *intestine* commences in segment xiv.; it has the usual pair of cæca.

There are, as in most species of *Perichæta*, especially thick tufts of nephridia on the septa in front of segment vii.

The ventral blood-vessel is not enclosed by the sperm-sacs.

The *spermathecæ* lie in segments vii. and viii.; each has a diverticulum bent upon itself three times.

The *atrium* has a large terminal sac.

I am not quite certain whether to identify this species with *Perichæta sumatrana* or whether to regard it as new. The diverticulum appears to be somewhat different in form, but this may perhaps be accounted for by the distribution of the spermatozoa in the pouch.

[1] Another specimen measured 3 inches and consisted of 93 segments.

PERICHÆTA DYERI, n. sp.

I obtained a single specimen of this *Perichæta* from Kew Gardens in August of last year; Mr. Crisp, one of the employés at the Royal Gardens, brought me the worm, which had been remarked for some days on account of its active habits; it had obviously come from some foreign country, but at that season so many plants in Wardian cases arrive from abroad that I found it impossible to ascertain its exact locality.

The colour of this species when alive (Plate IX. fig. 2) is a rich brown, darker posteriorly; the cuticle is markedly iridescent, the iridescence being probably more strongly marked on account of the dark background of pigment. During life it protruded, as other *Perichætæ* do, the whole of the buccal cavity during its movements; the clitellar region was also continually contracted: in preserved specimens this region of the body is, it should be observed, frequently much narrower than the rest; the older term of cingulum is thus particularly applicable, as the impression given is that of a belt tightly drawn round the middle of the worm. When placed in weak spirit, the worm threw out a quantity of turbid yellowish fluid.

After preservation the specimen measured 117 mm. and was composed of 72 segments. The circumference of the body in the region of the spermathecæ is 13 mm.

The *clitellum* occupies the three usual segments, but does not exactly coincide with the boundaries of those segments; it commences a little after the beginning of the xivth segment and terminates a little before the end of the xvith. There are no setæ upon the clitellum. The seta formula is

Segment I.	V.	XII.	XXV.[1]
27	27	39	45

The *oviducal pore* is single and occupies the usual position.

The *male pores* lie upon the xviiith segment within the line of setæ, which are, however, interrupted for a short distance on either side of each pore. On the same segment are two pairs of large sucker-like *papillæ*, which seem to have a concave surface. The anterior pair (Plate IX. fig. 8) lie in front, and to the inside, of the male pores; the other pair occupy a corresponding position behind the circle of setæ of the segment, and touch the border-line between the xviiith and xixth segments.

The *spermathecal pores* were not evident.

As to the internal anatomy. The alimentary tract is furnished with a *gizzard* occupying the usual position and number of segments. The paired *cæca* of the intestine arise between the xxvith and xxviith segments and reach forward as far as the xxvth.

From segment xxviii. backward are paired series of "*septal glands*"

[1] The segments selected for enumeration are not quite the same as those chosen by Prof. Bourne (Q. J. Micr. Sci. vol. xxxii. p. 53, footnote); but I find that the proportions and numbers are not altered by the segments which I give.

such as I have described in other species of *Perichæta*[1]. They appear, however (Plate X. fig. 1), to arise rather from the dorsal vessel than from the septum; each gland is somewhat pear-shaped, with a narrow stalk which approaches that of its fellow.

The *sperm-sacs* are in segments xi., xii.

The *atria* are very extensive; the glandular part occupies segments xvi.–xxi. inclusive; the muscular duct opens directly on to the exterior and is unprovided with a thin-walled sac.

The segments xvii., xviii., and xix. are masses of white glands which are no doubt connected with the papillæ already spoken of.

The *ovaries* (which are, as usual, attached to the front wall of segment xiii.) are very large and bunchy.

The *spermathecæ* are present to the number of four pairs, and lie in segments vi., vii., viii., and ix.; they open at the anterior boundary of these segments and are very dorsal in position, the external apertures being about 6 mm. from the nerve-cord. The pouch has the usual shape; the diverticulum is half again as long as the pouch.

The characters of the papillæ appear to distinguish this species from all other *Perichætæ* with four pairs of spermathecæ. It comes nearest to *P. modiglianii*.

The above description refers to a single specimen which I shall keep as the type of the species. Since the description was written I have received a large number of other examples, all living, from Trinidad and Jamaica, and from Lagos on the W. African coast; the specimens from Trinidad I owe to the kindness of Mr. Hart, Superintendent of the Botanical Gardens; the other specimens came from Kew. I kept a number of them alive for some weeks in the hope that they might possibly produce cocoons; unfortunately they died without producing any. One of these specimens (which I have also kept) is illustrated in the accompanying coloured drawing (Plate IX. fig. 2). The examination of a large number of individuals has shown that the characters of the genital papillæ as described above are not quite distinctive of the species. In a good many individuals the papillæ were precisely as I have described them, but in others there were only a single pair present, that pair lying behind the male pores. These individuals therefore bear a very close resemblance to *Perichæta sinensis*. If one had only alcoholic specimens to examine and were not allowed to dissect them, it would indeed be impossible to distinguish the species by any at all marked characters. The colour, however (*cf.* figs. 2 & 3, Plate IX.), is here quite distinctive of the species.

PERICHÆTA SINENSIS, n. sp.

Of this species of *Perichæta* I received a number of living specimens from Kew Gardens; they came from Foochow in China. A coloured drawing which I exhibit (Plate IX. fig. 3) was made by Mr. Smit from the living worm. I ought to mention, however, that that

[1] P. Z. S. *loc. cit.*

sketch does not show the prismatic colours, which were very evident. The hinder part of the body is extremely transparent and of a pale brown colour; the blood-vessels and the paired septal glands were quite clearly visible through the thin integument. The last dozen segments or so are yellow-coloured; beyond the clitellum, which is grey, is a patch of yellow due to the prostate.

The activity of this species is quite on a par with that of other Perichætes, and it possesses the same power of everting the buccal cavity that I have referred to in the case of *Perichæta indica* [1] and the other species described in the present paper. M. Vaillant has also figured the same protrusion of the buccal cavity in *Perichæta posthuma*. In *Perichæta sinensis* the length of the fully everted buccal cavity was quite equal to that of the first three segments of the body.

The length of the species is 126 mm., the circumference at the viiith segment 10 mm.

The individual with the above measurements had 104 segments.

The *clitellum*, as is occasionally the case, does not coincide exactly with the limits of the three segments (xiv.–xvi.) of which it is composed; it begins *after* the furrow separating segments xiii./xiv., and ends *before* the intersegmental groove xvi./xvii. I could discover no setæ upon it.

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

The *atrial pores* lie upon segment xviii.

Genital papillæ.—There are two large sucker-like papillæ of circular outline lying between segments xviii./xix.; each is placed a little to the inside of (and of course below) the atrial pore of its own side.

The *spermathecal orifices* were not visible.

As to the internal anatomy, this species shows the usual characters peculiar to the genus *Perichæta*.

There are a pair of *cæca* in the usual position.

There are four pairs of *spermathecæ* lying in segments vi., vii., viii., and ix. In several individuals which I dissected the proportions between the pouch and its single diverticulum, as well as the shape of the diverticulum, varied. The normal condition appears to be for the diverticulum to be quite as long as the pouch; like the pouch it consists of a distal sac where the spermatozoa are retained and a narrowed duct. The pouch itself contained no spermatozoa, only a quantity of material presenting the appearance shown in the accompanying drawing (Plate X. fig. 3); it is of a fluid consistency and contains minute granules as well as spherical bodies; the drawing, I should say, represents the contents of the pouch of a living worm. The diverticulum frequently shows a beaded appearance represented in fig. 4; in one case the upper end of the diverticulum was divided by constrictions into seven spherical chambers full of sperm; quite as often the diverticulum was tubular and of equal calibre throughout, except of course the proximal end, which is always narrower. My investigations upon the living worm, which I had

[1] P. Z. S. *loc. cit.*

hoped would be more thorough, were cut short by the drying up of the specimens; I had proposed to study the vascular system in detail, but my failure to do so is the less to be regretted since Prof. A. G. Bourne has recently published [1] an excellent account of the circulatory organs of the large *Megascolex cæruleus*, which would probably in any case have rendered a similar account of the circulatory organs of *Perichæta* unnecessary.

I may, however, call attention to figs. 7 & 8, which represent a portion of the capillary network upon the spermathecal diverticulum drawn from the living organ. It will be noticed that this network is of some vertical thickness; its branches lie in two planes, both of which are contained in the superficial layers of the pouch and do not penetrate between the cells of its lining epithelium.

The *atrium* is not furnished with a terminal sac.

A crowd of closely pressed white egg-shaped glands corresponds to each of the genital papillæ (Plate X. fig. 2).

The *setæ* of segments vi., vii., viii., ix. are longer and stouter than those upon the anterior and posterior segments; this is especially the case with the more laterally placed.

The seta formula is as follows:—

Segment I.	V.	XII.	XXV.
28	26	42	48

PERICHÆTA BERMUDENSIS, n. sp.

I received thirty or forty examples of this *Perichæta* preserved in spirit from the Bermudas; I am indebted for them to Surgeon-Major Windle.

The specimens were all of about the same size; the length of one specimen chosen at random is 120 mm., breadth 4 mm., number of segments 93. The colour (in alcohol) is a reddish brown dorsally, passing into a yellowish colour ventrally.

The *prostomium* extends back over about half of the peristomial segment.

The *setæ* are small on the first setigerous segment; they gradually increase in size on the next three, and then get small again; they are quite small on segment ix. They form complete circles.

The *clitellum* shows the unusual, though not unique (see description of *Perichæta dyeri*, p. 157), character of not *completely* occupying three segments. Instead of being developed over the entire circumference of segments xiv.–xvi., it only commences to be visible 1 mm. after the boundary-line of segments xiii./xiv. and terminates at about the same distance in front of the boundary-line between segments xvi./xvii. This gives the clitellum a peculiar and very characteristic appearance. As it occurred in all the specimens which I examined, I regard this reduction of the clitellum as a valid specific character.

The clitellum is not entirely unprovided with setæ; there is a

[1] "On *Megascolex cæruleus*, Templeton, from Ceylon, &c.," Q. J. Micr. Sci. vol. xxxii. p. 49.

single row present at the posterior boundary of the clitellar region, which belong therefore to segment xvi.; it is at this point that the thick clitellar epithelium ceases. The setæ do not form a continuous ring round that segment (the xvith); they are visible only upon the ventral surface and are developed for an equal distance on either side of the ventral median line; they extend for a distance of about one quarter of the entire circumference of the segment. The clitellar setæ are quite obvious without having recourse to a microscopical investigation of the integument, since the thick clitellar epithelium is much broken along the line of their emergence. The setæ themselves do not appear to present any differences in shape from those which are found in other parts of the body; they may perhaps be a trifle smaller, but there is no such differentiation as occurs, for example, in *Perichæta houlleti*. The most careful search failed to show any setæ on either of the two remaining segments of the clitellum: in one specimen I counted 20 setæ on segment xvi.; in another there seemed to be rather fewer, but there was no perceptible variation in the length of the line occupied by the setæ in different individuals.

I have been particular in calling attention to the characteristics of the clitellum, not only because the points to which I have directed attention are of specific importance, but also for the special reason that they serve to discriminate *Perichæta bermudensis* from *Perichæta aspergillum*. I was at first inclined to regard the species described in this paper under the name of *Perichæta bermudensis* as being identical with *Perichæta aspergillum*. The latter was first described by Perrier [1] as being "sans désignation d'origine." As I received a few years ago some Earthworms collected by Mr. Shipley in the Bermudas which seemed to be *P. aspergillum*, I considered that the present species was the same, as the individuals agreed, on a superficial inspection, with *Perichæta aspergillum*. However, in Perrier's description of *P. aspergillum* there are characters mentioned which appear to show that I am right in regarding *Perichæta bermudensis* as a distinct though closely allied form; in the figure [2] illustrating *Perichæta aspergillum* setæ are figured upon *all* the segments of the clitellum; but in the text the matter is left a little obscure. M. Perrier says (p. 120), "Je n'ai vu sur la ceinture que de faibles traces . . . . des ceintures de soies."

The great difference in size may possibly also be a valid specific difference; no doubt this character is one which has to be used with special caution in the case of Earthworms. There are other points, too, which I shall call attention to in referring to the characters offered by the male generative pores and the spermathecal pores.

The *dorsal pores* commence, as in *Perichæta aspergillum*, between segments x./xi.

The *oviducal pore* lies upon the middle ventral line of segment xiv.

[1] "Recherches pour servir à l'histoire des Lombriciens terrestres," Nouv. Arch. Mus. t. viii. p. 5.

[2] *Loc. cit.* pl. iv. fig. 71.

The *male pores* are upon segment xviii., comparatively near to the ventral median line; they are not, as is, for example, the case with *Perichæta affinis*, at the sides of their segment. The setæ of segment xviii. are present between the two pores, but they cease to be visible some little way from the pores on each side. The pores themselves lie in the direct line of the circle of setæ. Close to each of the apertures of the atria is a group of rounded orifices, which in one specimen showed the following arrangement:—There were four on one side and five upon the other, each group of pores lying in a circle below, and to the inside of, the atrial pores. The arrangement therefore, as well as the number of these pores, shows some differences from *Perichæta aspergillum*; I occasionally observed fewer than four pores, but never anything like so many as eleven, which Perrier states to be the number found in *Perichæta aspergillum*. When the cuticle is stripped off, these pores become very obvious and can be easily counted with a lens. Examined under the microscope they do not present the appearance of pores, but of solid papillæ covered by a reticulation; they are in fact, as I have already pointed out [1] for *Perichæta aspergillum* and other species of the genus, the openings of masses of unicellular glands.

I could not see the *spermathecal pores*, and there was no development of accessory papillæ corresponding to those which have just been described as occurring near the atrial pores. This is another point in which *Perichæta bermudensis* differs from *Perichæta aspergillum*, where such papilllæ have been described and figured by Perrier.

The *gizzard* occupies segments viii.–x., the septa of those segments being absent; the remains of the septa are to be recognized in a series of ligamentous bands which attach the gizzard to the parietes; of these there are three pairs: two on each side are attached, close to each other, not to the gizzard itself, but to the septum which lies just in front of it; they pass obliquely backwards and outwards; behind these and nearly at the posterior extremity of the gizzard is another band on each side. The walls of the œsophagus behind the gizzard are much folded (internally) and very vascular in segments xii.–xiv., particularly in segment xiii.; this region no doubt represents the calciferous glands of other Earthworms, which do not here form distinct diverticula.

In segments v. and vi. are "*blood-glands*" which present a racemose appearance.

The *intestine* is provided with the usual pair of cæca.

The *sperm-sacs* are in segments xi. and xii.

The curved duct of the *atrium* opens directly on to the exterior, and not through a dilated terminal portion; it is surrounded by innumerable small white glands, which correspond to the pores which surround the external orifice of the atrium.

The *ovaries* are in segment xiii.

[1] "Contributions to the Anatomy of Earthworms, with Descriptions of some New Species," Q. J. Micr. Sci. vol. xxx. p. 461 *et seq.* pl. xxix. figs. 3, 4, 5.

There are two pairs of *receptacula ovorum* in segments xiii.[1] and xiv. respectively. Those of segment xiii. lie above the ovaries.

The three pairs of *spermathecæ* lie in segments vi., vii., and viii. The oval pouch of the spermatheca has a long narrow duct: the diverticulum has the same form but is much smaller; it is hardly as long as the duct of the main pouch.

PERICHÆTA TAPROBANÆ, n. sp.

The following description is based upon the examination of some half-dozen examples of a *Perichæta* from Ceylon. The specimens were collected a good many years ago by Prof. Moseley and were deposited by him in the Oxford University Museum. Mr. W. Hatchett Jackson was so good as to place them in my hands for identification and description. The worms were labelled "*Perichæta cingulata*," and I presume therefore that they agreed with Schmarda's coloured figure of that species[2]. As, however, Schmarda's description of the species is not by any means sufficient for identification, I do not think it safe, in the present state of our knowledge of this genus of Earthworms, to define any species by colour only.

M. Vaillant[3], to whom we are indebted for the first anatomical account of *Perichæta*, identified six Earthworms in the Paris Museum with *P. cingulata*, apparently basing this identification upon the shape of the setæ. The futility of such a character is shown by the fact that Perrier[4] was rightly able to distinguish several distinct species among the individuals which were all called "*Perichæta cingulata*" by Vaillant. The name "*cingulata*" was applied by Schmarda in the belief that the species was characterized by possessing a clitellum. It is not, however, on this ground that I think it desirable to drop the name *Perichæta cingulata* altogether. Vaillant's *Perichæta cingulata* according to Perrier[5] is practically indistinguishable from the *Perichæta posthuma* of the same author; and it is impossible to be certain that they are different from Perrier's *Perichæta affinis*—so at least Prof. Perrier thinks, and Dr. Horst[6] agrees with him. But I do not follow Perrier in retaining the name *Perichæta cingulata* for *Perichæta posthuma*, since there are really

[1] Fletcher ("Notes on Australian Earthworms, Part III.," Proc. Linn. Soc. N. S. W. ser. 2, vol. ii. p. 394) describes in *Perichæta canaliculata* "a pair of smooth white sacs" lying above the ovaries in segment xiii., which are doubtless the same structures. *Two* pairs of these bodies occur in several species of *Perichæta*.

[2] 'Neue wirbellose Thiere,' Bd. ii. p. 16, pl. xviii. fig. 162.

[3] "Note sur l'Anatomie de deux Espèces du Genre *Perichæta*, &c.," Ann. Sci. Nat. 5e sér. t. x. p. 225.

[4] *Loc. cit.*

[5] *Loc. cit.* p. 114.

[6] "Descriptions of Earthworms, V.," Notes Leyden Mus. vol. xii. p. 232. It should be remarked, however, that Vaillant neither figures nor describes setæ upon the clitellum; he remarks, indeed, "la ceinture seule en [des soies] est privée." They *are* present in *Perichæta affinis*, so that probably Dr. Horst's earlier (Midden-Sumatra, Vermes, p. 4) identification of *P. cingulata* (of Vaillant) with *Perichæta indica* was more correct.

no reasons either for believing or disbelieving that Vaillant's *Perichæta cingulata* is the same species as Schmarda's *Perichæta cingulata*.

In the specimens which I examined there is no trace of the natural colour left; the worms are a pale brownish grey—the clitellum a darker brown. As they do not agree with any *Perichæta* of which there is an adequate description, I give them the new name *Perichæta taprobanæ*.

There are only four species of *Perichæta* which agree with the present in possessing only a single pair of spermathecæ, so that it is more easily to be discriminated than species which possess the more typical number of three or four pairs. The species in question are *Perichæta sangirensis*, Mich.[1], *Perichæta ceylonica*, F. E. B.[2], *Perichæta quadragenaria*, E. P., and *Perichæta elongata*, E. P. *Perichæta taprobanæ* differs from the last two species in a number of points; it will be sufficient here to mention one point of difference only for each species. *Perichæta taprobanæ* differs from *Perichæta quadragenaria* in the size and form of the spermathecal appendix; from *Perichæta elongata* in the characters of the "prostate"; from *Perichæta sangirensis* in the absence of a dilated sac at the distal extremity of the atrium. *Perichæta ceylonica* is distinguished by having two pairs of atria.

Perichæta taprobanæ is a stout worm, measuring about 80–100 mm.; the largest specimen was 105 mm. in length; an individual measuring 84 millims. in length had a breadth of 6·5 mm. and was composed of about 114 segments.

The worm undoubtedly belongs to the restricted genus *Perichæta*, although, as will be seen presently, one of the distinctive characters of the genus is absent: the *setæ* form continuous rows and are numerous; on the first setigerous segment of one specimen I counted 52 setæ, on the fifth 81, on the twelfth segment of the same individual there were 74, on the twenty-fifth 67. The seta-formula is therefore as follows:—

Segment I.	V.	XII.	XXV.
52	81	74	67

The setæ are present on *all* the clitellar segments and form complete circles. Their form is not different from that of the setæ elsewhere. Those upon the hinder segment of the body are nearly twice as long as those upon the anterior.

The *clitellum* is composed of the usual three segments, but is a little indistinct at both ends.

The *oviducal pore* is single and median; it lies in front of the circle of setæ of segment xiv.

The *atrial pores* are upon the xviiith segment and are sometimes very prominent—forming conical elevations—owing to a protrusion

[1] "Oligochaeten des naturhistorischen Museums in Hamburg, IV.," Jahrb. Hamburg. wiss. Anst. viii. p. 35.

[2] "Notes on some Earthworms from Ceylon and the Philippine Islands, &c.," Ann. & Mag. Nat. Hist., Feb. 1886.

of a part of the atrium ; the setæ are interrupted for a short space on either side of each pore, which, however, lie directly in the line of the setæ. I counted seventeen setæ between the male pores.

I could find *no* genital or copulatory *papillæ* of any kind.

The *spermathecal pores* were very evident in all the specimens ; they lie between segments vii./viii.

The *dorsal pores* commence between segments xii./xiii.

The anterior segments of the body are bi- or tri-annulate.

With regard to the internal anatomy of the species, I only direct attention to those points which are known to be of importance in the discrimination of species. The position of the *gizzard* is perfectly normal ; it lies in segments viii.–x., and the septa between these segments have nearly entirely disappeared, being represented only by a few ligaments binding the gizzard to the parietes. The *intestine* is very remarkable on account of the fact that there are *no cæca*. I looked for these structures very carefully, and entirely failed to discover them ; they are always (according to my experience) quite easy to find when present. I must therefore conclude that the present species is unique in the absence of cæca. Although there appears to be no Earthworm known on other grounds referable to the genus *Perichæta* (*s. s.*) which possesses no intestinal cæca, Mr. Fletcher [1] has described a *Megascolex* in which cæca are present. In *Perichæta queenslandica*, a worm with "interrupted circles of setæ," there are a pair of lateral cæca arising from the intestine in segment xxv. and directed anteriorly, as in all true *Perichætæ* with the exception of *Perichæta taprobanæ* [2] ; these two species evidently render it impossible to define strictly the genera *Perichæta* and *Megascolex*, though as a matter of convenience those names may be, for the present at least, retained until more exceptions are made known. In other particulars the alimentary tract of this Earthworm does not diverge from the normal.

The *intersegmental septa* commence to be distinct after the fourth segment ; the first four septa, viz. those bounding segments v.–vii., are rather thickened ; as are also the first two septa which lie behind the gizzard, that is to say those which separate segments x./xi. and xi./xii. The thick septa in front of the gizzard are covered with very conspicuous nephridial tufts.

The *sperm-sacs* lie in segments x., xi., and xii.

The *atria* consist as usual of a thick muscular duct bent upon itself and of a glandular portion consisting of ramifying cæca ; the latter is fairly compact except where it is cleft at its junction with the non-glandular part. The glandular part is much smaller than is usual in this genus, and is entirely limited to the xviiith segment. The muscular duct is unprovided with a dilated sac at its extremity.

There is only a single pair of *spermathecæ*, which lie in segment viii. They also are small ; and, as the facts contained in this account are based upon the dissection of several examples, I may emphasize the

[1] "Notes on Australian Earthworms, Part II.," P. Linn. Soc. N. S. W. ser. 2, vol. i. p. 964.

[2] I am not certain as to *Perichæta ceylonica*.

smallness of the atria and the spermathecæ as a characteristic of the species. Each spermatheca consists of a globular portion communicating with the exterior by a narrow duct, to which is appended a small diverticulum consisting also of a swollen terminal portion and of a narrow duct.

PERICHÆTA MORRISI, n. sp.

I name this species, of which I obtained several living examples from Kew, after Mr. Morris, Assistant Director of the Royal Gardens. Three or four specimens were forwarded to me, of which only one was sexually mature; the following description is based upon that specimen.

The species comes from Penang.

The accompanying coloured sketch by Mr. Smit (Plate IX. fig. 1) represents the natural colours of the worm and shows its distinctness from *Perichæta sinensis*, with which species, however, it cannot be confounded, as will be seen in the course of the following description.

The worms during life protruded the buccal cavity, as apparently all species of *Perichæta* do.

The length of the specimen (after preservation in weak, followed strong, alcohol) is 52 mm.; the number of segments in the body is 93.

The *setæ*, as in other species, form continuous rows.

The *clitellum* begins abruptly with the commencement of segment xiv., but does not terminate exactly at the posterior boundary of segment xvi.; the glandular substance ends at the level of the setæ which are present on the last segment of the clitellum, as in *Perichæta bermudensis* (see p. 160); the setæ of this segment, as in the species with which I have compared *Perichæta morrisi* in this particular, are only present upon the ventral surface.

The *oviducal pore* occupies the usual position.

The *atrial pores* open on to the xviiith segment, and are not separated by a very wide interval; they are in the line of setæ, but the setæ cease for a short space on either side of each pore.

The *spermathecal pores* lie between segments v./vi. and vi./vii.

There are no *papillæ* in the neighbourhood of the male pores, although on a subsequent dissection of the worm I noticed some minute white glands in the xviiith segment. Papillæ, however, are present upon certain of the anterior segments in the neighbourhood of the spermathecal apertures.

Upon each of segments vii. and viii. is a single circular disk occupying the median ventral line of the segment and lying just in front of the circle of setæ belonging to the segment.

The *gizzard* lies in segments viii.–x., the mesenteries which should divide those segments being absent.

The usual pair of *cæca* are present.

The *œsophagus* in segments x.–xiv. is much thickened and of a whitish appearance. This region doubtless corresponds to the calciferous glands of other Earthworms, which do not appear to be developed as distinct pouches in the genus *Perichæta*.

The *atrium* is not furnished with a distal sac.

There are two pairs of *spermathecæ*, which lie in segments vi. and vii.; the appendix is a tube of uniform calibre and is very nearly as long as the pouch. In the case of one spermatheca, the appendix is twisted at its commencement round the stalk of the spermatheca.

PERICHÆTA BARBADENSIS, n. sp.

In June of the present year I received from Kew Gardens five living worms of the genus *Perichæta*, which were all of a reddish-brown colour with a grey clitellum; the iridescence of the cuticle was very marked, on account of the dark pigment in the body-wall; when the worms were killed in weak alcohol, a quantity of yellowish fluid was expelled from the dorsal pores.

In spite of the close similarity in colour between all five specimens, I believe that they are to be referred to two distinct species, of which one—that which I call *Perichæta barbadensis*—is somewhat protean, showing considerable variations, which I do not, however, regard, for reasons which will be stated presently, as being of specific value. I describe the second species subsequently (see p. 169).

Two of the specimens were of about the same size, measuring 4¼ inches in length (when preserved in strong alcohol, after having been killed in *weak* alcohol); the diameter in front of the clitellum is 4 mm. The length of the preclitellar somites is 18 mm.; the clitellum itself measures 4 mm. The number of segments is 78.

In this individual—which I call *a*—setæ were present upon the last segment of the clitellum (Plate IX. fig. 6); the clitellum itself in all three specimens is fully developed upon all the segments xiv.–xvi. and bears anteriorly the single median oviducal pore; the number of setæ upon the last segment of the clitellum is small, about half a dozen.

In the second individual (*b*) the number of setæ upon the last segment of the clitellum is greater than in *a*.

In the third individual (*c*) the number of setæ upon the last segment of the clitellum is about as great as in *b*, but in addition the first segment of the clitellum (*i. e.* no. xiv.) bears three, or possibly four, setæ on each side of the oviducal pore (Plate IX. fig. 7), which there lies within the circle of setæ of its segment, and not, as is usually the case in the genus *Perichæta*, in front of the setæ. It might be supposed that these three individuals represented merely three stages in the disappearance of the setæ belonging to the clitellar segments. In immature worms setæ are always present upon the clitellar segments. I am not aware that any exact observations have been made as to the time and manner of their disappearance in those species which have, when adult, a clitellum devoid of setæ. But in the present species the differences in the clitellar setæ coincide with differences in the genital papillæ and also with differences in the number of spermathecæ. But, as will be seen presently, it does not happen that the worm with the fewest setæ upon the clitellum has the most marked development of the genital papillæ. Hence I

should conclude that this species is one whose characters are not yet definitely fixed; it is evidently on the way to entirely losing the setæ upon the clitellum.

The genital *papillæ*, as has been already remarked, differ in the three individuals.

In *a* there is, in the first place, a median sucker-like papilla upon segment vii., just in front of the circle of setæ; and in the second place, a single median papilla occupying an exactly corresponding position upon segment xviii.

In *b* there is no anterior papilla or papillæ; on segment xviii. are two papillæ placed on the inner side of each atrial pore and lying below the circle of setæ; the innermost papilla on each side is below as well as to the inside of the outermost, which occupies a corresponding position with regard to the male pore.

In *c* the arrangement is by far the most complicated, and yet this individual is the one which has the most setæ upon the clitellum.

There are no anterior papillæ; on the eighteenth segment a small circular papilla lies above each atrial pore and another lies exactly below it, on the boundary-line between segments xviii./xix. In the middle of segment xviii. are two papillæ lying side by side and above the setæ of that segment. On the right-hand side of the body is another papilla, which lies just above one of these two. There are thus seven papillæ in all.

In all three individuals the *atrial pores* are lateral in position, being separated by the entire diameter of the body, which is here a trifle wider than either anteriorly or posteriorly.

With regard to the internal anatomy, all three specimens showed the following characters in common:—

The *gizzard* occupies the usual position, and there are a pair of intestinal *cæca*.

The *intestine* has a small typhlosole.

The *atria* have an extensively developed glandular portion, which extends from segments xvii.–xxi. in *b* and from xviii.–xxii. in *a*; it is rather smaller in *c*, but then the worm itself is smaller [1].

I found two pairs of *egg-sacs* attached to the posterior face of the septa dividing segments xii./xiii. and xiii./xiv.; they are pear-shaped with a long stalk, and not very wide at the widest end.

The position and number of the *spermathecæ* differ in the three individuals: in *a* there were two pairs somewhat unsymmetrically disposed; they open, however, in the intersegmental grooves v./vi. and vi./vii. In segment vi. lie a pair, of which one was very small and immature; the fully developed spermatheca consists of an oval pouch terminating in a narrow duct, from which arises a long cylindrical appendix. In segment vii. the spermatheca of the right side of the body had the same characters; on the left side the duct of the spermatheca, although opening in the normal position, is greatly elongated, traversing septum vii./viii. and expanding in the viiith segment into the large oval pouch. The diverticulum of this spermatheca lies in segment vi.

[1] It measures 84 mm. and consists of 64 segments.

In *b* there are three pairs of spermathecæ in segments vi., vii., and viii., which are in every respect perfectly normal.

In *c* there are two pairs lying in vi. and vii., but quite normal in structure.

It may be that I am wrong in associating all these individuals together under one specific name.

PERICHÆTA HESPERIDUM, n. sp.

Two individuals out of the five specimens just referred to, of which I have described three under the name of *Perichæta barbadensis*, presented certain differences; these differences would, if the specimens had come from a different locality, be undoubtedly considered of specific value. As it is, I am uncertain, considering their exceedingly close similarity in coloration, whether to regard all five individuals as belonging to one protean species, or whether to regard the two specimens described here as a distinct species. Since the differences which they show to the three described as *Perichæta barbadensis* are more marked than either of the three exhibit among themselves, I give them at least a provisional name.

The *external characters* are those of *Perichæta barbadensis*, excepting that there are *no setæ upon the clitellum* and that there are *no genital papillæ*. In describing the last species, I pointed out that there is a gradual reduction in the three specimens of the setæ upon the clitellum, which is accompanied by a reduction in the genital papillæ. In the two specimens which I describe here as *Perichæta hesperidum* this reduction in number has culminated in the total disappearance of both the clitellar setæ and the genital papillæ. If it were not for certain differences in the internal anatomy, to which I shall call attention later, these facts would rather show that there is no necessity for separating the forms specifically.

In the internal anatomy there are, however, differences. I should say, however, that I have only dissected one of the two individuals associated together here under the name of *Perichæta hesperidum*.

In that worm the *cæca* are remarkably small as compared with those of other species. The *intestine* is provided with a fairly well-marked typhlosole; it commences in the xvth segment.

There are two pairs of *spermathecæ*, which lie in segments vii. and viii. and open on the border-line between segments vii./viii. and viii./ix.; in the case of the anterior pair, the displacement of mesentery makes the apertures, when viewed from the inside of the body, look as if they were placed in the middle of segment vii.

The diverticulum is contorted.

I only found a single pair of *receptacula ovorum* in place of the two pairs of the last species; they are attached to the front wall of segment xiii. and lie above the ovaries; they are elongate and lie obliquely on the septum.

The *atrium* shows a difference of importance from the last species; this is the presence of a terminal sac. This sac is, however, so extremely small in the present species that it needs careful looking

for and might very easily escape attention; the muscular duct of the atrium becomes very narrow just before it opens into this sac.

PERICHÆTA MAURITIANA, n. sp.

In August of last year I received from Kew a number of living Earthworms which had been accidentally imported from *Mauritius*; they proved on examination to belong to two distinct species: one is a *Urochæta*, indistinguishable, so far as I can see, from *Urochæta corethrura*; the other is a *Perichæta* belonging apparently to a new species.

At present one species of *Perichæta* is known to occur in Mauritius; and a second, although described from Australia, is believed to be indigenous to Mauritius. The first is *Perichæta mauritii* of Kinberg, which cannot be satisfactorily identified; the second—*Perichæta peregrina*—has been lately described by Mr. Fletcher [1], and so cannot be confounded with *Perichæta mauritiana*, which comes much nearer to *Perichæta robusta* from the neighbouring Ile de France.

The colour of the living worms was reddish brown, with a pale greyish-brown clitellum. Their habits are those of other species of *Perichæta*.

The length of the largest specimen, after preservation with corrosive sublimate and alcohol, is 80 mm.

The number of segments is 85.

The *clitellum* occupies the usual segments; the last segment of which it is composed has a short row of setæ in the middle ventral line, as in *Perichæta bermudensis*.

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

The *atrial pores* are in the line of setæ of segment xviii.; the setæ are interrupted for a short distance on each side of both apertures.

The *genital papillæ* are restricted to the neighbourhood of the atrial pores. There are three on each side, lying below and to the inside of the atrial pores.

The *gizzard* lies in segments viii. and ix.; it apparently does not extend, as this organ so often does in other species of *Perichæta*, into segment x.

The usual pair of *cæca* are present, which originate from the intestine in segment xxvi. and extend forwards to the anterior boundary of segment xxv.

There are two pairs of *spermathecæ* in segments vii. and viii. The diverticulum is as long as, or perhaps rather longer than, the spermatheca itself. It consists of a slightly sinuous tube with a globular extremity.

There are two pairs of *receptacula ovorum* (Plate X. fig. 5), both of which have the form which seems to be so generally met with in this genus of Earthworms. The organ is oval, with a long tail directed towards the median ventral line. The receptacula ovorum are attached to the front wall of segments xiii. and xiv. The anterior pair lie above the ovaries.

[1] "Notes on Australian Earthworms, Part II.," Proc. Linn. Soc. N. S. W. ser. 2, vol. i. p. 969.

The *atrium* is not provided with a terminal sac; the glandular part of each atrium is very extensive, and reaches from segment xvii. to segment xxii.

Between the opening of the atrium and the nerve-cord on each side of the body are three small white oval glands (*p.g.*, fig. 6, Plate X.), which correspond to the papillæ visible on the exterior of the xviiith segment.

Note on a Perichæta *from Singapore.*

I received a single specimen of this *Perichæta* in a living condition from Kew Gardens; it had reached there in a Wardian case from Singapore.

Unfortunately I omitted to make any notes upon the worm while alive; a quantity of other material which came about the same time obliged me to preserve it at once for future study; the specimen was killed in Perenyi's solution and investigated by means of transverse sections. It is very possibly the same species as that which I have called *Perichæta morrisi*, and described in the present paper; but my notes upon its diagnostic characters are so far from being complete, that I do not venture to express an opinion as to the name which should be applied to it.

It measured $2\frac{1}{2}$ inches when preserved.

The *clitellum* occupied the usual three segments, but I am not certain as to whether setæ were, or were not, present.

On the xviiith segment was a single median *papilla* placed between the two atrial pores.

I observed the *gizzard* to occupy the usual position and that *cæca* were present. There are two pairs of *spermathecæ* in segments vi. and vii.; these agree very closely with those of *Perichæta morrisi* in the proportions of the appendix to the spermatheca, but the extremity of the former was swollen, forming an oval sac. This is possibly merely due to the presence of more sperm in one case than in the other.

I desire to call special attention to the structure of the *atria*.

These organs have the usual form characteristic of the genus *Perichæta*.

Their minute structure, however, presents one character of some little interest, which has not yet been recorded in the genus. Transverse sections through the stout muscular duct by which the secretions of the glandular part of the atrium reach the exterior show that the muscular sheath encloses three separate ducts instead of only one, as is the case in all other species which have been as yet investigated microscopically. One of these tubes is large and is the main conduit of the secretion of the gland; the two other tubes are equal in size to each other, but very much smaller than the main tube.

The smaller tubes retain their distinctness from the larger tube until near the external orifice, though still remaining enclosed within the same muscular sheath. Just before the external aperture

they fuse with the larger tube, and all these open by a common orifice.

Traced in the reverse direction, one of the two smaller tubes was found to communicate with a separate lobe of the branched atrium. Whether this was or was not the case with the second of the two smaller tubes, I am not able to say.

These facts are of interest in relation to the structure of the terminal portion of the male efferent apparatus in *Perichæta ceylonensis*, a species which I described some years ago.

Perichæta ceylonensis differs from all other species of the genus in possessing *two* glandular bodies on each side in the xviiith segment. One of these is a lobed atrium like that of *Perichæta* in general, but with a straight instead of a curved muscular duct; the other is a tubular gland like the atria of *Acanthodrilus*. Unfortunately I have not been able to ascertain with which of these two glandular appendages the vasa deferentia communicate.

It seems to me that in this *Perichæta* there is a commencing separation of each atrium into two halves which culminates in *Perichæta ceylonensis*.

EXPLANATION OF THE PLATES.

Plate IX.

Fig. 1. *Perichæta morrisi*. Nat. size.
2. *Perichæta dyeri*. Nat. size.
3. *Perichæta sinensis*. Nat. size.
4. *Perichæta sumatrana* (?). Nat. size.
5. Genital segments of *Perichæta sinensis*. ♀, oviducal pore; ♂, atrial pore; *p*, genital papillæ. The segments are numbered, those of clitellum in roman numerals.
6, 7. Genital segments of *Perichæta barbadensis*, two varieties; letters as above.
8. Genital segments of *Perichæta dyeri*; letters as above.

Plate X.

Fig. 1. *Perichæta dyeri*, a portion of intestine and dorsal vessel showing septal glands. *D.V.*, dorsal vessel; *Int.*, intestine; *Spt.*, intersegmental septum; *gl.*, septal glands.
2. *Perichæta sinensis*, mulberry-shaped glands (*p.g.*) corresponding to papillæ.
3. *Perichæta sinensis*, a portion of contents of spermatheca in fresh condition.
4. *Perichæta sinensis*, a spermatheca drawn in the fresh condition. *sp.*, spermatheca; *d.*, diverticulum.
5. *Perichæta mauritiana*. *Spt.*, septum between segments xii./xiii.; *Spt.'*, septum between segments xiii./xiv.; *r.o.*, receptacula ovorum; *ov.*, ovary; *f.*, funnel of *od.*, oviduct.
6. *Perichæta mauritiana*. *N.*, nerve-cord; *v.d.*, vas deferens; *at.*, muscular part of atrium; *p.g.*, glands corresponding to papillæ.
7, 8. *Perichæta sinensis*, vascular plexus from spermathecal appendix.