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with the same kind of difficulty from an opposite cause ; the intense sun's light has to be obscured by a dark glass, which, at the same time, completely obliterates the spider-lines ; these are only seen on the sun's face. In consequence, the advent of the sun's edge to a wire cannot be observed ; the line must be fairly on the sun's face before we can see it, and thus the noted instant is necessarily too late,—too late by a quantity depending on the power of the telescope and on the skill of the observer. Hence the estimate of the sun's apparent diameter from observations of the meridian passage may be expected to err slightly in defect, while the thence-deduced right ascension must be too great.

But, if a thin cloud pass before us, we use a paler screen and see the wires over the whole field while the sun's edge remains distinctly defined ; the observations are then satisfactorily made. It occurred to me that, at all times, we may make an artificial cloud, and, to-day just four weeks ago, I laid a thin muslin over the object-glass of my alt-azimuth, and got all that is needed.

5. Observations on the Structural Characters of certain new or little-known Earthworms. By Frank E. Beddard, M.A., Prosector to the Zoological Society of London, and Lecturer on Biology at Guy's Hospital. (Plate V.)

The present paper contains a description of five apparently new species of Lumbricidæ from Australia and New Zealand, one of these species being perhaps the type of a new genus, which I have named *Neodrilus;* the remaining species are *Acanthodrilus neglectus*, from New Zealand, *Perichæta newcombei*, *Urochæta*, sp. ?, from Australia, and *P. upoluensis*, from one of the Pacific islands. I have endeavoured to make these descriptions as full as the material, in many cases in an excellent state of preservation, has enabled me to do. I have also incorporated into this paper some few notes on *Perichæta antarctica*, Baird, a species which has not yet been sufficiently discriminated.

Acanthodrilus neglectus, n. sp.

In my paper on New Zealand Lumbricidæ, recently published in the "Proceedings of the Zoological Society" (*P. Z. S.*, 1885, pt. iv.),

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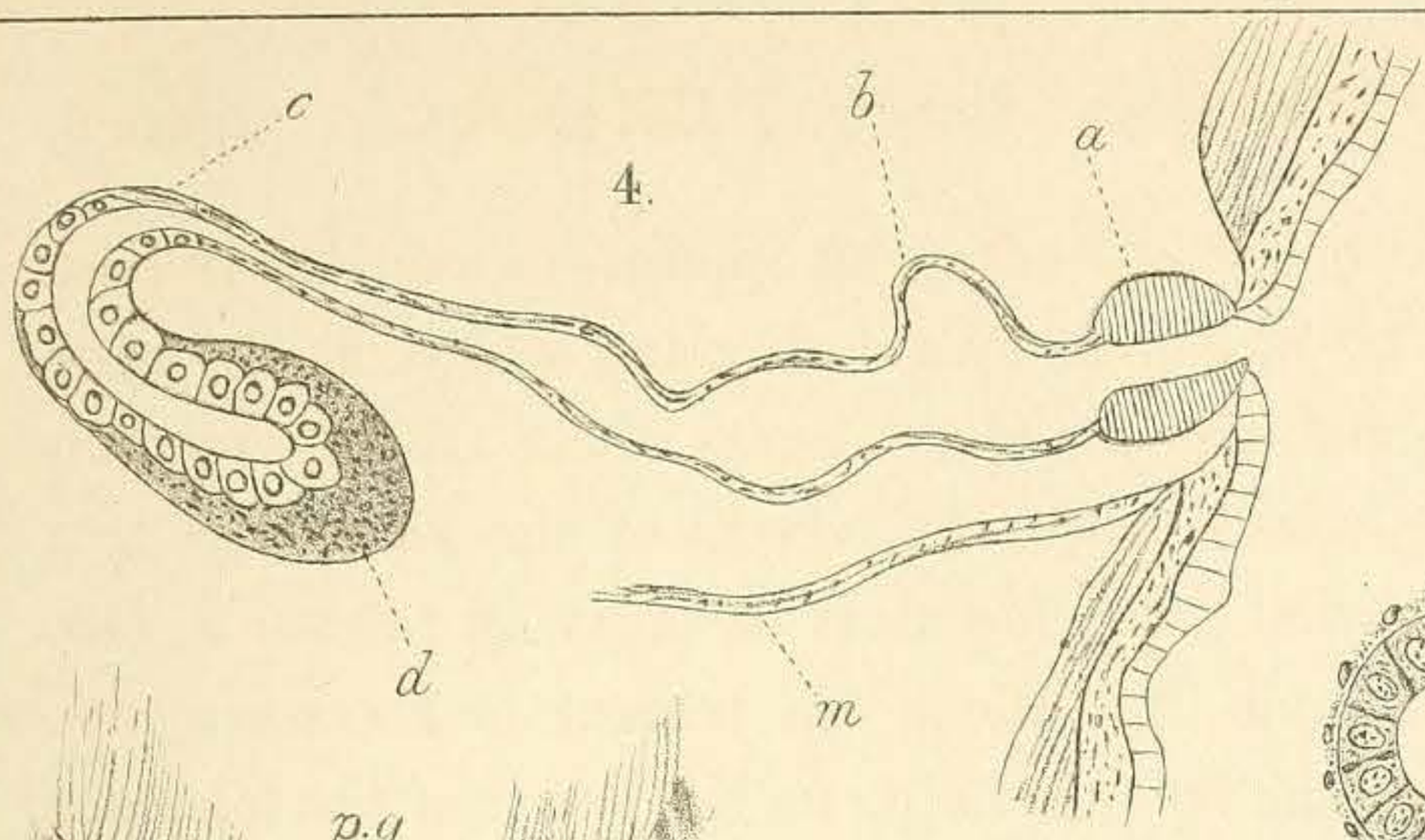

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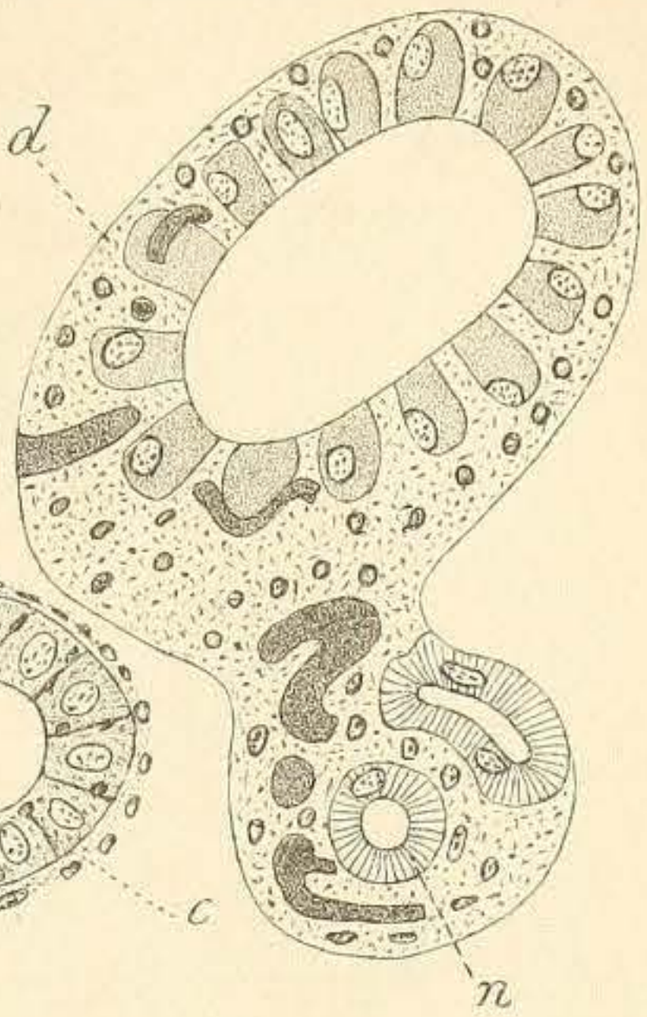

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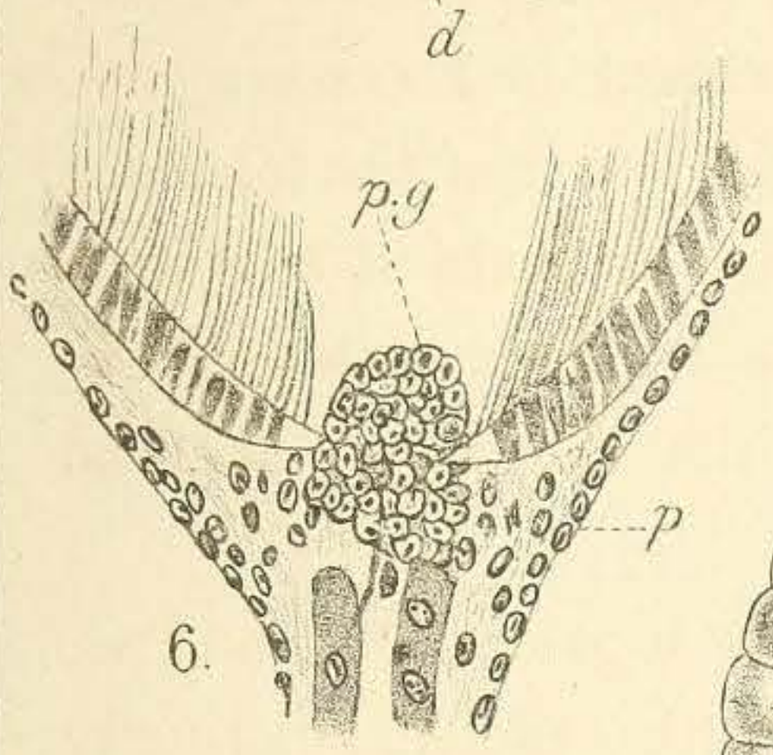

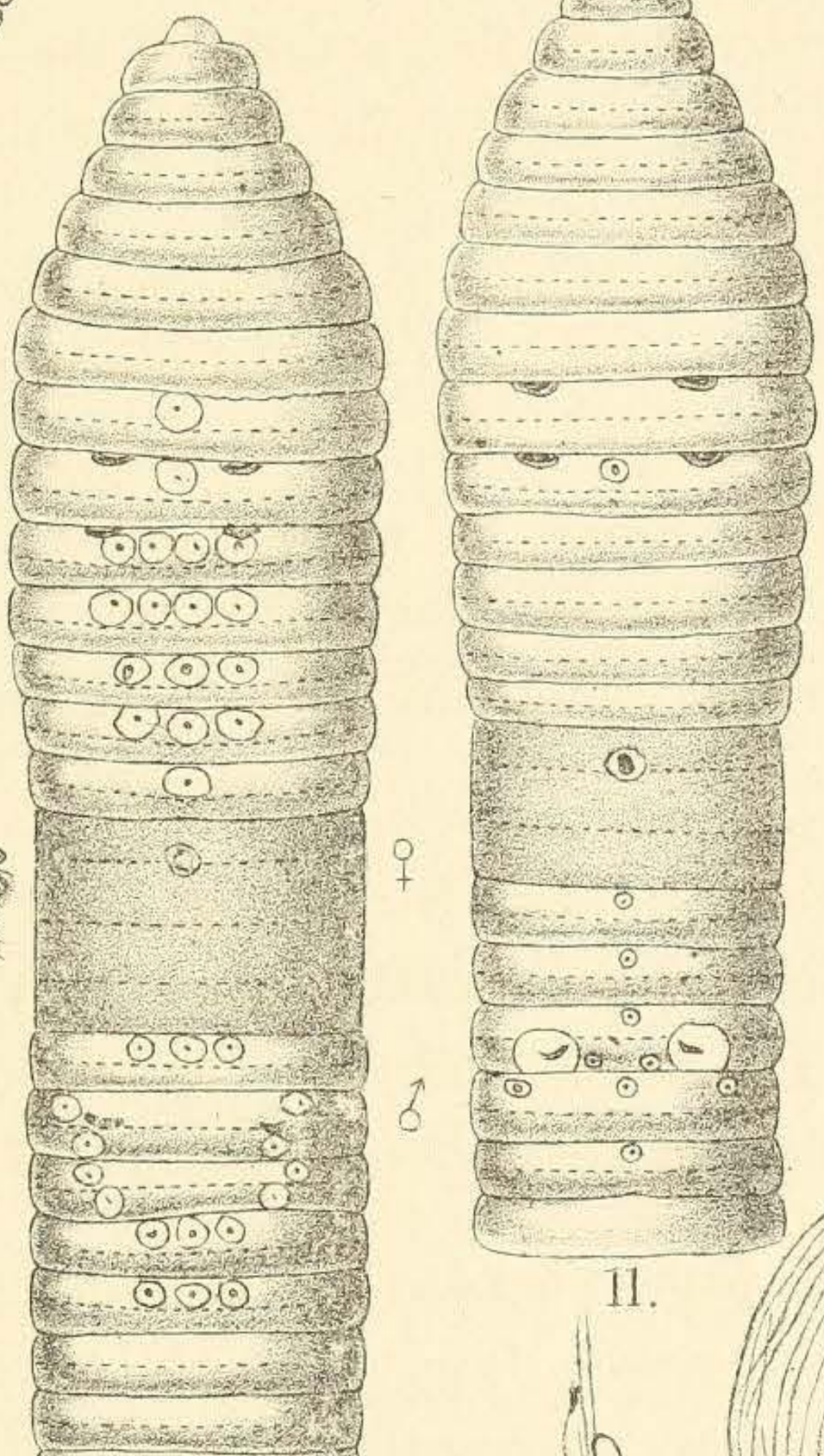

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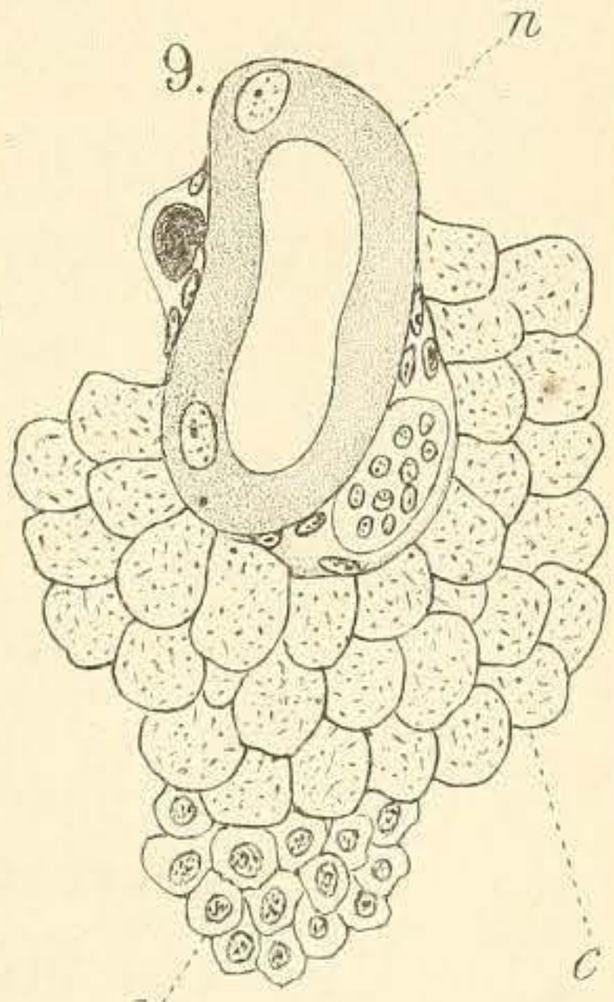

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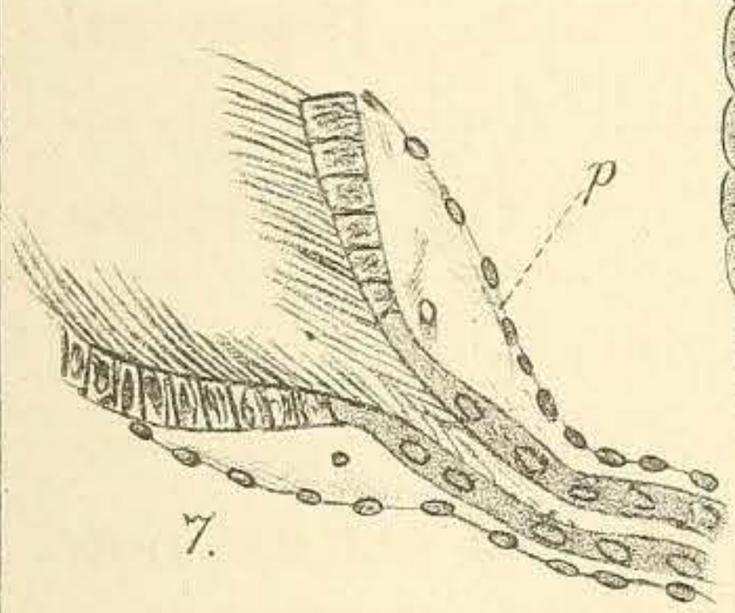

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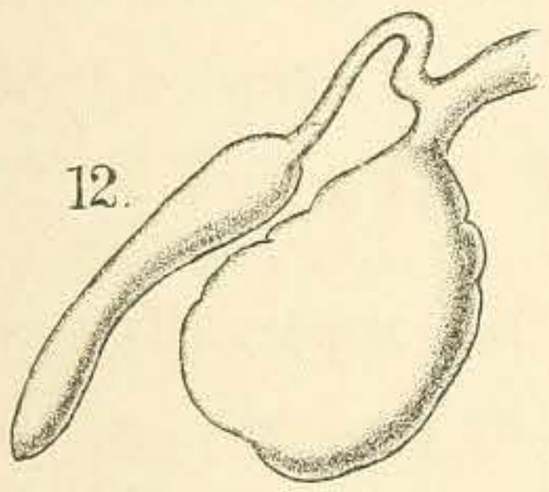

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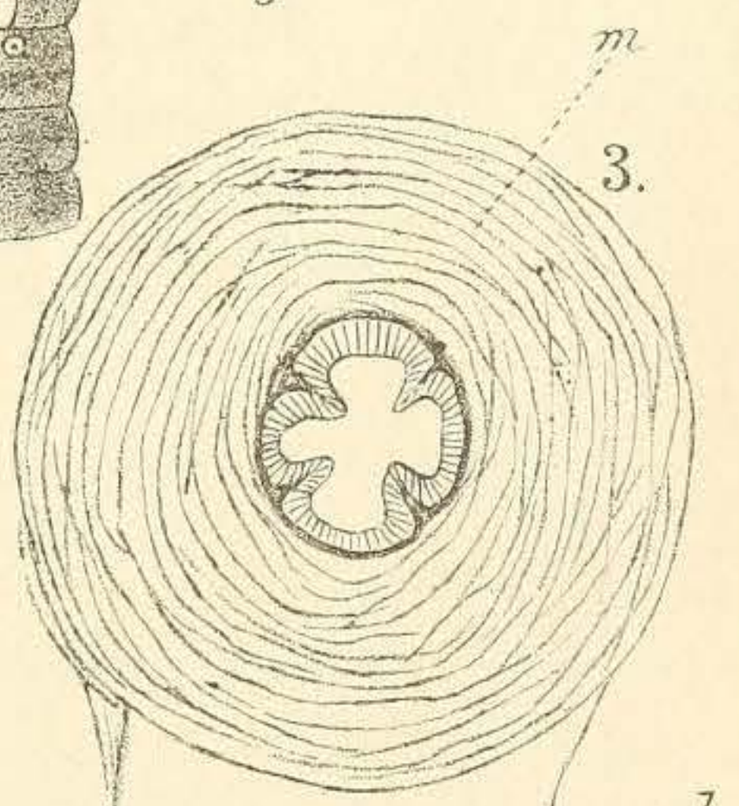

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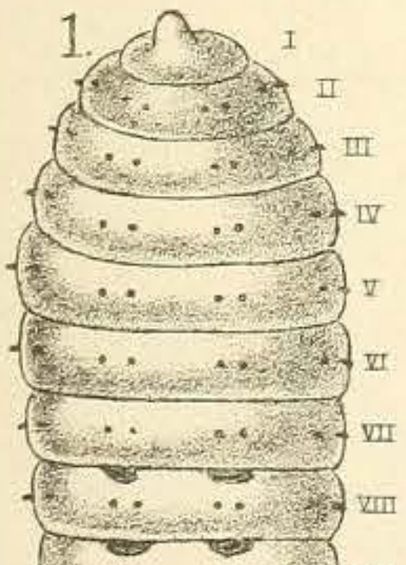

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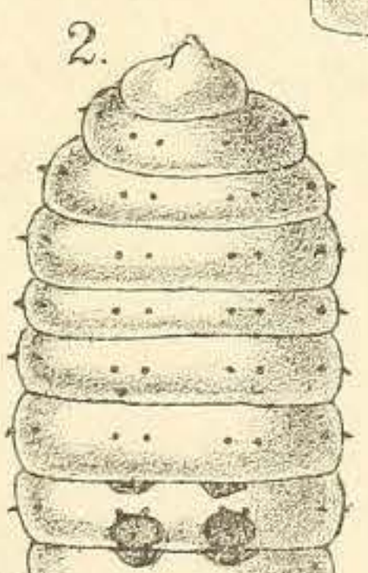

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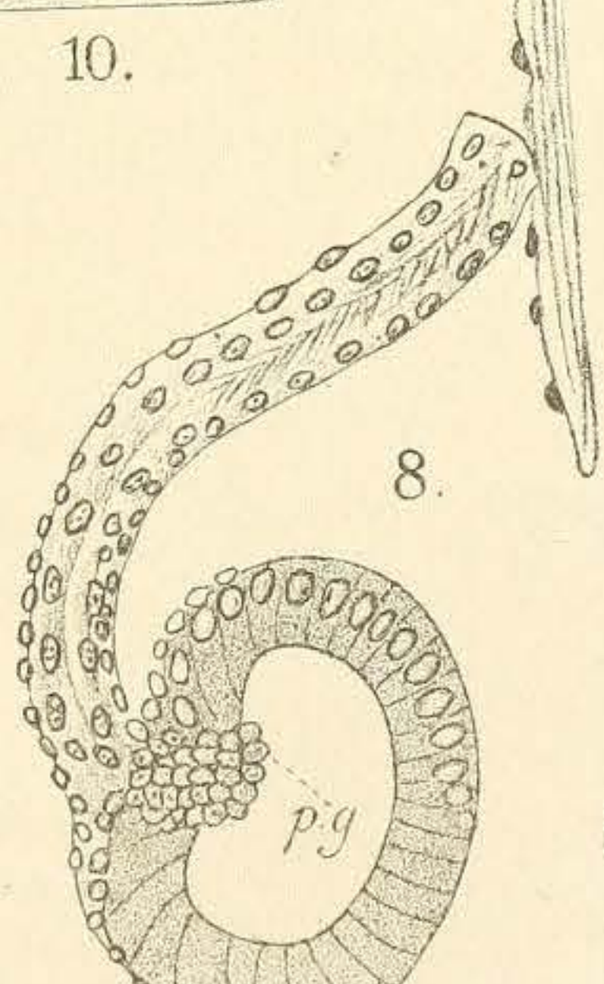

F. E. Beddard, ad. nat. del.

M^cFarlane & Erskine, Lith^rs Edin^r

I described two species of *Acanthodrilus*—*A. novæ-zelandiæ* and *A. dissimilis*—very closely allied in structure, and agreeing in a number of points to differ from the third species, *A. multiporus*. *A. dissimilis* is distinguished from *A. novæ-zelandiæ* mainly by the character of the spermathecæ; these organs are present in both species to the number of two pairs. In *A. novæ-zelandiæ* each spermatheca, which is somewhat pear-shaped, is provided with a number of small diverticula arranged round its external orifice; in *A. dissimilis*, the spermatheca has but a single pair of diverticula, which are of very considerable size. The former species is also frequently provided with a double dorsal blood-vessel; this character is, however, not absolutely distinctive of *A. novæ-zelandiæ;* some individuals agree with *A. dissimilis* in possessing a single dorsal vessel. I may state that the condition of the dorsal vessel is no criterion of the age of the individual. In the largest specimens of *A. novæ-zelandiæ* dissected by me the dorsal vessel was double, while those specimens in which it was represented by a single tube happened to be very small.

On again looking through the collection of New Zealand earthworms which Prof. T. J. Parker kindly sent me, I find that I have confounded two apparently distinct species under the name of *Acanthodrilus dissimilis*.

As there are a large number of individuals of *A. dissimilis* which fall into two series, I think that I am justified in making a specific, or at least a subspecific distinction, although the point wherein the two series of individuals differ is after all rather a small one; but it seems to me that a differential character, if it be constant for a large number of specimens, is of importance, however small.

The accompanying drawings illustrate the difference to which I refer.

In fig. 1, which represents the anterior segments of the body seen ventrally, there are a pair of genital papillæ situated on segment 10. For this variety I shall retain the name *A. dissimilis*. In fig. 2 the genital papillæ occupy a different position; they are situated on the 8th segment. For this variety I propose the name of *A. neglectus*.

Neodrilus monocystis, nov. gen. et sp.

On looking over a collection of earthworms which I have received

from New Zealand by the kindness of Prof. T. J. Parker, I found a single individual which differs from the rest in a number of characters. The remaining specimens belong to three distinct new species which I have lately described,* referring them to the genus *Acanthodrilus*. The specimen which forms the subject of the present communication appeared at first sight to belong to the species *Acanthodrilus dissimilis*, F. E. B., though considerably more slender than any of the individuals of that species which the collection contained.

The setæ are disposed in four series of pairs, and the nephridial pores alternate in position precisely as in *Acanthodrilus dissimilis*. The clitellum occupies a similar position, and extends over an equal number of segments, viz., 5 (13–17). Instead of there being two pairs of spermathecal apertures, there is only a single one situated between the 7th and 8th segments, on a line with the inferior pair of setæ. The male generative pore is placed upon the 17th segment, and each pore is continuous with a groove upon the integument, which extends over the following segment, and ends upon the middle of the 19th segment. I could not, however, detect a second pair of male generative pores upon this segment. In *Acanthodrilus dissimilis*—at least in many individuals—there is a similar groove connecting the genital pores of the 17th with those of the 19th segment entirely similar to that of *Neodrilus*. It is possible that this supposed new genus *Neodrilus* is really an *Acanthodrilus*, in which the posterior pair of male generative pores, together with their glands, have not yet been developed. I am not aware, however, of any similar instance in the genus *Acanthodrilus*, and the present species is fully mature. In favour of this supposition, however, is the condition of certain other peculiar accessory generative structures which I have lately described † in a species of *Acanthodrilus* from New Caledonia; these are sometimes present and sometimes absent in mature individuals. Another possibility is that the present individual is abnormal, and it is principally for these reasons that I have hesitated in making a new genus; though there can be no doubt of the *specific* distinctness of the worm.

The male generative pore is continuous with a long, coiled, tubular prostatic gland, the proximal region of which is a slender

* *Proc. Zool. Soc.*, 1885, pt. iv. † *Proc. Zool. Soc.*, 1886.

muscular (fig. 3 *m*) tube, while the distal region is thick and glandular (fig. 3 *gl*); with the aperture is also connected a thin-walled sac containing a bundle of long penial setæ.

Spermathecæ.—In the 8th segment are a pair of oval spermathecæ, which open on to the exterior in the groove which separates this segment from the one in front. As is so generally the case, they are provided with a diverticulum. The diverticulum of each spermatheca lies in the segment in front of that which contains the spermatheca itself, and is remarkable in being actually larger than the spermatheca. In most, if not in all, the genera of earthworms which are included in Perrier's two groups, Intraclitellians and Postclitellians, the spermathecæ open close to the anterior boundary of the segment which contains them. In certain species of *Lumbricus* and other Anteclitellian genera, the position is sometimes different, the spermathecal apertures being situated near to the posterior boundary of their segment. In one instance, at any rate, the spermathecæ actually perforate the mesentery bounding the segment which contains them on their way to the exterior. In a species of earthworm lately described by myself in a note communicated to the Royal Society of Edinburgh,* this is the case with one or more of the seven pairs of spermathecæ which are present in that species. It might be imagined, therefore, that in *Neodrilus* the anterior larger portion of the spermatheca really corresponds to the spermatheca, while the posterior smaller portion is the homologue of the diverticulum so constantly found in *Perichæta*, *Acanthodrilus*, and in other genera. Without an examination of the minute structure of the two regions of the spermatheca, it would be difficult to say which was spermatheca and which diverticulum. In three species of *Acanthodrilus* I have described, I believe for the first time, a very marked difference in minute structure between the spermatheca and the diverticulum, which is correlated with the fact that the spermatozoa always appear to be stored up in the diverticula. In the present species I find an identical difference in the structure of the spermatheca and its appendage, which leads to the inference that the anterior sac is the diverticulum. Seeing that in many cases, especially in *Perichæta*, the diverticula of the spermathecæ extend into the segment anterior to that which con-

* *Proc. Roy. Soc. Edin.*, 1885–6, p. 451.

tains the spermatheca itself, the disposition of these structures in *Neodrilus* is perfectly normal.

The *Nephridia* have exactly the same structure as in *Acanthodrilus dissimilis*, and, as already mentioned, alternate in position from segment to segment in the same fashion. This fact cannot, however, be regarded as a proof that the two worms belong to the same genus. I shall have occasion to point out in a future paper that an Australian earthworm, *Cryptodrilus fletcheri*, n. sp., possesses nephridia which are in every respect similar to those of *Acanthodrilus* and *Neodrilus* in structure and in position, and other instances are there mentioned.

Urochæta, sp.

The present description is the outcome of an investigation into the structure of an Australian species of the genus *Urochæta*. The specimens were kindly given to me by Mr S. Prout Newcombe, and come from Queensland. I have been able to examine a large number, all of which were in a very fair state of preservation for microscopical examination.

The genus is at present known to inhabit Brazil, the West Indies, Java, Sumatra, and Australia, and comprises only three species at most. The first of these was originally described by Fritz Müller,* who met with it in Brazil, under the name of *Lumbricus corethrurus*. The specific name "brush-tail" was given to the worm on account of the irregular disposition of the setæ at the posterior end of the body; the segments are in this region of the body very close together, and the setæ being usually (at least in the contracted state of the body) much protracted and directed backwards, the aptness of the name will be very evident to any one acquainted with these worms. Fritz Müller did not thoroughly investigate the structure of the worm, and was therefore unable to see any reason for removing it from the genus *Lumbricus*.

A somewhat fuller account of the same species was given by Perrier in his "Recherches pour servir à l'histoire des lombriciens serrestres." † Perrier rightly created a new genus for the reception

* *Arch. f. Naturg.*, xxiii.; *Ann. and Mag. Nat. Hist.*, ser. 2, vol. xx.; *Abh. d. naturf. Gesellsch. in Halle*, v., vi., 1857; in *Landplanarien*, von Max Schultze.

† *Nouv. Arch. d. Musèum*, t. viii. (1872).

of this species, which he termed *Urochæta*, but he altered the specific name of Müller into "*hystrix.*" Two years later M. Perrier published * a much more detailed and beautifully illustrated memoir upon the same species, which he referred to more correctly under the name of *Urochæta corethrura.* The specimens investigated by Perrier were obtained, not only from Brazil, but also from the West Indies (Martinique), and, which is more remarkable, from the island of Java. Perrier is inclined to think that the occurrence of the same species in the New World and in Java is rather to be explained by its accidental importation into the latter country, than to be regarded as of importance as a fact in geographical disposition. The occurrence, however, of a very closely allied species in the neighbouring island of Sumatra is somewhat against the supposition, and I am not at all certain that the species to be described in the present paper—a native of Australia—is really different from *Urochæta dubia.*

A second species of the genus has been quite lately described by Dr Horst, † under the name of *Urochæta dubia*, from Sumatra. Dr Horst's description is necessarily—owing to the poor condition of his material—brief, and only refers to the more important points.

The differences between *Urochæta dubia* and *U. corethrurus* are chiefly in the position of the spermathecæ (situated in segments 6, 7, 8, instead of 8, 9, 10) and in the fact that there are four pairs of modified clitellar setæ, a pair upon each of the segments 18, 19, 20, 21, instead of the single pair (on segment 20) of *U. corethrurus.* It appears also that in Horst's species all the segments anterior to the clitellum are furnished with setæ, while in *U. corethrura* the first three segments are devoid of these structures; furthermore, the irregularity in the arrangement of the setæ begins to be evident in segment 10 in *U. dubia*, and not until segment 14 in *U. corethrurus.*

The *clitellum* is very readily to be made out with specimens of the Australian *Urochæta*, and occupies about eight segments, commencing with the 14th and ending with the 22nd. Very often the first and last of these segments were only partially

* *Arch. de Zool. Exp.*, t. iii. (1874).

† *Midden Sumatra*, Vermes door Dr R. Horst, p. 7.

invaded by glandular substance. In fully mature individuals the clitellum was perfectly developed on the ventral as well as on the dorsal side of the segments pertaining to it. A remarkable fact about the clitellum of this species is that the glandular substance is entirely undeveloped between the segments, so that this region of the body is just as plainly segmented as any other region; indeed, the contrast between the thick glandular appearance of the segments themselves, and the deep furrows which separate them, renders the segmentation if anything rather more conspicuous than elsewhere.

It is to be noted that the number of segments occupied by the clitellum and their position is the same as in the other two species of *Urochæta.*

The disposition of the *setæ* is remarkable; in the anterior segments of the body, comprising the first eight segments, the setæ are arranged, as in *Lumbricus*, in four series of pairs; the two setæ of each pair are closely approximated to each other, and the intervals between the pairs are not widely different.

In the 9th segment there is already some little difference in the setæ; the two setæ of each of the ventral pairs are at a little greater distance from each other than in the preceding segments; the dorsal pair of setæ of the right side is completely similar to the same pair of setæ in the foregoing segments; on the left side, however, the two setæ have become widely separate, the distance between them being much greater than that which separates the individual setæ of the ventral pairs.

In the next segment the two setæ of each of the ventral pairs are somewhat more widely separated from each other, but the two setæ of each of the dorsal pairs are again quite close together, as in the earlier segments.

In the next few segments the two ventral pairs of setæ remain exactly as in the segments just described; the innermost setæ of the dorsal pairs correspond exactly in position to the innermost of the same pair of setæ in the earlier segments. The outermost setæ, however, vary very much in position, being sometimes nearer to, and sometimes further away from the innermost setæ; moreover, the two halves of the body are not symmetrical in this respect.

Throughout the greater part of the body, commencing shortly

after the clitellar segments, if not earlier, the setæ have a partly regular, partly irregular arrangement. The ventral setæ of each pair have a fixed position, and correspond for a large number of consecutive segments; the dorsal setæ of each pair are, on the contrary, quite irregular in their disposition. There appears to be no regular alternation in their arrangement; it sometimes happens that the seta of two consecutive segments will correspond in position, sometimes the setæ of one segment, and the next but one or next but two, &c., that it is impossible to lay down any general statements. The two halves of the body are not symmetrical in respect of their setæ. In the hinder part of the body there is a perfectly regular alternation of the setæ from segment to segment; each seta of one segment is exactly between two setæ of the preceding and consecutive segments; and this statement applies to all the setæ in that region of the body, hence there are exactly sixteen rows in this region of the body, while there are a great many more anteriorly.

In *U. corethrurus* the setæ of the anterior segments are disposed regularly and in pairs; but the two setæ of each pair do not appear from Perrier's description to be so closely applied as in my species. They agree in the fact that in the posterior part of the body the setæ regularly alternate, each seta being placed between two setæ of the preceding and succeeding segments. Perrier, however, says nothing about the disposition of the setæ in the middle portion of the body. I must assume, therefore, for the present that the remarkable arrangement of the setæ of my *Urochæta* in this, by far the greater portion of the body, is peculiar to that species, and distinguishes it from *Urochæta corethrurus.* Dr Horst's description of *Urochæta dubia* seems to show that this species differs but little in this particular respect from *U. corethrurus.*

With regard to the shape of the setæ, I have to record an important difference from *U. corethrurus.* Perrier describes and figures the setæ in the latter species as being bifid at their free extremity, and dwells upon the similarity in this respect to the *Naidea.* Horst says nothing about the structure of the setæ in *U. dubia.* In my species I did not succeed in observing any bifurcation of the distal extremity of the setæ; these structures are, in fact, precisely similar to those of other earthworms. This differ-

ence might be regarded as of generic value, were it not for the correspondence in all other essentials of structure.

Another point of difference from *U. corethrurus* concerns the genital setæ; not, however, in their general shape, for I find no difference in this respect between the genital setæ of my *Urochæta* and those figured by Perrier. But while in *U. corethrurus* the genital setæ are confined to segment 20, where they replace the ventralmost setæ on either side, my species has four pairs of these peculiarly modified setæ; they have precisely the distribution mentioned by Horst in *U. dubia*, being found upon segments 18–21, and occupying the position of the ventralmost setæ.

Intersegmental Septa.—As in so many other species and genera of earthworms, the present species exhibits a thickening of certain of the anterior mesenteries. There are four of these specially thickened mesenteries, the first of which immediately follows the gizzard; the last forms the posterior boundary of segment 10. It is in the segments bounded by these thick mesenteries that the spermathecæ lie.

The hindermost of these thickened mesenteries, as already stated, marks off the 10th from the succeeding segment; the arrangement of the mesenteries in front of this does not correspond exactly with the external segmentation. The posterior spermatheca lies in a segment which is bounded anteriorly by the last but one of the thickened mesenteries, and posteriorly by the last of these; externally, however, this segment is distinctly separated by a cross furrow into two segments; and, moreover, the difference between the external and internal segmentation is not only marked by a cross furrow, but also by what is more important, namely, a distinctly double row of setæ.

In the median ventral region of the body there are traces left of the mesentery which should divide the 9th from the 10th segment on either side of the nerve cord; and symmetrically disposed in relation to the nerve cord and to each other is a muscular band, which is attached above to the posterior stout mesentery, and below to the furrow which marks the division between the 9th and 10th segments. The stout mesenteries are everywhere at their insertion on to the body wall divided into separate muscular bands, two of them only being left between segments 8 and 9.

A comparison of the above description with that of Perrier (*loc. cit.*, p. 390) will show that there is some little difference in these points from *U. corethrurus*. Perrier, in fact, states that in his species the specially thickened mesenteries are inserted on to the posterior margin of segments 5, 7, 8, 9, and 11; two segments, viz., 6 and 10, appear therefore to have lost the posterior mesentery, instead of only one segment, as in my species.

There is some difficulty in making an exact comparison between the two species, because Perrier's figure (pl. xv. fig. 28) does not agree with his description. In the figure referred to there are but *four* thickened mesenteries, which seem to correspond exactly in their arrangement to the mesenteries of the Australian species. There seems, however, to be a slight difference in position; the last thick mesentery in my species forms the posterior margin of segment 10, if the commencement of the clitellum has been rightly referred by me to the 12th segment. It is, however, not an easy matter to differentiate the two or three anterior segments of the body; and, as Perrier had living specimens at his disposal, it is probable that his enumeration of the segments is more correct than mine. In this case the clitellum in my species begins a segment later than in his.

Integument.—Perrier's memoir contains a detailed account of the structure of the integument (pp. 382–400), illustrated by numerous figures. I cannot, however, altogether reconcile his description and figures, in so far as they refer to the structure of the epidermis, with the appearances presented by my own sections.

In fig. 1 Perrier gives a general view of the epidermis or surface view, in which it is seen to be marked out into polygonal areas, separated by a certain amount of interstitial matter; some of these contain granular bodies (lettered *a* in his figure), while others are without them. Between the setæ are certain very peculiar structures (*g*), which appear in section to be contained in sac-like diverticula (fig. 3) of the chitinous cuticle. The bodies themselves are highly refractive; these evidently correspond to similar structures described by Vejdovsky in *Anachæta.**

In transverse sections through the integument of my specimens of

* *Monograph. d. Enchytræiden*, p. 21; see also a paper by myself in *Proc. Roy. Soc. Lond.*, 1885, p. 464.

Urochæta, I have met with these peculiar structures in abundance. They stain very deeply in borax carmine, but have the appearance of being formed of some resistant substance, being frequently indented; they lie at the base of the epidermic cells, just in the position in which Perrier has figured them (*loc. cit.*, pl. xii. fig. 2 *g*). There is, however, this difference, that whereas in *U. corethrurus* they almost invariably form a regular line between the several setæ of a segment, being but rarely disposed irregularly, in my species the contrary is the case; they are very frequently irregular in size as well as position, though they form always a continuous row between the setæ, and are not, as far as my experience goes, found elsewhere. Perrier is quite right in stating that the polygonal areas in his figure correspond to cells, but has overlooked the fact (which was not known at the time when he wrote) that the "interstitial" substance is also cellular, and consists of elongated narrow cells, the polygonal spaces being occupied by large glandular cells with granular contents which do not stain. In fig. 2, pl. xii. of Perrier's memoir, a transverse section through the epidermis is figured, which does not at all represent the appearances presented by my sections. In Perrier's figure are represented a series of columnar granular cells, among which are a few peculiar rod-like bodies; these latter I am unable to identify in my preparations, unless, indeed, they correspond to the columnar hypodermic cells. The columnar granular cells appear to be a very inaccurate representation of the large glandular cells, which appear to be much more numerous in *Urochæta* than in *Lumbricus*. Judging by other earthworms, it does not appear to be at all likely that M. Perrier's fig. 2 illustrates a real difference in the structure of the epidermis from my species.

I have frequently noticed, on a superficial view of the epidermic, irregularly shaped refractive bodies, like those figured by Perrier and lettered *a* in his figure (pl. xii. fig. 1), within the glandular cells.

Excretory Organs.—My species of *Urochæta* possesses, like *U. corethrurus*, a pair of large glands in the anterior segments of the body, which have been termed by Perrier "glandes à mucosité." These glands open on to the exterior of the body through a long duct with muscular walls. With regard to

the external orifice, Perrier remarks (*loc. cit.*, p. 460):—"En faisant des coupes dans la région antérieure du corps, nous avous constamment rencontré dans l'épaisseur même des téguments un canal circulaire entouré d'une sorte de sphincter et présentant des cils vibratiles très-reconaissables même sur des individus desséchés. Nous avions d'abord pensé que nous avions sous les yeux la coupe de la portion du canal excréteur des glandes à mucosité qui est logée dans les téguments; mais nous n'avons pu nous convaincre de l'inexactitude [exactitude?] de cette appréciation. Dans nos coupes ce canal s'est toujours montré unique, et les glandes à mucosité ont des orificies excréteurs distincts; de plus, le canal en question nous a paru occuper la partie la plus antérieure du corps; et ces faits sont contraires à la supposition qui nous était d'abord venue à l'esprit." If M. Perrier means to state in the above-quoted words that the excretory duct of the "glande à mucosité" is furnished at its termination with a "sphincter" like that which surrounds the aperture of the nephridia, I am in a position to confirm the correctness of his statement. By a series of transverse sections, I have been able to trace on both sides of the body the duct of this gland to its external opening, and I find that the latter is surrounded by one of these peculiar bodies which Perrier was the first to record in the case of the nephridia. On the other hand, the duct never traversed the body walls except, of course, at the point where it perforates it on its way to the exterior, and the *two* ducts were both perfectly distinct. M. Perrier does not mention whether the single duct which he found in the transverse section was situated laterally or in the median line. I cannot detect any trace of cilia in these canals, which, indeed seem to be hardly needed, as they are physiologically replaced by the muscular walls. The presence of the "sphincter" is evidently an important additional resemblance between the glandes à mucosité and the nephridia.

With regard to the *nephridia*, I am unable to find in my species what Perrier states to be the relations of the internal funnel in *U. corethrurus*. He says (*loc. cit.*, p. 438)—"Les pavillons vibratiles . . . (sont) très-rapprochés de la ligne médiane et appliqués contre la cloison. Il y a là quelque chose de différent de ce qu'on observe chez les naïdiens, où les pavillons vibratiles traversent en général la cloison antérieure de chaque anneau, fait que l'on retrouve

aussi chez les *Pontodrilus.* Les Lombrics au contraire semblent d'après les auteurs, se comporter comme les *Urochæta.*"

M. Perrier figures (*loc. cit.*, pl. xvi. figs. 38, 39) the isolated nephridia, which obviously could not be detached entire if the funnel were not situated in the same segment as that which bears the external pore. Nevertheless, in my species I observed in numerous cases that the internal funnel of the nephridium is situated in the segment anterior to that which bears the external pore. I was able to prove this point conclusively by a series of longitudinal sections. It may be that Perrier's specimens and mine differ in this respect, which is certainly rather remarkable. Perrier's assertion about *Lumbricus* is evidently a slip. The funnel (figs. 6, 7, 8) of the nephridium recalls that of *Dendrobæna rubida* (Vejdovsky, *System u. Morph. d. Oligochæten*, pl. xiv. figs. 15, 16) in the extraordinary development of cells, doubtfully regarded by Vejdovsky as peritoneal cells, at the apex of the funnel.

A series of remarkable structures, termed by Perrier "glandes posterieures," and described by him as a portion of the excretory system, now remains for consideration.

These bodies are found as in *U. corethrurus* in the hinder region of the body, but appear to be more numerous than in that species, which has about forty pairs occupying as many segments.

M. Perrier gives a figure of one of these glands (*loc. cit.*, p. xvii. fig. 47), which only partially indicates their structure, as seen in my own preparations. They are somewhat pear-shaped, and terminate in a long slender peduncle, which disappears among the coils of the nephridial tubules. Perrier supposes that they open in common with the latter on to the exterior, but was unable to detect the orifice. Mr Benham* has detected these peculiar glands—"pyriform bodies"—in his genus *Urobenus*, and his description of their minute structure agrees pretty closely with my own observations; these glands open in *Urobenus* ventrally of the lower pair of setæ, while the nephridia open by the dorsal setæ.

Fig. 4 represents one of those glands in *Urochæta* in longitudinal section, reconstructed from a series of sections. It will be seen that its structure is closely similar to that of the same glands in *Urobenus.* The lumen of the gland is lined by a single row of

* *Quart. Jour. Mic. Sci.*, 1886, p. 87, pl. viii. figs. 10, 21.

peculiar cells, rounded and of large size, and each furnished with a distinct nucleus. These cells are evidently larger in proportion, and not so columnar as the corresponding cells in the pyriform vesicle of *Urobenus;* the rest of the gland lying to the outside of these cells is occupied (fig. 5) by a granular substance, with minute darkly staining bodies scattered throughout it (nuclei ?). The lumen ceases some little way in front of the apex of the gland, which is here entirely made up of the granular nucleated substance. It is permeated by blood capillaries derived from the vessels which supply the nephridia. The pear-shaped glandular region of the pyriform vesicle has the structure just described; distally it communicates with a slender muscular duct, which passes gradually into the substance of the gland. The latter is bent upon itself, as indicated in Perrier's figure, so that the duct runs parallel with the gland. But while in *U. corethrurus* and in *Urobenus* the duct is directed towards the nerve cord, the flexure in my *Urochæta* is exactly in the opposite direction. The rounded cells lining the lumen gradually decrease in importance, and the granular substance, with its interspersed nuclei lying to the outside of these cells, eventually disappears; coincidently with these charges the duct of the gland acquires a delicate muscular coat, and the lining epithelium finally becomes a flattened layer of cells. I have traced this muscular sac to its opening on to the exterior in common with the nephridium. Fig. 4 shows the termination of the duct in the rosette-like organ which here as elsewhere guards the orifice of the nephridium. The pyriform vesicle, therefore, is *anatomically* a diverticulum of the nephridial duct in this species.

Spermathecæ.—These organs are present to the number of three pairs; they are situated in segments 7, 8, and 9, and the aperture is in each case placed quite close to the anterior margin of the segment. The spermathecæ of this species are excessively delicate organs, and are often for this reason difficult to distinguish; they are also of very small size, as compared with the spermatheca of many other worms. The smallness of size is manifest rather in their breadth than in their length; when stretched out they reach rather further than across the segment which contains them. These organs are somewhat club-shaped; the distal region is extremely narrow, but widens

out gradually passing backwards, and finally becomes dilated into an oval sac. The spermathecæ sometimes lie straight, and are sometimes coiled into a circle. The walls of the spermathecæ are very thin, owing to the slight development of muscles and the character of the lining epithelium, consisting as it does of flattened cells; these structural features, together with the superficial covering of rounded, vesicular, peritoneal cells, and the general shape of the organs, gives the spermathecæ a very strong resemblance to the diverticula of the nephridia figured by myself in *Acanthodrilus novæ-zelandiæ*.* In view of a possible homology between the spermathecæ and such diverticula, it is worth while to record the points of similarity between the two series of organs. Furthermore, I may remark that in a large number of individuals, all fully mature, there was no increased development visible in the spermathecæ, which undoubtedly have a certain appearance of immaturity.

The general shape of the spermathecæ is very like that of the spermathecæ of *Diachæta*,† but they appear to be considerably smaller in the present species, and also differ in that their apertures on to the exterior are at the anterior, instead of at the posterior, boundary of their respective segments.

In *Urochæta corethrurus*‡ there are also three pairs of spermathecæ not unlike those at present under discussion in shape, and opening like them at the anterior margin of their segment; they are situated, however, rather further back (in segments 8, 9, 10); further, in both *Urochæta* and *Diachæta* the spermathecal segments contain nephridia.

Perichæta newcombei,§ n. sp.

This species is represented by eight individuals, of which four are sexually mature, with a fully developed clitellum.

The colour of the species is a dark purple upon the dorsal surface, gradually passing into a yellowish-brown upon the ventral surface; the intersegmental furrows dorsally, as well as ventrally, are of the

* *Proc. Zool. Soc.*, 1885, pl. lii. fig. 5.

† Benham, *loc. cit.*, pl. ix. fig. 29.

‡ Perrier, *Arch. d. Zool. Exp.*, t. iii. (1874), p. 518, pl. xiii. fig. 12 *pc;* pl. xvii. fig. 49.

§ Named after Mr S. Prout Newcombe.

same colour as the ventral surface; the clitellum also is distinguishable on the dorsal surface by its yellowish tinge.

It is interesting to note that the colour of this species is exactly that of a species of *Perionyx*, from the Philippine Islands, the characters of which I have recently described in a paper communicated to the Zoological Society of London.*

The *preoral* lobe does not divide the circumoral segment. *Dorsal pores* are present between all the posterior segments of the body; in the four mature individuals the first pore is situated between the 5th and 6th segments; the clitellum is marked anteriorly and posteriorly by a conspicuous pore.

The *setæ*, as in other species of the genus, are disposed in a continuous series, occupying the middle line of each segment; they are present on the clitellar segments.

The *clitellum* occupies three segments, Nos. 14, 15, 16; as in all species of *Perichæta* it is developed round the whole circumference of the body.

The *male* and *female generative pores* are placed in exactly the same situation as in other species. The female pore is placed upon the 14th segment, within the row of setæ in the middle line; the male pores are upon the 18th segment, at some little distance from each other, also within the row of setæ.

The *apertures of the spermathecæ* are between 7–8 and 8–9.

A very striking external character of this worm is caused by the great development of *genital papillæ*.

These are developed on the preclitellar segments (fig. 10), as well as on the segments which immediately precede, and on those which follow the 18th segment.

The arrangement of the preclitellar papillæ presents some individual variation, which is probably due to the fact that some of the specimens are more fully mature than others.

In one example the papillæ were more numerous than in any of the others. The 13th segment is furnished with a single papilla in the ventral median line; the 11th and 12th segment have each three papillæ close together, one being median, and the other two disposed symmetrically, one on either side; the 10th segment has four papillæ, of which the middle ones correspond in position to

* *Proc. Zool. Soc.*, 1886, p. 298.

the median papillæ of the two succeeding segments; the 9th segment has a single papilla, corresponding in position to the outermost right-hand one of the 10th segment, the others being indistinct; the 7th and 8th segments have each a single median papilla. In another example the 12th and 13th segments have a single median papilla; the 10th and 11th segments have each three papillæ; the 7th, 8th, and 9th a single median papilla.

Two other examples present an arrangement of the genital papillæ nearly identical with that last described, the only difference being that the papillæ on segments 7 and 8 are wanting.

In every case the papillæ present the appearance of a circular disc similar in colour to the clitellum, and surrounded by a whitish line; the greater part of the disc is placed in front of the row of setæ.

The postclitellar papillæ are not so distinct as the preclitellar. The whole of the ventral integument on the 17th, 18th, and 19th segments lying between the male aperture is whiter in colour than the rest, which renders it very difficult to map out the position of the papillæ. The 17th segment appeared to have a row of these papillæ; in the 18th and 19th segments I could only distinguish two pairs of papillæ, one placed outside of the male pore on the 18th, and in a corresponding position on the 19th segment, and the other placed below, and both inside of the male pore. The 20th segment has a median row of papillæ (3 or 4), the 21st segment has three median papillæ. The postclitellar papillæ are considerably smaller than the preclitellar. I am inclined to think that the whitish appearance of the integument between the male generative pores is due to the crowding together of a row of papillæ, which become distinct and separate on the 20th, and especially on the 21st segment.

The large *pharynx* extends back to about segment 3; the *gizzard* occupies segments 4, 5, and 6; it is important to notice that in every case the segments in which the gizzard lies are separated from each other by distinct, though rather delicate, mesenteries; this fact is worth recording, because in many species of *Perichæta* (and other genera) the gizzard occupies two segments, and the median mesentery has disappeared; there seems to be, however, some connection between this condition and the position of the gizzard.

In the present species the gizzard lies anteriorly to the spermathecæ; in those species where a mesentery has disappeared the gizzard lies further back, and in the same segments with some or all of the spermathecæ.

Calciferous glands are present in segments 10, 11, 12; they are, however, rather dilatations of the lumen of the œsophagus than distinct and separate glands.

The *testes* are situated in the 10th and 11th segments, close to the nerve cord and on either side of it. Dr Bergh is perfectly right in his statement * that the testes and vesiculæ seminales of *Perichæta* are in all essentials similar to those of *Lumbricus*. The testes in the present species are small digitate glands, and are enclosed by the vesiculæ, as is also the nerve cord. The vas deferens passes along the body just below the testis; the funnels of the vasa deferentia open into the vesiculæ seminales, which organs extend from the 9th to the 12th segment.

The *ovaries* are very large, and are situated in the 13th segment.

The *prostates* occupy the usual position.

The *spermathecæ* are present to the number of two pairs, situated in segments 8 and 9; the large somewhat pear-shaped pouch is provided with a small diverticulum on the dorsal side.

The only species of *Perichæta* recorded from Australia are two species, *P. australis* and *P. coxii*, described recently by Mr Fletcher.† It is evident that my species agrees with these two in a great many points; in the first place, there appear to be no intestinal cæca; secondly, the shape and location of the spermathecæ appears to be identical in all three species. The first point of agreement is, however, of more importance than the latter. In a good number of species of *Perichæta* there are two pairs of spermathecæ situated in segments 8 and 9, and each furnished with a slender cylindrical diverticulum; it will be interesting to know if the absence of intestinal cæca is characteristic of other Australian species of the genus.

The present species, however, differs from both its Australian congeners in the presence of vesiculæ seminales in all of the segments from 9–12 inclusive. Fletcher states that these structures are

* *Zeitschr. f. wiss. Zool.*, 1886.

† *Proc. Linn. Soc. N.S.W.*, June 1886, p. 561.

absent in segments 10 and 11 in his species; if this difference is not really due to difference of age, it is clearly of great importance as a distinctive character.

The arrangement of the nephridia is apparently very like what has been described in *P. australis* and *P. coxii*, particularly in the latter species. Fletcher's description is as follows:—"The segmental organs consist of tufted glandular masses, which are large, stalked, and dendriform in some of the most anterior segments, but smaller and inconspicuous elsewhere." I found these structures very conspicuous indeed, and in the 14th and a few succeeding segments they have a very strong superficial resemblance to the ovaries, with which organs their position almost exactly corresponds.

The most characteristic point of difference between my species and the other two is the number and position of the genital papillæ; a comparison of my description with that given by Mr Fletcher of *P. australis* and *P. coxii* will show that the species differ greatly in this respect. Mr Fletcher like myself appears to have examined a considerable number of specimens.

Perichæta upoluensis, n. sp.

This species of *Perichæta*, like the last, is mainly characterised by the number and arrangement of the genital papillæ. It is a native of the island of Upolu, in the South Pacific; I am indebted to Mr R. Damon, of Weymouth, for the opportunity of examining three specimens.

It is an average-sized species, measuring 5 or 6 inches in length.

The apertures of the spermathecæ are between 7–8 and 8–9.

The single aperture of the oviduct is upon segment 14.

The pores of the vasa deferentia are upon segment 18. Each pore is surrounded by a circular area of integument which is marked off from the rest.

The *clitellum* consists of only two segments, Nos. 14 and 15.

The genital papillæ are very small, compared, for example, with those of the last species; they occur in the neighbourhood of the spermathecæ as well as of the male generative apertures.

There is a single papillæ on segment 9, situated in the median ventral line and anteriorly to the row of setæ. The rest of the genital papillæ (so far as my specimens enable me to speak positively)

are situated after the clitellum, *i.e.*, in the neighbourhood of the male generative openings. Each of the segments 16–20 (inclusive) is furnished with a single median papilla, which occupies a precisely similar position to that occupied by the median papilla of segment 9, that is to say, it lies near to the anterior border of the segment (see fig. 11). The 18th segment possesses, in addition, a pair of papillæ, situated just within and close to the male generative orifices; these papillæ are almost on the border line between this and the following segment. The next segment (No. 19) has also an additional pair of genital papillæ; these are placed below and a little to the outside of the generative pores; hence they are placed very close to the anterior border of their segment.

In its internal structure this species does not present any remarkable features.

The *gizzard* is in segments 8 and 9, and as usual these segments are not separated by a mesentery.

In the same two segments are situated the *spermathecæ* (fig. 12), which (see p. 173) are not very different in shape to those of the last species.

The *vesiculæ seminales* are in segments 11 and 12.

The *ovaries* are in segment 13.

The termination of the vas deferens is furnished with a prostate gland, which has the usual lobulated structure.

The hearts are in segments 12 and 13, as is generally the case in *Perichæta.*

Perichæta antarctica, Baird.

Megascolex (*Perichæta*) *antarctica*, Baird, *Proc. Linn. Soc.*, vol. xi. (1873) p. 96.

This species has been described by Baird from a specimen in the British Museum in the following terms:—"Body consisting of about 180 rings. Setæ, surrounding the body, short, black, rather distant. Rings not keeled; larger and more distinct at the anterior extremity, closer at the posterior end, and all smooth. Length 7 inches." Capt. F. W. Hutton, in his "Catalogue of the hitherto described Worms of New Zealand,"* mentions this species, which is a native of New Zealand, and simply quotes Baird's description.

* *Trans. New Zealand Instit.*, vol. xi. (1878) p. 317.

It is perfectly clear that the above-quoted specific diagnosis is entirely insufficient to discriminate the species from many other *Perichætæ;* but an examination of the specimen itself leads me to believe that it is a distinct species. I am unable to give any anatomical description, but the worm exhibits an external character, overlooked by Baird, which is of some value as an aid to discriminating the species. The male genital pores are as usual situated upon the 18th segment of the body, and at some distance from each other; the 17th and 19th segments are each furnished with a single median genital papilla placed exactly in the centre of the segment, and therefore interrupting the line of setæ. The number and arrangement of the genital papillæ seem to be, so far as our knowledge goes, good characters for discriminating the different species of *Perichæta;* although the number is apt to vary somewhat (see p. 171) at different stages of maturity; the number of papillæ in the present species would have to be very largely increased to come up to the number which are characteristic of *Perichæta newcombei* (p. 171), the only other species of *Perichæta* which has genital papillæ in the *median ventral line* on the 17th and 19th segments.

Explanation of Plate V.

Fig. 1. *Acanthodrilus dissimilis.*
Fig. 2. *Acanthodrilus neglectus.*
Fig. 3. *Neodrilus monocystis*, section through prostate; *m*, muscular duct; *gl*, glandular region.
Figs. 4–9. *Urochæta*, sp.
Fig. 4. Median longitudinal section through glandular appendix of nephridium; *d*, glandular *cul-de-sac*; *c*, epithelial lining; *b*, muscular region; *a*, "sphincter" surrounding aperture; *m*, mesentery.
Fig. 5. Transverse section through glandular appendix and a portion of nephridium; *n*, nephridial tubule; *c*, *d*, regions similarly lettered in fig. 4.
Figs. 6, 7, 8. Sections in various planes through nephridial funnel; *p*, peritoneal cells; *p g*, peculiar agglomeration of peritoneal cells in the funnel.
Fig. 9. Transverse section of a nephridial tubule from hinder end of body; *c*, peritoneal cells; *b*, blood corpuscles; *n*, nephridial tubule.
Fig. 10. *Perichæta newcombei*, ventral aspect.
Fig. 11. *Perichæta upoluensis*, ventral aspect.
Fig. 12. Spermatheca of last species.