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CONDUCTED BY

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Oligochæta *intermediate between the* Limicolæ *and* Terricolæ *of Claparède.*

Claparede's division of the Oligochæta into Oligochæta Limicolæ and Oligochæta Terricolæ ("Recherches Anatomiques sur les Oligochètes," Mém. Soc. Phys. Genève, t. xvi., 1862), though certainly expressing the knowledge of his time when *Lumbricus* was the only terrestrial Annelid whose anatomy was known, has been shown to be no longer tenable. Many of the characters believed to be restricted to the Limicolæ have been discovered in Earthworms. The only

one of the points enumerated by Claparède which has hitherto held good is the absence of a vascular plexus upon the nephridia of the Limicolæ, and the presence of such a plexus in the Terricolæ.

Mr. Benham in 1886 ("Studies in Earthworms," Quart. Journ. Micr. Sci. vol. xxvi. pp. 215, 216) still retained the division, though with some other structural distinctions.

The Terricolæ are thus distinguished :—

(1) Nephridia present in genital segments.
(2) Abundant vascular network on nephridia.
(3) Almost universal presence of a gizzard (exc. *Pontodrilus*).
(4) The much smaller size of ova and the compactness of the ovary.

The first character could not now be made use of, since Vejdovsky (Syst. u. Morph. d. Oligochaeten, p. 150, footnote) had discovered nephridia in the genital segments of the sexually mature *Lumbriculus*.

The last-mentioned author (*loc. cit.* p. 14) dropped this scheme of classification and divided the Oligochæta into a series of families corresponding to the prominent generic types. The last three characters, however, still remained good, until in 1887 Giard found ("Sur un Nouveau Genre de Lombriciens phosphorescents et sur l'Espèce Type de ce Genre *Photodrilus phosphoreus*, Dugès," Comptes Rendus, Nov. 7, 1887) that *Photodrilus* was without a gizzard; this was extended by Rosa ("Sui Generi *Pontodrilus*, *Microscolex* e *Photodrilus*," Boll. Mus. Zool. Torino, vol. iii. No. 39, 1888) to *Microscolex*. *Criodrilus* also possesses no gizzard, and apparently *Pymæodrilus*. *Photodrilus* and *Pontodrilus* also render it necessary to dispense with the first of Mr. Benham's characters, for in them the nephridia do not commence until the 14th or 15th segment.

Notwithstanding these facts Rosa ("Nuova Classificazione dei Terricoli," Boll. Mus. Zool. Torino, vol. iii. 1888, No. 41) adhered so far to the Classification of Claparède as to retain his group Terricolæ; he admitted, however, the untenability of the group Limicolæ.

The latest contribution to the question is by Mr. Benham ("An Attempt to classify Earthworms," Quart. Journ. Micr. Sci. vol. xxxi. pp. 201 *et seq.*). He distinguishes two subclasses, viz. Naidomorpha and Lumbricomorpha. These are distinguished mainly on account of the occurrence of asexual reproduction in the former, and its absence in the latter. The statement that the blood in the Naidomorpha is uncoloured is only partially true, for in Naids it is yellowish red. If it be

definitely shown that in *Ilyodrilus*, which presents many intermediate characters between Naids and Tubificidæ, there is no asexual reproduction, this division seems reasonable *.

The Lumbricomorpha are "divided roughly" into two Orders, Microdrili or "Waterworms," and Megadrili or "Earthworms." One constant difference alone is allowed to distinguish the two Orders, *i. e.* the presence or absence of a capillary network upon the nephridia.

As a matter of fact these groups might be further distinguished as follows:—

Microdrili.	*Megadrili.*
(1) Sexual maturity at a fixed period.	(1) Sexual maturity more or less continuous.
(2) Clitellum consisting of a single layer of modified cells only.	(2) Clitellum consisting of two distinct layers of cells.
(3) Ova of large size and few.	(3) Ova small and numerous.

This separation between Microdrili and Megadrili is, however, rendered almost impossible by the structural characters of *Ocnerodrilus*, which I have recently had the opportunity of examining. Eisen's account of the anatomy of this form ("On the Anatomy of *Ocnerodrilus*," Nova Acta Reg. Soc. Upsala, 1878), at present the only one, does not agree in every particular with my own observations. I find that the testes are in the 10th and 11th segments, and the ovary in the 13th; the sperm-sacs, which do not enclose the testes or vasa deferentia funnels, are in segments 10–13; the oviducts open into the 14th segment; the vasa deferentia open into the 17th segment in company with a glandular atrium. The clitellum extends from the 13th to the 19th segment and has the same structure as that of *Lumbricus*.

So far the characters of *Ocnerodrilus* are those of the Megadrili, but it agrees with the Microdrili in two important points, one of which has been shown by Eisen in a figure, though not commented upon. This character is the total absence of any vascular plexus round the nephridia; I may further remark that the nephridia of the posterior segments (from the 20th) differ from those of the anterior segments in being surrounded by a mass of large clear cells as in many Microdrili and in *Pontodrilus* (Perrier, "Organisation des *Pontodrilus*," Arch. Zool. Exp. t. ix. 1881). In the genital segments of a specimen with fully-developed clitellum, testes, sperm-sacs, &c., the nephridia were present with the exception of the 11th and 12th segments (and here they were

* It is practically that of d'Udekem ("Mémoire sur les Lombriciens," Première Partie. Mém. Acad. Roy. Belg. t. xxxvi.).

recognizable though very rudimentary); they commence in segment 3.

The second character in which *Ocnerodrilus* resembles the Microdrili is the large size of the ova; they are not, however, so large as in *Phreoryctes*, *Enchytræus*, &c., but considerably larger than in any earthworm known to me.

Ocnerodrilus has no gizzard; it has septal glands; the atrium is lined by a single layer of cells as in the Microdrili and *Moniligaster*. It is clear, therefore, that the only characters distinguishing the Microdrili from the Megadrili are Nos. 1 and 2 of the list given above.

It is a question whether they are sufficient, in view of important points of agreement, to distinguish two such groups. I am inclined, for the present at least, to think not, and to revert to Vejdovsky's arrangement into families.

In discussing the affinities of any particular type of Oligochæt it is therefore necessary to compare it with a particular family and not to be content with indicating resemblances to the aquatic Oligochæta or to the terrestrial Oligochæta as a whole.

I have lately received from New Zealand, through the kindness of Mr. W. Smith of Ashburton, a number of examples of an Annelid which were collected in wet soil not far from the margin of a swamp.

I am uncertain whether to refer it to the Lumbriculidæ or Phreoryctidæ; it forms in any case a new generic type for which I propose the name of *Pelodrilus*.

I have referred above to Vejdovsky's discovery that in the sexually mature *Lumbriculus* the genital segments contain nephridia; although this one exception is sufficient to prove that the absence or presence of nephridia in the genital region is not a character of first-rate classificatory significance, the fact that *Pelodrilus* agrees with *Lumbriculus* is a further proof that the Lumbriculidæ and Phreoryctidæ stand nearest to some of the simpler forms of Earthworms. I am not certain as to *Lumbriculus*, but in *Pelodrilus* there is no vascular plexus upon the nephridia. I have shown elsewhere ("On the Anatomy, Histology, and Affinities of *Phreoryctes*," Trans. Roy. Soc. Edinburgh, vol. xxxv. (1889), pt. ii. No. 16) that the gonads and their ducts in *Phreoryctes* are extremely simple in structure, and that the male gonads and ducts correspond more closely than is the rule with the female gonads and ducts. In these particulars they resemble the gonads and ducts of the young *Acanthodrilus* just escaped from the cocoon. In *Pelodrilus* the gonads lie in segments 10, 11, and

12, the testes in the two former, and the ovaries in the latter segment. As compared with *Phreoryctes*, therefore, one pair of ovaries (belonging to the 13th segment) have been lost. The sperm-ducts open by funnels into the segments containing the testes: their external apertures are upon segment xii.; there is not a common aperture for the two vasa deferentia of each side, but each opens independently, one a little in front of the other. The conditions are therefore intermediate between those of *Phreoryctes* and *Eisenia* *. There are two pairs of vasa deferentia, as in both forms, but these open on to the same segment as in *Eisenia*, though separately as in *Phreoryctes*. It must be remembered, however, that at present we have no knowledge of the internal structure of *Eisenia*. In any case there is no known Limicolous Oligochæt in which the vasa deferentia open on to the exterior more than one segment behind that which contains the cœlomic funnel.

Another point in which *Pelodrilus* presents an affinity to the higher types is the specially thickened intersegmental septa of certain of the anterior segments. This fact is of some interest, because it tends to show that the medium in which the worm lives has some relation to the presence of these thick septa. *Pelodrilus* inhabits soil like Earthworms, and unlike its more immediate allies which swim in the water or burrow in the naturally soft mud at the bottom of pools and rivers.

A new Genus allied to Eclipidrilus *of Eisen.*

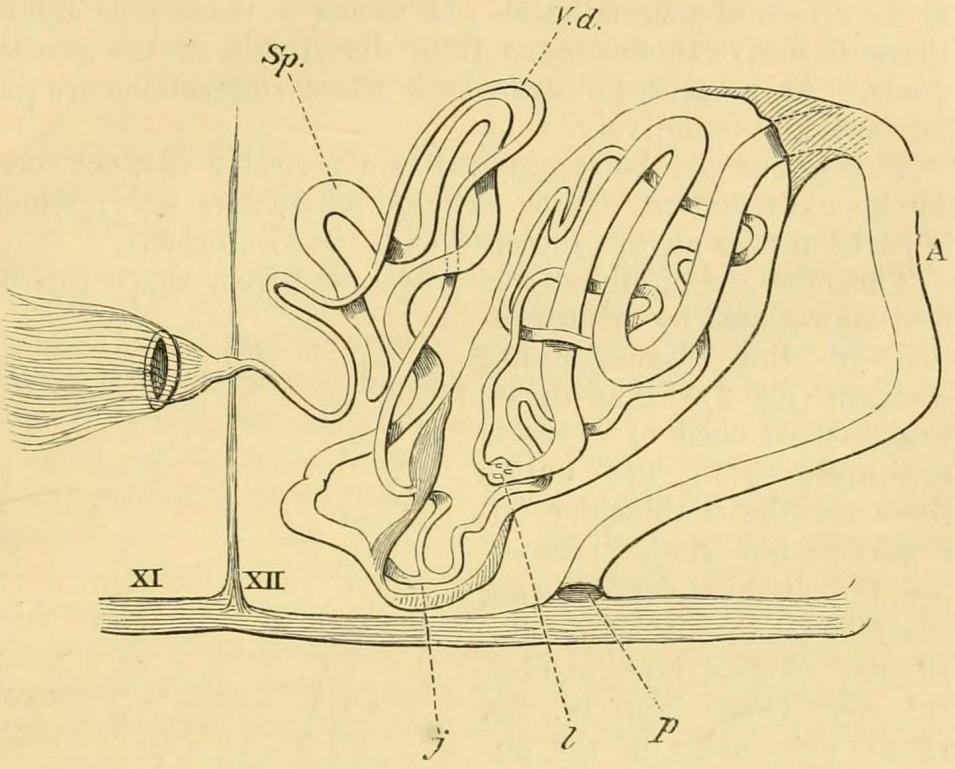
One of the most singular types of Oligochæta that has been described is Eisen's genus *Eclipidrilus* ("Eclipidrilidæ and their Anatomy," Nova Act. Soc. R. Upsala, 1881). Its main peculiarity consists in the inclusion of a vesicula seminalis within the sperm-duct; the sperm-duct apparently is not provided with a funnel of the usual pattern, but opens by three apertures placed close together into the cœlom, while the vesicula in its interior has a ciliated mouth.

I have lately received from New Zealand an Annelid which presents certain resemblances to *Eclipidrilus*. It was found by Mr. Smith, of Ashburton, in water from a well pumped up from a considerable depth, and I propose for it the name of *Phreodrilus*. The accompanying diagram shows the general arrangement of the sperm-duct, which is quite unique in its structure, unless it proves to resemble that of *Eclipidrilus*. The atrial pores are paired structures on seg-

* *Tetragonurus*, the name originally proposed by Eisen for this genus, being pre-occupied, Vaillant ("Annélides," Suites à Buffon) has suggested its replacement by the name "*Eisenia*."

ment 12. The atrium commences as a sinuous tube, which widens out to form a large thin-walled sac with muscular walls. This sac when cut open (see fig. 1) is seen to be nearly

Fig. 1.



Sperm-duct of *Phreodrilus*.

A, atrium; *l*, its junction with vas deferens; *j*, junction of the latter with cæcal appendage (*Sp*); *v.d*, vas deferens; *p*, external pore of atrium. The segments are numbered.

filled with a much coiled continuation of the atrium and the vas deferens. The vas deferens makes its exit from the atrium at a point nearly opposite to its entrance; just before this point it gives off (*j* in the figure) a diverticulum which, after being bent several times upon itself, ends blindly in the neighbourhood of the funnel in which the vas deferens terminates. The periatrial sac is filled with ripe spermatozoa not indicated in the woodcut. It is not, however, as far as I can ascertain, a cœlomic sac; its cavity is simply produced by a splitting off of the greater part of its muscular tissue from the atrium.

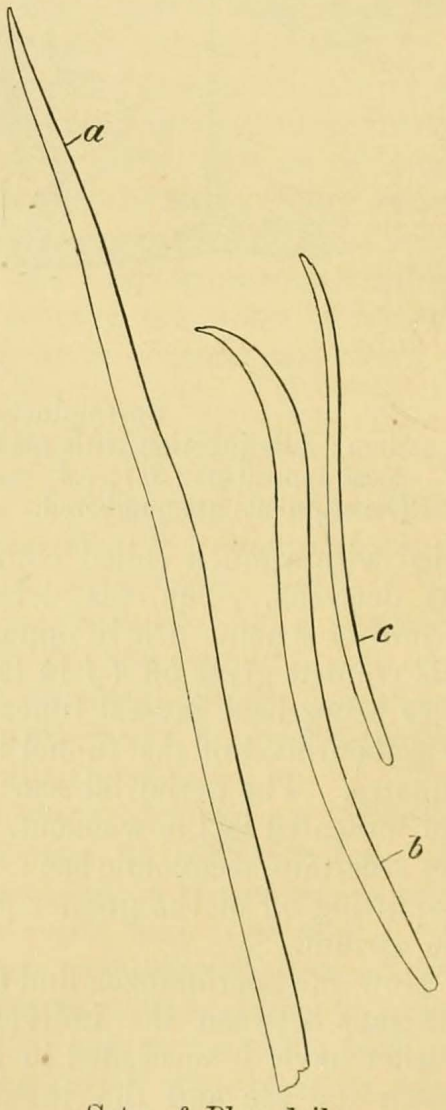
How the spermatozoa find their way in, unless it be through the gaps between the individual fibres, I cannot imagine; neither have I succeeded in finding any communication between the sac and the interior of the vas deferens. The diverticulum of the vas deferens is lined with a *non*-ciliated glandular epithelium and has a muscular covering; its structure is indeed precisely that of the unusually elongated

spermathecæ which open on to the exterior in the following segment (the 13th). I am inclined to regard the diverticulum in question as the equivalent of the second vas deferens of the Lumbriculidæ; and it may also furnish a clue to the origin of spermathecæ. It seems a reasonable hypothesis to derive these organs from diverticula of the genital ducts. At present, however, both these suggestions are put forward only tentatively.

This genus can be recognized as a perfectly distinct form by an examination of its external characters only, which is by no means always the case with the Oligochæta.

The setæ are highly characteristic, and their shape can be best appreciated by an inspection of the accompanying woodcut (fig. 2). The dorsal rows consist each of a single capilliform seta, not unlike those of the Tubificidæ (*cf. e. g.* Antonin Stolc "Monographie Českých Tubificidů, Morfologická a Systematiká Studie," Abhandl. böhm. Ges. Bd. vii. 1888, Taf. iv. fig. 13 *a* 1); in some of the anterior segments only was there occasionally a second seta, but of the same form. The ventral rows are made up of a series of paired setæ — one pair in each row. The two setæ of each pair are not quite alike in form, and one is markedly larger than the other. This can hardly be due to a difference in age, as every segment corresponded. These setæ are not quite similar to those of any other genus of Oligochæta. Their extremities are not bifid. I am disposed to regard this genus as the type of a new family lying between the Lumbriculidæ and the Naidomorpha, though its affinities to both are only very general; but our knowledge of the aquatic

Fig. 2.



Setæ of *Phreodrilus*.
a, dorsal seta; *b*, *c*, ventral setæ.

Oligochæta has by no means kept pace with that of the exotic forms of Earthworms, and a great many more facts will have to be accumulated before any profitable speculations can be indulged in as to the relations of different families and genera.

The Zone of Growth in Urochæta.

More than thirty years ago a note by Fritz Müller upon "*Lumbricus corethrurus*" (= *Urochæta hystrix*, Perrier, "Mémoires pour servir à l'histoire des Lombriciens terrestres," Nouv. Arch. Muséum, 1872; and *Urochæta corethrura*, id., "Organisation des Lombriciens terrestres," Arch. Zool. Exp. t. iii., 1874) was translated into these Annals ("Description of a new species of Earthworm," Ann. & Mag. Nat. Hist. 2nd ser. vol. xx. 1857, pp. 13–15) from Wiegmann's 'Archiv,' many of the facts in which seem never to have been either confirmed or refuted. I have lately received through the kindness of the authorities at Kew living examples of *Urochæta* from both Singapore and Mauritius, thus extending its known range. All the examples showed a spot at some distance from the tail end, distinguishable, as Fritz Müller correctly pointed out, by its tumid appearance, and also by the fact that the intestine here was empty of débris; this gave a whitish appearance to the part in question. In preserved specimens this region was not so obvious, but could be detected on a careful examination. Fritz Müller states that the skin here is devoid of bristles, and suggests that it is the spot where the formation of new segments takes place. I have found, by means of longitudinal sections, that the bristles are not always absent, but that they are, when present, extremely small and easily overlooked; this suggests that they are embryonic setæ*. Furthermore the epidermis in this region of the body is without the large oval glandular cells which are so characteristic a feature of the integument in all Oligochæta. All the cells are more or less alike. This, again, I take to be an embryonic feature. In the third place, the intestine in some individuals was very much contracted in diameter, and, as already mentioned, was empty of earth. This is not so distinctly an indication that rapid growth is going on. The nephridia, however, and the septa showed no

* In the embryo of Lumbricidæ within the cocoon, fully-developed setæ, but of small size, are found. These drop out and are replaced by setæ of the normal size. A setà does not appear to grow in thickness, but only in length; young setæ of an adult worm consist of only the tip, which is as large as it ever will be.

signs of growth, but I may, perhaps, after examining a larger series of individuals than I have yet done, discover some indication of growth in these organs. It appears, therefore, to be likely that new segments in Urochæta are formed at this point, and if so, the fact is of some interest in relation to the budding of the lower forms of Oligochæta; but I do not yet feel able to express an opinion as to the exact connexion between the two phenomena.

A new Species of Pontodrilus.

Surgeon-Major Windle, to whom I have been indebted on former occasions for Earthworms from Bermuda, has recently forwarded a large number of specimens of *Pontodrilus*. These were collected along the sea-shore among dried seaweed and coral débris. The want of a gizzard in the aquatic Oligochæta has been generally put down to the soft nature of their food. *Pontodrilus Marionis*, of which I received some years ago a number of living examples from Nice through the kindness of Dr. George Hoggan, has been stated by Perrier ("Organisation des *Pontodrilus*," Arch. Zool. Exp. et Gén. t. ix. 1881, to possess no gizzard; I have, however, found that the œsophagus is locally thickened, particularly the circular muscular layer. This is certainly the equivalent of the gizzard, though the organ is not recognizable without recourse to section cutting. The new species, *Pontodrilus bermudensis*, has apparently nothing better in the way of a gizzard; as the whole alimentary tract of this Annelid was crammed with fragments of coral, sometimes of quite a large size, it seems hardly reasonable to put down the feeble development of the gizzard to the nature of the food. It would be difficult to find any substance that appears more to need a gizzard for its trituration. I take this opportunity of observing that the bodies in segments 10 and 11 doubtfully regarded by Perrier as excretory organs are testes. I should not be surprised if it were ultimately proved that Schmarda's genus *Pontoscolex* (Reise um die Erde, Bd. ii.) were this *Pontodrilus*. The irregular shape of the body caused by the masses of coral sand in the alimentary tract give the setæ the appearance of being irregularly arranged; both worms come from the West Indies and have a littoral habit.