ON THE OLIGOCHÆTA FROM THE BLUE LAKE, MOUNT KOSCIUSKO.

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(Plates xlvi., xlvii.).

I have to thank the Trustees of the Australian Museum for giving me the opportunity of studying this small collection of Fresh-water Annelids, from the Blue Lake, Mt. Kosciusko, as they are, so far as I am aware, the first aquatic Oligochætes from the Australian continent that have been identified.

The tube received by me in March, 1906, contained a considerable number of small worms referable to three species :—

Family TUBIFICIDÆ.

1. *Tubifex davidis*, sp. nov.
2. *Branchiura pleurotheca*, sp. nov.

Family PHREODRILIDÆ.

3. *Phreodriloides notabilis*, gen. et sp. nov.

These were collected by Mr. Charles Hedley, under the direction of Prof. T. W. E. David, in the Blue Lake, which is situated at a height of 6000 feet above the sea, near the top of Mt. Kosciusko. The depth from which they were obtained is thirty-five feet ; the bottom is of soft mud, and the temperature was 44° Fahr.

The worms had, apparently, been treated with osuric acid, which, unhappily, is ill-suited for these animals ; for not only does it render the body wall rather opaque, so that the internal organs can only be studied with difficulty in entire specimens, even when stained and mounted in canada balsam, but it also appears to render the chætæ brittle, for, in the smaller specimens, they are broken off short at the level of the body wall. Hence the labour of identification is increased by the use of this reagent.

The worms, too, were soft and so readily torn in handling that it was not possible to make satisfactory dissections for the isolation of the genital ducts. Sections have been prepared, which with the study of entire individuals, both in glycerine, and after being stained, have enabled me to give the following account.

Of the three species, *Tubifex davidis* is readily distinguishable by its larger size, especially by its greater stoutness; the other two are more slender and scarcely distinguishable from one another except by aid of the microscope, though *Phreodriloides notabilis* is altogether a more delicate worm than *Branchiura pleurotheca*.

I have not attempted to make an exhaustive study of either species, but have limited myself to a description of such features as are important in characterising the species.

The types and microscopic preparations which were used in this study, are in the Australian Museum.

TUBIFEX DAVIDIS, *sp. nov.*

(Pl. xlvi., figs. 1-6).

The numerous individuals of this worm seem to indicate that it is the predominant species, so far as this collection allows me to judge. Unfortunately the majority are broken, and others so coiled as to make it impossible to give reliable measurements.

Dimensions.—I estimate that the worm measures from 25 to 40 mm. in length, with a diameter of 1 mm.

The skin is smooth, there are no papillæ, though the posterior segments are highly glandular.

The *Prostomium* is bluntly conical, and is equal to nearly twice the length of the first segment.

Chætæ.—The usual four bundles are present on each segment; the dorsal bundle consists of two kinds, "capilliform" and "forked crochets," but in the anterior dozen or so segments some of the latter have an extremely delicate membrane, or a single intermediate tooth, between the limbs of the fork ("ctenates") (Pl. xlvi., fig. 2).

The two kinds of chætæ alternate in a bundle, and in the greater part of the worm each bundle consists of three or four capilliforms and three or four crochets; but in the ante-clitellian segments, the number of capilliforms is increased to six or even seven—in these segments the additional capilliforms are dorsally placed (Pl. xlvi., fig. 1).

The capilliforms of the anterior segments are much longer than those at the hinder end, and there is a gradual diminution backwards.

One of these chætæ from segment vii. measures 5 mm., while one from near the hinder end measures only 1·87 mm. total length.

The crochets of the dorsal bundles have the two teeth of equal size and form, diverging somewhat from each other, but the "lower" tooth is not curved away for the "upper."

The number of chætæ in the dorsal bundles of the anterior segments is shown in the following table :—

Segment ...	ii.	iii.	iv.	v.	vi.	vii.	viii.	ix.	x.
Capilliforms	1	4	5	6	7	6	5	4	4
Crochets ...	2	3	4	4	4	3	4	3	4

The ventral chætæ are crochets throughout the body and usually are three or four per bundle. Those of the anterior segments are larger in all dimensions than those of the rest of the body.

The two teeth are nearly of equal length, but the distal (or upper) tooth is the more slender, the proximal (or lower) tooth being curved away from it in the usual typical manner (Pl. xlvi., fig. 3). In the anterior segments the two teeth are much more different in form, the proximal being stouter and the distal still more slender, so that it appears to be rather larger.

As is generally the case in the family Tubificidæ, there are no chætæ, either dorsal or ventral, on segment xi. of the mature worm, though they are present in the immature individuals ; in one individual, in which the genital organs were not yet fully developed, there is still one capilliform chæta remaining in the dorsal bundle of this segment, indicating, of course, that the bristles drop out as the worm attains its full sexual development.

In segment x. of the immature worm, the ventral chætæ have the normal shape and arrangement ; but these also drop out as maturity is approached, and each bundle becomes represented by a single "copulatory chæta" of special form and surrounded by a spherical gland (Pl. xlvi., fig. 6).

The copulatory chæta is a delicate, slightly curved rod, with a simple blunt point, not recurved. It measures 0·105 mm. and is much slenderer than a ventral chæta, and shorter (Pl. xlvi., fig. 4). The copulatory chæta, indeed, is so delicate, that

although I had seen it and sketched it in glycerine mounts,[1] I am totally unable to detect it in an individual stained and mounted in canada balsam, although the worm is mature. In sections the chæta is seen to be solid and without a groove, such as exists in some species.

The *Clitellum* covers the segments x., xi., xii. The male pores and spermathecal pores occupy the usual position in segments xi. and x. respectively; the spermathecal pore is situated just posterior to the "copulatory chæta."

INTERNAL ANATOMY :—

Reproductive System.—The testes and ovaries occupy the usual segments, and the sperm sacs occur in segments x. to xiii. The male-apparatus is constructed as follows :—The flat sperm funnel, lying in the tenth segment, against the anterior face of its posterior septum, leads into a delicate sperm duct, which after entering the eleventh segment, is somewhat coiled, or at least undulating, and passes upwards to enter the "atrium" near the dorsal surface of this segment. The atrium has the usual retort-shape of Tubificids generally, with its wider end upwards, into which there open the sperm duct and the moderate sized prostate (Pl. xlvi., fig. 5). The atrial duct then passes almost straight downwards to the ventral surface, piercing a small penis, which projects into a small penial sac or chamber, opening to the exterior by the male pore. There is no chitinous sheath to this penis, and the entire apparatus is confined to the segment xi.

The spermatheca, on either side of segment x., consists of an ovoid or cylindrical "ampulla" with very muscular wall, and a narrow duct about half the length of the ampulla (Pl. xlvi., fig. 6). The circular muscles of the ampulla are very strongly developed to form distinct rings. As above mentioned, the spermathecal pore is just behind the copulatory chæta of each side.

I find no spermatophores, but that is not to say that these are not formed by this species. As a matter of fact, I could not detect any spermatzoa in any of the mature individuals studied, and unfortunately, the specimen sectionised turned out to be incompletely developed. The sexual organs are present, but not fully formed, and still more unfortunately I cannot find any other mature individual suitable for sectionising.

[1] The quantity of sand-grains in the intestine, and the soft condition of the body, rendered the investigation of the chætæ rather difficult. As compression caused the intestine to burst, and the sand-grains by their refringency interfered with the study of these structures.

Vascular System.—This presents a large heart in segment viii., and in the preceding segments, iv. to vii. paired, very undulating commissurals, which are also repeated in the subsequent segments throughout the body. At the hinder end, these become much longer, and therefore take a more undulating course along the inner surface of the body wall—but they give off no branches; there is no network.

I made no particular study of the *nephridia*, owing to the broken condition of the sections, due to the sand contained in the intestine. I note, however, that the nephridia commence behind the clitellum; here the pores are well defined, and evident in the body wall in an individual that had been bisected and flattened out, after removal of the gut. These pores are in line, as usual, with the ventral chætæ, but no similar pores occur anteriorly to the clitellum.

Remarks.—This species belongs to that group of the genus *Tubifex*, which is characterised by the presence of special copulatory chætæ near the aperture of the spermatheca, as in the familiar European species *T. (Psammoryctes) barbatus*, Grube. The genus *Tubifex*, as emended by Michaelsen (1900), includes a number of species which have been described under several generic names such as *Hemitubifex*, *Spirosperma*, *Heterochæta*, *Embolocephalus*, as well as *Psammoryctes*.

Of the "Psammoryctes" group only eight species have been recorded, viz.:—*T. velutinus*, Grube, *T. barbatus*, Gr., *T. heuscheri*, Bretscher, *T. camerani*, Visart, *T. illustris*, Ditlevsen, *T. fossor*, Ditl., *T. sarneensis*, Pierantoni, and *T. hamatus*, Moore.

From each of these the present species differs in certain characters, such as the form and number of the chætæ in the dorsal bundle, details as to the proportions of the teeth of the ventral chætæ, form of the copulatory chætæ, absence of penial sheath, etc., etc.

The species which it most closely resembles is *T. heuscheri* (with which *T. camerani* is possibly identical), but from this the form of the copulatory chæta seems to mark it off. In that species the free end is sharply curved and pointed, it is twice the length of the ordinary ventral chæta, and thicker than it; it is also said to be grooved on its exposed surface. It is possible that in my specimens of *T. davidis*, the copulatory chæta is not fully formed—see above as to the difficulty of studying it—and that when fully formed it would differ from the condition described above, but I do not suppose that this is the case, and I believe that we are justified in regarding it as distinct from the European forms.

For the convenience of comparison with Michaelsen's diagnoses of the first two of the above listed species, I give briefly the characters of the new species :—

Tubifex davidis, sp. nov.

Integument smooth, dorsal chætæ capilliform and crochets, usually three or four of each kind per bundle. Some of the crochets anteriorly present an intermediate tooth, or a delicate membrane. Ventral chætæ, crochets three or four per bundle; the teeth equal, but the lower one stouter. A single copulatory chæta on each side of segment x., slender, slightly curved, blunt pointed, and smaller than the ventrals. There is no chitinous penis; spermatheca short, cylindrical, with a duct of half its length.

BRANCHIURA PLEUROTHECA,[2] *sp. nov.*

(Pl. xlvi., figs. 7-12)

This is a much slenderer worm than the preceding, and stouter, but owing to the coiled state of the mature worms, the figures given here are only estimated, though approximately correct. The body wall is highly grandular.

Dimensions.—About 12 to 15 mm. × 0·5 mm.

Chætæ.—The dorsal chætæ consist of crochets, and, in the anterior segments, capilliforms are added to the bundle. Owing to the brittle nature of the chætæ, the majority of them, in all the individuals, have the outer ends broken off, hence there is some difficulty in distinguishing the existence of capilliforms—but by a prolonged and careful study of entire preparations and sections, and preparations treated with glycerine and potassium-hydrate, and the use of high powers of the microscope, it is possible to recognise that in these anterior bundles, one or two of the dorsally placed bristles are rather more delicate than the rest, and their bases are rather longer and straight.

I was led to examine the matter very carefully for other anatomical characters—*e.g.* the modified chætæ near the male pore—have been hitherto found only in association with these chætæ.

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[2] Πλευρον—side, θηκα—spermatheca : refers to lateral portion of the aperture of this organ.

Anteriorly there are three or four chætæ in each dorsal bundle, of which one or two are capilliforms. After the clitellum, only crochets are present, and usually two per bundle.

The ventral chætæ are crochets to the number of two or three in each bundle. They are slender and short, measuring 0·08 mm.; the upper (distal) tooth is nearly twice the length of the proximal, and is much slenderer (Pl. xlvi., fig. 7).

The arrangement of the chætæ is as follows :—

Segment ...	ii.	iii.	iv.	v.	vi.	vii.	viii.	ix.	x.	xi.	xii.
Crochets ...	2	2	2	2	2	2	2	2	2	2	2
Capilliforms	2	1	2	3	1	1	1	1	0	0	0

On the segment xi. the ventral chætæ are characteristically arranged in a bunch—the bases divergent, the tips all close together, projecting through a pore on a small papilla (Pl. xlvi., fig. 11)—this bunch of four to six chætæ, instead of being arranged transversely to the axis of the body, is sagittal,[3] and hence conspicuous in an entire specimen. The copulatory chætæ, are thus arranged in a reverse way from the normal ventrals, but in form, the individual copulatory chætæ are crochets, nearly twice the length of the ventrals, measuring 0·15 mm. The bases of these are surrounded by a group of muscles, but there is no special gland.

The *Clitellum* covers the segment ½ x., xi., xii. The male pore is on xi., just outside of and anterior to the copulatory chætæ. In section, a furrow is seen to run backwards from the pore to the level of the chætæ, possibly indicating that in copulation such a furrow is formed for the transference of the spermatzoa from the male pore to the spermatheca of another worm, and corresponds to the "spermatic groove" in Acanthodriline Earthworms.

The spermathecal pore is situated near the anterior margin of segment x., and occupies an unusual position, in that it lies near the lateral line of the body, about midway between the dorsal and ventral chætal rows (Pl. xlvi., fig. 10).

INTERNAL ANATOMY :—

Reproductive System.—The testes, ovaries, etc., occupy the usual segments. The sperm sac is median, and extends through segments xi. to xvi., while the four preceding segments, vii. to x.,

[3] I find the copulatory chætæ of *Taupodrilus simplex*, Benham, to have this disposition, which is apparently shown in Stole's figure of *B. (Ilyodrilus) coccinea*.

are filled with loose masses of developing spermatozoa. The sperm funnel is flat, leads into a short and delicate duct which passes directly downwards after piercing the septum to enter the eleventh segment; here it passes below the ovary, and I have been unable to trace it accurately amongst the ova—it winds somewhat and appears again near the apex of the atrium. Its course, indeed, is similar to that in *Taupodrilus simplex*, but it does not coil round the atrium as in that species.

The *Atrium* is a cylindrical organ, rounded at its upper end. It presents three more or less distinctly marked regions—the sac, the neck, and the atrial duct—each having a structure similar to that described by Beddard (1) in *B. sowerbyi*. That is, the sac itself is lined by tall glandular cells similar to those described and figured by me for *Taupodrilus simplex;* the short neck, which is not abruptly marked off, is lined by cubical cells (I was unable to detect cilia in my sections, though no doubt they exist as in other species), but the duct, which is sharply differentiated, is lined by columnar cells, which support a distinct cuticle, continuous with that of the outer epidermis (Pl. xlvi., fig. 8). The wall of the atrium is muscular, and outside this coat is a layer of "prostate cells" of a form essentially similar to those described and figured by Beddard (1)[6] and Stolc (14). In fact, except for minor details, the apparatus is characteristically Branchiuran. There is no penis other than the bunch of copulatory chætæ on their papilla.

The spermatheca, situated on each side of segment x., is relatively small, pyriform in shape, with a short distinct duct, bent at right angles to the ampulla (Pl. xlvi., fig. 9), to open laterally as above described. Though the ampulla is filled with spermatozoa, they are not moulded into a spermatophore.

The Vascular System.—Two pairs of enlarged "hearts" are visible in the entire specimens, lying in segments viii. and ix., while in transverse sections, a third is seen in segment x.

The usual narrow, undulating commissurals are present in the remaining segments. I was unable to detect a "supra intestinal vessel," except possibly in segments x., xi., xii.—for in these segments, in transverse sections, two vessels lie above the gut, a larger, the "dorsal," and a smaller one below it, which may be the "supra intestinal." Further back, and further forwards, only a single vessel is visible above the gut; and throughout only a single one, the "ventral" vessel below. In the greater part of the body the commissural vessels instead of going directly from the dorsal to the ventral vessel, break up into a more or less elaborate plexus on the body wall (Pl. xlvi., fig. 12), and in the

[6] For references numbered in brackets see Bibliography at end of paper.

posterior third or so this network has very small meshes; the network is continuous from segment to segment. Such a network is rare in Tubificids—it has been described only in *Branchiura*, as emended by Michaelsen (9), as well as in *Rhizodrilus limosus*, Hatai (8), and to some extent in *R. pilosus*, Goodrich (7).

The form and constitution of the network is more like that figured by Hatai than of the other species referred to, viz.:—Each "latero-dorsal" and "latero-ventral" vessel *(pv.)*, of which there is a pair in every segment, after reaching the body wall in these post-clitellian segments, breaks up into a number of anastomising branches, with a tendency to a longitudinal and transverse arrangement. It is quite unlike the simpler arrangement of *B. sowerbyi*, and is less elaborate than that in *B. coccinea* (14).

The first nephridium occurs behind the atriopore in segments xiii. and xiv.

Remarks.—That this worm is closely allied to Stolc's "Ilyodrilus coccineus" there can be no doubt, and there appears to me a certain amount of truth in Ditlevsen's criticism (6) of Michaelsen's union of this worm with *Branchiura sowerbyi* in the genus *Branchiura*—but I am not in a position to discuss this question on the present occasion, and I have therefore followed Michaelsen in placing the species in the genus *Branchiura*. I would remark, however, that if the two species are distinct, a new generic name must be found for "Ilyodrilus coccineus," since *Ilyodrilus* was used by Eisen earlier in a different sense.

In a recent article Michaelsen has severely criticised my genus *Taupodrilus*, and denies that it is even specifically distinct from *B. coccinea*. To this criticism I hope to reply after reading his memoir on the Elbe Oligochætes, which, unfortunately, I have not yet seen. Possibly, *B. pleurotheca* may be a variety of *B. coccinea*, but till I have studied this memoir I shall allow the above account to stand.

The present species may be diagnosed thus:—

Branchiura pleurotheca, sp. nov.

Chætæ, dorsal bundles of 2-3 crochets, with capilliforms added in anterior segments; ventrals crochets, with upper tooth longer than the lower. On segment xi., behind the male pore, a bunch of copulatory chætæ in the sagittal plane, the points converging, the chætæ similar in form, greater in size than the other ventrals. Clitellum $\frac{1}{2}$ x., xi., xii.; spermathecal pore lateral, near anterior margin of x. Male efferent apparatus as in *B. coccinea*, but the atrium elongated ovoid, and the sperm duct opening at its apex. An elaborate integumental blood plexus in the greater part of the body.

PHREODRILOIDES, *gen. nov.*

Resembling *Phreodrilus*, Beddard, but without a spermatheca. The sperm duct opens into a muscular, but non-glandular sac, containing spermatozoa, which opens to the exterior in segment xii.

PHREODRILOIDES NOTABILIS, *sp. nov.*

(Plate xlvii.).

Only a single individual of this very interesting worm was received, but fortunately it was sexually mature. It was, after examination in glycerine, stained and mounted in canada balsam; later it was unmounted, and the anterior end cut into serial sections.

Dimensions.—It is altogether shorter and more slender than the preceding; it was coiled in a flat spiral at each end, so that the length here given is only approximately correct, viz., 8 mm. The body wall is very glandular; the glands are in two distinct annular groups in each segment, that is, each segment is biannulate, of which the larger occupies the greater part of a segment, and a much narrower one lies near the posterior intersegmental furrow.

Chætæ.—The ventrals commence in segment ii., and the dorsals in iii. (as in *Phreodrilus*). The ventral bundle normally contains a single chæta, which is a simple-pointed sigmoid, with very feebly expressed nodulus (Pl. xlvii., fig. 13). But in a few segments I noted two such chætæ. These ventrals measure 0·05 mm.

The dorsal chætæ are entirely capilliforms, and there appear to be two in each bundle, one longer and thicker, one shorter and finer. This is certainly the case in segments iii. and iv., but unfortunately the rest were broken, the anterior end being protected by its curvature retained them when mounted in glycerine. After manipulation, however, I found that even these had been broken. I failed to measure them, but the longer chæta was rather greater than half the diameter of the body.

A careful study of transverse sections shows that each of the subsequent segments contain bases identical with that of these two segments, *i.e.*, the inner end is abruptly truncated, there is no nodulus, and the embedded portion is straight—all characters of capilliforms. Chætæ are absent in segment xii., and there are no copulatory chætæ.

The *Clitellum* commences at about the middle of segment xii. and surrounds segment xiii., but only a very short portion of the ventral surface is glandular.

The *male pore* is situated near the anterior margin of segment xii, rather mediad of the line of the ventral chætæ. There is no spermathecal pore.

INTERNAL ANATOMY :—

Reproductive System.—The structure of the male efferent apparatus is very peculiar. A pair of testes lies in segment xi., on the anterior septum; the sperm funnel is simple, and the sperm duct after piercing the septum xi./xii., passes backwards in a slightly undulating course on the mesial side of a large muscular sac, into the neck of which it opens (Pl. xlvii., fig. 15).

The muscular sac in segment xii. was very conspicuous in the entire specimen, as it is filled with ripe spermatozoa. It is nearly cylindrical, but curved, so that it is convex dorsally; its rounded free extremity is directed forwards and rests close behind the septum xi./xii., while posteriorly, after curving downwards as it approaches the middle of the segment, becomes rather narrower, to form a short "neck." This now opens into a small, subspherical chamber through its mesial wall. This chamber, which may be termed the "penial chamber," in its turn communicates with the exterior by a comparatively small pore on the ventral surface of segment xii. (Pl. xlvii., fig. 14).

The structure of these parts is as follows:—The "muscular sac" is lined by a flat epithelium, in which nuclei can only be distinguished here and there, surrounded by a thick coat of circular muscle-fibres (Pl. xlvii., fig. 16). There is no glandular covering, and no gland opening into this sac. The sperm duct has the usual structure, and opens into the narrow neck of the preceding near the opening of the latter into the "penial chamber" (Pl. xlvii., fig. 15). The short "common duct" thus formed does not differ in structure from the rest of the sac. At the point of entrance of the sperm duct, the cilia project into the sac (Pl. xlvii., fig. 16). The subspherical "penial chamber" appears to be an invagination of the epidermis, it is lined by an epithelium, which over the greater part of the outer hemisphere is similar to the epidermis, but the whole of the mesial surface of the wall, as well as the apex and part of the outer wall, is lined by a layer of tall glandular cells (Pl. xlvii., fig. 17). The wall is, further, provided with a thin coat of circular and longitudinal muscles, as well as "retractor muscles" connected with the body wall. The structure of this chamber suggests that it is capable of protrusion, and on one side of the body, the common duct (or neck of the muscular sac) is itself pushed forward into the cavity of the "penial chamber" (Pl. xlvii., fig. 17) in such a way as to suggest a "penis" such as exists in some species of *Phreodrilus (P. albus, P. lacustris)*, but of much smaller dimensions.

In segments xi. and xii. are masses of developing spermatozoa; the former segment is filled by them, the latter only partly so,

and in segment xiii. is a median sperm sac, with a definite wall. The ovary is in segment xii. in the usual position, and loose ova of various sizes also occur in this segment; in xiii. and xiv. are also very large ova, one in each segment, lying in an ovisac. The oviduct I was unable to trace satisfactorily, but at the boundary of segments xii./xiii. I detected a mass of small nuclei in a position suggesting the duct, but the compression to which the worm had been subjected had entirely obliterated the lumen, if it be the duct, and though I was able to trace these cells into continuity with the epidermis, no pore was visible

The *alimentary canal* presents no special features. The pharynx is present in segment ii.; the œsophagus, thick-walled and of small diameter, extends into the tenth segment, beyond which it opens abruptly into the thin-walled intestine, which has a diameter about twice that of the œsophagus; here, starting in segment xi., the gut is filled with sand grains, diatom shells, etc. There are salivary glands or septal glands on the anterior wall of segments v. and vi.

Of the *vascular system* the following facts were noted. The dorsal and ventral vessels are the only longitudinal trunks; these are connected by delicate commissurals in segments iii. to vii., the last being slightly larger than the rest, but not definitely "heart"-like. There are no integumental vessels; on the outer wall of the intestine, however, there is a very regular network of blood-vessels formed of closely and regularly set circular vessels connected by short longitudinal ones. This recalls Michaelsen's account of the arrangement in *Phreodrilus kerguelenensis* (10). The blood is quite pale in colour.

The nephridia are loose-coiled tubes of a Tubificid character; they seem to be asymmetrically disposed, for the first organ lies on the left side of segment vi. Those of the following segments are also confined to the left side; that in segment x. is on the right side; and further back I see only one in a segment.

Remarks.—Although the worm agrees with *Phreodrilus* in general external anatomy and in several of the internal characters, so as to be easily included in the family Phreodrilidæ, as defined by Michaelsen (1902), yet it differs from all the species of the genus *Phreodrilus* in the structure of the male efferent apparatus, and in the apparent absence of a spermatheca. I say "apparent" absence, for it may possibly be that the muscular sac, filled with spermatozoa, has received those spermatozoa during copulation with another worm. But in no Oligochæte hitherto studied do we know of such a spermatheca connected in this way with the male duct. On the other hand, we not unfrequently find the ripe spermatozoa filling more or less of the atrial cavity, through

which of course they must pass on the way to the exterior. But in most of these cases there is no doubt as to the nature of the chamber; it is provided with a glandular lining, or receives the necks of the gland cells of the prostate, and though we are in ignorance as to the exact function of this secretion, yet it appears probable that it takes some share in the process of copulation. In the present worm, however, the sac which contains the spermatozoa is absolutely non-glandular—there is neither prostate, nor prostate cells outside it, nor glandular cells lining it. The wall is strongly muscular, far more muscular than is the atrium in other aquatic Oligochætes, and in this respect resembles the muscularity of the spermatheca in many Tubificids. At any rate, we have to note the entire absence of a spermatheca corresponding to that of *Phreodrilus*.

In all the species of this genus the spermatheca is a long sac extending through two or more segments and opening near the anterior margin of segment xiii. This is quite an exceptional position for this organ, in the class, for it is almost universally in front of the male pore, though in certain of the Lumbriculidæ it is behind the pore.

The idea occurs to one that in *Phreodriloides* the pore of the spermatheca has passed forwards into segment xii., and has become coincident with the male pore. But there is nothing analogous to such a fusion throughout the Oligochæta, and a more reasonable explanation is that the atrium has become a reservoir for the spermatozoa, and that copulation does not occur, that the muscular sac (or "autospermatheca") discharges its own spermatozoa on its own ova, during the formation of the cocoon.

But there is another feature in which this new genus differs from *Phreodrilus*—in that genus the sperm duct opens into a more or less tubular organ lined with glandular cells and termed the "atrium," which in turn opens through a "penial sac" lined by flatter cells, and surrounded by muscles This sac is quite small or evanescent in *P. kerguelenensis* (10), but is of considerable size in *P. lacustris* and others (see Benham, 4), and further, in most species the pore is at the end of a conical protrusible organ lying in this sac.

From a mere inspection of a figure, the male apparatus of *Phreodriloides* appears to be readily comparable with that of *P. kerguelensis*, Michaelsen, and *P. lacustris*, Benham, were it not that what is a highly glandular sac (atrium) in these two species, is a non-glandular, highly muscular sac in *Phreodriloides*; and it appears that the "penial chamber" of the latter—partly glandular as it is—may represent both the atrium and the penial sheath of such a form as *P. lacustris*. On the other hand, there

is some slight evidence that this penial chamber is eversible, when it would correspond only to the penial sheath of *P. lacustris*.

If this chamber is really eversible, we must probably conclude that copulation does take place, and if so, the only sac capable of receiving spermatozoa is the muscular sac, which would thus function as a spermatheca. So that whatever may be the true homologies of these parts, the distinctness and pecularity of the new genus are sufficiently striking.

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