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THE  
SUBANTARCTIC ISLANDS  
OF  
NEW ZEALAND.

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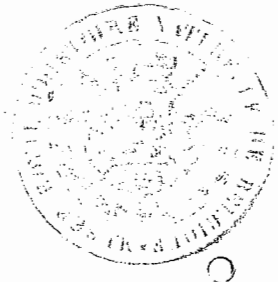
REPORTS  
ON THE  
GEO-PHYSICS, GEOLOGY, ZOOLOGY, AND BOTANY OF THE  
ISLANDS LYING TO THE SOUTH OF NEW ZEALAND,  
BASED MAINLY ON  
OBSERVATIONS AND COLLECTIONS MADE DURING AN EXPEDITION IN THE GOVERNMENT  
STEAMER "HINEMOA" (CAPTAIN J. BOLLONS) IN NOVEMBER, 1907.

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## ARTICLE XII.—REPORT ON OLIGOCHAETA OF THE SUBANTARCTIC ISLANDS OF NEW ZEALAND.

By W. B. BENHAM, D.Sc., F.R.S., University of Otago.

PLATES X AND XI.

THE earthworms described in this report may be regarded as fairly representative of the Oligochaet fauna of these southern islands—at any rate, of the Auckland Island group, on which the majority were collected.

Since the stay of the "Erebus" and "Terror" at Port Ross in 1840, no naturalist has been able to spend more than a few hours at each of the islands. The usual opportunity afforded him is the occasion of the annual visit in search of shipwrecked mariners when the New Zealand Government steamer makes a tour of inspection of the islands and the depots. On these occasions the naturalist has only a few hours in which to make a collection, and that only in the immediate proximity of the landing-place. I have been more fortunate, as on the occasion of each of my two visits the circumstances have been such as to permit a more prolonged investigation of the fauna.

In February, 1907, I had the honour of being invited by His Excellency the Governor of New Zealand (Lord Plunket) to accompany him on his visit to these distant parts of the Dominion under his charge, and I had every opportunity, commensurate with the time allotted to the trip, to collect. While at the Auckland Islands we spent one morning at Port Ross, an afternoon on Enderby Island, and a whole day on Adams Island. Our stay at Campbell Island covered two days, and I had time to ascend Mount Honey; another day was occupied in traversing the Antipodes Island; while at the Snares we spent a few hours. Both at the Auckland and Campbell Islands I collected a considerable number of earthworms, but at the Antipodes I found none, chiefly, I think, because I had no spade with me, for we had landed at a spot where we had to climb up a very steep face of smooth slippery rock through a penguin-rookery, where it was inadvisable to hamper one's self with unnecessary gear. I have since regretted this lack of a spade.

My second visit was paid in November, 1907, and was confined to the Auckland Islands, except for some hours on the Snares, at each of which a good number of earthworms were obtained. At the Aucklands ten days were spent, and here I paid attention not only to the *Oligochaeta*, but also to all groups of invertebrates, except *Lepidoptera*, both terrestrial and marine. Those members of the expedition—viz., the botanists and geologists—whose work necessitated their going to the more distant parts of the islands, brought earthworms from all their excursions, and I owe many thanks to Dr. Cockayne and Messrs. Aston, Speight, and Tennant,

as well as to other members of our party, for their kind and willing help in getting together so good a series of earthworms from the Auckland Group. Only a few worms were forwarded to me from Campbell Island, collected by Messrs. Mayne and Marriner and Professors Chilton and Kirk.

I have not included in this report the earthworms from Stewart Island, of which I have a good number, but as yet unidentified. They are nearly all members of the *Acanthodrilinae* genera, common in the South Island of New Zealand, none of which were, however, collected during this expedition.

#### LIST OF OLIGOCHAETA.

##### Fam. PHREODRILIDAE.

*Phreodrilus campbellianus*, sp. nov.  
Campbell Islands.

##### Fam. TUBIFICIDAE.

*Rhizodrilus aucklandicus*, sp. nov.  
Auckland Islands.

##### Fam. ENCHYTRAEIDAE.

*Lumbricillus intermedius*, sp. nov.  
Auckland and Campbell Islands.  
\* *Lumbricillus macquariensis*, Benham.  
Macquarie Island.  
\* *Marionina antipodum*, Benham.  
Antipodes Island.  
\* *Enchytraeus albidus*, Henle.  
Campbell and Macquarie Islands.

##### Fam. HAPLOTAXIDAE.

*Pelodrilus tuberculatus*, sp. nov.  
Auckland and Campbell Islands.  
*Pelodrilus aucklandicus*, sp. nov.  
Auckland Islands.

##### Fam. MEGASCOLECIDAE.

##### Subfam. ACANTHODRILINAE.

*Notiodrilus haplocystis*, Benham.  
Snares Island.

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\* Those marked with an asterisk were not obtained during the expedition.

- Notiodrilus fallax*, sp. nov.  
Snares Island.
- Notiodrilus aucklandicus*, Benham.  
Auckland Group.
- Notiodrilus campbellianus*, Benham.  
Auckland and Campbell Islands.
- \* *Notiodrilus macquariensis*, Beddard.  
Macquarie Island.
- Plagiochaeta plunketi*, sp. nov.  
Auckland Islands.
- Rhododrilus cockayni*, Benham.  
Auckland and Campbell Islands.
- Leptodrilus leptomerus*, Benham.  
Auckland and Campbell Islands.
- Leptodrilus magneticus*, sp. nov.  
Auckland Islands.

## Subfam. MEGASCOLECINAE.

- Plutellus aucklandicus*, sp. nov.  
Auckland Islands.
- Diporochaeta heterochaeta*, sp. nov.  
Snares Island.
- Diporochaeta brachysoma*, sp. nov.  
Auckland Islands.
- Diporochaeta helophila*, sp. nov.  
Auckland Islands.
- Diporochaeta perionychopsis*, sp. nov.  
Auckland Islands.

## Fam. LUMBRICIDAE.

- Helodrilus constrictus*, Moore.  
Introduced. Campbell Island.

## GEOGRAPHICAL RELATIONS.

The only endemic genus is *Leptodrilus*, which is closely related to a purely New Zealand genus, *Rhododrilus*, in which, indeed, I formerly included it. This new genus, represented by two species, occurs both on the Auckland and on the Campbell Islands, as does also *Rhododrilus*.

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\* Those marked with an asterisk were not obtained during the expedition.

*Plagiochaeta*, represented by a single species on the Aucklands, is peculiar to New Zealand, and hitherto has not been found in the North Island; in the South Island it is represented by several species, from Nelson to Invercargill and from the east coast to the west; and it also occurs on Stewart Island.

The occurrence, then, of these three genera evidently indicates a former land continuity between the mainland and these subantarctic islands.

*Notiodrilus* (*s.l.*) is a genus which is found in New Zealand and its southern outliers, as well as at Kerguelen, Marion Island, the Crozets, South Georgia, Falkland Islands, Patagonia, Tierra del Fuego, and Cape of Good Hope—in other words, it is circumpolar—and to its importance I have already called attention in my address to Section D at the meeting of the Australasian Association for the Advancement of Science, at Hobart, 1902. It may be remarked, however, that further research has shown that the genus occurs elsewhere, as in Mexico, Madagascar, Guatemala, Cameroon, and north-west Australia. I have some remarks on this matter under the account of *N. fallax*. Three species of this genus were already known from these subantarctic islands of New Zealand, and I now add a fourth from the Snares.

The genus *Phreodrilus* is characteristically Antarctic, with nine hitherto-described species; it is represented in New Zealand by at least three—perhaps four—species, the remaining species occurring on Kerguelen, Crozets, Falkland Islands, and Tierra del Fuego. The majority of the species are found on the sea-shore.

Although this subantarctic distribution of *Notiodrilus* and *Phreodrilus* seems to be best explained by the supposition of a larger tract of land in these regions, as was first indicated by Beddard and later dealt with by me at some length in 1902, yet the leading authority on *Oligochaeta* is entirely opposed to this suggestion. Michaelsen, in 1902, and again in 1907, having noted that many of the species of *Notiodrilus* (and of some others) can and do live on the sea-shore, and, using the term "euryhaline" to express this mode of life, says, "Through their euryhaline nature one easily explains this wide distribution of the genus across the seas, which in consequence of the 'West-wind Trift'—a current present in the circumpolar subantarctic seas—can be carried from station to station, and thus come to have a circumpolar distribution" (1907, *a*, p. 144). He supposes that the worms or their cocoons may be carried in seaweed from island to island. Any one who has had experience of the size and tremendous power of the waves in these southern latitudes, and of the terrific wind-storms that constantly rage over these seas, will be in a position to recognise the high degree of improbability that seaweed could be carried from island to island by the "West-wind Trift" without being torn into fragments. *Oligochaeta* or their cocoons would soon be wrenched from the plant, and their arrival at any distant land-surface—say, from Marion Island to Kerguelen—is, in my opinion, quite outside the realm of probability. When I stood at the top of the sheer cliffs, some 500 ft. to 1,000 ft. in height, which form the whole of the west coast of Auckland Island, and saw the tremendous breakers which even in moderately calm weather dash with incredible force against the rocks, I was more than ever convinced that the "West-wind Trift" cannot account for the transference of *Oligochaeta* from the various land-surfaces of this subantarctic region. It is also extremely likely that the worms would fall a prey to fishes, or be engulfed by whales while feeding, long ere they would reach another land-surface. Even if it be within the bounds of possibility to explain the distribution of *Notiodrilus* and

certain Enchytraeids in this way, it will not, I think, commend itself to the students of other groups of animals and of plants. The evidence in favour of a circumpolar continent or shifting archipelago is much stronger now than when I discussed the matter in 1902.

The subfamily *Megascolecinae* is Australian in its origin, but representatives of it have been recorded by myself from the North Island—species of *Megascolecoides* (= *Tokea*, Benham) and *Spenceriella* (= *Diporochoeta*)—and it is only very sparsely represented by *Diporochoeta* in the South Island and Stewart Island—so far, at least, as our knowledge allows me to state. But, as I mentioned in 1904, while the common earthworms of the South Island are Acanthodrilines, these are less numerous in the North Island, where they are replaced by Megascolecines. It is therefore surprising to find that the larger and commoner worms at the Auckland Islands belong to this subfamily—viz., *Plutellus* (one species) and *Diporochoeta* (four species).

Lumbricologists are agreed that the Megascolecines are derived from Acanthodrilines—that, indeed, *Notiodrilus* (*s.l.*) is the most archaic of the family, from which *Maoridrilus*, *Plagiochaeta*, *Rhododrilus*, and *Leptodrilus* have been developed, in somewhat that order. The *Megascolecinae* have, in the same way, been derived from *Notiodrilus* through *Plutellus*, the most archaic of its subfamily; and *Diporochoeta* is a descendant of it. (I am omitting reasons for these views, for they have been fully dealt with by their author, Michaelsen, in a recent work, 1907, *a.*)

The discovery of *Plutellus* on the Auckland Islands is, perhaps, the most astonishing outcome of this expedition, so far as the earthworms are concerned. Characteristically Australian, and chiefly Tasmanian and Victorian, its occurrence in this southern outlier of New Zealand is difficult of explanation, for the genus has not yet been recorded from the mainland nor from any of the islands in this area. It is true that in 1904 I attributed a lacustrine species to this genus, but Michaelsen regards it as belonging to *Pontodrilus*. In order to account for the presence here of this genus, the following alternatives occur to me: (1.) It was introduced into the islands at the time of the Enderby Settlement, from New South Wales. (2.) It passed into and remained in the islands from New Zealand when this land had its great extension southwards. (3.) It arrived from Tasmania, *via* the Antarctic Continent. The last view seems to me the least probable. There is evidence that Tasmania became separated from the Antarctic Continent before New Zealand did—*i.e.*, previous to the evolution of the *Megascolecinae*, at a time when *Notiodrilus* and its immediate allies were the predominant genera of the family. *Plutellus*, indeed, is a direct descendant of this genus, and no doubt appeared early. Again, if *Plutellus* entered from the north, how is it that we do not find it on the mainland? Its descendant *Diporochoeta* is here, alongside the more archaic Acanthodrilids; and it is clear that climatic and edaphic conditions of New Zealand are not antagonistic to the Megascolecines. On the whole, I am inclined to take the view that the worm was introduced by man (see below), for it is allied to certain of the New South Wales species, such as *P. tuberculatus*.

The family *Haplotaxidae* is richly represented in the Southern Hemisphere, for, with the exception of two or three species of *Haplotaxis* and one of *Pelodrilus* in the Northern Hemisphere, the rest are known from the following places: In New Zealand—two species of *Haplotaxis*, one species of *Pelodrilus*; in Western Australia—

two species of *Pelodrilus*; at the Cape of Good Hope—one species of *Pelodrilus*. The genus is a lover of moist earth.

The new species of *Lumbricillus* is closely related to *L. verrucosus* and *L. maximus*, both of which occur in subantarctic regions; but the genus is found all over the Northern Hemisphere.

The genus *Marionina*, although of northern origin, has several species in the subantarctic region—viz., on Tierra del Fuego, South Georgia, Kerguelen, and Crozet Island.

The genus *Enchytraeus* is a European one, and the species *E. albidus* has been recorded from south Patagonia, Tierra del Fuego, and the Crozets, as well as from the main islands of New Zealand.

#### Fam. PHREODRILIDAE.

##### PHREODRILUS, Beddard, 1891.

##### *Phreodrilus campbellianus*, n. sp. (Plate X, fig. 1.)

A considerable number of this worm were collected in February, 1907, but are poorly preserved.

*Colour* (in alcohol) white anteriorly, while the translucent body-wall posteriorly leads to a greyish tint; the clitellum is pale brown.

*Dimensions*.—As the worms are a good deal twisted, it is difficult to give accurate figures, but they are approximately 18 mm. by 1 mm., with about 60 segments. Except for the 3 anterior segments, they are each biannulate, consisting of a very short anterior annulus and the chief posterior annulus.

The *prostomium* is short, blunt, with a broad base; it is nearly as long as the first 2 segments together.

The *chaetae* are arranged as in *P. lacustris*; the ventral couple are of two kinds, a simple sigmoid and a notched chaeta, though in some segments both are notched. The dorsals are solitary, capillariform, and commence on the 3rd segment.

The *clitellum*, which is yellowish-brown in colour, covers segments  $\frac{1}{2}$  12, and 13; and extends all the way round the body.

The *male pore* is on a slight prominence at the anterior margin of 12, from which in one specimen at least a penis protrudes.

The *spermathecal pore* is of large size, near the anterior margin of 13. Both these pores are in line with the ventral chaetae, which, however, are absent in 12, 13; and there are no penial chaetae, as in *P. lacustris*. The female pore at 12/13 is invisible externally.

##### *Internal Anatomy.*

Septal glands lie on each side of septa 4/5, 5/6, and at the anterior face of 6/7.

There are no enlarged hearts, though the dorsal blood-vessel is enlarged in 5, 6, 7.

There is no gizzard; the oesophagus is narrow up to the 10th, then suddenly opens into the intestine.

The first pair of *nephridia* is in 7, of rather large size; the next pair in 10; then in 14, 15, 17, 18, 19, &c. I was unable to detect any nephridia in 16 on either side of the body in the specimen sectionised.

The *testes* and *funnels* are in 11, in the usual positions. The sperm-duct is slightly convoluted immediately behind the septum, and receives a long convoluted prostate just before entering the copulatory apparatus. The prostate fills the segment; it is surrounded by a refringent sheath, which may be muscular; but there is no common sac, such as exists in *P. beddardi* and *P. subterraneus*. The penial sac contains a long penis, which is protruded on one side of the worm. The whole apparatus closely resembles that of *P. lacustris*.

Segments 8, 9, 10, 11, are more or less occupied by masses of developing spermatozoa, but there is no definite sperm-sac.

The *ovary* is small, in 12, but there are large ova free in this segment. The oviduct is quite small, and opens at 12/13.

The *spermatheca* has the usual elongated form characteristic of the genus; it extends back to the 14th, or on one side to the 15th, segment. The narrow muscular duct, which passes through the septum 13/14, is constricted sharply from the ampulla, and enters, in 13, the apex of a large atriumlike invagination of the body-wall of about the same size as the penis-sac.

The "antrum" of the spermatheca is lined by tall granular cells, surrounded by a coat of circular muscles, covered by coelomic epithelium. The lining epithelium becomes lower as it approaches the pore, and is there continuous with the epidermis.

*Locality*.—Campbell Island. Under stones, sea-shore, near exit of a stream from the flanks of Mount Honey; (W. B. B.).

*Remarks*.—The present species of *Phreodrilus* agrees most nearly with *P. lacustris*, Benham,\* from Lakes Wakatipu and Manapouri, from which it differs in—(a) the presence of the large muscular sac at the exit of the spermatheca; (b) the absence of copulatory chaetae near the aperture; and in the minor fact that the duct of the spermatheca is in *P. lacustris* much shorter, in that it does not enter the 14th segment. The new species agrees with *P. albus*, Beddard,† from the Falkland Islands, in the possession of the spermathecal sac referred to, but the male apparatus in that species is much less extensive; and it differs in other details. The great interest of the genus is its circumpolar Antarctic distribution, for all the species are limited to the extreme southern lands; at least three (perhaps four) species occur in New Zealand, one species in Kerguelen,‡ one species on Crozet Island,§ two species on the Falkland Islands, and two species in the extreme south of the American Continent.|| The present species thus forms a geographical link with that of Kerguelen.

\* Benham, "On some New Species of the Genus *Phreodrilus*," Quart. Journ. Micr. Sci., xlviii, p. 271, 1904.

† Beddard, "Naiden, Tubificiden, und Terricolen," in Hamb. Magalhaens. Sammelreise, p. 11, 1896.

‡ Michaelsen, 1902 (*P. kerguelarum*), p. 136.

§ Michaelsen, 1905 (*P. crozetensis*), p. 5.

|| Beddard, *loc. cit.*



## Fam. TUBIFICIDAE.

RHIZODRILUS, F. Smith, 1900.

**Rhizodrilus aucklandicus**, sp. nov. (Plate X, figs. 2-7.)

Of this littoral worm I obtained several.

*Colour*, as in Tubificids generally, red, owing to the blood in the integument and elsewhere showing through the transparent skin.

*Dimensions*.—Long, narrow, with feebly expressed segments, due perhaps to the condition of preservation. Length, 29 mm. by 0.5 mm., with 80 segments, which are triannulate—anteriorly, at least.

*Prostomium* rather long, greater than the length of segments 1 and 2 together.

*Chaetae*.—Two bundles of forked sigmoids on each side of each segment; the two prongs are of equal length and of comparatively large size. Dorsals, 3 or 4, in the anterior part of the body; 1 or 2 posteriorly. Ventrals, anteriorly 3 or 4, occasionally 5; but posteriorly 2, or rarely 1. The chaetae are absent in 11 and 12. In some of the segments long fine hairs have become entangled with the chaetae, which at first examination were mistaken for capillariform chaetae.

*Dorsal pores* commence at the anterior end of the 4th segment; they are not really intersegmental, as they lie behind the first annulus, while the septum is inserted in front of this annulus.

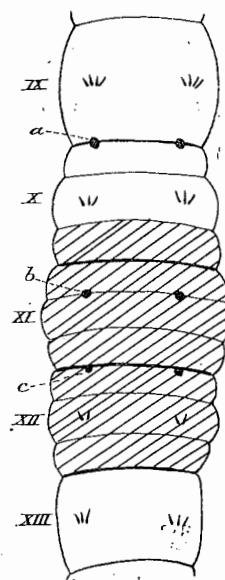
*Clitellum* on dorsal and lateral surface of 10, and surrounding the body of 11, 12.

*Genital Pores*.—The male pores are paired on 11, at the junction of annuli *a*, *b*, at the position of the absent ventral chaetae. Spermathecal pores also paired at 9/10, in line with ventral chaetae. Oviducal pores at 11/12, in the same line.

*Internal Anatomy.*

There is an elaborate integumental blood-plexus, but I did not work out the details, nor am I able to state whether the characteristic moniliform structure of these vessels, as described by Goodrich and others, is or is not present. I did not detect any "hearts."

The pharynx is very feebly developed. The roof is recessed, but has only an extremely slight musculature, either intrinsic or extrinsic. This recess is lined by tall ciliated cells, which take the stain but feebly. The nuclei are basal in position. On the floor is a well-defined pad of high ciliated cells of quite a different character, more triangular in form, with distal or central nuclei and deeply staining cytoplasm; amongst them are a few large gland-cells. This pharynx lies in the 3rd segment. The ciliated pad and the ciliated cells of the recess are very sharply



RHIZODRILUS AUCKLANDICUS.

Ventral view of the genital region, showing the annulation of the clitellar segments, the actual number of chaetae, and the genital pores. *a*, spermathecal pore; *b*, male pore; *c*, oviducal pore.

marked off from the cuticulated and much lower cells of the buccal region. I do not recall any pharynx having this simple structure.

The narrow oesophagus passes gradually into the intestine, which is only dilated behind the ovisac in the 24th segment.

The *nephridia* are small, and recall those of Enchytraeids in structure. A small preseptal region; a more or less triangular post-septal region, as seen in longitudinal sections, with a wide but short duct leading from the posterior end. The lumen passes in an undulating course through a mass of cells, few in number. The first pair lies in segment 7, the next in 9, the third in 13, and then they occur in each of the following segments.

*Testes*.—One pair in 10. Large wide funnels lie on the hinder septum; each leads into a short straight sperm-duct, which passes directly backwards along the ventral body-wall, below the ovary, to enter the apex of a penial apparatus (Plate X, fig. 7). The wall of the duct is covered with groups of gland-cells, as described and figured by Goodrich for *R. pilosus*, and such as are familiar in prostates. This covering commences immediately behind the septum 10/11, and ceases as the duct curves upwards at the hinder end of the segment to enter the penial sac. The thin muscular wall of this sac is attached to the dorsal body-wall of segment 12 by a group of retractor muscles arising from its apex, which pushes the posterior septum of segment 13 backwards; the cavity of the sac, close to its proximal extremity, is traversed by a few bundles of fibres of, apparently, connective tissue. The sperm-duct passes through the sac, and is divisible into two regions which differ structurally from each other: first it dilates into an ovoid glandular bulb; then the wall becomes thin and folded to form the penis, which opens into a small penial chamber unprovided with any chitinous lining; this in its turn communicates with the exterior by a comparatively small pore in segment 11. It is to the wall of this chamber that the fibres above mentioned are attached. The structure of the duct alters as it traverses this sac. At first, just after entering the sac, the wall is formed of small ciliated cells of the usual type; after reaching the interior of the sac the cells elongate considerably, so that the diameter is now more than twice what it is outside the sac, but the lumen remains small: the cells are still ciliated (Plate X, fig. 4). This region forms a large bulb or swelling in the course of the duct. Further down, the cells decrease in height, and lose their cilia and granulation, so that at the lower end they are quite low, and the lumen becomes much wider (Plate X, fig. 6). This region is somewhat folded, indicating its protrusibility. The duct opens on a slight papilla into a small penial chamber, an invagination of the epidermis.

There are *sperm-sacs* in 9, and an unpaired one passing through segments 11 to 19.

The *ovaries* and *oviduct* lie in the normal positions. An unpaired ovisac extends through segments 19 to 23.

*Spermathecae*.—A pair in segment 10, with widely separated pores. Each spermatheca (Plate X, fig. 3) is distinctly divided into two parts, a smaller and a larger; the larger is posteriorly directed, somewhat ovoid in shape, with a pointed end and wide base, which is deeply constricted from the smaller globular anteriorly situated portion; the latter communicates by a very small aperture with an invagination of the epidermis, which has the form of a short tube, into which the pore of the globular sac projects slightly. The ovoid ampulla is lined by low cells, except at its

proximal region, where they resemble the higher cells of the globular sac, which corresponds to the diverticulum of higher worms. This sac has an epithelium of tall gland-cells, and the whole organ is enveloped in a thin muscular coat.

The ampulla is filled with spermatozoa, without any arrangement or order; but in the globular sac the sperms are orientated, so that the heads are towards the epithelial cells, and it appears that each cell has many sperms associated with its end. Hence I conclude that spermatophores are formed.

*Locality*.—Auckland Islands (Erebus Cove, in Port Ross). Under stones on the sea-shore.

*Remarks*.—The only genus that has a sperm-duct covered with gland-cells, and is of short extent without any convolutions, is *Rhizodrilus*. It appears to me that the brief diagnosis of *Monopylephorus* given given by Levinsen\* is insufficient to enable one to identify his worm. Beddard and Michaelsen, in their systematic treatises, have regarded it as, possibly, synonymous with Stolc's *Bothrioneuron*; while Ditlevsen† believes it to be identical with Goodrich's *Vermiculus*‡, as he found this worm (*V. pilosus*) in abundance on the stretch of shore on which Levinsen collected his *M. rubroniveus*.

In view of the meagre diagnosis given by Levinsen, one is still in doubt as to whether this is the case, and it seems to me better, and more in accordance with a common-sense interpretation of the Rules of Nomenclature, to place Levinsen's generic name as a *nomen nudum*.

There may be a great probability that *Monopylephorus rubroniveus* is identical with *Vermiculus pilosus*, but, as all sorts of changes in environment lead to disappearances of worms from a given locality, this is by no means beyond the region of doubt. Then, since *Vermiculus* was used by Dalyell (*vide* Michaelsen) for a Nematode, we must fall back on Smith's generic name, *Rhizodrilus*.

The present species differs from the other species of the genus in the wide separation of the paired pores of sperm-duct and spermathecae, for in all but *R. trichochaetus*, Ditl., these organs open by median pores—that is, into a median invagination of the epidermis—which Goodrich has shown to be a secondary condition, attained at maturity. The new worm also differs in having a distinct penis.

In *R. limosus*, Hatai§, and *R. glaber*, Moore||, the lower end of the sperm-duct is widened out to form an atrium, but there appears to be no penial sac or penis in any of the species, though one regrets that Ditlevsen has not given more details about *R. trichochaetus*. Moore speaks of *R. glaber* having an "eversible median bursa which probably acts to some extent as a substitute for a penis."

The seven species hitherto described have been found in Europe and North America (east coast). It is therefore difficult to explain the presence of the genus in these antipodal shores; but, as practically nothing is known of the "Microdrili" of places outside these two continents, no suggestion as to the manner of the occurrence here is possible.

\* Levinsen, in Vid. Medd. Nat. Foren., 1883.

† Ditlevsen, Zeit. fur Wiss. Zool., lxxvii, p. 423, 1904.

‡ Goodrich, Zool. Anz., xv, p. 476, 1892; and Quart. Journ. Micr. Sci., xxxvii, p. 253, 1895.

§ Hatai, "On *Vermiculus limosus*," Annot. Zool. Japon., ii, p. 103, 1898.

|| Moore, "Some Marine *Oligochaeta* of New England," Proc. Acad. Nat. Sci., Philadelphia, 1905, p. 378.

## Fam. ENCHYTRAEIDAE.

## LUMBRICILLUS, Oersted, 1844.

*Lumbricillus intermedius*, sp. nov. (Plate X, figs. 8-11.)

A littoral species, dull opaque-white in formol, with pinkish clitellum. The worm is relatively stout, with well-marked segments. The body-wall is thick, owing to the depth of the longitudinal muscles, which are about three or four times as thick as the rest of the wall. The cuticle is thin.

*Dimensions*.—From 10 mm. to 20 mm. in length, with a diameter of 1-1.25 mm.

*Prostomium* rather long, about equal to the first 2 segments together; with blunt rounded tip, and broad base.

The *chaetae* are in groups of 4-5 dorsally and 5-7 ventrally in the fore part of the body; one less—i.e., 3-4 and 4-5 respectively—in the hinder segments. Feebly sigmoid.

*Clitellum* completely surrounds the segments ( $\frac{1}{2}$  11), 12, 13. These latter are longer than the neighbouring segments.

Genital pores in the usual position.

*Internal Anatomy.*

The longitudinal muscle-layer of body-wall is about four times as thick as the epidermis + the circular muscles.

The *dorsal vessel* rises far back, at the 17th segment. I made no observations on the distribution of the anterior vessels, this being a very difficult matter to study in sections or preserved worms.

Coelomic corpuscles are spindle-shaped.

The oesophagus passes quite imperceptibly into the intestine. Septal glands lie in the 4th, 5th, 6th, and 7th segments. The presence of the glands in the last appears unusual; but I examined and found them in several specimens, both in section and in entire worms.

*Nephridium* with a somewhat ovoid post-septal body, with duct rising from the posterior end, and passing sharply forwards below it to the pore (Plate X, fig. 11).

The *genital organs* lie in the usual segments. The testes are digitiform, and of large size. The long funnel occupies the entire segment; its length is about five times its diameter; it is bent slightly at its hinder end (Plate X, fig. 10). The penis has the typical structure, a gland with muscular wall, opening by a wide mouth on 12; the sperm-duct enters this on its median side. Retractor muscles also pass from it to the body-wall.

*Sperm-sacs* in 10, 12.

The *ovary* is also lobulated, and large ova occupy the 13th. The oviduct is out of all proportion small—little more than a pore in the ventral wall of 12—with scarcely any funnel.

The *spermatheca* in 5 has a wide duct, not marked off distinctly from the ampulla, opening through a group of glands at 4/5. The pyriform ampulla narrows as it approaches the oesophagus, and then is suddenly constricted, entering the gut by a very small pore provided with a sphincter muscle (Plate X, fig. 8).

Subneural *copulatory glands* in 14, 15, 16, and 17 in all the four mounted specimens. The gland extends up the side of the nerve-cord to reach the level of its upper surface; the "wing" on each side is rather greater than the width of the cord.

*Locality*.—Campbell Island: (a.) Perseverance Harbour; shore; a considerable number collected in February, 1907, under stones, sea-shore, near exit of a stream from the flanks of Mount Honey; (W. B. B.). (b.) Collected in November; (J. B. Mayne).—Auckland Islands: Norman's Inlet, on the east coast; (H. B. Kirk).

*Remarks*.—This new species is intermediate in most characters between *L. maximus*, Mich.,\* and *L. verrucosus*, Clap., both of which have been recorded from Antarctic shores. In size it is about half that of the former, and twice that of the latter. The number of chaetae agrees with *L. maximus*,† as do also the copulatory glands. With *L. verrucosus*‡ it agrees in the enveloping clitellum, the length of the sperm-funnel, and the form of the spermatheca; but from both it differs in the backward point of origin of the dorsal vessel, which is further back than in any species of that group of species to which it belongs, as well as in the presence of a septal gland in the 7th segment.

It is quite distinct from *L. macquariensis*, Benham,§ which belongs to another group of this genus, in which the spermathecal duct is sharply marked off from the ampulla.

#### *Lumbricillus macquariensis*, Benham.

1905. Trans. N.Z. Inst., xxxvii, p. 295.

The species, as I remarked in my description of it, is nearly allied to Ude's¶ *L. maritimus*, from Tierra del Fuego.

#### ENCHYTRÆUS, Henle, 1837.

##### *Enchytraeus albidus*, Henle.

1904. *Enchytraeus simulans*, Benham, Proc. Zool. Soc., 1903, ii, p. 219. 1904.

*E. albidus*, Benham, Trans. N.Z. Inst., xxxvii, p. 295.

This species was recorded by me from the Campbell and Macquarie Islands; but I did not meet with it during this expedition. It has also been recorded by Michaelsen from the Crozets,|| and is found on Tierra del Fuego and south Patagonia.

#### MARIONINA, Michaelsen, 1890.

##### *Marionina antipodum*, Benham.

1905. Trans. N.Z. Inst., xxxvii, p. 294.

I did not meet with this species during the present expedition, but it was collected by Dr. Cockayne on Antipodes Island. It is related to certain Fuegian species¶¶ and to those on Kerguelen and the Crozets.\*\*

\* Michaelsen, "Die Oligochaeten v. Sud-Georgien," Mt. Mus. Hamburg, 1888, p. 56.

† Michaelsen, Die Oligoch. Deutsch. Sud-polar Exped. 1901-3, p. 10, 1905.

‡ Ude, "Enchytraeiden," Hamb. Magalhaens. Sammelreise, 1896, p. 3.

§ Benham, Trans. N.Z. Inst., xxxvii, p. 295, 1905.

|| Michaelsen, *loc. cit.*, 1905, p. 17.

¶ Ude, *loc. cit.*, 1896, p. 17.

\*\* Michaelsen, *loc. cit.*, 1905, p. 13.

## Fam. HAPLOTAXIDAE.

## PELODRILUS, Beddard, 1891.

*Pelodrilus tuberculatus*, sp. nov. (Plate X, figs. 12-14.)

A considerable number of these small and characteristically coloured worms were collected both on the Auckland and on the Campbell Islands.

*Dimensions*.—Length, from 40 mm. to 70 mm., by 2 mm. in diameter. The segments are well marked, and number from 100 to 110 in those examined. The body is somewhat flattened, especially towards the posterior end. A lateral line is very evident.

*Colour*.—Except for the anterior preclitellian end, which is opaque-white, the body is bluish-grey, owing to the transparent wall allowing the intestinal contents to be seen. The clitellum is pale yellowish-brown in preserved worms, though in life it is yellow. A remarkable feature about the body-wall is the thick cuticle, which gives a shining appearance to the worm, so that it bears a resemblance to certain Enchytraeids. In specimens preserved in alcohol the wall is less translucent, but in formol this character is retained.

The *prostomium* is small and rounded, not as long as the segments 1 and 2 together.

The *chaetae* are in four couples, all sigmoid. The individual chaetae are, of course, quite close together. The dorsal gap (*dd*) is less than the ventral gap (*aa*), which is in its turn less than the lateral gap (*bc*). In the anterior part of the body the dorsal and ventral chaetae are of the same size, but in the mid and hind body the dorsals are only two-thirds the length of the ventrals.

The ventrals are absent from the 12th segment in the mature worm.

The *clitellum* is confined to the dorsal and lateral portions of the segments  $\frac{1}{2}$  11, 12, and 13, though in some cases nearly the whole of the 11th is glandular dorsally. On the ventral surface of 12 is a pair of latero-ventral glandular ridges in line with the ventral chaetae; these ridges are broad and low, and may extend slightly on to 11 as far as the chaetae. These ridges carry the two pairs of male pores, and no doubt function as prostate glands; they may be termed the copulatory glands (text figure, p. 264, and Plate X, fig. 12).

*Tubercula pubertatis* are present in several segments. They have the form of paired or median, rounded, slightly prominent papillae, which are very evident as white spots in specimens preserved in alcohol. They are somewhat variable in number, but are usually situated as follows: Segment 7, a pair of closely approximated or even median papillae; segment 8, a pair of closely approximated or even median papillae (these are placed behind the chaetal zone); segment 9, paired, mediad and posterad of ventral chaetae, also a pair dorsad of the chaetae in the chaetal zone; segment 10, paired, mediad and posterad of ventral chaetae, also a pair dorsad of the chaetae in the chaetal zone; segment 13, pair, mediad of the chaetae; segment 14, pair, mediad of the chaetae. More rarely there is a median papilla on the 15th segment also. In one specimen the number was greater, as a series of post-chaetal papillae of smaller size, close to the posterior margin of 10, 13, and 14, were present. I am not aware that such tubercula have been recorded in the genus.

*Genital Pores.*—There are two pairs of male pores, the anterior pair on the hinder margin of 11, the posterior pair a little behind the middle of 12. These pores are situated on the glandular copulatory ridge, and therefore are in line with the ventral chaetae. The single pair of female pores are at 12/13, in the same line. They are slitlike, and visible under a pocket-lens in some individuals.

The single pair of spermathecal pores are rather high up the side of the body, at about the lateral line, at 7/8.

#### *Internal Anatomy.*

The epidermis consists almost entirely of very large gland-cells, opening through the very thick cuticle by distinct pores. The cuticle is nearly as thick as the epidermic layer. Squeezed between the gland-cells are a few columnar cells (Plate X, fig. 13).

The *septa* behind 6, 7, 8, 9, and 10 are thickened.

The *dorsal vessel* contains a large "cardiac body" in the 14th and some segments anteriorly. Free commissural vessels, more or less undulating, are visible in each segment, though they were not followed out in detail.

The *nephridia* are of large size in proportion to the size of the worm. They are present in 6, 7, 8, 9, 13, 14, &c. I am not satisfied as to their occurrence in the 10th; they are certainly absent in 11 and 12.

The *pharynx* occupies 2, 3, and 4, and has the typical dorsal pad. There is no gizzard. The oesophagus is narrow, has folded walls from the 7th to 14th; the intestine commences in the 15th.

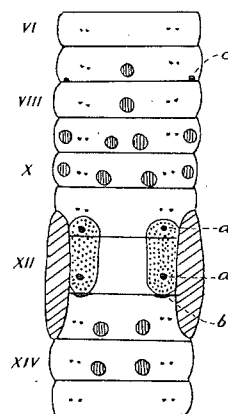
*Septal glands* lie in 5, 6, and 7.

There are two pairs of *testes* and *sperm-funnels* in the normal position in segments 10 and 11. They are, in opposition to Beddard's statement for *P. violaceus*, not contained in sperm-bladders; segments 11 and 12 are, however, filled with developing sperms.

There is a paired *sperm-sac* in 9, and the segments 10–16 are filled with developing spermatozoa.

The sperm-funnel is large and flat, with the lower margin upturned; the greater part of it is free from the septum, to which it is attached by only quite a small area; its margin is somewhat folded.

Each sperm-duct is a delicate tube, coiling immediately after perforating the septum, and opens independently by a very fine pore through the glandular ridge on segments 11 and 12 respectively (Plate X, fig. 14). The histology of this ridge or copulatory gland is quite distinct from that of the clitellum, where the epithelium consists of small ovoid cells filled with large refringent spherules, which are not stained by borax-carmin, though they take carm-alum powerfully. The cells of the copulatory gland, however, are long, club-shaped, and filled with very fine granules that are stained in borax-carmin, and recall those of a prostate.



PELODRILUS TUBERCULATUS.

View of genital region.

$a^1$ ,  $a^2$ , the two pairs of male pores, situated on a glandular pad or copulatory organ;  $b$ , the oviducal pore;  $c$ , spermathecal pore. The circular, vertically striated areas are the tubercula pubertatis.

Each of the *tubercula pubertatis* is a spherical mass of club-shaped cells, filled with smaller spherules than the clitellar cells, but highly refringent, and unstained in borax-carminé as they are; they are about one-quarter the diameter of the clitellar spherules. All the cells are of the same length, the necks or ducts being convergent, and are usually deeply stained.

The single pair of *ovaries* lies in the usual position in the 12th segment; and a paired ovisac, containing large ova, passes through 13, 14, and 15.

The single pair of *spermathecae* lies in the 8th; each is a long club-shaped sac, confined to this segment, and opening by a short narrow duct at the anterior margin of the segment.

*Localities*.—Auckland Islands: (a.) Camp Cove magnetic station; (two specimens). (b.) 200 ft. above the Watering Creek; (five). (c.) Masked Island; (one). (d.) Under logs, near camp; (several). (e.) Soil, North Arm, Carnley Harbour; (one). (f.) Port Ross; (two). (g.) Fairchild's Garden, Adams Island; (thirteen).—Campbell Island: (h.) Several; (W. B. B. and W. K. Chambers).

*Remarks*.—This new species agrees with *P. ignatovi*, Mich.,\* *P. darlingensis*, Mich.,† and *P. africanus*, Mich.,‡ in (1) having the male pores on successive segments 11, 12, as in the genus *Haplotaxis*, and (2) a single pair of oviducal pores at 12/13; and it agrees with *P. violaceus*, Bedd.,§ *P. darlingensis*, and *P. africanus* in having a single pair of spermathecal pores at 7/8. But from all the previous species it differs in various ways: the Western Australian species (*P. darlingensis*) is smaller, and the dorsal chaetal gap (*dd*) is about equal to half the circumference of the body, while it is much less in this new species; but in none of the species is any mention made of the glandular copulatory ridge on the 11th segment. Further, the position of the male pores on the segment is different: in the Western Australian species they are outside the chaetae, whereas in this they are in line with them.

***Pelodrilus aucklandicus*, sp. nov.** (Plate XI, fig. 15.)

This is apparently a rarer worm, for only three individuals were collected. The segments are well defined by deep intersegmental furrows.

*Dimensions*.—The length is 55 mm. by 1.25 mm., with 140 segments in the fully mature specimens.

*Colour*.—Grey (in alcohol), the body-wall translucent, except the anterior end, which is opaque-whitish; the cuticle is thinner than in the preceding species, and somewhat less shiny.

*Prostomium* short, conical, rather more pointed than in the previous species, with a narrower base.

*Chaetae* in couples, all sigmoid, the dorsal and ventral being of equal length throughout the body—*aa* is less than *bc*, which is less than *dd*.

\* Michaelsen, Verhandl. Naturwiss. Vereins. in Hamburg, 3, folge x, p. 3, 1903.

† Michaelsen, Die Fauna S.W. Austral., bd. i, Oligochaeta, p. 134, 1907.

‡ Michaelsen, Die Oligoch. Deutsch. Sud-polar Exped. 1901-3, p. 19, 1905.

§ Beddard, Trans. Roy. Soc. Edinburgh, xxxvi, p. 292, 1891.



The dorsal gap (*dd*) is about one-third the circumference of the body.

The *clitellum* covers the whole surface of segments 12, 13, and  $\frac{1}{2}$  14; its boundaries are quite sharply marked, and are especially well seen when the body-wall is stained and mounted entire. The anterior margin crosses behind the male pores.

There are two pairs of *male pores*, both on the 11th segment, on a low papilla. The anterior are immediately behind the ventral chaetae; the posterior are quite close to the hinder margin of the segment.

There are two pairs of *oviducal pores*, large and slitlike, in line with the ventral chaetae at 12/13, 13/14, as in the genus *Haplotaxis*.

The single pair of *spermathecal pores* is at the side of the body, at 6/7.

#### Internal Anatomy.

The *septa* behind 7, 8, 9, 10, and 11 are slightly thicker than the posterior ones.

The short *pharynx* occupies 2, 3. There is no gizzard; this I specially looked for, since Michaelsen has pointed out that the only difference between *Pelodrilus* and *Haplotaxis* is the presence of a gizzard in the latter.

The oesophagus is straight, and has no dilatations. The intestine commences in 17.

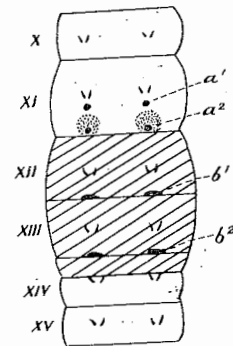
*Septal glands* in 5, 6, 7, and 8.

There are no enlarged hearts, though vascular loops are present as usual.

The *nephridia* commence in 8, occur in 9, 10, are absent in 11, 12, 13, 14, and resume in 15, 16, &c.

The two pairs of *testes* and *funnels* are in 10, 11. The funnels are large and flat, except at the ventral margin, which is curled upwards below the exit of the duct. In contrast with the preceding species, the whole back of the funnel is attached to the septum. The sperm-ducts are not convoluted (Plate XI, fig. 15). The anterior duct, after perforating the septum, passes obliquely upwards and backwards in a straight line, so that it is cut for nearly its entire length in a longitudinal section; then it forms two or three small undulations before returning parallel to its former course downwards and forwards along the posterior surface of the chaetal muscles to the body-wall, to open by a small pore just behind the ventral chaetae of segment 11. The posterior sperm-duct, after perforating the septum 12/13, takes a similar course, and opens to the exterior close in front of the intersegmental furrow 11/12. The septum 11/12 is here in front of this furrow, so that internally the pore would be said to belong to the 12th segment, but externally the furrow, though but slight just here, can be traced across the ventral surface, and becomes quite deep. There is no doubt that this pore lies in front of this furrow.

In segments 11 and 12—*i.e.*, on each side of the septum separating them—is a great gland on each side of the body, opening on to the flat papilla mentioned in the account of the external anatomy. This copulatory gland, like that in *P. ignatovi*



PELODRILUS AUCKLANDICUS.

View of the genital region.

$a^1$ ,  $a^2$ , the male pores;  $b^1$ ,  $b^2$ , the two pairs of oviducal pores.  $a^2$  lies in a dotted area, which represents the openings of an internal copulatory gland or prostate.

and *P. hologynus*, consists of several groups of long club-shaped cells, whose necks pass through the epidermis in separate bundles. It is no doubt functionally a prostatic gland. The anterior sperm-duct opens in front of it, the posterior duct near its hinder margin.

There is a paired *sperm-sac* in 9; a second pair arises as an evagination of septum 11/12, and extends through at least segments 12 to 19, the last segment to be included in the series of longitudinal sections.

There are two pairs of *ovaries*—in 12, 13—and the oviducts are provided with large funnels, opening at 12/13, 13/14. A pair of ovisacs lies in 13 and 14, which are occupied by large eggs.

A pair of *spermathecae*; each is a long pyriform sac, which starts from the pore at 6/7 as a narrow short muscular duct, but soon widens out into the ampulla, which curves backwards as it passes below the oesophagus into segment 8; here it crosses over to the opposite side, and ends in an enlargement.

*Localities*.—Auckland Islands: (a.) Camp Cove magnetic station; two; (W. B. B.). Adams Island: one; (Speight). [I have also a specimen which I collected some years ago on Stewart Island.]

*Remarks*.—The species is so similar to *P. hologynus*, Mich.,\* from Western Australia, that were it not that the second male pore, which is undoubtedly on the 11th segment in this new species, is according to Michaelsen on the 12th, close to the anterior margin, I should have placed it in that species. It agrees with it and with *P. ignatovi*† in possessing the copulatory gland inside the 11th and 12th segments. In this genus we have exemplified a most interesting shifting of the male pores, so that the difference between it and *Haplotaxis* is reduced to a minimum. In the typical species, *H. gordioides*, the male pores are on successive segments, and the two pairs of female pores are at 12/13, 13/14, as in *P. hologynus* and *P. aucklandicus*; but the remaining species of *Pelodrilus* have only one pair of female organs, while *Haplotaxis heterogyne*, Benham,‡ has also but one pair of ovaries. As to the male pores, in *P. violaceus* they are both on 12—the anterior at the front, the posterior at the back of the segment. In *P. ignatovi* and *P. africanus* the anterior pore is in 11, at the front margin, the posterior at the front of 12; in *P. darlingensis* the anterior pore has moved back to the middle of the 11th; in *P. hologynus* it has reached the hinder margin of the segment; while in *P. aucklandicus* the posterior pore has moved forwards into the 11th segment, so as to be quite near the anterior pore.

The study of this genus seems to be opposed to the Mutationists, for there is quite a gradual transition—no sudden jump from one condition to another. I am almost inclined to unite the two genera, *Pelodrilus* and *Haplotaxis*, as I lay less stress upon the importance of the gizzard than does Michaelsen: surely it is one of those characters that are readily affected by the habits of life.

\* Michaelsen, Die Fauna S.W. Austral., bd. i, Oligochaeta, p. 136.

† Michaelsen, Verhandl. Naturwiss. Vereins, 1903, p. 3.

‡ Benham, "On a New Species of the Genus *Haplotaxis*" Quart. Journ. Micr. Sci., xlviii, p. 299, 1904.

## Fam. MEGASCOLECIDAE.

## Subfam. ACANTHODRILINAE.

## NOTIODRILUS, Michaelsen, 1899.

*Notiodrilus fallax*, sp. nov. (Plate XI, figs. 16, 17.)

Three individuals.

*Colour*.—Dark chocolate-brown (in formol); pigment extends over the ventral surface.

*Dimensions*.—The largest, which is a good deal contracted, is 175 mm. in length and 11 mm. in diameter; no doubt, in life it would have reached at least 200 mm.

The *prostomium* is epilobic about half, with a transverse groove, but no marginal extensions backwards. The anterior segments are biannulate, the limits quite distinct; the post-clitellar segments are triannulate.

*Chaetae*.—In the mid-body  $ab = cd$ ;  $bc$  about  $1\frac{1}{2} ab$ ;  $dd = 6 ab$ ;  $aa = 2 ab$ —that is,  $> bc$ . In the preclitellar region  $ab < cd$ ;  $aa = bc$ .

The *clitellum*, which is very dark brown in colour, is saddle-shaped, and ceases at line  $b$ ; it covers segments 14–19, the ventral surface of which is pale yellowish.

*Genital Pores, &c.*—The spermatic groove is concave ventrally, and allows both chaetae  $a$  and  $b$  to be seen in each of the segments 17, 18, and 19. Spermathecal pores are invisible externally, but lie in the usual position. Nephridiopores, as seen in section, are just below chaeta  $c$ .

*Internal Anatomy.*

The *septa* behind segments 9–12 are very thick, and that of 13 nearly as thick.

The *dorsal vessel* is double throughout; hearts in 10–13.

The *gizzard* is large, in the 6th segment; oesophageal glands in 13 and 14.

*Nephridia* very small, in a single row; extend only from  $b$  to  $c$ ; those of the 4th segment are large pepto-nephridia, but whether they open into the gut or not I did not ascertain, as the body is too contracted to allow me to trace them by dissection.

The *testes* and *ovaries* are on the anterior wall of their segments: sperm-sacs in 9 and 12; both are large, saclike, and but feebly racemose; there are none in the intervening segments.

*Prostates* compressed, the tube being a good deal contorted, so as to form a more compact mass than is common in the genus (Plate XI, fig. 17). Each is limited to its own segment; has a narrow duct, which passes transversely across the body-wall for a distance equal to about half the breadth of the gland, to open to the exterior in the line  $b$ . No penial chaetae are recognisable, and no "arcuate" muscles are present in these segments.

*Spermathecae*.—Two pairs, in the 8th and 9th segments; each has a couple of glomerulate diverticula opening into the duct, close to the body-wall, on the anterior and posterior aspects respectively (Plate XI, fig. 16).

*Locality*.—Snares Island; in company with *N. haplocystis*.

*Remarks.*—In an important monograph of the earthworms of south-west Australia, Michaelsen\* proposes to subdivide the older genus *Notiodrilus* into two genera, one of which has a well-developed gizzard, and the other has it in a vestigial condition. To the former he gives the name *Eodrilus*; the latter group of species he places in the genus *Microscolex*, for which he gives an amended diagnosis.

His diagnosis of *Eodrilus* only differs from that of *Notiodrilus*† in the words “gizzard well developed.” In it he includes three New Zealand species—*E. annectens*, *E. haplocystis*, and *E. paludosus*.

The amended genus *Microscolex* (= *Notiodrilus*, Mich. + *Microscolex*, Rosa) contains species in which there are two pairs of prostates, on segments 17 and 19, with the male pore on the 18th (the characteristic old *Acanthodrilus* condition), as well as species with only one pair of prostates and male pores, both on the 19th segment (the typical *Microscolex* condition). He separates the former from *Eodrilus* merely on account of the minute gizzard. It seems to me that the double prostate pair is a more important feature than the size of gizzard, which may, one would imagine, readily be associated with the nature of the food. The only recommendation for the union of the old genera *Notiodrilus* and *Microscolex* is that by the removal of those species which he includes in *Eodrilus* he obtains a group of species which has an antarctic circumpolar distribution; whereas *Eodrilus* is more diffusely distributed, but at the same time contains several species found in the southernmost lands—indeed, half the species are subantarctic.

I regret that I cannot follow him in thus rearranging these species. It seems to me that on grounds of convenience and evolution‡ the name *Notiodrilus* should be retained for the worms with the two pairs of prostates, and that to make use of the name *Microscolex* for the mixed set of species is undesirable, quite apart from the insufficient grounds for such a grouping as he proposes. In this paper, therefore, I shall retain the name *Notiodrilus* as defined by Michaelsen§ in 1899.

I may point out that Michaelsen does not seem quite consistent in the value he puts upon this gizzard-character. He uses it also to distinguish the genus *Perionyx* from *Perionychella*, the former having a vestigial gizzard, the latter a more or less well-developed one. Yet in an account of some new species of these genera from India, 1907 (“*Neue Oligochaeten von Vorder-Indien*,” &c.), he describes species of both in almost identical terms: thus, several species of *Perionychella* are stated to have “very small gizzards, only a little thicker than the neighbouring part of the oesophagus.” For instance (p. 156), *P. sikkimensis*: “Ein kleiner cylindrischer Muskelmagen in 6 (?) Segment, kaum dicker als die benachbarten Oesophaguspartien, aber nicht eigentlich rudimentar.” Of *Perionyx himalayanus* he writes of the gizzard, “Derselbe ist kaum dicker als die benachbarten Partien des Oesophagus und hat kaum dickere Wände.” What remains of the distinction between the two genera?

\* Michaelsen, *Die Fauna S.W. Austral.*, bd. i, Oligochaeta, p. 138.

† Michaelsen, “*Das Tierreich: Oligochaeta*,” 1900, p. 128.

‡ According to Michaelsen, species of *Microscolex* may arise at different times, in different parts of the world, from different species of *Notiodrilus*. This thesis involves so profound a modification in the accepted ideas of evolution that space will not permit me to discuss the problem here.

§ Michaelsen, *Zool. Jahrb. Syst.*, xii, 1899, p. 239.

It is true that in some of the species of *Perionychella* he writes that the testes and sperm-funnels are "apparently free," while for the species of *Perionyx* he states that they are enclosed in "testikelblasen."

#### **Notiodrilus haplocystis**, Benham.

1901. *Acanthodrilus haplocystis*, Benham, Trans. N.Z. Inst., xxxiii, p. 130.

1907. *Eodrilus haplocystis*, Michaelsen, Die Fauna S.W. Austral., Oligochaeta, p. 141.

I obtained a number of individuals on the occasion of each of my visits to the Snares, in February and November, 1907. I am thus able to add the following facts to my original account.

It is very common under stones and in the soil.

*Colour*.—Orange-brown; the darker segmental ring referred to in my former account is not so striking in fresh as in preserved specimens, nor so marked in those in formol as in those in alcohol, but when fully extended a paler band is recognisable in the anterior region of each segment.

*Dimensions*.—The largest individual measures 460 mm. by 6 mm.; the smallest is 220 mm. by 9 mm.; this is, however, much contracted, so that it is unusually thick. The average seems to be about 360 mm. by 7 mm. The worm is thus of considerable length and stoutness.

The anterior segments are quadriannulate; the post-clitellar segments are triannulate.

*Clitellum*.—When fully developed the clitellum is dark brown, and extends over segments (13) 14–19 (20). Of the five individuals collected in February only two have the clitellum well developed; while of the seven obtained in November it is present in three, but in only two of these is it fully developed. Hence it appears that there is no seasonal difference in regard to the maturity of the reproductive organs, and that, like the European worms, the breeding season is not confined to any particular period of the year.

#### *Internal Anatomy.*

The large *gizzard* is not wholly confined to the 6th segment, but the anterior third lies in the 5th, the septum 5/6 being inserted round it at this point. The oesophagus has thick longitudinally folded—*i.e.*, "lamellate"—walls in segments 9–13; it becomes much narrower in 14–19, but is somewhat dilated in each of the segments 14, 15, and 16, though no distinct glands exist. The intestine commences in the 20th.

The *nephridia* are, in proportion to the diameter of the body, of very small size, extending from chaeta *a* to *c*, lying close to the wall, as a fine slightly convoluted tube, without a muscular bladder or duct. The tube can be traced through the wall at the level of *c*.

Of the three pairs of *sperm-sacs*, those in segments 9, 10, are long, narrow, and far apart, while those in the 12th are close together.

The simple form of the spermatheca which characterizes the species is exhibited by all the individuals dissected.

**Notiodrilus aucklandicus**, Benham.

1903. Trans. N.Z. Inst., xxxv, p. 275. 1905. Trans N.Z. Inst., xxxvii, p. 287.  
1907. *Microscolex aucklandicus*, Michaelsen, Die Fauna S.W. Austral.,  
Oligochaeta, p. 143.

This species was originally collected by the late Captain Hutton on the Auckland Islands, probably at Fairchild's Garden, on Adams Island, which is usually visited by the Government steamer. Later, Dr. L. Cockayne brought me specimens from the same spot and also from Campbell Island, and an injured specimen from the Antipodes Island. During the stay of the expedition on the Aucklands I obtained specimens from several more or less widely separated spots, enumerated below; I am therefore able to give a more detailed account of this species than was possible in my former paper.

*Colour*.—The general colour, when alive, is brown, though it offers variations in the depth of tint—for instance, that from Disappointment Island is much paler than the typical form. The preclitellar region is normally reddish-brown to sienna. Those preserved in formol appear rather greyish posteriorly, owing to the intestine being filled with earth, which shows by transparency through the body-wall and tones down the brown tint. Those preserved in alcohol have a yellowish tint.

*Dimensions*.—The length varies from 72 mm. to 118 mm.; naturally, the size depends on the state of preservation, some being killed in an extended condition, either well preserved and firm or ill-preserved and soft; others are killed in a state of contraction. The average length seems to be about 90 mm. to 110 mm., with a diameter of 3 mm. These have about 100 segments. The number of segments is not proportional to the length: thus, the greatest number is 112 for a worm 95 mm. in length; the least number is 84, measuring only 72 mm., though another has 94 segments in the same length of body; while the longest specimen (118 mm.) has only 108 segments. Owing to the different conditions of preservation, these numbers have but little value.

*Chaetae*.—Each individual chaeta is usually surrounded at its base by a pale ring, so that their position is very evident in the anterior region. The chaetal formula is somewhat variable, but the three intervals *aa*, *bc*, *dd*, are essentially equal; *ab* is a very little less than *cd*, which is considerably less than *bc*; *ab* is approximately equal to two-thirds *aa*; the slight differences observable on careful examination may be due to the differences in preservation—whether soft or firm—as well as to the study of different parts of the body, as towards the hinder end of the worm the intervals all become practically equal. The method followed in measuring these intervals was as follows: I examined individuals from various localities, cutting through the body-wall along one side and flattening out the skin after removing the intestine; the chaetal intervals were then measured with the ocular micrometer. A comparison with the type, which I re-examined, shows that the formula given in my paper (1903) is not correct, for I seem to have confused the line of nephridiopores which occurs *a little below* the line of *c* with that line, so that the formula gave  $bc = cd$ . I also measured the intervals on the "round" without slitting the body up; and in other cases, as a confirmation, I measured them in transverse sections. As a result of these varied measurements, I now find the chaetal formula to be  $aa = bc = dd$ ;  $ab = cd = \frac{2}{3} aa$ .

The *clitellum* usually covers segments 14–17, though in one case the 13th segment was glandular, while in others the 17th was not.

There is a considerable amount of variation in the number and position of the *tubercula pubertatis*; though typically they are paired, yet often only one of a pair is present. The typical arrangement seems to be as follows: A pair on each of the segments 17, 18, 19, and 20, sometimes also on 16 and 21; these are in the neighbourhood of chaeta *a*, usually prechaetal in 17, 18, 19, and 20, post-chaetal in 16; but these positions are not quite constant. In addition, there are preclitellar tubercles on segment 10, and in one case on 8 as well; these are post-chaetal.

The *dorsal pores* commence at 11/12; and the *nephridial pores*, instead of being in line with chaeta *c*, as I described in 1902, are in reality a little distance below this line, as can be seen both in trans-sections and on the flattened skin.

#### Internal Anatomy.

I must add to the facts recorded in my previous paper the following:—

A small *gizzard* is present in the type, which I overlooked till I had noted it in the new specimens. It is situated in the 5th segment, and is concealed by the dorsal wall of the pharynx. Being no broader than the oesophagus, it was only in bisected worms that the thick cuticle and compact musculature became evident; of course, in longitudinal sections it is readily recognisable.

The oesophageal glands in the 13th and 14th segments are not always definitely rounded, but the tube is here somewhat dilated and the walls lamellate; it narrows in the 15th, and the intestine commences in the 17th segment.

I have also to note that there is a third *sperm-sac* in the 9th, of small size.

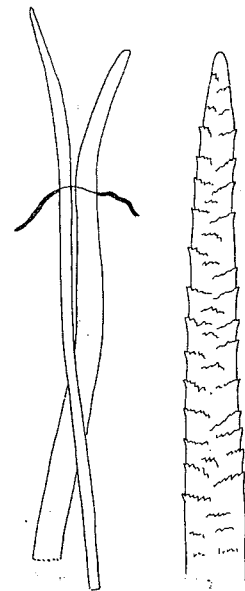
The two *penial chaetae* in each bundle are slightly different from one another—one (*a*) is broader, of deeper colour, and bluntly pointed (this was figured in 1903, pl. xxvi, fig. 10); the second (*b*) is rather finer, tapering, and more sharply pointed. Both are slightly bent at about the level of the surface of the body. The ornamentation extends nearly to the apex, though in those which have been worn it ceases some little way below the end.

*Localities*.—Adams Island; on the *Pleurophyllum* meadow, or Fairchild's Garden, as it is usually termed. Camp Cove magnetic station; a flat piece of grassy ground just about a foot or so above sea-level. Masked Island; among the roots of *Stilbocarpa polaris* (Aston). Under logs in various parts of Auckland Island.

Var. *bollonsi*, n. v.

Two worms were collected for me on Disappointment Island by members of the expedition.

One of them is a variety of *N. aucklandicus*. It is paler than the majority of the typical individuals, and has a different spacing of the chaetae, in that *aa* is less than



NOTIODRILUS AUCKLANDICUS.

The pair of penial chaetae; the curved transverse line represents the surface of the body ( $\times 100$ ); and the tip of slender chaeta enlarged ( $\times 250$ ).

*dd*, so that the formula is  $aa < ab < bc$ ;  $bc = cd$ ;  $aa = \frac{3}{4} dd$ . In this respect it is intermediate between a typical *N. aucklandicus* and *N. campbellianus*. It has tubercula on 9 and 10, median in position; while those of 17, 18, 19, and 20 are paired. The spermathecal duct is much wider and the ampulla less dilated than in the typical specimens, although the organ is filled with spermatozoa. These differences are, however, overshadowed by the undoubted agreements in such matters as the size and shape of the penial chaetae and other diagnostic features; so that, while not deserving specific separation, it seems desirable to distinguish it by a name. I therefore associate with the variety the name of Captain Bollons, of the Government steamer "Hinemoa," a keen naturalist himself, who did all in his power to further our aims and to assist us in every way during the expedition.

Var. *pallidus*, n. v.

Other divergent individuals were found in logs on Enderby Island, in company with *N. campbellianus*.

This variety is a minute, colourless form, only 23 mm. in length by 3.25 mm. in diameter; contains only 76 segments, though it is quite mature, with a half clitellum covering segments 14-16, and tubercula pubertatis as follows: Paired on 10, 20; median on 16 and 18. It agrees in its chaetal formula and in its general anatomy, including the penial chaetae and spermatheca, with *N. aucklandicus*.

*Notiodrilus campbellianus*, Benham.

1905. Trans. N.Z. Inst., xxxvii, p. 288. 1907. *Microscolex campbellianus*, Michaelsen, Die Fauna S.W. Austral., p. 143.

Like the foregoing, this species was originally collected by Dr. Cockayne, who discovered it on the sea-shore on Campbell Island.

It is much smaller than the foregoing, and appears to be less common; perhaps this is only because its colour, being darker and harmonizing more nearly with the logs under which it is usually found, renders it less noticeable. The dark chocolate-brown pigment is distributed almost over the entire body, the lower side being nearly as dark as the upper, and the hinder as the anterior end. The chaetae are set in white spots, which are much more conspicuous and are absolutely larger than in *N. aucklandicus*.

The length varies from 23 mm. to 45 mm., while one well-preserved specimen extended to 52 mm. The number of segments varies from 65 to 85.

The *chaetal formula* differs from that of the preceding species chiefly in the much greater separation of the dorsal chaetae (*dd*), the remaining spaces being approximately equal, though *ab* is less than *cd*.

The *tubercula pubertatis* exhibit the same sort of variability as before. It appears that a pair on 17 and 19 are constant. An additional pair often occurs on the 21st, and more rarely on the 22nd. In one individual they are also present on 14th and 16th, and in one case the 8th and 9th also bear tubercles.

The *nephridiopore* is in the same position as in the preceding.

*Internal Anatomy.*

Although I can detect no gizzard, yet in sections there is visible a small one in the 6th segment, concealed by the pharyngeal muscles and glands. The oeso-



phagus is dilated in 11 and 12, with lamellate walls; in 13, which is constricted from the last, the wall has the same structure, but the tube is much compressed; it narrows in the 14th; and in the next segment, the 15th, the tube widens to become the intestine.

As in the preceding species, there is a small *sperm-sac* in the 9th segment, as well as in the 11th and 12th.

The *penial chaetae* differ from those of *N. aucklandicus*. The two chaetae of a bundle are about equal in length and thickness, but exhibit a difference in curvature, one being more sharply bent than the other. Both are finely pointed, and herein I was in error in my original account, where I stated that "the tip is blunt." I find that I had mistaken a chaeta from a specimen of *N. aucklandicus*, collected on the Campbell Island, for that of the present species. A re-examination of the type and of other individuals shows that both are finely pointed, and the ornamentation extends nearly to the tip, but, being much finer than in the preceding species, is easily overlooked in a worm bristle.

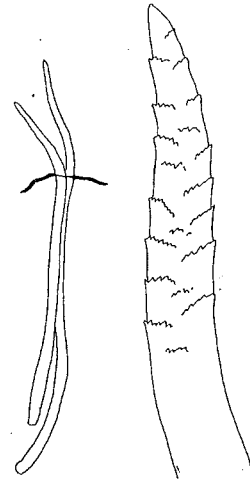
In my original account of this species (1904, p. 289) I indicated the slight amount of difference between it and *N. aucklandicus* and *N. macquariensis*. After a renewed study of each of them I am convinced that they are distinct, as indicated by differences (slight perhaps, yet constant) in chaetal formula, penial chaetae, &c. Apparently *N. campbellianus* is more nearly allied to *N. macquariensis* than to *N. aucklandicus*, as seen in the size of the worm, the chaetal formula, penial chaetae, and spermatheca.

A comparison of the chaetal formula of *N. aucklandicus* and *N. campbellianus* can be made by reducing the interchaetal spaces to some common term. These spaces were measured on the flattened skin by means of an eye-piece micrometer in a number of specimens of each species. Taking *dd* equal to 24, the spaces are,—

Interchaetal Space.	<i>N. aucklandicus</i> .	<i>N. campbellianus</i> .
<i>aa</i>	24	15
<i>ab</i>	16	12
<i>bc</i>	24	15
<i>cd</i>	17	15
<i>dd</i>	24	24

There is no doubt that *N. macquariensis* differs from both the others in having the nephridiopore in the same line as chaeta *c*—not below it, as in the other two; also, the dorsal vessel is double up to the 11th; the oesophagus is dilated in the 16th segment.

*Localities*.—Campbell Island; (W. B. B.; February, 1907). Auckland Island; in logs; and bush soil on shore of Carnley Harbour; (W. B. B.; November, 1907). Enderby Island; in logs; (W. B. B.).



NOTIODRILUS CAMPBELLIANUS.

The pair of penial chaetae. The curved transverse line represents the surface of the body ( $\times 100$ ); also the tip of the chaetae further enlarged ( $\times 250$ ).

**Notiodrilus macquariensis**, Beddard.

1896. *Acanthodrilus macquariensis*, Beddard, Proc. Zool. Soc., p. 208. 1900. *Notiodrilus macquariensis*, Michaelsen, "Oligochaeta." 1901. Benham, Trans. N.Z. Inst., xxxiii, p. 132. 1907. *Microscolex macquariensis*, Michaelsen, Die Fauna S.W. Austral., p. 143.

I gave a detailed account of this species in 1900. Although the Macquaries were not included in our expedition, as it is not under the Government of New Zealand, yet I include it in this report as a link with the other subantarctic islands.

## PLAGIOCHAETA, Benham, 1892.

**Plagiochaeta plunketi**, sp. nov. (Plate XI, figs. 18-20.)

A single individual.

*Colour* dark violet, even after eighteen months in formol. Each of the pre-clitellar segments has a pale chaetal ring round it. The clitellum is uniformly violet-grey posteriorly; a narrow line of bluish-grey runs along the median dorsal line. This pigment is situated in the connective tissue of the circular and longitudinal muscle-layers, not in the epidermis, except in the clitellum, where it appears in amongst the gland-cells.

*Dimensions*.—The worm is 70 mm. by 1.75 mm., and consists of 112 segments.

The *prostomium* is epilobic,  $\frac{3}{4}$ , without transverse groove.

The *clitellum*, though not fully developed, as the chaetae are still visible, covers segments 14-16 (17); it extends over the ventral surface in the anterior portion, but leaves the middle of the 15th and following segments free from glandular tissue.

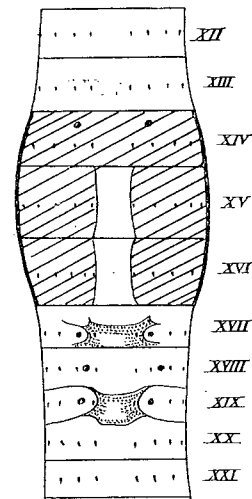
The *chaetae* are 16 in each segment, 8 on each side, throughout the worm. The spaces  $ab = cd = fg = \frac{3}{4} bc$ ;  $bc = de = ef = gh$ ;  $aa = 2 bc$ ;  $hh = 2 ab$ —that is, the dorsal gap is rather greater than the ventral.

*Dorsal pores* commence at 12/13 segments.

*Nephridiopores* in line with *d* or *e*.

*Genital Pores*.—The single specimen was studied by means of longitudinal sections, for it was so bent at the critical point that it was impossible to make out accurately the arrangement of the genital pores. The "porophores," or papillae carrying the prostate pores, on segments 17 and 19 are in a deep depression, owing to the contraction of strong dorso-ventral muscles of these segments.

The two most ventral chaetae are present on the median side of the pores. There is no apparent ornamentation; at any rate, none is visible in Canada-balsam mounts. The lowest, *a*, is normal, but *b* is enlarged, and by no means so much modified as usual. Each penial chaeta is stouter and longer than an ordinary locomotor chaeta, and is hooked terminally (Plate XI, fig. 19).



PLAGIOCHAETA PLUNKETI.  
Ventral view of the genital segments. ( $\times 10$ .)

The male pore is on a slight papilla on the 18th, just outside chaeta *b*.  
 The oviducal pores are clearly visible in line *b*, on the usual segment.  
 Spermathecal pores, two pairs, at 7/8, 8/9, are also very distinct, owing to their pale colour, just outside *b*.

#### *Internal Anatomy.*

The *dorsal vessel* is double; the last heart in the 13th segment.

The *nephridium* is small and difficult to trace in sections; it is entirely limited to the prechaetal portion of the segment, and the tube is "tufted" at the level of *d* and *e*; but I am not quite sure at which level it opens.

The *gizzard* may be said to be "absent," and in a dissection would be overlooked; but in sections one may detect a minute vestige in the 6th segment. The wall is no thicker than that of the oesophagus immediately behind it, but the musculature is slightly better developed, and it is recognisable by the absence of villi on the inner surface (Plate XI, fig. 18).

The oesophagus is dilated in segments 14, 15, and its wall lamellate; it is also thick-walled; though narrow in 17th to 19th, the gut suddenly dilates again, the wall becomes thin, and the intestine commences in the 20th segment.

*Testes* and *ovaries* in the usual position; two pairs of sperm-sacs, in 9 and 12, racemose. The prostates are tubular. The ovary large.

Two pairs of *spermathecae*, in 8, 9. The ampulla is more or less ovoid; the duct wide and short, and receives two diverticula, tubular in form—one comes off anteriorly, close to the body-wall, the other posteriorly, a little further from it (Plate XI, fig. 20).

*Locality*.—Snares Island.

*Remarks*.—The occurrence of so typical a New Zealand genus on the Snares is, of course, just what one would expect. The species comes near *P. lateralis*, Benham,\* from which it differs in the practical absence of a gizzard and in the less number of chaetae.

I cannot here discuss Michaelsen's recent proposal (1909) to subdivide this genus.

#### LEPTODRILUS, gen. nov.

In 1904 I described a species of worm from one of the southern islands under the name *Rhododrilus leptomerus*,† which, resembling *R. cockaynei* in most of its anatomical features, presents the very remarkable character of having the male pores on the 16th segment instead of on the 17th, which is the generic character for *Rhododrilus*. In order to emphasize this fact, I deem it desirable to separate this and another species from *Rhododrilus* as a new genus.

*Leptodrilus leptomerus*, Benham. (Plate XI, fig. 21.)

1905. *Rhododrilus leptomerus*, Benham, Trans. N.Z. Inst., xxxvii, p. 291.

Of this species, which was originally collected by Dr. Cockayne, I have now a good series, both from the Auckland Islands and from Campbell Island. In the latter place it seems very common, judging from the number received by me since

\* Benham, Trans. N.Z. Inst., xxxv, p. 282, 1903.

† Benham, Trans. N.Z. Inst., xxxvii, p. 291, 1905.

the return of the expedition. Some two or three dozen were collected by Mr. Chambers, who lived on the island for some months in the early part of 1908. I will, therefore, add a few notes to my original account.

*Colour*.—The anterior, preclitellar, region is whitish, or very pale grey; there is no pigment, but the thick wall is opaque; posteriorly, where the wall is thin, the intestinal contents are visible through it, so that a grey colour results (in formol), as in life. The clitellum is pale orange-brown, the colour being retained in formol better than in alcohol, in which the type was preserved.

The *dimensions* of the mature worm vary from 50 mm. by 2.75 mm. to 85 mm. by 2 mm.; the number of segments from 45 to 122; but, as in other cases, the longest worm has not necessarily the most segments, partly, no doubt, owing to differences in the method of killing and preservation. Thus: Length 80 mm., 90 segments; length 75 mm., 122 segments (and this is soft, so that it is really shorter); length 65 mm., 118 segments.

Of the internal anatomy, the only organ to which I will draw attention is the *spermatheca*, the diverticulum of which is, in several individuals, roughened at its apex, from the number of chamberlets which beset it; this is especially well seen in empty spermathecae.

*Localities*.—Auckland Islands: (a.) Bush soil; North Arm of Carnley Harbour; (W. B. B.). (b.) 300 ft. above sea-level; (W. B. B.). (c.) Adams Island; Fairchild's Garden; (Aston). (d.) Adams Island; 2,000 ft. above sea-level; (Speight). (e.) Enderby Island; near shore; (W. B. B.).—Campbell Island: (W. K. Chambers).

**Leptodrilus magneticus**, sp. nov. (Plate XI, fig. 22.)

A solitary individual was collected, with several other species, at the magnetic station No. 1, at Camp Cove. It differs from the preceding in the following points:—

The dimensions are greater, the length being 133 mm. by 2 mm., with 130 segments.

Chaetal formula:  $bc = 2 ab < aa$ ;  $bc$  slightly greater than  $cd$ .

The clitellum occupies segments 13 to  $\frac{1}{2}$  16.

Small paired tubercula pubertatis on the 13th and 14th segments, post-chaetal in position; and a median one on the 19th.

There is but one pair of spermathecae, in the 8th segment.

The penial chaetae are more strongly bent than in the preceding, and resemble those of *Rhododrilus cockayni*.

RHODODRILUS, Beddard, 1889.

**Rhododrilus cockayni**, Benham.

1905. Trans. N.Z. Inst., xxxvii, p. 289.

The distribution of this species, which occurs both on the Auckland and Campbell Islands, is of interest owing to its "euryhaline" nature, which, being interpreted, means that it can withstand considerable changes in the salinity of the water, and thus may occur on or in the immediate neighbourhood of the sea-shore. I found it in great numbers at the head of the North Arm of Carnley Harbour, below high-water mark; on the other hand, it also occurs on hills, as on Mount Honey, on Campbell Island.

The range in size is greater than that recorded in my original account, the specimens then at my disposal being all in a soft, ill-preserved condition. Those recently collected by me are in a better state, and the worm has a smaller average length than I supposed.

The mature animals vary from 60 mm. to 115 mm., with from 83 to 110 segments.

*Localities*.—Auckland Islands: (a.) Carnley Harbour; sea-shore; (W. B. B.). (b.) On plants. (c.) Adams Island; Fairchild's Garden (*Pleurophyllum* meadow); (W. B. B.; February, 1907). (d.) Top of hill above western entrance to Carnley Harbour; (W. B. B.; February, 1907). (e.) Norman Inlet; sea-shore; (G. R. Marriner).

Campbell Island: (a.) Mount Honey; (W. B. B.; February, 1907). (b.) Monument Harbour; (J. B. Mayne). (c.) Sea-shore; (C. Chilton). (d.) Tussock, near shore; (H. B. Kirk and W. K. Chambers). (e.) Under moss, Monument Harbour; (G. R. Marriner).

Var. *waterfieldi*, nov.

While at the Snares in February four specimens of a *Rhododrilus* were collected which differs only in unimportant details from *R. cockaynei*, worthy perhaps of varietal recognition owing to geographical rather than anatomical reasons. I therefore name it after the Private Secretary to His Excellency.

Pale grey in colour, the size varies from 58 mm. to 78 mm., with 90 segments. It is rather curious that the same number of segments occurs in each individual.

The chaetal formula agrees with that of the type, as does the position of the clitellum. There are, however, only two spermathecal pores; and were it not that in some individuals of *R. cockaynei* I note this reduced number I should place this variety in a new species.

The tubercula pubertatis occur on the 19th segment, large and paired so as to look like the propophores of *Notiodrilus*, which I at first glance supposed it to be. The papilla possesses three stout chaetae, of which two are "reserves": the third is a normal locomotor chaeta.

There is a second pair of tubercles on the 9th segment, outside the chaeta *b*.

The only internal difference is the existence of only two pairs of spermathecae, in segments 8, 9, each with a tubular diverticulum as long as the ampulla. The other genitals agree with *R. cockaynei*.

Subfam. MEGASCOLECINAE.

PLUTELLUS, Perrier, 1873.

*Plutellus aucklandicus*, sp. nov. (Plate XI, figs. 23-26.)

This worm forms a marked contrast to the rest of the earthworms collected on the Auckland Islands, in being white. Several individuals were obtained, both during the stay of the expedition and in the short visit I paid in February. The specimens at both times of the year were at various degrees of maturity.

The colour is white, with orange-brown clitellum, and has quite the appearance of a species of *Octochaetus*, for which I at first mistook it.

*Dimensions.*—The mature worms vary from 100 mm. to 125 mm., with a diameter of 4 mm. or 5 mm. There are from 126 to 130 segments.

The *chaetae* are, of course, 8 per segment. The ventral chaetae are close together; the dorsals are further apart, the distance being about equal to the lateral space between the two couples. The ventral gap is greater than the lateral, and the dorsal still greater, equal to about  $\frac{3}{8}$  of the circumference of the body. The formula, then, reads:  $ab = \frac{1}{3}cd$ ;  $bc = cd$ ;  $aa = 4ab$ ;  $dd = 8ab = 2\frac{1}{2}bc$ . The line *d* is straight—*i.e.*, there is no shifting of the dorsal chaetae, as in certain other species.

The *clitellum* is saddle-shaped on segments 13–18 (six).

*Genital Pores, &c.*—On segment 18 is a pair of small papillae, in line with the ventral chaetae, from the outer margin of which a slight longitudinal ridge crosses the segment. The actual male pore is quite minute, in line with *b*.

*Tubercula pubertatis* are present in all the mature and even in some of the immature worms—*i.e.*, those in which the clitellum is not present (? past the breeding season). There are four pairs of intersegmental tubercles in line with *ab*, at 15/16, 16/17, 19/20, and 20/21. There is also usually a pair at 10/11, and sometimes at 11/12; either of these may be absent. These tubercula have the form of oval depressions, with a raised margin, and a small papilla rising from the centre, which appears to be pitted.

The *spermathecal pores*, though not recognisable on the exterior, lie at 7/8, 8/9, in line of *a*.

*Nephridiopores* are in line *b*, also unrecognisable from the exterior.

The *prostomium* is one-third epilobic, and has no transverse groove. The preclitellar segments are bi- or tri-annulate; the posterior ones are biannulate.

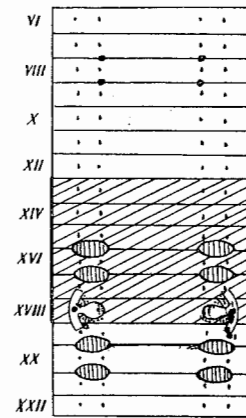
#### Internal Anatomy.

There are thick septa behind the segments 9–12, while those behind 13 and 14 are somewhat less thick. The last heart is in the 12th segment.

The *gizzard* is in the 6th, and there is a relatively long piece of oesophagus in front of it, a “proventriculus,” which is dilated and thrusts the anterior end of the gizzard back to the level of 7/8, while its posterior end is at the level of 9/10, so that its length equals that of two segments. The oesophagus is narrow in 8, 9, and 10, having the usual lamellate wall; in segments 11, 12, it is somewhat dilated, and constricted by the septa; in 13, 14, these lamellae are higher; and in the 15th the tube is enlarged to form a swollen globular “oesophageal gland,” though I do not detect any calcareous particles therein. In the 16th and 17th it again narrows, and then opens into the intestine in the 18th segment.

The *nephridia* are small, and without a bladder; the greater part lies at the level *ab*. There is a pair of compact “peptonephridia,” one on each side of the pharynx, at its hinder part.

*Testes* and *ovaries* are normal. Two pairs of *sperm-sacs* lie in 9 and 12, the former small, the latter large; both are lobulated. (In one specimen an additional sperm-sac lies in the 14th.)



PLUTELLUS AUCKLANDICUS.

Ventral view of the genital segments, somewhat diagrammatic. ( $\times 5$ .)

The *prostates* are flattened, compact, and lobulated, occupying the lateral part of the 18th segment. The short wide duct, as it passes through the body-wall, retains its own muscular coat, and is thus easily traced to the pore (Plate XI, fig. 24); in this respect it differs much from the prostate duct of *Diporochoeta*.

In spite of the external lobate form, the *prostate* is essentially a cylindrical tube, closely undulating and compressed, so that the waves are in contact. There is a central canal traversing the gland, with a uniform diameter throughout; it is lined by a flat epithelium with large nuclei, and receives short branches at intervals along its course; into these branches the necks of groups of gland-cells discharge their secretion (Plate XI, figs. 25, 26). (Cf. Sweet, pl. 15, fig. 17, illustrating *P. intermedius*).

The ventral chaetae are replaced by long slender "penial chaetae."

The *ovaries* are very large and project upwards above the oesophagus, and the strings of ova fully occupy the segment.

The two *spermathecae* lie in segments 8 and 9; each is a somewhat pyriform ampulla, with a duct nearly as long as itself, into which opens, about half-way along its course to the body-wall, a single small subglobular diverticulum (Plate XI, fig. 23). The pore is close to the nerve-cord.

*Locality*.—Auckland Islands: (a.) Adams Island; among the roots of *Pleurophyllum* in Fairchild's Garden; (Aston; W. B. B.). (b.) Adams Island; 1,350 ft.; (Speight). (c.) Port Ross; (W. B. B.). (d.) 200 ft. above the Watering Creek, at Camp Cove; (W. B. B.). Those collected by myself were found both in February and November.

*Remarks*.—The genus *Plutellus* is a characteristic Australian worm, for about fifty-five out of the sixty species occur on that continent. Possibly the Indian species should be removed from the genus. The present species differs from any of the known species, though it is clearly related to some of the Australian worms. Some years ago I described *P. lacustris*\* from Lake Manapouri, which Michaelsen† has transferred to the genus *Pontodrilus*, which differs from *Plutellus* only in (a) the absence of nephridia from the anterior segments, and (b) in the absence of a gizzard, while all the species are littoral with the exception of *P. lacustris*. It was on account of the last peculiarity that I placed the species in *Plutellus*, at the same time noting its resemblance to *Pontodrilus*, and suggesting that its aquatic habit had led to the disappearance of the gizzard and anterior nephridia. However that may be, the present species is the first terrestrial species of *Plutellus* that has been recorded from the New Zealand area. It appears to be allied pretty closely to *P. tuberculatus*, Fletcher,‡ from New South Wales, from which it differs, however, in the disposition of the tubercula pubertatis, which in that species are stated to be on the first annulus of segments 17–22; also in the chaetal formula.

In discussing the geographical relations of the earthworm fauna of these islands (p. 255), I have suggested the manner in which this species may have been introduced into the Auckland Islands.

\* Benham, "Some New Species of Aquatic *Oligochaeta* from New Zealand," Proc. Zool. Soc., 1903, ii, p. 228.

† Michaelsen, Die Fauna S.W. Austral., p. 160.

‡ Fletcher (*Notoscolex tuberculatus*), Proc. Linn. Soc. N.S.W., ser. 2, vol. ii, p. 611, 1887.

## DIPOROCHAETA, Beddard, 1890.

**Diporochoeta heterochaeta**, sp. nov. (Plate XI, figs. 27-29.)

*Colour*.—Rich red-brown, paler posteriorly and ventrally; the chaetae are surrounded by white areas, so that in the hinder region of the body, as the pigment gets less, each segment appears to be marked by a white line; hence the worm as a whole has a striped appearance. The clitellum is pale brown.

The average *size* is somewhere about 125 mm. in length, with a diameter of 3 mm.; but there is a good range even among mature forms—thus, one extreme is 50 mm., the other is 170 mm.; in both cases the specimens are soft, so that the true length is not represented by these figures. Whereas in a group of well-preserved specimens the numbers run from 65 mm. to 135 mm. for mature ones, several immature individuals are longer than the smallest mature ones. The number of segments ranges from 85 to 140. In this instance there is a direct relation between the length of body and the number of segments.

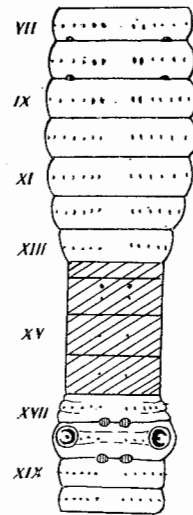
The *prostomium* is half epilobic.

The *clitellum* covers the three segments 14, 15, and 16; it is very well marked, and surrounds the body.

The *chaetae* are 32 per segment in the post-clitellar region, though in the anterior segments the number is less. The dorsal gap equals the ventral, which is about twice the ordinary interchaetal space. The chaetae on the lower surface are rather longer and stouter than those on the upper, there being a gradual transition from below upwards. The most noticeable external feature of the species is the large size of the two ventral chaetae. In segments 5, 6, 7, 8, and 9 these are very greatly enlarged, so as to be relatively of enormous size as seen in section (Plate XI, figs. 27, 28). Those of segments 3, 4, 10, 11, 12, 13, and 14 are also enlarged, though not to such a noticeable degree as the former. It is the remarkably stout chaetae in the preclitellar segments to which the specific name refers. The number of chaetae seems to increase with age, or at least with size, for an individual of about 70 mm., with 100 segments, has in the hinder segments 28 chaetae; in the 3rd, 20; in the 7th, 24; in the 9th, the full number, 28. On the other hand, a specimen measuring about 120 mm., with 130 segments, bears 32 on the hinder segments; the 3rd has 26; the 7th, 28; the 21st, 30; while the 23rd has 32. This number is not invariable, as some segments bear as many as 34.

*Genital and other Pores*.—The *male pore* is carried on a papilla in the 18th, in line with the chaeta *d* or *e*. The papilla is not very evident, as it is only on the mesial side that it rises above the level of the body; on this aspect there is a slight groove, in which lies the actual pore, which is microscopic.

In only two specimens are *tubercula pubertatis* present, as a pair of intersegmental structures, close to the median line at 18/19 in one case, or 19/20 in the other.



DIPOROCHAETA HETEROCHAETA.  
Ventral view of the genital segments. ( $\times 4$ )



Two *spermathecal* pores, apparently at 7/8, 8/9, are seen in well-extended specimens to be really on the hinder margins of segments 7, 8, in line with *de*. In one case I note three pairs of these pores; in another, three on one side and two on the other side, the extra one being anterior.

The *nephridiopores* are at the level of the 7th chaeta (*g*) or the 8th (*h*).

#### *Internal Anatomy.*

None of the septa are noticeably thickened. The dorsal vessel is single, and the last heart is in the 12th segment. There are some rather interesting facts about the relations of the hearts, but in the present communication I will confine myself to those characters which are diagnostic.

The *gizzard* is vestigial in the 6th segment; it appears in sections as a short muscular ring, whose length is about equal to half the length of the segment; it does not project beyond the outline of the oesophagus, and is about as thick as one of the villi that line this part of the tract. Behind the gizzard the oesophagus is a narrow tube with the usual villous epithelium; in the 12th and 13th it is dilated, and the epithelium is raised into a series of lamellae; in the 14th it again narrows; it is dilated once more in each of the segments 15 and 16, still being lamellate; and the same structure is retained in the 17th–20th, when the epithelium alters its character and puts on the ordinary appearance of intestinal epithelium. In a dissection, one would say that the intestine commences in the 17th, judging merely from the diameter, but the limitations of the regions of the enteron in these and most worms, other than the European Lumbricids, deserve further study, especially from the histological point of view.

The *nephridium* is limited to the lower half of the body-wall, extending up to the 8th chaetae, where the large pyriform bladder is seen to penetrate the wall to open to the exterior. The tubule of the organ is compactly coiled.

The *testes* and *ovaries* are in the normal position. There are two *sperm-sacs*, in the 9th and 12th, large and lobulate.

The *prostate* is long, extending from the 18th segment to the 28th or 29th segment; the tip is recurved sharply, and runs forward, in the specimens dissected, to the 26th. The narrow duct, limited to the 18th, is transversely directed towards its pore; as it passes through the body-wall it is excessively fine, so that it is not easy to trace. The united sperm-ducts open into the prostate in the 19th segment, passing through the gland-cells obliquely to enter the lumen of the gland.

The lumen, which in section is wide, is lined by tall narrow cells, between which the delicate necks of the gland-cells pass to open into the central canal. Outside the epithelium is a finely granular region, which appears to be due to the sections of the necks in all planes as they approach the canal.

The *spermatheca* (two pairs, in the 8th and 9th) has a small diverticulum joining the duct close to the ampulla (Plate XI, fig. 29).

*Locality*.—Snares. Several specimens were collected both in February and in November, so that it is a common worm.

*Remarks*.—Hitherto five species of worms have been described from New Zealand area as belonging to the genus *Diporochoeta*—indeed, the type of the genus is one

of them, viz., *intermedia*, Beddard\*—but the genus also includes numerous species from Australia. Two of the New Zealand species, *D. gigantea* and *D. shakespearei*, Benham,†, have recently been removed from this genus by Michaelsen,‡ owing to their micronephric character, and placed in a new one, *Spenceriella*, with two or three Australian species; but, as I noted in my account of the species, the nephridial funnel of the meganephridium still remains, and it does not seem to me at all a satisfactory feature to adopt as a generic character. Most of our species of *Diporochoeta*, in having only two pairs of spermathecae, differ from the Australian species, which have four or five pairs.

***Diporochoeta helophila*, § sp. nov. (Plate XI, figs. 30–33.)**

This small species is remarkable for the very dark chocolate-brown coloration of the skin, and for the peculiar distribution of the pigment. The usual position of the pigment in earthworms is in the connective tissue of the circular muscle-layer; but in this worm, in addition to this, there is a fine brown pigment amongst the epidermal cells, close to the surface, and apparently in the columnar cells. The pigment in the circular muscles consists of black granules, and is especially abundant in the anterior 11 segments. Thirdly, and posteriorly to the 11th segment, there is a peculiar flaky brown pigment in the somatic coelomic epithelium. This extends all the way round the body in these segments, whereas the other pigments are confined to the dorsal half of the body (Plate XI, figs. 30, 31). This flaky pigment appears to lie in the superficial portion of the vesicular cells, and in segments 13–18 there are three to five rows of cells forming a very conspicuous layer in sections (Plate XI, fig. 32). The colour is not, therefore, limited to the anterior portion of the body nor to the dorsal region, but is only a little paler in the hinder end and on the ventral surface. The chaetae are set in pale spots, which may be almost white. The clitellum is uniformly paler brown.

*Dimensions.*—The length of the mature worm varies from 26 mm. to 47 mm., with a diameter of 1 mm.; there are from 47–98 segments, an unusually wide range.

The *chaetae* are 24 per segment, though in the hinder part of the body I counted only 20 in a trans-section. They are very noticeable, owing to the white dots that surround their bases. The interchaetal spaces are somewhat irregular, but subequal; the dorsal gap is greater than the ventral, in the proportion of 5 to 3, the latter about twice an interchaetal gap.

The *clitellum* occupies the 14th to 17th segments, the anterior two of which are completely encircled.

*Genital Pores, &c.*—The *male* pore, on the 18th, is in line with chaetae *bc* (in reality, it is in the line of *b*, but, as in other species, the ventral chaetae are thrust outward in these segments to the level of *c* in neighbouring segments); being white in colour, it is more readily recognisable than usual. The *oviducal* pore, likewise white, is in front of chaeta *a*.

\* Beddard, Proc. Zool. Soc., 1890, pp. 55, 56.

† Benham, "An Account of some Earthworms from Little Barrier Island," Trans. N.Z. Inst., xxxviii, p. 252, 1906.

‡ Michaelsen, Die Fauna S.W. Austral., p. 161.

§ Swamp-lover.

The two *spermathecal* pores, at 7/8, 8/9, are in the same line as the male pores. *Tubercula pubertatis* are present as white paired glands on segments 10, 11, 16, 17, and 19, in line *ab*, prechaetal and median of the genital pores. In one specimen additional glands are on the 9th and 12th. The *nephridial* pores are in line *d*.

#### Internal Anatomy.

The pharynx extends back into segment 6. There is no gizzard; not even the usual vestige could be detected in sections.

The oesophagus extends from the 7th to the 12th as a straight tube of nearly uniform diameter; it widens in 13 and 14, the walls becoming lamellate; the gland is not constricted by the septum. The tube now narrows in the 15th, widens again in the 16th, and enters the intestine in the 17th, when the wall becomes thin and the lumen wide.

The nephridia are relatively large, extending round the wall from the 2nd to about the 9th chaeta, so that they reach the dorsal surface.

Testes and ovaries in the normal position, the latter very large. Two pairs of *sperm-sacs*, in the 9th and 12th segments.

The *prostates* are tubular, reaching from the 18th to the 20th. The duct is minute, and there are no penial chaetae.

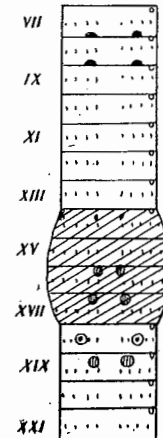
Two pairs of *spemathecae* lie in 8 and 9; each has a subspherical ampulla, with a short thick duct into which opens a single tubular diverticulum close to the base of the ampulla; it is about as long as the diameter of the latter (Plate XI, fig. 33).

*Locality*.—Auckland Islands: (a.) Bush soil, North Arm of Carnley Harbour; (W. B. B.). (b.) At mouth of fresh-water creek, as it falls into a pool; (Page). (c.) 200 ft. above Watering Creek, Camp Cove, in somewhat swampy ground; (W. B. B.). (d.) Enderby Island; in a log near a pool; (W. B. B.).

*Remarks*.—This species agrees in several features with *D. aquatica*, Benham,\* which I described from Lake Manapouri, but from it is readily distinguished by the thick body-wall and abundant pigment, as well as by fewer chaetae per segment. It is, however, clearly related to it in its general structure and habits.

#### *Diporochoeta brachysoma*, sp. nov. (Plate XI, figs. 34, 35.)

Five specimens of this striking worm were obtained—striking from its stout short form of body and from its very dark colour. The following note was made of the living animal: "A very dark purplish-brown, nearly black, worm, with orange clitellum and pale-brown under-surface. The general facies reminds me of *Plagiochaeta sylvestris*." In formol the colour is dark purplish-grey, paler below, with a narrow dark band along the entire ventral surface, occupying the interchaetal area, this being absent only on the clitellar segments. The clitellum is now brown,



DIPOROCHAETA HELOPHILA.  
Ventral view of the genital segments. ( $\times 12$ .)

\* Benham, Proc. Zool. Soc., ii, 1903, p. 226.

with a greyish tint. The chaetae are inserted in pale spots. The pigment, appearing brown in sections, is densely aggregated in the connective tissue of the circular musculature, but there is also a little black pigment in streaks amongst the longitudinal muscles. There is none in the epidermis.

*Dimensions.*—The worm is remarkable for the breadth of the short body. Its length is from 30 mm. to 35 mm.; diameter, 4 mm. The body contains 60 to 70 segments.

*Chaetae.*—There are about 40–50 chaetae on each segment; they are of the same size, but unequally spaced, those near the dorsal surface being rather further apart than those on the ventral region; the spaces bear the proportion of 3 to 2 respectively. The ventral gap is greater than the dorsal, as 5 to 4, the former being about three times larger than the neighbouring interchaetal space, the latter four times the nearest space.

The *clitellum* covers segments 14–17, and completely encircles the body.

*Genital Pores, &c.*—The *male* pore is in a depression on each side of the 18th, in line of chaeta *b*, which, as usual, is thrust outwards; both chaetae *a* and *b* are present, but are smaller than those of other segments.

The *spermathecal* pores are at 7/8, 8/9.

On the anterior margin of segments 18, 19, and 20 there is a pair of circular admedian *tubercula pubertatis*; there is, however, some variability, especially in regard to the tubercula in the neighbourhood of the spermathecal pores; in one individual there is a pair at the anterior margin of the 8th, in another at the anterior margin of the 9th, in others none are present in this region.

The *nephridiopores* are, I think, in line with the 14th chaeta—*i.e.*, are high up on the body.

The *prostomium* is half epilobic; there is a transverse groove, from which short longitudinal furrows pass back.

#### *Internal Anatomy.*

The septa behind segments 10–13 are thickened.

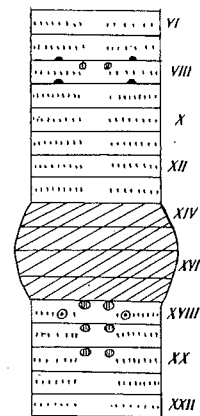
The dorsal vessel, as it passes through 9–13, is narrow, owing to the thick muscular wall; in the 14th it loses most of this muscular coat, and dilates to form the usual wide vessel. The hearts are in the 10th, 11th, and 12th, arising not from a supra-enteric vessel, but directly from the enteric blood-plexus, with which the dorsal vessel is connected in the 14th by four short vertical vessels.

The pharynx is very powerfully developed, the retractor muscle and the glands extending as far back as the 10th segment. I see no gizzard, even in sections. The oesophagus in 10, 11, is narrow; it dilates in 12, 13, and 14 successively, being constricted by the septa through which it passes, and, as the wall is lamellate here, these dilations may be regarded as glands; it narrows again in 15, and widens into the intestine in the 16th segment.

The nephridia are small.



DIPOROCHAETA BRACHYSOMA.  
Natural size.



DIPOROCHAETA BRACHYSOMA.  
Ventral view of genital segments. ( $\times 4$ .)

Testes and ovaries are normal. There are two *sperm-sacs*, in 9 and 12, small and much lobulated. In the series of longitudinal sections I see a third pair in the 13th, of small size, but whether this is normal I cannot say.

The *prostate* is a curved, subcylindrical gland, confined to its segment, rising up so as to overarch the intestine (Plate XI, fig. 34). Its surface is rough, and the lumen is simple—*i.e.*, does not branch—though at intervals it receives the necks of groups of gland-cells, which open into slight diverticula, which, however, cannot be traced as definite lumina.

The epithelium lining the very narrow lumen of the prostate consists of tall, narrow columnar cells, beyond which is a layer of fibres of extreme fineness, due either to a connective tissue or, more probably, to the necks of the gland-cells being cut across at various planes as they curve towards the canal.

In the neighbouring segments there are well-developed dorso-ventral muscles ("arcuate muscles"), but there are no penial chaetae.

Two pairs of *spermathecae* lie in segments 8 and 9, opening at the level of chaeta *e*. The ampulla is large; the diverticulum single and small, on the anterior median side of the duct (Plate XI, fig. 35).

*Locality*.—Adams Island; 2,000 ft.; under stones; (Speight).

#### *Diporochaeta perionychopsis*, sp. nov. (Plate XI, figs. 36–39.)

About eighteen specimens were collected from various parts of the Auckland Islands. The greater number are immature.

*Colour*.—In life the worm is "deep crimson-red," but in formol the colour has changed to a reddish-purple, and even brown later, with paler clitellum.

The *dimensions* of mature individuals reach a maximum of 225 mm. in length, with a diameter of 6 mm., and contains 200 segments. Others are slightly smaller.

*Prostomium* half epilobic, without a transverse groove. The preclitellar segments are not annulated; the posterior ones are triannulate.

The *chaetae* are about 50 to 60 per segment, with a small ventral and smaller dorsal gap. They are similar in size all round the body. The chaetae are more numerous in the preclitellar than in the postclitellar segments, thus:—

NUMBER OF CHAETAE IN CORRESPONDING SEGMENTS IN THREE INDIVIDUALS.

	A.	B.	C.
Segment III .. .. .	32	30	30
" VIII .. .. .	36	42	30
Mid-body .. .. .	30	28	26
Tail .. .. .	25	24	—

The *clitellum* is saddle-shaped, and covers segments (13), 14–18, but it is not developed in the majority.

*Genital Pores, &c.*—In the most fully developed specimen I see no papilla on the 18th. This segment is grooved transversely in its middle, and I believe I can detect a minute pore at the lateral margin of the groove on each side, in line with the chaetal row, just mediad of chaeta *a*.

*Tubercula pubertatis* are present as small paired oval papillae, each with a depression in its centre, at the intersegmental furrows 17/18, 18/19. These are present even in specimens in which the clitellum is not developed. Further, on the anterior margins of 10 and 11 there are paired projections which may be also tubercula; they are in line with chaetae *cd*; in one case they are also on the 9th.

There are three pairs of *spermathecal pores* (invisible externally), at 6/7, 7/8, and 8/9, in line with chaeta *b*.

The *nephridial pores*, though likewise invisible, are at the level of about the 15th or 16th chaeta.

#### Internal Anatomy.

The posterior septa of segments 10–15 are thick, especially the last four.

There is no gizzard; not even a trace of it is recognisable in a dissected worm. The oesophagus is thin-walled as it passes through 7 and 8, becomes thick-walled in the 9th to 16th, then it narrows in the 17th, and the intestine commences in the 18th as the usual wide thin-walled tube. There are no oesophageal glands.

The dorsal vessel is single; the last heart lies in the 12th segment.

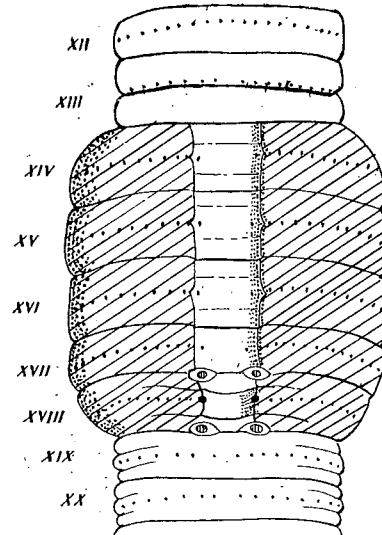
The worm is meganephric; the coiled tubule forms a compact mass in the ventral portion of the body, but the large muscular bladder passes upwards to open rather above the lateral line at the level of about the 15th chaeta.

The testes and ovaries are normal. There are two *sperm-sacs*, in the 9th and 12th. The *prostate*, in contrast to the form it has in the preceding species, is a flattened compact mass, somewhat lobulated on its inner margin, and with a quadrate outline (Plate XI, fig. 36). Its short duct arises from its under-surface, and is thus invisible from above.

Sections show that the duct contains three or more channels when it leaves the gland (Plate XI, fig. 38); these unite as the body-wall is approached. The sperm-duct joins this prostate duct after it has left the gland, but does not enter the lumen at once; it runs alongside the three channels for some distance, and enters the lumen after they have united, and, indeed, after the prostate duct has entered the body-wall. The three or four channels above mentioned pass up into the gland and diverge, each giving rise to a few branches as it traverses the substance of the prostate (Plate XI, fig. 37)—in other words, the prostate has a character which Michaelsen assigns to the genus *Perionyx*, and which does not occur, according to his diagnosis, in *Diporochaeta*.

The ventralmost chaetae, *a*, *b*, on this segment are slightly longer than the rest, as 4 to 3, but scarcely deserve to be termed "penial"; they do not differ in form.

The *spermathecae* occur in segments 7, 8, and 9. In one individual I find an asymmetry, in that on one side the three spermathecae are in these segments,



DIPOROCHAETA PERIONYCHOPSIS.  
Ventral view of the genital segments.  
( $\times 4$ .)

on the other they lie in 8, 9, and 10, with the pores at the anterior margin of the segment in each case. Each spermatheca has a large subspherical ampulla, a short thick duct, which receives at about the middle of its length a pair of small ovoid diverticula (Plate XI, fig. 39).

*Localities*.—Auckland Islands: (a.) Magnetic station, Camp Cove; (W. B. B.). (b.) North Arm, Carnley Harbour; (Captain Dorrien-Smith). (c.) Magnetic station, Musgrave Harbour; (W. B. B.). (d.) Masked Island, Carnley Harbour; among the roots of *Stilbocarpa polaris*; (Aston). (e.) Adams Island; at roots of *Pleurophyllum*, Fairchild's Garden; (W. B. B., February; Aston, November). (f.) 2,000 ft.; under stones; (Speight). (g.) Disappointment Island; fragmentary; (Kirk).

*Remarks*.—Anatomically, this species appears to differ from the rest of the species of *Diporochoeta* in having a branched lumen to the prostate, and on that account should perhaps be placed in the genus *Perionyx*, according to Michaelsen's most recent views on the diagnostic characters of the genera of the subfamily *Megascolecinae*.\* But, considered from a geographical aspect, this seems an impossible view to take. I cannot persuade myself that it can belong to this genus, which is confined to the Oriental region. This species (*D. perionychopsis*) is, as has been noted above, widely distributed over the Auckland Group. It lives all round Carnley Harbour, at all heights, from sea-level to the topmost altitude; is to be met with in soil at roots of plants and under stones; and it is extremely interesting that of the two worms obtained on Disappointment Island one is of this species. These islands have no commercial intercourse with the Orient—they are, in fact, uninhabited, and, except for a brief period, have always been without inhabitants but for unwilling, shipwrecked mariners. In the year 1850 a small settlement of Europeans was established by Governor Enderby on what is now known as Enderby Island; the settlers came from New South Wales, and broke up in 1852; at the same time a number of Maoris lived on the main island at Port Ross. But this species of earth-worm could not have been introduced by these immigrants, for the genus *Perionyx* is unknown either in Australia, or the Chatham Islands, whence these Maoris came. Nor could it have arrived there at the time when New Zealand was of continental dimensions, when the country was probably in some connection with the Oriental region, otherwise one would expect to find the genus represented to-day in New Zealand. I do not see how one can explain the occurrence of the genus at these southern islands. It seems to me more easy to imagine that the slight branching of the prostate lumen has arisen within the genus *Diporochoeta*. Had it not been for the emphasis which Michaelsen places on the point it would not have occurred to me to discuss any other probability.

The microscopic structure of the prostate of *Pheretima* (*Perichaeta*) was described by Beddard, and later Miss Sweet† investigated the lobate prostate of some of the Australian genera, while Michaelsen‡ has given an account of that of *Perionychella dendyi*, a species formerly included in the genus *Diporochoeta*. From these the prostate of the present species differs in that there are three or more canals in the prostate

\* Michaelsen, Die Fauna S.W. Austral., p. 152.

† Sweet, Linn. Soc. Journ. (Zool.), xxviii, p. 109, 1900.

‡ Michaelsen, "Oligochaeten von Australien," in Abhandl. aus dem Gebiete Naturwiss, Hamburg, xix, p. 12, 1907.

duct, which pass up into the gland and there branch, whereas apparently in those just referred to the single lumen in the duct does not begin to branch till the gland has been entered. In the structure of the prostate, *Woodwardia callichæta* appears, from Michaelsen's account,\* to resemble this new species. But in spite of this small difference there is no doubt that this species has what Michaelsen terms a "*Pheretima* prostate." He is strongly of opinion that the "*Pheretima* prostate" has been evolved only once—from the "*Plutellus*" form of prostate (p. 152); nevertheless, on p. 158, he admits that this is not absolutely without doubt—*i.e.*, there is a possibility of the branched lumen having arisen more than once. It seems to me that the present species is a case in point.

Fam. LUMBRICIDAE.

HELODRILUS, Hoffmeister, 1845, em. Michaelsen, 1900.

Subgen. BIMASTUS, H. F. Moore, 1893.

*Helodrilus constrictus*, Rosa.

1884. Rosa, Lumbric. Piemonte, p. 38.

The occurrence of this common European species on Campbell Island is clearly related to the habitation and cultivation of a patch of garden by the shepherds at the island. Only two specimens were forwarded to me.

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## EXPLANATION OF PLATES X AND XI.

## PLATE X.

*Phreodrilus campbellianus.*

Fig. 1. Longitudinal section through the sperm- and spermathecal pores, combined from two consecutive sections. (Camera outline,  $\times 100$ ; details somewhat diagrammatically sketched in.) *a*, spermiducal pore in xii; *b*, penis in its sac; *c*, prostate, in transverse section; *d*, neck of prostate entering penis; *e*, spermathecal pore in xiii; *f*, spermathecal antrum, surrounded by muscles; *g*, narrow duct of spermatheca.

*Rhizodrilus aucklandicus.*

- Fig. 2. Transverse section through the paired male pores. (Camera,  $\times 60$ ; details of body-wall diagrammatically sketched.) *a*, male pore; *b*, penis-sac, with sperm-duct above; *c*, nerve-cord; *d*, intestine, to the left of which are the dorsal and ventral blood-vessels; *e*, sperm-sac.
- Fig. 3. Spermatheca, from a transparent specimen. *a*, ampulla; *b*, globular, glandular sac; *c*, epidermal pit; *d*, spermatozoa projecting from the pore.
- Fig. 4. Base of the penis, in transverse section (*cf.* *d* in fig. 7). ( $\times 370$ .)
- Fig. 5. Sperm-duct, in transverse section, with prostate glands surrounding it. The groups of glands are confined to the dorsal and lateral surfaces, each group being enveloped in a sheath of coelomic epithelium. (Camera,  $\times 370$ .)
- Fig. 6. The lower part of the penis, in transverse section (at about the level of *c* in fig. 7); the wall is a good deal folded. *d*, lumen. (Camera,  $\times 370$ .)
- Fig. 7. Longitudinal section through the male apparatus. (Camera,  $\times 250$ .) The region from the funnel to the upward curve of the duct lies in one section, the posterior part was contained in several consecutive sections. *a*, male pore; *b*, muscular penis-sac; *c*, penis, folded protrusible portion; *d*, glandular bulb; *e*, sperm-duct; *f*, prostate glands enveloping the duct for the greater part of its length; *g*, retractor muscles of penis; *g'*, retractors of the sac; *s*, *s'*, septa 10/11 and 11/12.

*Lumbricillus intermedius.*

- Fig. 8. Spermatheca, from a bisected specimen. (Camera  $\times 60$ .) *a*, pore, surrounded by a rosette of glands; *b*, aperture into oesophagus. The thicker portion of the wall is the muscular duct.
- Fig. 9. Subneural gland. (Camera,  $\times 185$ .)
- Fig. 10. Sperm-funnel, from a longitudinal section, which cuts it lengthwise. (Camera,  $\times 100$ .)
- Fig. 11. Nephridium, combined from two consecutive sections. (Camera,  $\times 370$ .)

*Pelodrilus tuberculatus.*

- Fig. 12. Transverse section of the body, at the level of the copulatory gland, showing the circumferential extent of the clitellum and the position of the gland through which the sperm-ducts open (*cf.* fig. 14). *a*, copulatory gland; *b*, clitellum; *c*, large ovum. (Camera outline,  $\times 35$ .) The chaetae are inserted on one side only, and the body-wall is represented diagrammatically.
- Fig. 13. Portion of the body-wall, enlarged. (Camera,  $\times 370$ .) The cuticle (*a*) is remarkably thick; *b*, goblet cells; *c*, circular muscles; *d*, longitudinal muscles.
- Fig. 14. Longitudinal section through the genital segments, which are numbered above in roman numerals. (Camera,  $\times 100$ .) *a*<sup>1</sup>, *a*<sup>2</sup>, the male pores; *b*, female pore; *c*, *c*<sup>2</sup>, the sperm-ducts; *d*, oviduct; *e*, the copulatory (? prostate) gland.

## PLATE XI.

*Pelodrilus aucklandicus.*

- Fig. 15. Longitudinal section through the genital segments, which are marked in roman numerals below. (Camera,  $\times 60$ .) The two limbs of the sperm-duct lie almost wholly in two consecutive sections. *a*<sup>1</sup>, *a*<sup>2</sup>, the male pores; *b*<sup>1</sup>, *b*<sup>2</sup>, the female pores; *c*, testis; *d*, sperm-funnel; *e*, sperm-duct; *f*, copulatory (? prostate) gland; *g*, oviduct; *h*, ovary (the other ovary is omitted for sake of clearness); *j*, base of chaetae (the entire chaeta is represented in segment x).

*Notiodrilus fallax*.

- Fig. 16. Spermatheca. ( $\times 6$ )  
 Fig. 17. Prostate of the same. ( $\times 6$ )

*Plagiochaeta plunketi*.

- Fig. 18. Longitudinal section of vestigial gizzard, with neighbouring portion of oesophagus. (Camera,  $\times 30$ .)  
 Fig. 19. Penial chaeta of segment 17, and normal locomotive chaeta of 20th segment. ( $\times 60$ )  
 Fig. 20. Spermatheca; figure compiled from sections.

*Leptodrilus leptomerus*.

- Fig. 21. Spermatheca. ( $\times 18$ .)

*Leptodrilus magneticus*.

- Fig. 22. Spermatheca. ( $\times 18$ .)

*Phutellus aucklandicus*.

- Fig. 23. Spermatheca. ( $\times 12$ .)  
 Fig. 24. Prostate of left side *in situ*, and the arcuate muscles (*m*) of the 19th segment. *a, b, c, d*, the four chaetal rows, indicated by their gaps in the longitudinal muscular layer of the body-wall (the prostate duct perforates the wall in line with chaeta *b*); *n*, nerve-cord.  
 Fig. 25. Plan of the course of the lumen of the prostate, compiled from a series of sections. ( $\times$  about 30.) Only a few of the bunches of glands are shown opening into the little diverticula of the central lumen.  
 Fig. 26. Portion of the foregoing, enlarged. *a*, main lumen of prostate; *b*, diverticula; *c*, bunch of gland-cells.

*Diporochoeta heterochaeta*.

- Fig. 27. Portion of the ventral surface of segment 7, showing the two much enlarged chaetae on each side of the middle line. (Camera,  $\times 30$ .)  
 Fig. 28. Ventral chaeta of segment 6 (*a*) and of segment 14 (*b*) from a transverse section. (Camera,  $\times 30$ .)  
 Fig. 29. Spermatheca. ( $\times 8$ .)

*Diporochoeta helophila*.

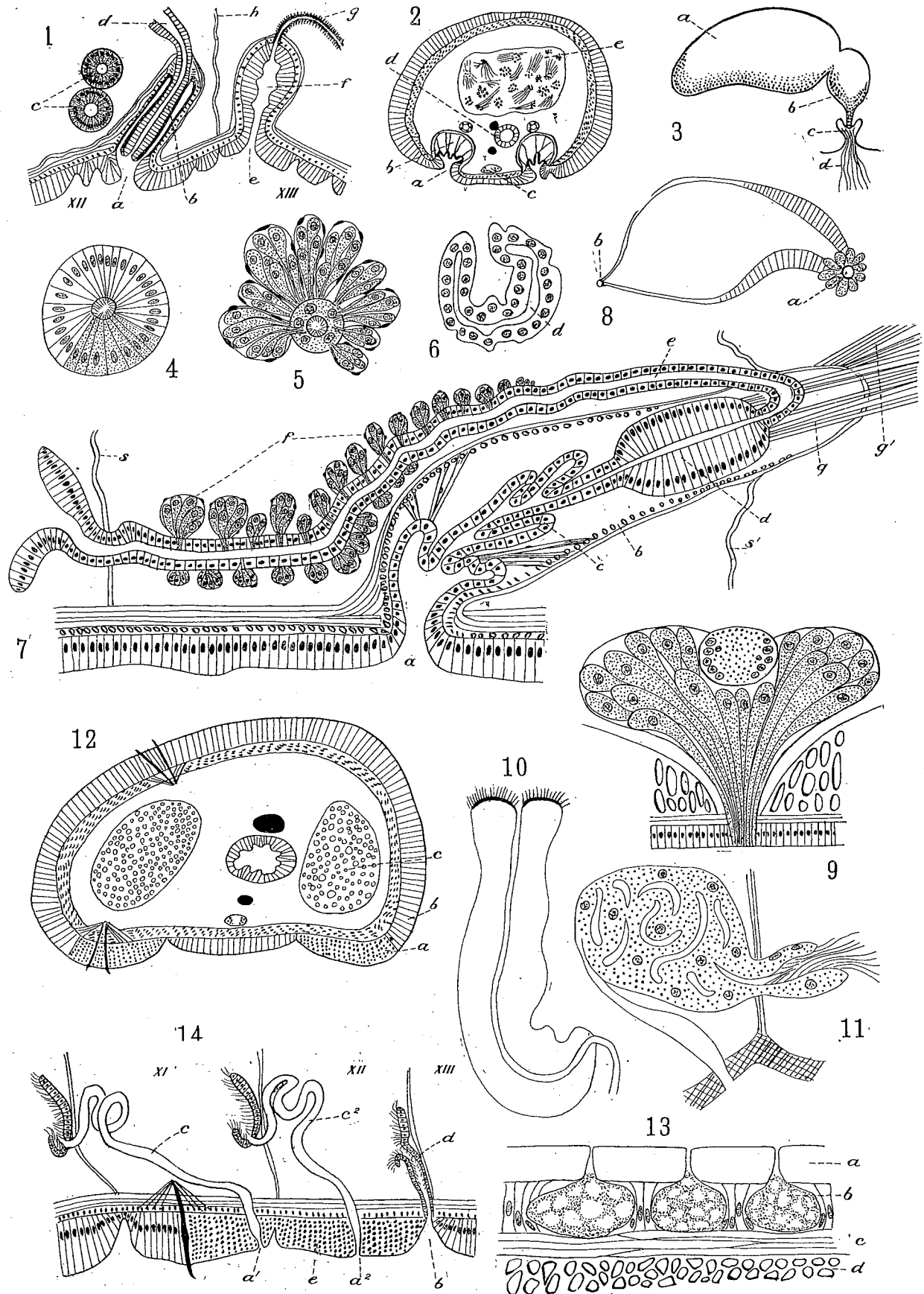
- Fig. 30. Transverse section, to show the peculiar arrangement of the pigment (*a*) on the coelomic epithelium all round the body, (*b*) in the epidermis on the dorsal surface only. (Camera,  $\times 30$ .)  
 Fig. 31. Portion of the preceding, enlarged. (Camera,  $\times 185$ .) *a*, flaky pigment in somatic coelomic epithelium; *b*, longitudinal muscles; *c*, circular muscles, with granular pigment between the fibres; *d*, epidermis, with very fine granules of pigment apparently inside the cells.  
 Fig. 32. Portion of the somatic coelomic epithelium on dorsal wall, from a longitudinal section. (Camera,  $\times 185$ .) The pigment lies at the surface of vesicular cells. *a*, pigmented cells; *b*, longitudinal muscles; *c*, nuclei of pigment-cells.  
 Fig. 33. Spermatheca, as compiled from a series of longitudinal sections.

*Diporochoeta brachysoma*.

- Fig. 34. Prostate, *in situ*, from a bisected specimen. D, dorsal wall, nearly in the median line; V, ventral wall; *a*, arcuate muscles.  
 Fig. 35. Spermatheca. ( $\times 30$ .)

*Diporochoeta perionychopsis*.

- Fig. 36. Prostate. ( $\times 6$ .)  
 Fig. 37. Horizontal section of prostate, showing the branching of the lumen. The gland-cells are not indicated. (Camera outline.)  
 Fig. 38. Transverse section of the prostate duct. (Camera outline.) The sperm-duct (*a*) lies in the muscular wall. The three lumina (*b*) do not unite till close to the external pore.  
 Fig. 39. Spermatheca. ( $\times 12$ .)



W. B. Berham del.

PLATE X.

