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## XXVIII.—On the genus *Trichodrilus*, and on a British species of the genus

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XXVIII.—On the Genus *Trichodrilus*, and on a British Species of the Genus. By FRANK E. BEDDARD, D.Sc., F.R.S.

THROUGH the kindness of Sir S. F. Harmer, K.B.E., F.R.S., I received in the middle of March a number of specimens of an Oligochaetous Annelid in a living and quite active condition. These were sent to Sir S. F. Harmer by Mr. Charles Candler; and that gentleman had received them from the Rev. B. Barton, in a well in whose garden they occurred "in enormous numbers." The locality whence they were obtained is Pulham St. Mary, Norfolk.

The general aspect of these worms was that of a Tubificid, and they showed the same habit of collecting together into balls, from the mass of which the tails of the individual worms protruded and waved in the surrounding water. A more careful examination, however, showed that the species was not a Tubificid, but a Lumbriculid. Having ascertained this much, it appeared to me that I should probably find them to be identical with another Lumbriculid, found also in a well and in a neighbouring county, and also forwarded to me by Sir Sidney Harmer in the year 1908\*.

This latter worm was found in a well on the property of a gentleman resident near Cambridge.

I was able to give some account of it in a communication addressed to the Zoological Society of London, referred to below, and to show that this worm from Cambridge was undoubtedly a close ally of the species *Phreatothrix pragensis*, described a good many years ago by Prof. Vejdovsky from a well in the city of Prague†. It appeared to me, however, that the species from Cambridge should be assigned to a new species, and this conclusion is accepted by Mr. Southern‡. There is no doubt, however, that the examples from Pulham are not referable to the genus *Phreatothrix* sensu stricto (I reserve for the present a consideration of the definition of the two genera concerned), but are clearly to be placed in the at least nearly allied genus *Trichodrilus*. This will be apparent in the ensuing description, which is based upon an examina-

\* "A Note on the Occurrence of a Species of *Phreatothrix* (Vejdovsky) in England, and on some Points in its Structure," P. Z. S. 1908, p. 365.

† "Ueber *Phreatothrix*, eine neue Gattung der Limnicolen (Ein Beitrag zur Brunnenauna von Prag)," Zeitschr. wiss. Zool. Bd. xxvii. 1876, p. 541.

‡ "Contributions towards a Monograph of the British and Irish Oligochaeta," Proc. R. Irish Acad. vol. xxvii. sect. B, no. 8, 1909, p. 119.

tion of the living worms, as well as upon sections through the body of preserved individuals.

When living this species of *Trichodrilus* was remarkable for its very active movements if touched. It is a slender worm of rather under an inch to perhaps an inch and a half in length, perhaps even longer. Its diameter is only half a millimetre. The red blood-vessels are conspicuous, but the thick covering of chloragogen cells upon the intestine renders it difficult to study in the living condition under low powers of the microscope.

Certain characters can, however, be ascertained by such an examination. The colour, when the worm is seen in reflected light, is a golden yellow, from which the bright red main trunks of the vascular system stand out. Claparède mentions yellow as the colour of the only species of the genus described by him\*, viz. *Trichodrilus allobrogum*. I do not think that this colour is due to pigment, but rather to a reflection of the effect of the chloragogen covering of the intestine. In any case it is very conspicuous, but disappears when the worm is viewed under the microscope with transmitted light.

The *prostomium* is long, rather more than twice the length of the first segment of the body; it is bluntly pointed. It agrees fairly well with the figure given by Claparède†. I did not find any tactile processes standing out from the surface of the prostomium, such as occur in *Phreatothrix* and are referred to by Vejdovsky and myself; but it may be that these processes had disappeared or been withdrawn when the worms had been for some time in a dish and were, perhaps, commencing to die.

The *setæ* are strictly paired, slender and delicate, with simply pointed free extremity—in fact, precisely like those of the individuals examined by Claparède. It was very rarely that I observed “soies de remplacement.” I could detect no differences in character or size between dorsal and ventral *setæ* or between those of different segments.

*Vascular System*.—So far there is no reason to believe that the specimens of *Trichodrilus* sent to me from Norfolk differ from Claparède's species, *T. allobrogum*, found in Switzerland. But an inspection of the trunks of the vascular system does show differences, and those of some importance. Claparède figures branches of the dorsal vessel, of which there are five or, occasionally, six in the posterior segments of the body.

\* “Recherches Anatomiques sur les Oligochètes,” Mem. Soc. Phys. et Hist. Nat. Genève, t. xvi. pt. 2 (1862).

† *Loc. cit.* pl. iii. fig. 15.

These vessels, he states, join the dorsal vessel with the ventral. Vejdovsky doubts the continuity of these transverse vessels with the ventral vessel, and regards them as probably ending blindly like the contractile appendages of *Lumbriculus* and many other Lumbriculids. I could myself see nothing of the kind in the live specimens examined by myself. It is true that the chloragogen layer upon the dorsal vessel and the gut is thick and opaque; but at least during the systole and diastole of the dorsal vessel the inflow of the blood into that vessel must have been visible were such vessels present. On the other hand, I was able to note the generally diffused red colour of the wall of the intestine, which is doubtless to be regarded as the expression of a blood-sinus round the gut. This is to be contrasted with the network of non-contractile capillaries which I found upon the wall of the gut in *Phreatothrix cantabrigiensis*, in which species also the blind appendages of the dorsal vessel were not to be seen. These species, however, are not unique among the Lumbriculidæ, by reason of the absence of these undoubtedly highly characteristic vascular appendages. Were they so, I should have asserted their absence in the worms just mentioned with greater hesitation.

In *Claparedilla asiatica* \*, a genus later transferred to the older genus *Bythonomus* of Grube by the same author †, Michaelsen has gone at some length into the proof of the absence of cæcal vascular appendages of the dorsal blood-vessel, and has convinced himself that they are actually absent. With less certainty, perhaps, Michaelsen has also come to the conclusion that while some species of his genus *Lamprodrilus* have these appendages others have them not ‡. That I myself was not able to detect them in transverse or longitudinal sections of preserved examples of *Trichodrilus* would of itself be dangerous evidence perhaps; I dwell rather upon their invisibility in the living worm with contracting dorsal vessel. I have not myself examined these vessels in any Lumbriculid, where they undoubtedly occur, by the section method §. But Michaelsen records a good many such observations, and is thus able to speak more positively upon their absence in others. In both *Stylodrilus* and *Styloscolex* there is a similar absence of blind appendages.

\* "Oligochæten der zoologischen Museen zu St. Petersburg und Kiew," Bull. Ac. Imp. Sciences St. Petersb. (5) xv. 1901, p. 181.

† "Die Oligochæten des Baikal-Sees," in Wiss. Ergebn. Zool. Exp. Baikal-See, Kiew and Berlin, 1905.

‡ *Ibid.* p. 49 for *L. pygmaeus* and p. 51 for *L. isoporus* &c.

§ Except in *Sutroa* (Trans. R. Soc. Ed. 1892, p. 195); but have no note on the subject to refer to.

The *nephridia* of *Trichodrilus allobrogum* are described by Claparède; but my own observations upon this British species do not agree in many particulars with his. I rely entirely, as to this part of the anatomy of the worm, upon longitudinal sections; I was unable to make any trustworthy observations upon the living worm by reason of its opacity.

Claparède remarks—and I am in agreement with him—that the *nephridia* are absent in the first six segments of the worm. He found these organs in the VIIth and VIIIth segments, but asserted their absence thereafter until the XIIIth, where they again begin, and continue in following segments. There is, I think, no doubt about the fact that, as in *Phreatothrix*, according to both Vejdovsky\* and myself†, the pairs of *nephridia* are not necessarily limited to one segment. In the present species the first pair lie in VII., but extend also through VIII., IX., and a part of segment X. This was very plain in my sections, and the continuance of the tube through the septa quite clearly to be made out. I did not see the funnel, which no doubt lies in segment VI., but I found the duct leading to the external pore upon segment VII. In segment XI. I could find no *nephridia* at all; but in segment XII. and the following these organs were again present. I am not certain whether the difference between the species described by myself here and that of Claparède, as is to be inferred from his description, is a real one; for recently Bretcher, in an account of *Bichæta sanguinea*‡, which species Piguet considers to be referable to the genus *Trichodrilus*§, has mentioned that the *nephridium* of segment VII. traverses also segment VIII. Nor can it be considered that the extension of this *nephridium* settles the identity of the genera *Trichodrilus* and *Phreatothrix* (which Michaelsen would join) on account of the conditions observable in other genera of the family.

In *Styodrilus vej dovskyi* Benham|| describes the first pair of *nephridia* as extending through segments VII.—X. in precisely the same way as has been referred to above.

In *Lumbriculus variegatus* Mrazek¶ found that a single

\* System. u. Morph. d. Oligoch. Taf. xi. fig. 18.

† Proc. Zool. Soc. *tom. cit.*

‡ "Süd-schweizerische Oligochæten," Rev. Suisse Zool. viii. 1900, p. 444.

§ "Notes sur les Oligochètes," Rev. Suisse Zool. xxi. 1913, p. 141.

|| "Notes on some Aquatic Oligochæta," Quart. J. Micr. Sci. (n. s.) xxxiii. p. 211.

¶ "Beiträge zur Naturgeschichte von *Lumbriculus*," SB. k. Böhm. Ges. 1913.

nephridium may also occupy three segments, but considers that he is here recording an abnormality\*. Furthermore, both Vejdovsky and Benham find in the genera *Phreatothrix* and *Stylodrilus* a similar state of affairs in the second pair of nephridia which traverse segments XIII.-XV. or (*Phreatothrix*) XIV.-XXI. I am not quite certain how far I can agree with those authors from my examination of my species of *Trichodrilus*. The nephridial tubules in segments XII. &c. undoubtedly come into very close contact at the intersegmental septa; but I should not like to allege positively that they form part of one nephridium extending through these segments.

In Vejdovsky's figure of the two first nephridia of *Phreatothrix*† the complex nephridia, if they are really formed by fusion of the pairs belonging to the several segments through which they pass, are represented as very simple in character; they consist of simply two tubes running side by side. This simplicity is also to be seen in *Stylodrilus*. In my species, on the other hand, the coils of the nephridium are much more numerous, and a considerable thickness of nephridial "tissue" is thus to be seen in each segment. I take it that there is here a resemblance to *Teleuscolex korotnevi* as seen by Michaelsen‡.

As to the reproductive organs, none of the specimens appeared to be fully mature§ when examined with a hand-lens. The clitellum could not be detected, and the only external sign of maturity was the whitish appearance of the two or three segments in a region just posterior to the male pores, and which seems to be due to ripe ova. I therefore did not preserve many examples for the elucidation of these organs, but studied them in the living condition for the sake of other organs, after which they were not in a very fit state for fixing and hardening. Fortunately, however, I kept three examples, in all of which the sexual organs were quite well developed, and, indeed, tending perhaps towards degeneration; for while the thirteenth, fourteenth, and fifteenth segments contained a few ripe ova and the sperm-sacs were obvious, the funnels of the sperm-ducts were, perhaps, rather

\* Claparède had already mentioned this fact in a worm erroneously supposed to be *Lumbriculus variegatus* of Grube in his account of that worm (in Mém. Phys. Genève, t. c.). The genus, however, to which Claparède's observations referred is now named *Claparedilla* (to be merged in *Bythonomus*?).

† Syst. u. Morph. Olig. Taf. xi. fig. 18.

‡ Bull. Ac. Imp. Sci. St. Petersb. 1901, p. 169.

§ According to Ditlevsen (referred to later) *Trichodrilus allobrogum* is fully mature in July. This difference of season may be a valid distinction from the present species.

reduced in size, though still plain enough for the purposes of identification as such.

The numbers and position of the spermathecae were those of *Trichodrillus* as opposed to *Phreatothrix*, for there were two distinct pairs of the spermathecae of quite equal size in segments XI., XII., instead of two spermathecae only—those of the anterior pair,—together with a smaller pair belonging to posterior set. But it will be remembered that in my species *Phreatothrix cantabrigiensis* there was no trace of the second (posterior) pair. Doubtless this is not a strong reason for separating the two supposed genera; but it is a reason, among others, for proving the difference between the two subterranean worms of East Anglia, which would certainly have been expected to be of the same species.

The *spermathecae*, like those of other Lumbriculids, consist of a thin-walled sac and a thicker-walled duct. The sac has a lining composed of a single layer of cells. This is covered by a delicate peritoneal layer also one cell thick. I could detect no muscle-fibres between the two layers. The general form of the sac is oval, but varies a little. There is nothing in any way remarkable about their form. Spermatozoa, not aggregated into bundles, were to be seen lying loosely but closely in the sacs. The ducts of the organs are very narrow and fully one-third of the length of the sac or rather more, and either straight or twisted in their course to the exterior. The muscular wall of circular fibres is relatively thick. The openings are posterior in the eleventh and twelfth segments on a level with, and occupying a similar position to, the atrial pores, or very nearly so.

There are two pairs of *testes* in segments IX., X., close to the nerve-cord. They are flattened dorso-ventrally and not very wide. They extend through perhaps a length of half the segment.

The *ovaries* correspond exactly in position to the testes and lie in segment XI. They are, however, different in shape, being pear-shaped and much larger.

I have found *sperm-sacs* in one or other of the two specimens which I have investigated by longitudinal sections in segments X.-XIII. inclusive. There are also sperm-sacs in segment VIII., and, like those of *Aurantina aurantiaca* \*, are attached to the wall dividing VIII./IX., and depend into segment VIII.

The *egg-sacs* are in segments XIII., XIV., XV., XVI.

\* Pierantoni, "Oligocheti del Fiume Sarno," Archiv. Zoolog. Napoli, 1905, vol. ii. fasc. 2, p. 232, tav. xiv. figs. 4, 6, *ssp.*

Whether they extend further than this I do not know. They contained large ripe ova with the usual abundant yolk.

The *sperm-ducts* are in segments IX., X., XI., and open on each side by the atrium on to the tenth segment. The funnels are in the ninth segment and the tenth, and are much as figured and described by Claparède in this, and, by him and others, in other Lumbriculids allied to *Trichodrilus*. The funnels were, as is usual, conspicuous owing to the bundle of spermatozoa caught up by the ciliated mouth of each. The main part of the posterior pair of sperm-ducts forms a coil in the eleventh segment close to the anterior wall of that segment. I did not observe the actual openings of the sperm-ducts into the atrium with absolute certainty. The funnels, instead of being flattened over the septum and plate-shaped, are cup-shaped, as Hesse (quoted below) figures in *Lumbriculus* \*.

The *atrium* is generally as recorded by Claparède †. It is noteworthy for the very thick circular muscle-layer figured by that author, and subsequently by Ditlevsen ‡ and Piguët §. Its duct to the exterior is narrow and projects as a penis into an ingrowth of the epidermis, forming a small circular cavity. This is not indicated by Claparède. As I point out later, the characters of the atrium may distinguish this genus from *Phreatothrix*. Hesse ||, and, later, Mrázek ¶ have given figures of the atrium of *Lumbriculus*, and the first-named has compared it with that of *Claparedilla*, *Rhynchelmis*, *Stylo-drilus*, and *Trichodrilus*, remarking that these forms have always glandular cells outside of the atrium, but never muscle-layers as in *Lumbriculus*. This in spite of Claparède's figure referred to by him. However, Hesse appears to be correct in his statements of the other genera mentioned in his list, admittedly taken from the writings of others \*\*. It

\* Or perhaps they would be better described as funnel-shaped. Miss Dixon (*Tubifex*, Liv. Mar. Biol. Comm. Memoirs, xxiii., London, 1915) remarks (p. 58, cf. pl. iv. figs. 17, 18) that the funnels of *Tubifex* are cup-shaped in the more immature worm, and more expanded later.

† Mém. Soc. Phys. Genève, t. c. pl. iii. fig. 6. Claparède does not indicate the lining epithelium of the atrium.

‡ "Studien an Oligochäten," Zeitschr. wiss. Zool. Bd. lxxvii. 1904, p. 441, Taf. xvii. fig. 49.

§ Rev. Zool. Suisse, t. c. woodcut, p. 141.

|| "Die Geschlechtsorgane von *Lumbriculus variegatus*, Grube," Zeitschr. wiss. Zool. Bd. lviii. 1894, p. 355 (also published as Bd. i. no. 1 of 'Tübinger Zoologische Arbeiten').

¶ "Die Geschlechtsverhältnisse und die Geschlechtsorgane von *Lumbriculus variegatus*, Gr.," Zool. Jahrb. Bd. xxxiii. 1906, p. 381.

\*\* More lately Michaelsen has figured (Bull. Ac. St. Pétersb., Sept. 1901, pl. xi. fig. 19) a circular muscle-layer in *Rhynchelmis brachycephala*.



would appear, therefore, that the presence of a muscular layer is of some systematic importance in *Trichodrilus*. There is, however, undoubtedly, in the latter at least, no such thick layer of longitudinal fibres as Hesse has figured \* in *Lumbriculus*. I have been unable to see any longitudinal layer at all, nor is it shown in Ditlevsen's figure; but if there be one present, it can hardly consist of more than a single layer of fibres. The figures of Hesse are borne out by those of Mrazek †.

The *oviducts* were not seen by Claparède, who located them as probably lying in segment IX., by reason of the fact that this segment contained (as he thought) no nephridium, its place, on the older theory of the correspondence between nephridia and gonad ducts, being taken by the oviduct. As a matter of fact, the ninth segment in the species described here does contain a part of the anterior complex nephridium. The oviduct, as might be expected, opens into segment XI., and opens on to the exterior between this segment and the following one. Its outline is not that of a funnel with a very short stalk, as this organ is apt to be depicted; in longitudinal section it has the outline of a lyre, the edges above being recurved and the cavity widest some way below this edge, which is the actual funnel. The duct narrows.

The above account of this worm may be summed up as follows:—Length 25 mm. and upwards; diameter .5 mm. or less. A thin, slender, and active worm. Prostomium conical, with no special tentacle-like prolongation at apex, in length rather greater than breadth of first segment. Colour golden-yellow. Setæ slender and simply pointed; closely paired, rarely with reserve setæ. No vascular appendages of dorsal vessel; intestine surrounded by sinus, and not network of blood-vessels. Chloragogen layer of intestine begins in VI. First pair of nephridia lie in segments VII.–X. inclusive, open on to VII. with funnel in VI.; no nephridia in XI., but occur in XII. and onwards. Nephridia forming coils several tubules wide. Testes in IX., X.; funnels of vasa deferentia in IX. and X.; atrium with thick muscular walls of circularly running fibres, lined by an epithelium of small cells and covered by large pear-shaped cells externally; narrows into a muscular duct which projects into external depression at orifice on X. Spermsacs in VIII.–XII., those of first pair rising from septum VIII./IX., and thus directed forwards. Ovaries in XI. Oviducts with long dilated tube opening on to XI./XII. Egg-sacs from XIII. or XIV. to third segment or more (?) from this.

\* *Loc. cit.* Taf. xxii. fig. 4.

† *Loc. cit.*, several woodcuts on pp. 431, 432, 433, 435, &c.

I term this species, if it be accepted as undescribed, *Trichodrilus icenorum*, after the plan of nomenclature initiated for the genus by Claparède.

To determine whether this subterranean species is or is not identical with *Trichodrilus allobrogum* of Claparède is very difficult on account of the incomplete description given by that naturalist. I do not find it possible to come to any conclusions as to differences in the form of the spermatheca and atria in the two forms. It would seem, however, that the vascular and excretory systems do offer differential characters.

I do not think that there is room for error in the quite diverse descriptions given above of the appendages of the dorsal vessel which were lacking in the examples of this *Trichodrilus* examined by myself, and are fully figured and described by Claparède. Furthermore, that author is detailed in his account of the nephridia of the early segments of the body, and his descriptions differ from what I have seen myself; the doubts, therefore, which I have expressed above may be unnecessary. The slender looping of the nephridia in the Swiss species seems also to be different from the closely packed and rather numerous coils which I found in the nephridia of the worm from Norfolk.

There can be, as I think, no doubt that both Bretscher\* and Piguet† are right in distinguishing *Trichodrilus sanguineus* as a species different from that of Claparède. Nor can I identify it with the form described here by myself. The possession of only one pair of spermathecae seems to be a sufficient mark of specific distinctness. Moreover, this form is a smaller one, measuring only up to 13 mm. as compared with 14–25 mm.

This leads at once to the question of the identity or non-identity of the genera *Trichodrilus* and *Phreatothrix*, for the main difference between the two genera, according to Vejdovsky‡, is the presence of two pairs of spermathecae in the former genus, while *Phreatothrix* has only one pair of these organs in the eleventh segment, the second pair disappearing at maturity. This latter statement does not, however, apply to the species which I found myself in water from a well at Cambridge. In this species§ there was but one pair of the organs, and no trace of the smaller pair of *Phreatothrix pragensis*. Vejdovsky is doubtless correct in noting a protrusible penis in *Phreatothrix*; but is it so clear

\* Rev. Suisse Zool. vol. viii. p. 444.

† Loc. cit. vol. xxi. p. 141.

‡ Zeitschr. wiss. Zool. t. c.

§ Proc. Zool. Soc. t. c.

that he is right in denying one to *Trichodrilus*? It is true that Claparède, as Vejdovsky says, neither mentions nor figures such; but, though present and obviously protrusible in my *Trichodrilus icenorum*, it is not very conspicuous, and would probably be overlooked in examples studied without the aid of microscopic sections. My species, in addition to the penis, has two pairs of spermathecae, and thus would be intermediate between the two genera. A possible difference is not referred to by Vejdovsky, and that is the thick muscular walls of the atrium figured by Claparède and the much thinner atrial walls figured by himself in *Phreatothrix*.

I have no notes as to the state of affairs in *Phreatothrix cantabrigiensis*, but I have already referred to this matter above, and may here point out that Piguët\* figures such an atrium in *Trichodrilus sanguineus*, which, on account of its single pair of spermathecae "should be" a *Phreatothrix*. I am disposed to follow Michaelsen in fusing these two genera.

*Note on a possibly second British Species of Trichodrilus.*

A third example of *Trichodrilus*, which I examined by longitudinal sections, was not put aside by me as a probably second species of the genus; but on microscopical study it shows certain differences from those upon which the above account of *Trichodrilus icenorum* was mainly based.

As I am unable to give more than an account of the reproductive system, I hesitate—for reasons which will be explained—to refer it definitely to a second species, and therefore do not give it a name.

Inasmuch as this worm has two pairs of testes in IX., x., one pair of ovaries in XI., sperm-duct funnels in IX., x. opening into an atrium which itself opens on to the exterior in segment x., an oviduct funnel in XI. opening on to the segmental border-line XI./XII., two pairs of spermathecae lying in XI., XII., and, finally, that it was found with others showing exactly the same characters and described above, it would seem impossible to create for it a new species.

Nevertheless, the atrium and sperm-ducts show marked differences from those of the type-specimens of *Trichodrilus icenorum*, which are as follows:—The atrium consists, as in the others, of a nearly spherical sac communicating with the exterior by a much narrower duct. It has a wall, which is, however, very much thinner than that of the others, though it is composed of precisely the same layers. It is lined by

\* Rev. Zool. Suisse, t. c.

a layer of cells, around which are disposed muscular fibres running in a circular direction; the outer layer is again cellular. But the characters of these layers are totally different—at any rate, of the outermost and innermost. The middle muscular layer is simply much thinner. That there is an outer layer at all is not obvious at first sight; the pear-shaped cells, closely pressed together, of the typical *Trichodrilus* (as shown in the figures of Claparède and Ditlevsen and in my own sections) are replaced by a scanty layer of cells, whose nuclei are visible, but at some distance from each other. The cells are clearly flattened and few. So, too, with the lining epithelium of the atrium. The general aspect in fact of this organ is that of the “normal” atrium greatly dilated, and its various layers therefore flattened through pressure and extension. This may, of course, be the actual fact; but in the first place the difference of diameter may be slightly, but is not greatly, in excess of that of the examples reported upon above, and the sac is not gorged with sperm, which might have been the cause of its dilation. The sperm may, however, have escaped to the exterior or to another individual. A nearly exactly similar difference in two individuals of *Lumbriculus* is figured by Mrazek\*.

Be this as it may, the condition of the sperm-ducts show another kind of difference from those of the typical *Trichodrilus icenorum*. They were particularly easy to study on account of their large size, which was not the case with those of the other examples of the genus which I have described in the present communication.

The great increase of size was particularly marked in the case of the anterior pair, in the middle of the course of which the diameter of the duct was dilated to a width not very far from that of the atrial cavity. A long piece of the sperm-duct was thus increased.

This increase of size of the sperm-ducts and of the cavity of the atrium has brought it about that the entry of the former into the latter is quite clear. They enter at opposite sides—anterior and posterior—and at about the middle of the atrium. It is not a question here of the dilation of the sperm-ducts owing to pressure—at any rate, pressure which has thinned and flattened out the walls. For the cellular walls of the sperm-duct (surrounded, of course, by a flattened peritoneal layer) are actually thicker than is the case with the sperm-ducts of the individuals described above. I have noted, indeed, that in some regions the whole sperm-duct of

\* Zool. Jahrb. xxiii. 1906, fig. F, p. 430, and fig. M, p. 440.

the typical individuals was not wider than one cellular wall of the sperm-duct of the individual now under consideration.

This fact alone does not render impossible the view that the difference shown in the individuals is really due to distention; for if the sperm-duct lumen is intercellular, it would mean simply a pushing out of the cells by their inclosed contents, and no necessary alteration in the epithelium itself. The case obviously becomes different, however, if the sperm-duct has an intracellular lumen. In the present specimen there would seem to be every probability that for some distance after the funnel the lumen is intercellular, since the nuclei in the walls of the ducts are fairly closely arranged in the walls of the tube side by side. But later on this is not the case, and I have observed transverse sections of a piece of tube with but one nucleus therein, and pieces of longitudinal section with very few nuclei. This means at least fewer and larger cells to the wall, if it does not prove an intracellular duct.

In this region it is to be noted that there is no perceptible dilation of the tube, which is therefore really larger than in the specimen described above.

I may take this opportunity of observing that the distinction between an intracellular and an intercellular duct is not perhaps of great importance; but it is, after all, an anatomical difference between the nephridia of the *Oligochæta* and the sperm-ducts of the great majority of those worms. It is thus worth pointing out in the present instance as a character of the genus *Trichodrilus*, for the observations which I have made upon the example which I now refer to are confirmed by a re-examination of the other specimens of the genus dealt with in the present paper. Undoubtedly intracellular sperm-ducts only occur among the "Limicoline" *Oligochæta*, and are not commonly met with. Benham\* has given ample reasons for thinking that the sperm-ducts in his *Phreoryctes heterogyne* are of such a character. More to the immediate point are Mrazek's figures of *Lumbriculus*† where the atrial

\* "On a new Species of the Genus *Haplotaxis*, with some Remarks on the Genital Ducts in the *Oligochæta*," Quart. Journ. Micr. Sci. (n. s.) xlviii. 1904, p. 304.

† Zool. Jahrb. t. c. p. 435, figs. J 1, J 2. See especially the latter figure for the atrial part of the sperm-duct. In *Tubifer*, according to Miss Dixon (*loc. cit.* pl. iv. figs. 18 A, 19 A, B), the sperm-duct also seems to become intracellular. But Gatenby (Quart. J. Micr. Sci. (n. s.) lxi. p. 320 &c.) describes and figures the duct (pl. xxiv. fig. 17 E) as intercellular.

end of the sperm-duct seems to be represented in his figures as with an intracellular duct, while the region immediately succeeding the sperm-duct funnel would appear to possess an undoubtedly intercellular duct. This condition, it is to be noted, is precisely that of *Trichodrilus*.

Although, on the above analysis, it would seem that the differences between the two sets of individuals does not affect characters of importance, it is clear to anyone examining the actual structures concerned that a line can easily be drawn between them. Such as it is, I have attempted to put the difference into words. A glance, however, at the sections themselves renders impossible any confusion between the two varieties; I may remark, without further detail, that this also applies to the spermathecæ. I cannot, however, find other reasons for dividing the British *Trichodrilus* into two species; nor, on the other hand, am I in a position to assert that such do not exist. It is just possible, but not likely, that the last-described specimen was not so carefully examined by me when alive; it *may* therefore possess, for instance, the vascular appendages of the dorsal vessel which I found wanting in all the examples which I did examine. Nor can I see any reason for explaining the differences in the sperm-duct as positively due to distention, or to immaturity or degeneration. But the fact that a similar variation occurs in the atrium of *Lumbriculus*, so nearly allied a genus, makes me unwilling to lay undue stress upon the varying sperm-duct of the present species, although I cannot recollect an analogous case\*. I prefer—at any rate, for the present—to leave the matter of the specific identity or non-identity of the series of examples described here as uncertain.

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### XXIX.—*Three new Mammals from Northern Rhodesia.*

By MARTIN A. C. HINTON.

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THAT famous collector Captain Guy C. Shortridge was attached for some considerable time to the air-station at N'dola, in Northern Rhodesia. As was to be expected, he made very good use of his opportunity, and his large collection of mammals has now arrived in the Museum. A

\* At any rate, a strictly analogous case. It will be recollected that in *Sutroa* (Beddard, Tr. Roy. Soc. Edinb. t. c.) one of the two pairs of sperm-ducts has a distinctly less calibre than the second.