

which, according to Büchner, very closely resemble *O. erythrotis*. Büchner's actual words are :—" Die Incisivöffnung ist durch einen parigen Vorsprung des Zwischenkiefers in zwei Abschnitte, eine vordere und eine hintere Incisivöffnung getrennt ; in Form und Grösse gleichen diese Oeffnungen vollständig denjenigen bei *L. rutilus* " ; and on the strength of this I have no hesitation in placing *O. erythrotis* in the *ladacensis* (subgen. *Pika*) group, a finding with which Mr. Lyon, had he seen specimens of *O. rutila*, would, I feel, sure agree.

The only other discrepancies relate to *O. curzonice*, *O. dawrica*, *O. melanostoma*, and *O. pusilla*, but as Mr. Lyon has never seen specimens or figures of any of these, his conclusions with regard to them must of necessity be of a rather speculative character.

To sum up shortly, we may fairly consider Mr. Lyon's conclusions as regards the main divisions of the genus to be clearly borne out by the foregoing pages, and, so far as the Palaearctic species are concerned, this paper may claim to have clearly shown to which subgenus any particular species should be assigned.

5. On some Edible and other New Species of Earthworms from the North Island of New Zealand. By W. B. BENHAM, D.Sc., M.A., F.Z.S., Professor of Biology in the University of Otago, New Zealand.

[Received May 31, 1904.]

(Text-figures 41-82.)

The Earthworms that have hitherto been described from New Zealand by Mr. Beddard and by myself have been collected, with one exception, from the South Island, and indeed from the southern half of that island. The majority of these belong to the genera *Maoridrilus*, *Notiodrilus*, and *Plagiochaeta*, belonging to the subfamily Acanthodrilinæ, and to the genus *Octochaetus*, of Michaelsen's subfamily Octochætinae ; and the general *facies* of our South Island fauna is very characteristic and quite distinct from the Australian Earthworms. But I have recently been able to examine specimens of a number of species from various parts of the North Island, with the astonishing result that they present a striking contrast to those of the South Island, and as striking a resemblance to the Australian Cryptodrilids. Even in the South Island we have in two species of *Diporochaeta*, and the lacustrine species of *Pluteillus*, representatives of the Australian fauna ; but whereas the species just referred to are by no means common, and might probably be regarded as comparatively recent arrivals, possibly even accidentally introduced from the adjoining continent, such an explanation appears to be quite inadmissible for the northern species ; for the new genus *Tokea*, which I find it necessary to make, is represented by seven species in quite distant parts of the North Island ; and the Acanthodriline genera are just as scarce

in the North Island as the Cryptodriline forms are in the South ; moreover, most of these worms are found in inland places, or in spots more or less remote from European cultivation ; and, indeed, some of the species were formerly used as food by the Maoris, who recognise several different species of Earthworms and give distinctive names thereto.

Before attempting to explain this Australian faunal resemblance of the North Island, we must wait till we can obtain more material, both from the southern portion of that island and the northern districts of the South Island.

Another interesting group of Worms is also represented in the collection, viz., two new species of *Rhododrilus*—a genus peculiar to New Zealand, but allied to *Microscolex*, which is an American form.

Finally, I find it necessary to create a new genus, *Dinodriloides*, for a worm which bears the same relation to *Dinodrilus* that *Neodrilus* bears to *Maoridrilus*, in that the hinder pair of prostates has disappeared ; though this is not the only point of difference from Beddard's genus.

For the majority of the species described below I am indebted to Mr. Elsdon Best, of Ruatahuna, who, at my request, took the trouble to collect, preserve, and despatch to me, in February 1904, several kinds of worm that were formerly used as food by the Maories, of which he has written an account in the 'Transactions of the New Zealand Institute' for 1901, on p. 64, in his article on "The Food-products of Tuhoe-land." Tuhoe-land or the Urewera Country lies on the eastern part of the North Island, south of the Bay of Plenty, and not far from Rotorua, so famous for its baths. The country is much rougher and less affected by civilisation than elsewhere, and is still peopled by Maories in a less Europeanised condition than in other parts.

In this article Mr. Best enumerates and gives a brief description of eight different kinds of earthworm as being eaten by the natives : these are "Kuharu, Noru, Wharu, 'Tarao, Pokotea, Tai, Kurekure, and Whiti." The "two last are famed for their sweetness and flavour," and "were reserved as food for the chiefs. 'The sweet flavour is said to remain in the mouth for two days,' though Mr. Best states that he "cannot speak from experience" as to this fact.

In preparing these worms for food, "those which contain earth are stripped with the fingers before being prepared for eating, this forces the earth out of them." I suppose this means "stripping" in the way fish are "stripped" of their milt and ova, in hatcheries.

"To cook these worms some water is placed in a bowl and rendered warm (not hot) by means of hot stones. The worms are then cast into the water and allowed to remain there for some hours. Before long the worms will have become dissolved or partially so, but were the water too hot they would not melt. Some cooked greens are added to the mess, and a prized dish is

ready; the gods who live for ever would smile at the sight of it."

"Worms were preserved in gourds for some time. The best kinds were favourite *o matengo* of former days; the last food taken by a dying person is so termed."

Of the earthworms referred to in this extract, Mr. Best sent me specimens of "Tarao," "Pokotea," and "Kurekure," as well as another earthworm, called by the natives "Tokerangi," but not included in his list of foods.

"Tarao" and "Tokerangi" belong to the genus *Rhododrilus*; "Kurekure" and "Pokotea" to the new genus *Tokea*. But "Kurekure" includes two species, so that we have four (or five if "Tokerangi" is eaten) species of edible earthworms, belonging to two distinct genera. I believe this is the first time that the use of Oligochæta as an article of diet has been recorded; for no mention is made of earthworms in the series of Animals used as Food enumerated by Professor Lankester in his introduction to the recently published volume of "Reports on Economic Zoology," issued from the British Museum.

The following is a list of the twelve new species of Earthworms described in the present paper: I desire to express my thanks to my various friends and correspondents who have so kindly collected these, and other, worms in out of the way districts.

Fam. MEGASCOLECIDÆ.

Subfam. ACANTHODRILINÆ.

*Maoridrilus maurienseis*.  
*Octochætus michaelseini*.  
*Dinodriloides beddardi*.  
*Rhododrilus edulis*.  
*Rhododrilus besti*.

Subfam. MEGASCOLECINÆ.

*Tokea*, gen. n.  
*T. esculenta*.  
*T. sapida*.  
*T. urewera*.  
*T. huttoni*.  
*T. suteri*.  
*T. kirki*.  
*T. maorica*.

MAORIDRILUS MAUIENSIS, sp. n. (Text-figs. 41-44.)

A single incomplete specimen, collected in 1899 by Mr. Suter and now preserved in alcohol. It is soft and ill-preserved.

*Locality*. Auckland.

*Colour*. Pale yellowish, in marked contrast to the usual dark tint of members of the genus; possibly the pigment has been dissolved.

*Dimensions.* 80 × 4 mm., for 117 segments.

*Prostomium* tauglobic.

*Chæta.* 8, closely coupled;  $aa < bc = dd$ .

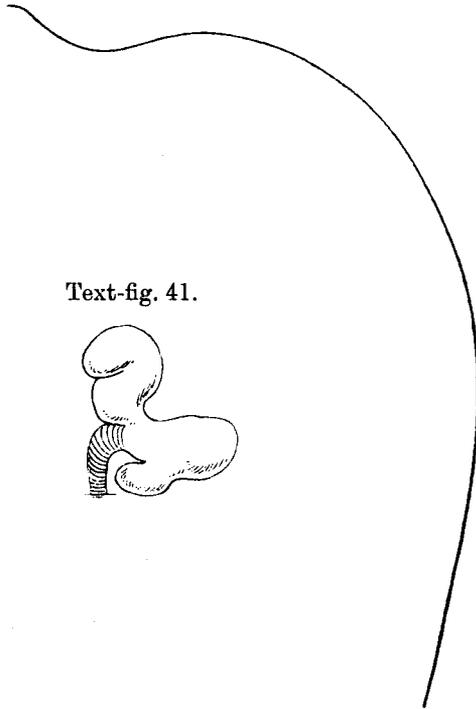
*Clitellum* undeveloped.

*Genital pores.*—The porophores\* in 17 and 19 are in line of chætæ *ab*, which are absent. The spermathecal groove passes straight backwards between *a* and *b*, which are present on 18 in the manner characteristic of the genus; spermathecal pores normal in number and position, in line *ab*.

#### *Internal Anatomy.*

The septa behind segments 8 to 14 slightly thickened.

Text-fig. 42.



Text-fig. 41.

Text-fig. 41. *Maoridrilus maviensis*.—A spermatheca (× 12: camera outline): no structural difference could be detected between the two lobes of the sac, to enable a distinction of diverticulum and ampulla to be made.

Text-fig. 42. *Maoridrilus maviensis*.—A penial chæta (× 30. Laty oc. 1, obj. 2, camera).

\* I have suggested, in an article on *M. uliginosus* (Tr. N.Z. I. 1900, p. 125), this name for papillæ carrying the male or prostate pores.

Dorsal vessel double; last heart in 13th segment.

Gizzard large; œsophagus with 3 pairs of glands, quite distinct and typically developed, situated in segments 13, 14, 15, the last more dorsally placed and smaller than the preceding.

Sperm-sacs of fair size, in segments 11, 12; botryoidal.

Prostates\* normal. Penial chætæ delicate, much curved in an exaggerated S-shape, with the tip spoon-shaped, though pointed and curved in side view.

The *spermathecae* are of peculiar form (text-fig. 41, p. 223). Each consists of a bilobed sac; the two lobes are of about the same size and irregularly ovoid, and joined by a short, narrow isthmus, whence the muscular duct originates. One might imagine that one lobe is a "diverticulum" in the usual sense, but examination of stained specimens shows no structural difference between them;

Text-fig. 43.



*Maoridrilus mauriensis*.—Tip of penial chaeta, side view ( $\times 350$ . Oc. 1, obj. 7, camera).

Text-fig. 44.



*Maoridrilus mauriensis*.—Tip of penial chaeta; view of plane at right angles to the above (? perhaps the extreme tip is injured).

the epithelium is folded, irregular, and apparently glandular, as a quantity of stained material is present in the lumen; I could see no spermatozoa. As a rule, there is a marked difference in structure between sac and diverticulum. Unfortunately the specimen is not sufficiently well preserved to enable me to decide this question.

At any rate the form of the spermatheca and the arrangement of the œsophageal glands mark the species from any of those hitherto described.

This is the first species of *Maoridrilus* described from the North Island, and is the only specimen amongst the material I have received from various correspondents collected in several widely scattered districts.

\* No doubt Beddard's term "spermiducal gland" is in some respects better, but it is a clumsy term, and when "duct" is added it is by no means euphonious.

*OCTOCHÆTUS MICHAELSENI*, sp. n. (Text-fig. 45.)

A single individual of this worm was collected by Capt. F. W. Hutton at Wellington. It was broken into four or five pieces when I received it; in general appearance it agrees with other species of the genus

*Dimensions.* About  $210 \times 8$  mm.; the number of segments was not counted, as the worm was too greatly contracted and broken to make the attempt profitable.

The *clitellum*, though not fully developed, appears to cover segments 15 to 19.

The porophores are in line of *b*, as also are the spermathecal pores, and their position on the body is lateral rather than ventral, though of course on the under side.

The *chaete* have the usual spaced arrangement, and, in spite of examination of the skin, I was unable to detect them in front of the tenth segment.

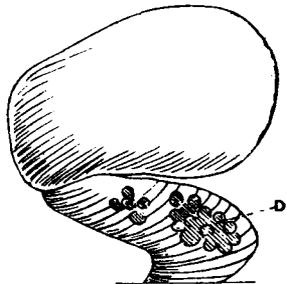
The arrangement is as follows: *d* is a little above the lateral line, so that  $d-d$  is about  $\frac{1}{3}$  of the circumference,  $aa = cd = 1\frac{1}{2} ab$ ;  $ab = bc$ . The gap *aa* is wider in the clitellar and preclitellar segments than posteriorly.

*Internal Anatomy*

There are seven very stout septa, the last being behind the 12th segment.

The dorsal vessel is double as far forward as segment 8, and the last heart is in the 13th segment.

Text-fig. 45.



*Octochætus michaelсени*.—Spermatheca ( $\times 12$ ): the diverticulum is represented by several small sacculi (D) embedded in the thickness of the muscular duct.

The long gizzard is in the 6th segment, with the thin septum five-sixths attached near its anterior margin.

The oesophagus bears a single pair of glands in the 15th segment and is well marked and hemispherical, though a good deal compressed antero-posteriorly owing to the contractions of the body.

The intestine commences in the 16th segment.

With regard to the *reproductive system*, the testes and ovaries are on the posterior wall of their segments, as in *O. thomasi* and other species. The penial chætæ are small and do not appear internally, but on each of the prostate pores, when examined under a lens, the broken bases of two dark chætæ are visible.

The spermathecæ are unsymmetrically developed; on the right side the normal two pairs are present in segments 8 and 9, but on the left side the anterior sac is absent. Each spermatheca is a simple ovoid sac (text-fig. 45, p. 225), with a short, thick duct which forms an acute angle with the sac (probably owing to the contraction of the body). There is apparently no diverticulum, but in the stained and clarified organ there are seen to be a number of small saccules, irregularly arranged and embedded in the wall of the duct; they do not form any projection, but are situated in the widest part of the duct, where it is bending to reach the body-wall; and though I have not yet sectionised the organ, it appears as if their presence here caused the duct to be of greater diameter at this spot.

*Remarks.*—The form of the spermatheca and the arrangement of the œsophageal glands suffice to distinguish this species from any hitherto described.

#### DINODRILOIDES, gen. nov.

Chætæ 12 per segment. Clitellum girdle-like, on segments 14–16 (= 3 segments). Prostate pores, one pair, on the 17th, and male pore on 18th segment. A single spermatheca, opening at 8/9. Meganephric: pores in line not alternating. Gizzard in segment 6. 2 pairs of testes, segments 10, 11. 2 pairs sperm-sacs, in segments 11, 12. Prostates: a single pair much coiled, cylindrical.

#### DINODRILOIDES BEDDARDI, sp. n. (Text-figs. 46, 47.)

A single specimen of this interesting worm was collected by Mr. H. Suter at Auckland.

The *colour* (in the specimen preserved in alcohol) is a very distinctive bluish grey, equally dark in tint along the entire length, and the pigment extends down the sides to the ventral surface, which, however, is paler and becomes yellowish in the hinder region. The clitellum is yellow-brown.

The worm consists of 95 segments, and measures 78 mm. × 4 mm.

The *chætæ* are arranged as in *Dinodrilus*\*—that is to say, there are 12 in each segment; in 3 couples on each side, the individuals of which are widely separated, so that the 6 are practically equidistant, while the dorsal and ventral gaps are only slightly greater than the other gaps. The middle couple (*c-d*) are lateral in position.

\* Prof. Spencer has recently described an Australian Cryptodriline genus, *Trichæta*, with six couples of chætæ (*vide* Proc. Roy. Soc. 1900, p. 30).

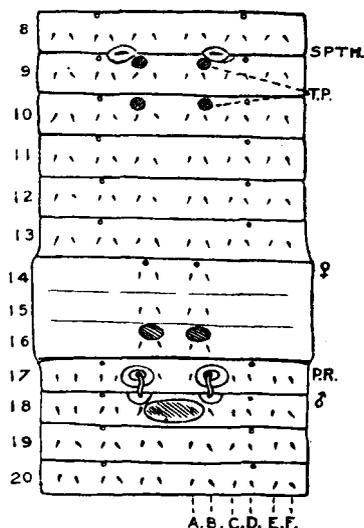
Each chaeta is carried on a slight papilla (in the preserved specimen), which is very pale and, indeed, nearly white.

The *prostomium* is only slightly, if at all, embedded, but as the buccal region is everted, producing wrinkles on the peristomium, it is impossible to detect the actual limits of the prostomium.

The *clitellum* is fully developed and very well-defined, both in front and behind; it completely surrounds segments 14, 15, 16.

*Genital pores, &c.* (text-fig. 46).—The most remarkable thing about the worm, in which it contrasts with *Dinodrilus*, is the presence of only one pair of “porophores” bearing the pores of the spermiducal glands, which are situated on the 17th segment

Text-fig. 46.



*Dinodriloides beddarli*.—View of part of the fore-body, slit open along the dorsal mid-line, flattened out, and seen from below. ( $\times$  about 3.)

The six chaetae are seen, lettered A-F [*a-f* in the text] on the right side, at their true relative distances. The genital pores, nephritic pores, and tubercula pubertatis (T. P.) are also shown.

in line of *b*. The papilla is oval, and extends outwards nearly to the level of *c*; it is traversed by a spermatic groove, which passes backwards on the next segment, on the anterior margin of which is a depressed, semicircular prominence, in the same line as the porophore. The spermatic groove ceases some distance in front of the chaeta *b*, so that the male pore is close to the anterior margin of segment 18.

The ventral surface of segments 16, 17, 18 is pale yellow, and thus contrasts with the grey tint of the neighbouring segments. On the 18th segment there seems to be an oval glandular area

extending from *b-b*, and in the prechætal portion of the 16th segment a pair of similar glands, which perhaps represent tubercula pubertatis, but they are not well-defined.

The two oviducal pores are visible in the usual segment, in front of the chætal space *a/b*.

The species possesses a single pair of spermathecæ which open between segments 8/9; each pore has a very prominent pale yellowish lip in front and behind, in line *bc*: further, on each of the segments 9 and 10 is a round, pitted tubercle in front of chæta *b* on each side.

The *nephridiopores* are in line *d*.

*Dorsal pores* are very evident, and commence behind segment 6, continuing to the last segments of the body.

#### *Internal Anatomy.*

There are no noticeably stout septa.

The dorsal vessel is double right up to the pharynx (as it is in *Dinodrilus*); the last of the four pairs of hearts is in segment 13, and of considerable size.

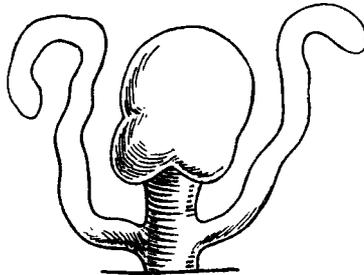
The gizzard is very feebly developed in segment 6; the cesophagus is dilated in segments 14, 15, 16, but no definite gland is formed.

The intestine commences in segment 18.

The worm contrasts with *Dinodrilus* in being meganephric; and in the mid-body, at any rate, the large muscular duct is easily traced, under a dissecting-lens, to the body-wall, which it penetrates in line of chæta *d* to open to the exterior.

*The Reproductive system.*—There are two pairs of testes and

Text-fig. 47.



*Dinodriloides beddardi*.—Spermatheca, enlarged.

funnels in the usual segments. The two pairs of sperm-sacs are in segments 11, 12; of small size, and botryoidal (or racemose) in form. There is but a single pair of spermiducal glands, which are thoroughly Acanthodriline in form, each being cylindrical and compactly convoluted to form a mass of considerable size, provided with a short narrow muscular duct.

There are no penial chætæ.

The ovaries are large and occupy the usual segment.

There is a single pair of *spermatheca* in segment 9; each is a subglobular sac (text-fig. 47) with a muscular duct, narrower than the sac, which does not graduate into it but suddenly diminishes in diameter. Two long tubular diverticula open, one on each side, into the duct close to the body-wall. Each diverticulum, when extended, is about twice the length of the sac.

*Remarks.*—This genus, as I have remarked above, bears the same sort of relation in regard to the prostates to *Dinodrilus* as *Neodrilus* does to *Maoridrilus*; but in *Neodrilus*, which Michaelson has termed a "microscoleicine form," the number of testes has also been reduced. Here, however, the reduction does not occur. Moreover, *Dinodrilus* is micronephric instead of meganephric.

We have in New Zealand a series of genera that illustrate the evolution of Earthworms in a very remarkable manner.

Starting with *Notiodrilus*, which on general grounds is considered by Michaelson as an ancient genus (and herein I agree with him), we have a meganephric worm with 8 coupled chætæ, 2 pairs of prostates opening on segments 17 and 19, while the sperm-ducts open independently on the intervening segment. From this genus several lines of evolution start:—

- (a) *Maoridrilus*—which differs only in having alternately arranged nephridia, opening, that is to say, alternately in relation to the dorsal and ventral couples of chætæ.
- (b) *Neodrilus*—in which the second pair of prostates, second pair of tubes, and spermatheca have disappeared, but male pore still in the middle of segment 18.
- (c) *Dinodriloides*—in which the number of chætæ is increased to 12 and widely separated, and in which the male pore is close to the anterior margin of the 18th segment.
- (d) *Rhododrilus*—which still retains 8 clusters, but in which the male pore has moved forwards to the 17th segment and opens close to the prostate pore.

Starting again from *Notiodrilus*, we have *Plagiochæta*, which differs from it chiefly in having a considerable number of chætæ; and we readily see how this condition may have come about through a *Dinodrilus*-like form with 12 chætæ. But in this genus *Plagiochæta*, some, like *P. sylvestris*, have meganephridia, others, like *P. rossi*, have micronephridia\*.

Once more reverting to our archaic genus, and imagining the development of micronephridia, we reach *Octochætus*, in which the

\* See Benham ('02, a). The statement on pp. 287, 289, however, that *P. ricardi* and *P. montana* are similarly micronephric is erroneous. The nephridium is very small in proportion to the size of the worms, and the tubuli of the meganephridium are in tufts, which, under an ordinary dissecting-lens, suggests a series of isolated micronephridia; but in *P. rossi* (laps. cal. *rossii*) the meganephridium has broken up into micronephridia. I am preparing an article on the nephridia of this and other genera of New Zealand Earthworms, and for the present refrain from further detail.

number of chætæ remain normal, though they are differently arranged.

Then there is *Dinodrillus*, with 12 chætæ and micronephridia. But both these genera have the prostate pores and male pores arranged as in the archaic form.

It seems to me that Michaelsen is in error in separating these two genera from other Acanthodriline forms and associating them in a separate subfamily, the Octochætinae, with *Eutyphœus* and *Hoplochetella*; for, apart from the micronephric condition, there is really little to distinguish *Octochætus* from *Notiodrilus*; moreover their presence in New Zealand indicates their close association therewith. The step from the Acanthodriline series to the Megascolecine is a small one, and appears easily conceivable from analogy with the origin of *Rhododrillus*: that is, one prostate pore has shifted so as to open close to and in common with the male duct in the 18th segment, for several species of Cryptodriline worms have prostates similar to those of *Rhododrillus*.

*RHODODRILUS EDULIS*, sp. n. (Text-figs. 48-54.)

Two individuals of "Tarao," a worm eaten by the Maoris, were received from Mr. Best preserved in formol.

*Dimensions.* Length 275 and 285 mm. respectively, with a diameter of .13 mm. just behind the clitellum. The worm is cylindrical, tapering only very slightly posteriorly, and then suddenly decreasing as the anus is approached, so that at segment  $n-8$  the diameter is 10 mm., and at  $n-2$  it is still 8 mm. The total number of segments in the larger individual is about 300, but as the hindmost segments are very closely contracted and small, and triannulate, it is not easy to count them with absolute correctness—nor does this matter. There is no doubt that the living worm was, when extended, at least 15 inches and possibly more. Mr. Best in a letter says: "These Tarao are small, I have seen them 18 inches in length."

The segments 2-5 are biannulate, 6-12 are quadriannulate, with the chætæ in the third annulus, while those of the clitellar and postclitellar regions are triannulate.

The colour of the "Tarao" is (in formol, which does not cause the colour to change much) red; the anterior end appears pale greyish, much paler than the rest of the body, which is pale reddish, with a tinge of purple on the upper half of the body; the clitellum is buff.

The *prostomium*, like the first segment, is a good deal furrowed; it is epilobic, being dovetailed into the peristomium for about half the length of the latter, and it ends in a transverse groove.

The *chætæ* are eight in number, rather widely spaced; the lateral spaces (*bc*) on each side are nearly equal in the mid-body and posterior region, while the dorsal space (*dd*) is about twice the ventral (*aa*) and three times the lateral.

As is frequently the case in allied genera, the ventral couple (*a*, *b*) approach one another in the region of the genital pores;

so that, on segment 21,  $ab$  is only  $\frac{1}{2} ab$  in the mid-body segments, and in the subclitellar segments (*e. g.* 16th) it is even less. At the same time the ventral gap ( $aa$ ) enlarges, so that  $b$  keeps in its line, while  $a$  moves outwards. In the preclitellar region this increased gap remains, and the lateral and dorsal gaps are also larger, but the gaps  $ab$  and  $cd$  remain the same size as in the mid-body; in other words, the rather increased diameter of the preclitellar region affects the interchaetal zone, and not the chaetal spaces themselves.

I measured the spaces on the body by means of dividers, with the following results:—

	Mid-body.	Tail.	Segment xxi.	Seg. xviii.	Seg. xvi.	Seg. ix.
$aa$ ...	5	4	5.25	6	5.25	5.5
$ab$ ...	3	2.5	1.5	0.75	1	2.5
$bb$ ...	4	3.5	...	...	6.5	5
$cd$ ...	2.5	2.5	...	...	2.5	2.5
$dd$ ...	11	9	...	...	...	12

Put in the usual formula for the mid-body, starting with the smallest gap,

$$cd < ab < bc < aa : aa = 2 cd : dd = 2 aa = 3 bc.$$

On segment 17 the ventral chaetae are replaced by two long, delicate penial chaetae.

The *clitellum* is saddle-shaped, and though the annuli and intersegmental furrows are quite evident ventrally, there is no distinct latero-ventral margin such as exists in *Lumbricus* &c. The glandular tissue extends down to the line of chaeta  $b$ . The clitellum extends over the six segments 13–18.

*Genital pores, &c.*—The male pore is on segment 17, situated on a low, rounded, and slightly prominent porophore in line with the chaetal gap  $ab$ . The pore itself is nearly in line with  $b$ , and the penial chaetae project therefrom.

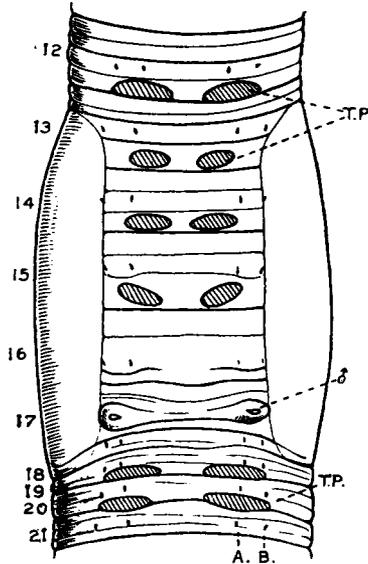
*Tubercula pubertatis* are well-developed, in the form of a series of transversely disposed, paired oval pads (text-fig. 48, p. 232) situated on the hinder regions of the segments 12, 13, 14, 15, and 19, 20. These pads are developed from the last annulus of the segment in each case, but the last two pairs appear to be intersegmental, owing partly to the contraction of the worm, and partly, perhaps, to their size. These tubercles have not all the same position relative to the chaetae: those of the 12th, 19th, and 20th segments extend from the level of  $b$  inwards nearly to the middle line, while the other three pairs, on segments 13, 14, 15, extend from chaeta  $a$  and almost touch in the middle line.

There is a single pair of *spermathecal pores* on the intersegmental groove 7/8, in line with  $b$ . As a matter of fact, each pore is double: *i. e.*, the main sac and its diverticulum open independently one above the other, but close together, in the furrow.

I was unable to detect either dorsal pores or nephridiopores by

examination of the surface, owing to the strongly contracted state of the worm: the nephridiopores, however, are in line *c*.

Text-fig. 48.



*Rhododrilus edulis*.—Ventral view ( $\times$  about 3) of clitellar region, showing male pores ( $\delta$ ) and arrangement of tubercula pubertatis (T.P.); A B [*a b* in the text], the chætal rows. Segment 16 is unfortunately drawn a little too large.

#### Internal Anatomy.

The body-wall is of great thickness and the septa behind segments 7 to 12 are very stout.

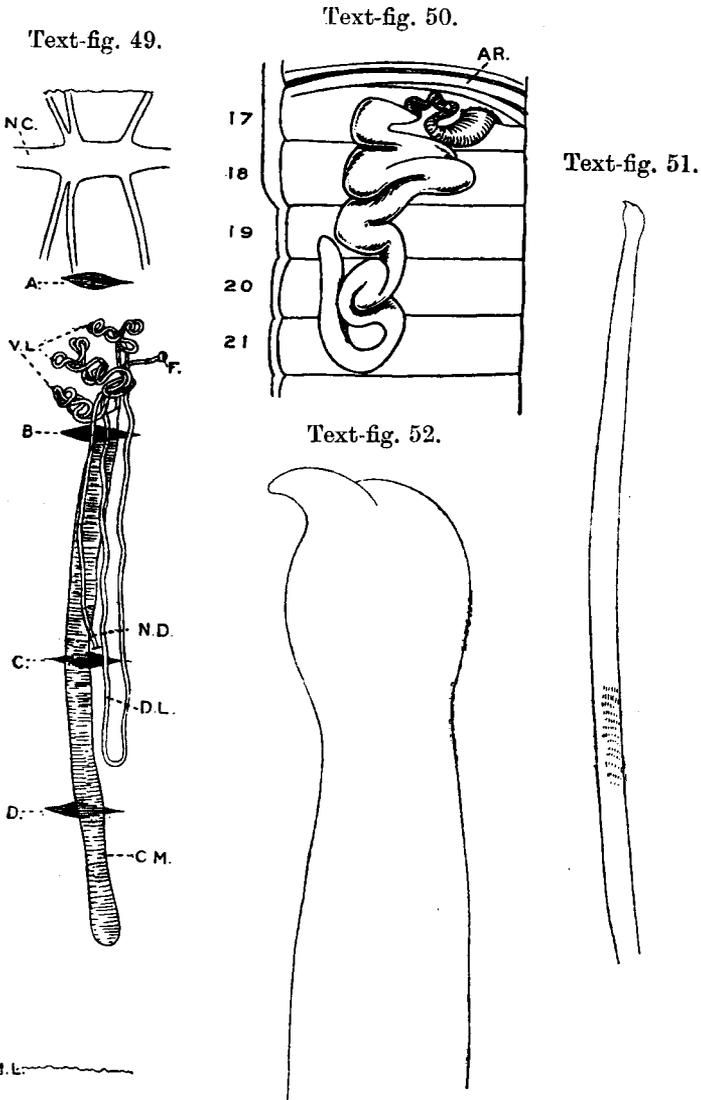
The dorsal vessel is single; the last heart in segment 13, and rather smaller ones in 10, 11, and 12.

The gizzard, in segment 5, is large, with thick walls, and contains stones. There is no œsophageal gland, nor any dilatation. The intestine commences in the 17th segment, where the gut suddenly enlarges to twice its previous diameter.

The worm is meganephric, and the nephridia commence as far forwards as segment 3. Each nephridium (text-fig. 49) consists of a bunch of 3–5 loops ventrally (situated in line *a–b*), whence a long dorsal loop passes upwards to a point about midway between *c d*, and a straight duct leaves the same bunch, and passes to the body-wall just below *c*, at which point no doubt it opens externally.

There is, in addition, a blind cæcum or bladder with muscular wall, which extends almost to the mid-dorsal line: the exact connections of it I have not determined.

The nephridiostome is small.



Text-fig. 49. *Rhododrilus edulis*.—A nephridium, shown in its natural relation to the wall of the body, as seen when spread out in the normal way. A, B, C, D [*a, b, c, d* in the text], the position of the four chaetae of this side; F, nephrostome; V.L., ventral loops or coils of tubules; D.L., long dorsal loop extending nearly to chaeta D; C.M., muscular caecum; N.C., nerve-cord; M.L., dorsal mid-line; N.D., nephridial duct.

Text-fig. 50. *Rhododrilus edulis*.—The prostate of the left side (enlarged). It occupies five segments and is provided with a muscular duct, which thickens as it penetrates the body-wall just below and behind the arcuate muscles (AR.). The penial chaetal sac has been removed.

Text-fig. 51. *Rhododrilus edulis*.—A penial chaeta ( $\times 80$ . Zeiss oc. 3, obj. 3, camera.

Text-fig. 52. *Rhododrilus edulis*.—The tip of a penial chaeta ( $\times 480$ ).

*Reproductive system.*—There are two pairs of large, botryoidal sperm-sacs in segments 11 and 12, attached, of course, to the anterior wall of these segments.

The prostate (text-fig. 50, p. 233) is tongue-shaped, long, more or less convoluted, with apex recurved; it extends through segments 17 to 21; its muscular duct is confined to segment 17; it is rather long, but very narrow where it leaves the gland, dilating to form a thicker, pear-shaped bulb as it penetrates the body-wall.

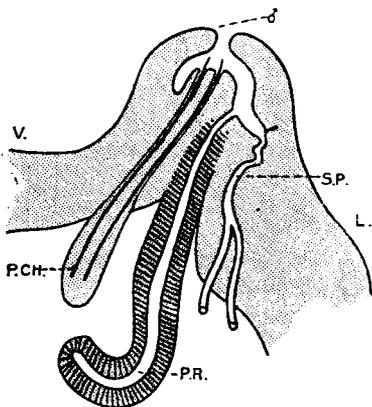
Arcuate muscles are developed in segment 17.

Associated with each prostate are two sacs containing each two penial chætæ, a long functional and a shorter reserve bristle.

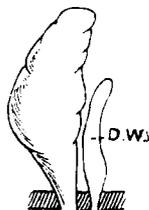
Each penial chætæ (text-figs. 51, 52, p. 233) is stout, nearly straight, and, compared with the size of the worm, not very long: it terminates in a rounded knob, which carries at its end a short, stout, curved, blunt hook. There are no markings at this end; but about midway along its length there is a series of rather closely-set, irregularly arranged, short, oblique, and finely serrated ridges.

The relations of the various parts of the male ducts, as studied

Text-fig. 53.



Text-fig. 54.



Text-fig. 53. *Rhododrilus edulis*.—Diagrammatic sketch of a section through the porophore, showing the openings of the sperm-duct (S.P.), prostate duct (P.R.), and the penial chætæ (P.CH.) into a small antrum or chamber, which communicates with the exterior at the apex of the papilla (♂). The sketch is compiled from a series of sections, and the above pores are not, in reality, in one plane—the prostate pore being most anterior, and the sperm-pore most posterior of the three. V. is the ventral side. L. is laterally placed.

Text-fig. 54. *Rhododrilus edulis*.—Spermatheca ( $\times 4$ ). The main sac, or ampulla, opens externally, independently of the diverticulum (D. W.).

in sections, is as follows (text-fig. 53):—at the apex of the porophore is a small pore, which leads into a shallow, but laterally extended chamber, the floor of which rises up as a papilla. At

the apex of this "penial papilla," as it may be termed, are two independent apertures, belonging to the two sacs of penial chætæ. At the base of this penial papilla, and on the outer side, there opens the muscular duct of the prostate, while the vasa deferentia (which have united) open into a posteriorly placed recess of the above-named chamber. This chamber is very shallow, and we practically have *four* pores on the porophore; and probably in a less contracted condition these four pores would open into a shallow pit, the margin of which has, in our specimen, closed over the pit so as to leave only a single small aperture.

The *spermatheca* (text-fig. 54) lies in segment 8, on each side; it is a large and long sac, broadest in the middle, without a definite duct, but narrowing as it approaches the body-wall. The diverticulum is narrow and tubular, more than half the length of the sac and about one-fourth of its diameter; it opens independently of the sac itself.

As a matter of detail, the length of the main sac is 8 mm., its breadth is 2.5 mm.

*Loc.* Ruatahuua, Urewera Country, North Island of New Zealand.

#### RHODODRILUS BESTI, sp. n. (Text-figs. 55-61.)

A very pale, and probably white, worm, with yellow clitellum; its general appearance is that of an *Octochaetus*. A much smaller worm than the preceding, and known to the Maoris as "Tokerangi."

*Dimensions.* Length 125 mm., diameter 5 mm. just behind the clitellum; with 206 segments, which, with the exception of the first four, are triannulate.

The *chætæ* are spaced, and as measured on the body,  $ab=cd$ ;  $bc=aa=1\frac{1}{2} ab$ ;  $dd=2\frac{1}{2} bc$ =about 4  $ab$ . That is, the interchætal spaces on each side are equal and less than the lateral space; the ventral space is less than half the dorsal space. Relatively  $aa$  is greater than in the preceding species.

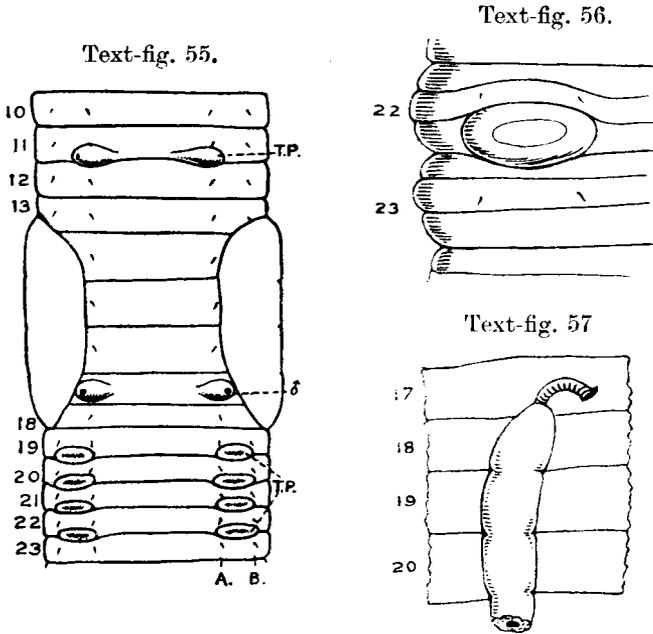
*Clitellum* saddle-shaped; on segments  $\frac{1}{2} 13-18$  (=  $5\frac{1}{2}$  segments). The glandular tissue extends downwards as far as line of chæta  $a$ .

*Genital pores, &c.*—A pair of porophores in segment 17, in line of  $a$ : on each, two pores are readily visible under a lens, and the penial chætæ project from the outer one. There are four pairs of postgenital *tubercula pubertatis*, on the posterior annulus of segments 19, 20, 21, 22, in line with the gap  $ab$ , the ventral margin extending below  $a$ ; so that they are separated by a much greater space than in *R. edulis*. Each *tuberculum pubertatis* is oval, and slightly depressed in its central part, so as to appear sucker-like (text-fig. 56, p. 236).

In addition to these four pairs, there is on the hinder margin of segment 11 a pair of rounder swellings—not pitted apparently—in line with the porophores, and not extending so far outwards

as the postgenital tubercle; further, the pair are connected across the middle line by a transverse ridge.

A single pair of spermathecal pores at the groove 8/9.



Text-fig. 55. *Rhododrilus besti*.—Ventral view of the clitellar segments, &c. ( $\times$  about 5), showing porophores and arrangement of the tubercula pubertatis (T.P.).

Text-fig. 56. *Rhododrilus besti*.—An enlarged view of one of the tubercula pubertatis, showing the glandular depression centrally, and also the fact that it is on the hinder annulus of its segment, though apparently intersegmental.

Text-fig. 57. *Rhododrilus besti*.—Portion of prostate, showing shortness of duct, as compared with that of *R. edulis*.

#### Internal Anatomy.

There are stout septa behind segments 7 to 12. The gizzard is large and occupies segments 5 and 6. The spermiducal glands are long, undulating, tongue-shaped, extending into the 24th segment. The prostrate duct is short, narrow, and only slightly curved (text-fig. 57).

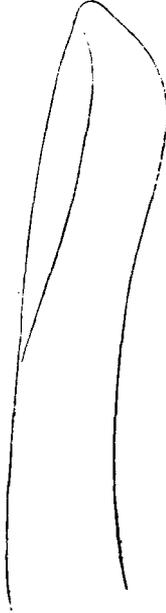
The sacs of penial chætæ extend from segments 17 to 21. Each penial chæta (text-figs. 58-60) is much slenderer than in the preceding species, and larger and of a different form; it is gently curved and the blunt point is bent in the opposite direction; here it is flattened and slightly excavated, so as to be spoon-

shaped when seen from above; in side view, however, the point is narrower.

Text-fig. 58.



Text-fig. 59.



Text-fig. 60.

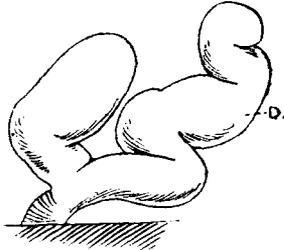


Text-fig. 58. *Rhododrilus besti*.—A penial chaeta ( $\times 80$ ).

Text-fig. 59. *Rhododrilus besti*.—Tip of penial chaeta ( $\times 480$ ). View of one plane, showing spoon-shaped excavation.

Text-fig. 60. *Rhododrilus besti*.—Tip of penial chaeta, side view ( $\times 480$ ), also showing spoon-shaped excavation.

Text-fig. 61.



*Rhododrilus besti*.—A spermatheca ( $\times 12$ ) (camera outline), showing remarkable coiled diverticulum (D).

The single pair of spermathecae (text-fig. 61) lie in segment 9;

each sac is more or less ovoid, somewhat bent at the commencement of the duct (? perhaps artificially by contraction of the body).

The duct is short, but wide, and receives a very long, tubular diverticulum, which is spirally coiled at its lower end, where it enters the common duct close to the body-wall. The lower end of the diverticulum is muscular, though of the same diameter as the rest.

*Loc.* Ruatahuua, Urewera Country, North Island, N. Z. A single individual.

*Remarks.*—It will be seen that this species differs from *R. edulis* in details with regard to the arrangement of chætæ and copulatory tubercles, in form of penial chætæ and spermatheca, as well as in size, form, and colour of the worm itself.

#### *The Genus Rhododrilus.*

It is clear that in many features *R. edulis* and *R. besti* agree with *Microscolex*; nevertheless there are certain points of difference, which, in view of geographical distribution, may be of more importance than the resemblances.

For example, most noticeable, but perhaps of no great systematic importance, is the great size of these two species, and especially of *R. edulis* (285 mm.), as compared with the small worms included in the genus *Microscolex*, ranging as they do from a length of 30 mm. to that of 58 mm.

But the point upon which I would lay stress is as to the form and extent of the prostate.

In all the species of *Microscolex* this gland is of comparatively small size, and limited to segment 17, or extends, in *M. hempeli* and *M. novæ-zealandiæ*, into the next segment; whereas in the two species just described these glands are of very considerable extent, passing through 5 or even 8 segments.

It is also worth noting, in view of the fact that Beddard is inclined to lay some importance on the point in some genera, that in all the species of *Microscolex* the last heart is in segment 12, whereas in my two species it is in segment 13.

Michaelsen points out, too, that in the genus *Microscolex* the single pair of spermathecae open in the furrow 8/9: this is the case with one of my species, whereas the pore in the other is at 7/8.

The gizzard, too, in *Microscolex*, is "absent or rudimentary," which is not true of our edible worms; and, finally, the clitellum of the latter is not "complete" or "girdle-like," but saddle-shaped.

These small points of difference necessitate one of three courses: either we must amend the diagnosis of *Microscolex*, or we must create a new genus, or we may place our species in the closely allied genus *Rhododrilus*. The last plan, it will be seen, is the one I have followed, though even this procedure necessitates the

alteration in the definition of this genus. But this, it seems to me, is a better plan than to modify the diagnosis of *Microscolex*, for the latter is an American genus, though one species\* at least has been recorded from New Zealand; whereas the only species of *Rhododrilus* hitherto described are from this region.

The genus, originally founded by Beddard ('89) for *R. minutus*, has suffered from its resemblance to *Microscolex*. Originally distinguished from it by its author, as having the prostate pore separate from the male pore, it was, later, included in that genus, on the discovery that the same arrangement is true of certain species of the older genus. Michaelsen ('00), however, retains it as distinct, owing to the fact that *Rh. minutus* has four pairs of spermathecae.

In 1900 I described a worm from the Chatham Islands as "*Microscolex huttoni*," with two pairs of spermathecae, following Beddard in disallowing *Rhododrilus*. But since the publication of that article I have studied a species from Campbell Island and the Lord Auckland Group, in which there are three pairs of spermathecae.

Now all these worms agree with the two species described in the present article in having an elongated prostate, extending through several segments, and in most of them the gizzard is well developed; the clitellum saddle-shaped. But the position of the last heart is not constant.

The size of the worms, too, exceeds that of the species of *Microscolex*.

I therefore agree with Michaelsen to resuscitate Beddard's genus *Rhododrilus* to include our New Zealand worms, but regard the form and extent of the prostate as the chief character, and one that readily distinguishes it from *Microscolex*.

The characters of the genus as thus modified may be defined as follows:—

Chaetae 8 per segment, more or less widely spaced. Nephridiopores not alternating; male pores on 17; prostatic pores one pair, in 17, opening close to the male pore. Clitellum saddle-shaped, occupying 4 to 6 segments, 13 (14)—(17) 18. A gizzard in 5. Testes two pairs. *Prostates tongue-shaped, elongated, more or less undulatory, extending through 4 to 8 segments*. Penial chaetae present.

*Distribution.* New Zealand and neighbouring islands.

1. *Rh. minutus*, Beddard, 1889. South Island.
2. *Rh. huttoni*, Benham, 1900. Chatham Island.
3. *Rh. edulis*, Benham, sp. n. North Island.
4. *Rh. besti*, Benham, sp. n. North Island.

I have specimens of other species in my possession of which a description has not yet been published.

\* Of a second species, *M. monticola*, our information is not altogether sufficient to permit us to make use of its characters in this discussion.

## TOKEA \*, gen. nov.

*Characters of the genus.*—Chætæ 8, spaced, and more or less equidistant; clitellum girdle-like (13) 14—17 (18), *i. e.* covers 4 or 5 segments.

Male pore common with that of prostate, in 18th segment. Two pairs of testes in usual segments; two pairs of sperm-sacs in segments 9, 12; the prostates are long, tongue-shaped, lie below the gut, close to one another, and extend through several segments. No penial chætæ.

The gizzard in 5; no calcareous glands; last heart in 12 or 13. Micronephric, with meganephore in last few segments. Spermathecae two or three pairs, the last in segment 9.

*Distribution.* North Island, New Zealand.

## 1. TOKEA ESCULENTA, sp. n. (Text-figs. 62–67.)

This is one of the edible earthworms alluded to in Mr. Best's article as "Kurekure"—as being a specially tasty article of food. As a matter of fact, under this name I find two species recognisable, viz., this and the following.

Mr. Best states that it is "a short red or brown worm about 6 inches in length; found in stony places."

Of this species I received four individuals.

The colour (in formol) is a rather dark purplish-red, paler below; but the pigment extends further round the body than usual; the anterior end is not perceptibly darker; the clitellum is brown.

*Dimensions.* The largest is 115 mm. in length; the one studied is 100 mm.  $\times$  6 mm., with 110 segments.

The body is cylindrical.

*Prostomium* is epilobic,  $1/2$ ; the posterior groove is but feebly developed, but visible when the buccal region is everted.

*Chætæ*: the 4 on each side are nearly equidistant, and when viewed from above both *c* and *d* are visible; *i. e.* *d* is dorsally placed and *c* is on the lateral line.

In the mid-body  $aa = bc = cd > ab$ ;  $dd =$  nearly  $2aa$ .

In the preclitellar region the gap *aa* becomes greater and *ab* rather smaller.

*Clitellum*: this is complete (*i. e.* girdle-shaped) and well developed over the four segments 14–17, where the intersegmental furrows are obliterated. The dorsal surfaces of 13 and 18 are also glandular, but the clitellar colouring is not so definite, and, moreover, the grooves 13/14 and 17/18 are deep.

*Genital pores, &c.* (text-fig. 62).—There is a pair of male pores in the 18th segment; each is a small pit, in a small, oval, pale spot, and from this small pit a little papilla projects up to the level of the body-wall (text-fig. 63).

This oval poriferous area is in line with *a*.

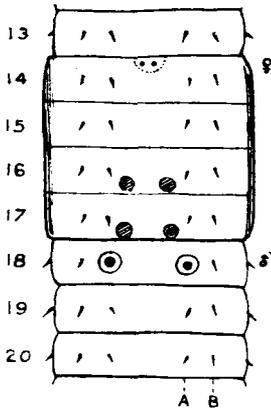
*Tubercula pubertatis*, in the form of small paired glands, are

\* "Toke" is the Maori for Earthworm.

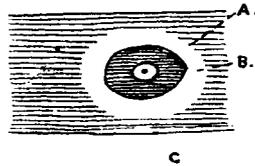
present on the hinder margin of segments 16 and 17, [mediad of the line *a*.

The two oviducal pores are close to the median line, near the anterior margin of the 14th segment.

Text-fig. 62.



Text-fig. 63.



Text-fig. 62. *Tokea esculenta*.—Ventral view of clitellar region, &c. ( $\times 4$ ), showing male pores and arrangement of tubercula pubertatis and disposition of chaetae. This and the views in text-figs. 68, 70, 73, 76, 78, and 80 are somewhat diagrammatic in that they are represented as flat projections, but the relative spacing of the chaetae, &c., is correct.

Text-fig. 63. *Tokea esculenta*.—Enlarged view of the male pore, the actual aperture is situated on a small papilla (C) which projects from the bottom of a pit (B), the skin round which is paler (A) than the surroundings. The chaeta *b* is shown on the left side.

There are three pairs of spermathecal pores on the hinder region of segments 6, 7, and 8; these are not intersegmental, but are situated about midway between chaeta *a* and the margin, in each case.

I could not detect dorsal pores.

#### *Internal Anatomy.*

There are 8 stout septa, behind segments 7 to 14; but, in comparison with the thickness of the body-wall, their thickness is not so great as one would expect.

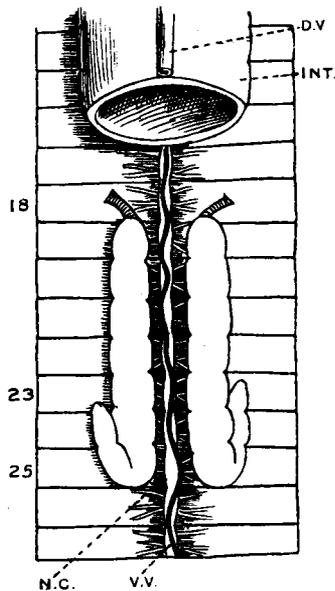
The dorsal vessel is single; the last of the four pairs of hearts is in segment 13. In the heart-segments there is a supra-enteric vessel, with which the hearts are in part connected.

The worm is micronephric\*, and these organs commence in segment 3. In the last 20 segments of the body there is, in addition to micronephridia, a pair of compact groups of tubules

\* I think this term, which was first employed by Vejdovsky, is preferable to my term "plectonephric," for it is by no means certain that a "network" of tubules always (if ever) exists.

constituting a meganephridium. In these the nepridial funnel is present and can be traced into communication with the nephridium, which opens to the exterior, probably in line with *a*, as it is in another species which was more carefully studied in this respect. I did not trace it in the present species. Not only is there this meganephric nephridiostome in these hinder segments, but a similar funnel is present throughout the worm. In the micronephric segments it is unconnected with the nephridium and has no external opening.

Text-fig. 64.



*Tokea esculenta*.—A somewhat diagrammatic drawing of a dissection of the worm, showing the tongue-shaped form and sub-enteric position of the prostates characteristic of the genus; the intestine is cut away exposing the glands; the ventral vessel and nerve-cord remaining *in situ*. INT., intestine; D.V., dorsal blood-vessel; V.V., ventral blood-vessel; N.C., nerve-cord.

The presence of a funnel, independent of the micronephridia, throughout the worm is of very considerable interest. Such an arrangement has not hitherto been recorded. The funnel is of the same size and structure as that of the meganephridia, and both in its large size and peculiar form differs from any funnel hitherto figured. In each of the species of *Tokea* the same general arrangement occurs, though the details as to character and arrangement and extent of the micronephridial tufts differ in each case. I am preparing a detailed account of the excretory

apparatus of these worms, so that I will not further describe it here.

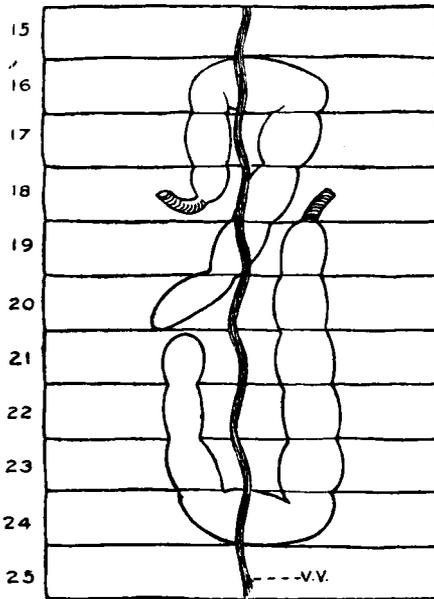
*Alimentary system.*—The gizzard is small, rounded, and hidden by the extrinsic muscles of the pharynx; it lies in segment 5.

There are no definite œsophageal glands, but in segment 15 the tube is dilated, and its dark vascular wall contrasts with the paler wall of the neighbouring region, and here its lining is thrown into a series of horizontal lamellæ.

The intestine commences in segment 16; there is no typhlosole.

*Reproductive system.*—The testes and funnels are free and, like the ovaries, lie in the usual segments. The two pairs of sperm-sacs lie in segments 9 and 12: their wall is smooth. Further, on the anterior wall of segment 13 is a minute curved sac, close to the gut, whose curvature it follows; it is of about the same size as a similar sac in the 14th segment, which I take to be the ovisac.

Text-fig. 65.

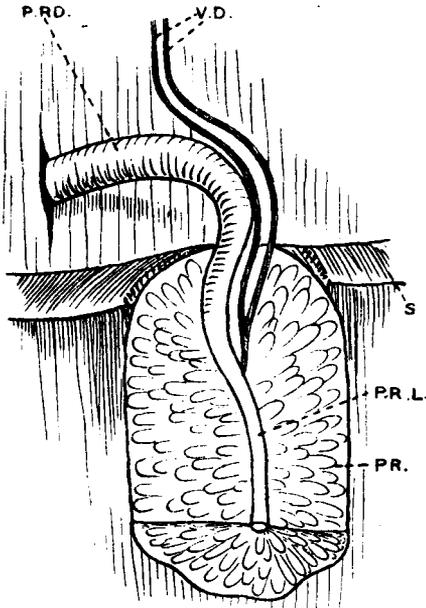


*Tokeo esculenta.*—An asymmetrical arrangement of the prostates, such as occasionally occurs in some species of the genus; V.V., ventral blood-vessel.

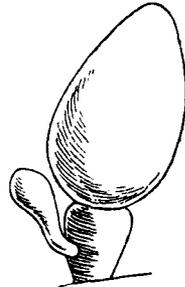
Spencer has noted in some of the Cryptodrilids studied by him such an extra sac in the 13th segment, which he regards as a sperm-sac. I could not discover any developing sperms by teasing this sac on the slide, and I have not yet studied it in sections. I have met with similar structures in some other species.

The prostates have a form and disposition on the body which appear to be peculiar and characteristic of the genus. Each prostate is a long "tongue-shaped" gland (text-fig. 64, p. 242), *i. e.*, though it is tubular in that its axis is hollow, it is not cylindrical but somewhat flattened, extending through several segments, and its apex is usually recurved. The pair of glands, typically, lie side by side, pressed against the body-wall below the gut, and indeed below the ventral blood-vessel; but in individual cases the right and left glands are asymmetrically disposed. For instance, in one case (text-fig. 65, p. 243), the right gland passes backwards from its duct to the 24th segment, and then bends forwards from the left side, and its apex lies in the 21st segment; whereas the left gland passes forwards into the 16th segment, then curves round to the right side, passes at first backwards, and then obliquely to the left side, so that its apex lies in segment 20.

Text-fig. 66.



Text-fig. 67.



Text-fig. 66. *Tokeia esculenta*.—A diagram, compiled from serial sections, showing the course of the sperm-ducts, their union, and junction with the canal of the prostate, well within the region of the glandular tissue. PR., prostate; P.R.L., its lumen; P.R.D., its duct; S, septum; V.D., vas deferens.

Text-fig. 67. *Tokeia esculenta*.—Spermatheca ( $\times 12$ . Camera outline of mounted specimen).

The surface of the gland is smooth; it is constricted by the successive septa, and at its anterior end gives rise to a muscular duct which passes to the exterior in segment 18. Sections

through this region of the body show that the two sperm-ducts run back separately along the body-wall as far as the 18th segment, when, meeting the prostate duct, they pass on to its dorsal surface into the 19th segment, and after uniting with one another open into the canal of the prostate gland some distance from the commencement of the muscular duct (text-fig. 66).

The prostate is traversed by a canal lined with columnar cells; at intervals this canal receives small canalicules, around which the gland-cells are grouped and into which they open. The arrangement is similar to that described by Miss Sweet for *Plutellus intermedius* (*loc. cit.* fig. 17).

There are no penial chætæ.

There are three pairs of spermathecae in segments 7, 8, and 9: each (text-fig. 67) is an ovoid sac passing gradually into a short wide duct, which receives the diverticulum close to the body-wall. The diverticulum is a short ovoid body, with duct; it is about  $\frac{1}{3}$  the length of the main sac.

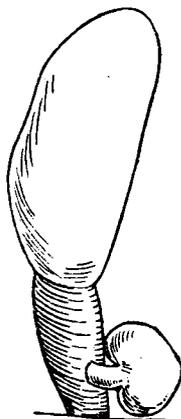
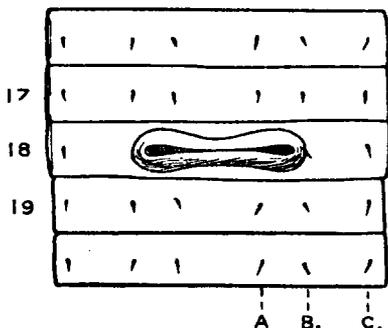
The diverticulum of this and the following species is placed mediad of the sac.

## 2. TOKEA SAPIDA, sp. n. (Text-figs. 68 & 69.)

This species is founded on a single specimen of about twice the size of the former species, but included with it as "Kurekure" by Mr. Best.

Text-fig. 69.

Text-fig. 68.



Text-fig. 68. *Tokea sapida*, similar view to that in text-fig. 62. ( $\times 6$ .)

Text-fig. 69. *Tokea sapida*.—Spermatheca ( $\times 12$ . Camera outline of mounted specimen).

In colour it is purple-red, with an imperfectly developed clitellum of a deeper red than the rest of the body.

*Dimensions.* 200  $\times$  8 mm., with 190 segments. The pre-clitellar segments are biannulate.

*Chaetæ.* These are smaller than in *T. esculenta*, and have a different arrangement; for, when viewed from above, *d* is more laterally placed and *c* is not visible. In other words, the dorsal gap (*dd*) is much greater. The formula is:— $ab = cd$ ;  $bc > ab$ ;  $aa = 1\frac{1}{2} ab$ ;  $dd = 5 ab$ . I cannot detect any chaetæ in front of the 10th segment on examination by a dissecting-lens.

*Clitellum*: not yet fully developed, as intersegmental grooves are still unobliterated, though the difference in colour is well marked. It is "complete," and covers the five segments 14–18.

*Genital pores, &c.* (text-fig. 68, p. 245).—On segment 18 is a pale, tumid, transversely disposed ridge, somewhat enlarged at each end: it extends from *b*–*b*, and chaeta *a* appears to be absent. The actual male pore is uncinatè, and on the mesial side of *b*, but close to it. No *tubercula pubertatis* are present. The three pairs of spermathecal pores are at 6/7, 7/8, 8/9, in line with the gap *ab*.

#### *Internal Anatomy.*

There are eight stout septa, behind segments 6–13, but the first and last are less stout than the others.

The last heart is in segment 13.

The gizzard, in segment 5, is of large size; the œsophagus presents no dilatation.

The nephridia have the same general arrangement as in *T. esculenta*.

The genital organs agree on the whole with the latter species; but in the single individual in my possession the prostates are asymmetrically arranged, viz., the left gland extends back to segment 23, and then bends forwards and ends in the 23rd segment. But the right gland is bent in an S-shaped manner, and lies wholly in segments 18, 19, and 20; but, as in the preceding species, both are pressed against the body-wall.

The spermathecae, in segments 7, 8, 9, differ in shape from those of *T. esculenta*; the diverticulum (text-fig. 69, p. 245) being globular, with a short duct, opening into the spermathecal duct close to the body-wall.

*Loc.* Ruatahuua, North Island, New Zealand.

#### 3. TOKEA UREWERÆ, sp. n. (Text-figs. 70–72.)

This worm is known to the natives as "Pokotea," and is described by Mr. Best as "a short white worm." I received three specimens, which in formol are quite a pale pinkish brown, paler still behind the clitellum, which is orange or orange-brown, with a dusky anterior margin.

*Dimensions.* 65 to 80 mm. in length, with a diameter of 7 or 8 mm.; there are 78 segments in the larger individual. The segments are not annulated.

The *prostomium* is  $\frac{1}{2}$  epilobic; without a transverse furrow.

The *chaetæ* have the same general arrangement as in the

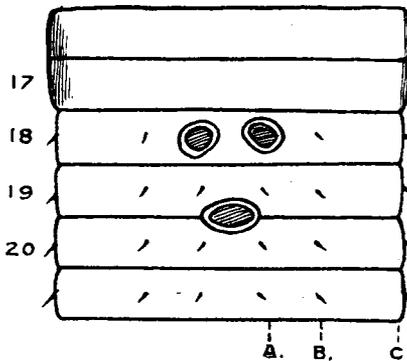
preceding species; when viewed from above *d* is dorsally and *c* laterally placed, but in the tail the line *c* approaches *d*.

$aa = ab = cd$ ;  $bc > ab$ ;  $dd > bc$ . But the differences, measured in millimetres, are very slight: thus  $aa = 2.5$ ;  $bc = 3$ ;  $dd = 4$ .

The *clitellum* is well marked, complete, and covers the four segments 14–17; but the ventral surface of the last segment is less glandular than the rest.

*Genital pores, &c.* (text-fig. 70).—On segment 18 is a pair of subcircular depressions, with a distinct, slightly raised margin; this is in line *a*.

Text-fig. 70.



*Tokca urewera*, similar view to that in text-fig. 62. ( $\times 6$ )

There is a single, median *tuberculum pubertatis*, in the form of an oval, glandular, depressed area, extending from *a*–*a*, between segments 19/20.

The three pairs of spermathecal pores are in line *a*.

#### *Internal Anatomy.*

The seven septa behind segments 6 to 12 are only slightly thicker than the following.

The last heart is in segment 12.

The micronephridia are more delicate than in the preceding species, and do not form so dense a covering to the body-wall.

The meganephridia are confined to the last 12 to 15 segments.

The gizzard (in segment 5) is longer than in *T. esculenta*, though not so wide.

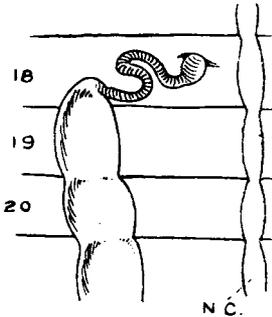
The œsophagus is more or less dilated in segments 11–15; and in the first two of these the thick vascular wall is provided with lamellæ internally.

The prostates extend back to the 26th segment; the muscular duct is long, narrow, and more or less undulating, becoming thicker where it dips into the body-wall.

The three pairs of spermathecæ are in segments 7, 8, 9; each sac is ovoid (text-fig. 72), and the duct is much narrower than the sac; the diverticulum is small, and also has a narrow duct.

*Loc.* Ruatahuua, North Island, New Zealand.

Text-fig. 71.



Text-fig. 72.



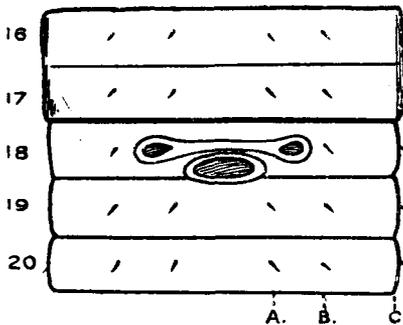
Text-fig. 71. *Tokea urewera*.—View of the anterior end of the prostate, showing the long, narrow and undulating duct. N.C., nerve-cord.

Text-fig. 72. *Tokea urewera*.—Spermatheca ( $\times 12$ . Camera outline of mounted specimen).

#### 4. TOKEA HUTTONI, sp. n. (Text-figs. 73–75.)

A single individual collected by Capt. Hutton; it is much bleached, but was apparently purplish.

Text-fig. 73.



*Tokea huttoni*, similar view to that in text-fig. 72. ( $\times 9$ .)

*Dimensions.* 80  $\times$  5 mm., with 63 segments; but possibly imperfect\*.

*Prostomium*  $\frac{1}{3}$  epilobic; segments of body not annulated.

\* On opening the tail, I find no meganephridia; perhaps the true hinder end had been severed and the wound healed. The lining of the intestine was continuous with body-wall round anus, but this region was thin.

*Chaeta*: when viewed from above, both *c* and *d* are on the dorsal surface, and *c* is well above the lateral margin.

$aa = bc = cd$ ;  $ab < bc$ ;  $dd = 2b > bc$ .

The *clitellum* is fully developed, complete, and includes segments 14 to 17; but both the 13th and 18th segments are glandular on the dorsal surface, the furrows 13/14 and 17/18 are, however, quite deep, whereas the intervening ones are obliterated.

*Genital pores, &c.* (text-fig. 73).—In segment 18 is a slight circular depression with raised margin, in line with the gap *ab*; the *chaeta a* appears to be absent. There is a single median, oval *tuberculum pubertatis* on the hinder margin of the 18th segment, extending from *a-a*.

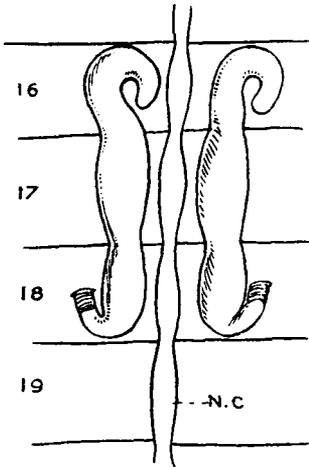
The three pairs of spermathecal pores are on the hinder margins of segments 6, 7, 8, in the gap *ab*, though nearer to *a* than to *b*.

#### *Internal Anatomy.*

There are seven thickish septa behind segments 7–13.

The last heart is in segment 12.

Text-fig. 74.



Text-fig. 75.



Text-fig. 74. *Tokeea huttoni*.—View of the prostates, which, though symmetrical, have assumed a reversed position (? abnormal), with the anterior end directed forwards. N.C., nerve-cord.

Text-fig. 75. *Tokeea huttoni*.—Spermatheca ( $\times 12$ . Camera outline of mounted specimen).

The gizzard is long, narrow, and the wall rather thin.

The micronephridia form a pretty close felt over the body-wall, and commence (as in other species) in segment 3.

The prostates (text-fig. 74) are shorter than in either of the preceding species, and both are directed forwards, but lie side by

side below the gut. They only extend through the three segments 18, 17, and 16.

The duct is very short and thick.

The spermatheca (text-fig. 75, p. 249) likewise has a short duct, and the diverticulum is similar to that of the foregoing species.

*Loc.* Whangarei, North Island, New Zealand.

*Remarks.*—This species is evidently nearly allied to *T. urewerae*, but differs from it in the relative position of the male and spermathecal pores, in the position of the *tubercula pubertatis*, in the chætal formula, and especially in the relation of *ab* to *bc*, as well as in the less extent of the prostate and its duct.

5. *TOKEA SUTERI*, sp. n. (Text-figs. 76, 77.)

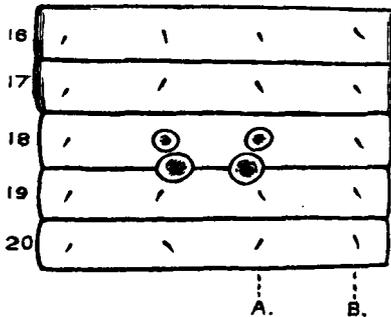
A single individual collected by Mr. H. Suter in 1899. It differs in general appearance from any of the preceding species, not only in size, but in colour. It is dark purplish brown throughout the entire dorsal surface; the clitellum is reddish purple.

*Dimensions.* 50 × 5 mm.; with 86 segments.

*Prostomium*  $\frac{1}{3}$  epilobic; without transverse groove.

The *chaete* are practically equidistant, i. e.  $aa = ab = bc = dd = 2$  mm., while *cl* is only 1.75 mm.

Text-fig. 76.



Text-fig. 77.



Text-fig. 76. *Tokea suteri*, similar view to that in text-fig. 62. ( $\times 9$ .)

Text-fig. 77. *Tokea suteri*.—Spermatheca ( $\times 12$ . Camera outline of mounted specimen).

On the clitellum the gap *aa* is a little less than posteriorly, and in the preclitellar region still less; the gap *ab* is less in the clitellar region, but not anteriorly. But these differences are not perceptible till measured with compasses.

*Clitellum* in segments 13–17 (= 5 segments), girdle-like.

*Genital pores, &c.* (text-fig. 76).—A pair of small papillæ on segment 18, in the line of *a*.

There is a pair of small *tubercula pubertatis*—subcircular and pitted—between 18/29 in line *a*, and extending further medially thereof than do the prophores.

The three pairs of spermathecal pores are in line *a*, at 6/7, 7/8, 8/9.

*Internal Anatomy.*

There are five slightly thickened septa, behind segments 8 to 12.

The last heart is in segment 12.

The gizzard is feebly developed; its wall is not thicker, though tougher, than that of the œsophagus.

The prostates are quite typical, and extend back to segment 23, with tips recurved; the duct is short and narrow.

The spermatheca (text-fig. 77) has a long duct, with a long narrow diverticulum opening into it at the body-wall.

*Locality.* Auckland, New Zealand.

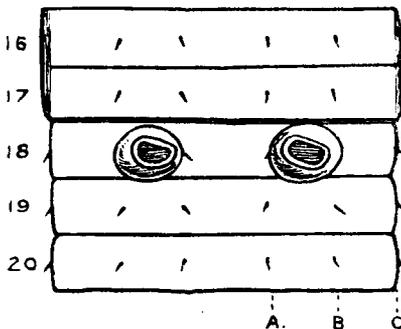
*Remarks.*—Anatomically there is a rather close resemblance between this and the two preceding species; but in the coloration and dimensions it is remarkably distinct, while the practical equidistance of all the 8 chaetae, the paired *tubercula pubertatis*, and the details as to the prostate and septa, mark it off as distinct.

6. TOKEA KIRKI, sp. n. (Text-figs. 78, 79.)

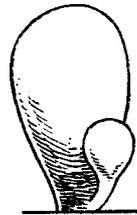
Five specimens collected by Professor H. B. Kirk, in 1902, are about the same size and colour as *T. esculenta*, i. e. reddish purple, but rather paler than the latter; the pigment extends further round to the ventral surface than is usually the case, and ceases about the level of *b*.

The clitellum is brownish red.

Text-fig. 78.



Text-fig. 79.



Text-fig. 78. *Tokea kirki*, similar view to that in text-fig. 62. ( $\times 7$ .)

Text-fig. 79. *Tokea kirki*.—Spermatheca ( $\times 12$ . Camera outline of mounted specimen). This has no muscular duct distinct from the sac.

*Dimensions.* The length varies from 80 to 100 mm., with a diameter of 6 mm. for 110 segments in the larger individuals.

The chaetae are practically equidistant; but on measurement it is found that  $ab=bc=cd$  ( $=1.75$  mm.), while  $aa=dd=2$  mm.

When viewed from above, *d* is dorsally placed and *c* rather above the lateral margin.

The *clitellum* is not fully developed on any of the specimens, as the intersegmental furrows are distinct; but the characteristic coloration extends over the five segments 13 to 17.

*Genital pores, &c.* (text-fig. 78, p. 251).—The male pores are situated in what appears to be a pair of *tubercula pubertatis* on segment 18; there is a very large, broad, subcircular papilla on each side, extending from nearly *a* to *c*; this carries a somewhat quadrangular depression surrounded by a distinct rim or margin; this depression is glandular and has all the characters of a tuberculum pubertatis (as seen in section); and the male pore is quite small and situated in the outer edge of this gland, just within the margin, *i. e.* nearly in line *b*. The two oviducal pores are situated close together, in a pale area, near the anterior margin of segment 14.

There are only two pairs of spermathecal pores, situated at 7/8, 8/9.

#### *Internal Anatomy.*

There are no specially thick septa.

The last heart is in segment 12.

The gizzard is quite small; the œsophagus is very much dilated in segment 14, but there is no constriction separating it from the canal; its lining, however, is thrown into a series of horizontal, lamelliform folds.

The micronephridia, instead of being spread over a great part of the body-wall, in each segment, form a very distinct and narrow row close to the septa.

The prostates extend from the 18th to 23rd segments, and each is provided with a narrow duct.

There are two pairs of spermathecae in segments 8, 9; each (text-fig. 79) is a somewhat pyriform sac, without a distinctly marked duct; the diverticulum is of the same shape, and also without definite duct.

*Locality.* Ohaeawai, North Island, New Zealand.

*Remarks.*—A very distinct species, characterised both by the remarkable coincidence of male pore and copulatory tubercle, and by the possession of only two pairs of spermathecae.

#### 7. TOKEA MAORICA, sp. n. (Text-figs. 80–82.)

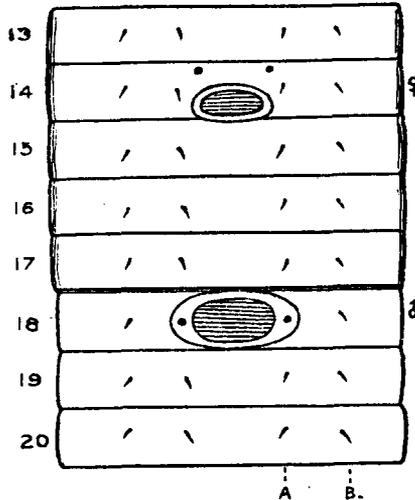
I have eight specimens of this species, collected at different times by Mr. H. Suter, at different places in the neighbourhood of Auckland. The colour is a dark purplish brown, more brown than purple in these alcohol specimens, and resembles that of *T. suteri*. The *clitellum* is paler brown; the *chaetæ* are inserted in white spots, as in *Plagiochaeta sylvestris*, to which also they bear a resemblance both in colour and their short, stout form; indeed, from a hasty first glance, I had placed them with the latter genus, awaiting examination.

*Dimensions.* The largest specimen measures  $70 \times 4$  mm., and consists of 75 segments; the shortest mature individual measures  $25 \times 2$  mm., and likewise consists of 75 segments; and the same number occurs in a worm of intermediate size.

We have here an instance—unique, so far as I am aware—of an earthworm increasing in length without adding new segments posteriorly. It is true that we do not know much on this subject; but the accepted view is that the number of segments is continually added to during growth.

With regard to this, Beddard ('95, p. 2) states:—"There are at present no exact data as to the constancy of the number of segments among Earthworms. In all probability the number is not absolutely fixed, but there appears to be a mean for each species round which there is a certain amount of variation."

Text-fig. 80.



*Tokea maorica*, similar view to that in text-fig. 62. ( $\times 11$ .)

*Prostomium*  $\frac{1}{2}$  epilobic; without a transverse groove.

*Chaetal* formula:— $ab < cd < bc$ ;  $bc = 2 ab = aa$ ;  $dd = 2 aa$ .

*Clitellum* girdle-like, over the five segments 13 to 17.

*Genital pores, &c.* (text-fig. 80).—On segment 18 is a transverse, elliptical area, paler than its surroundings; glandular centrally, with a distinct margin surrounding it. It extends between points *a* little outside *a*, on each side. This is a *tuberculum pubertatis* (text-fig. 81, p. 254), and the male pore is situated on the thickened margin, at each pole of the ellipse in line with *a* (which is absent in this segment). There is a second *tuberculum pubertatis* of the same shape, but of much smaller size, on the hinder border of

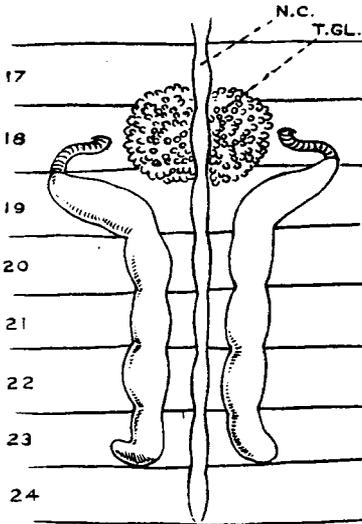
segment 14, and not quite reaching the line of *a* on either side. This tubercle is absent in some individuals.

The oviducal pores are wide apart, nearly in line of *a*, but a little mediad.

The two pairs of spermathecal pores are distinct and slit-like, about midway between the chaeta *a* and the posterior margin of each of the segments 8, 9.

Dorsal pores are present, at least in the postcelitellar region.

Text-fig. 81.



Text-fig. 81. *Tokeo maorica*, the prostates and the gland of the *tuberculum pubertatis* (T.G.L.).

Text-fig. 82. *Tokeo maorica*.—Spermatheca ( $\times 12$ . Camera outline of mounted specimen).

Text-fig. 82.



#### *Internal Anatomy.*

The last heart is in segment 12.

The gizzard, though small, is distinct.

The micronephric tubercles are more delicate than in other species, and all concentrated to form a latero-ventral mass on each side.

The prostates extend back to segment 23; the duct is narrow and rather long, and between the pair of ducts lies a great glandular mass, which thrusts the anterior ends of the prostates outwards, so that the duct is transverse.

Each of the spermathecae (text-fig. 82), in segments 8 and 9, consists of a pyriform sac with a very thick duct, thicker than the neck of the sac. A small tubular diverticulum, dilated terminally, opens into the duct near the body-wall.

*Localities.* Auckland: Waitakerei Bush and Nikau Palm Bush (near Auckland); North Island, New Zealand.

*Remarks on the Genus Tokea.*

The distribution of the seven species attributed to this genus extends over a considerable portion of the North Island of New Zealand, for the localities from which specimens have been collected are widely separated and cover more than three degrees of latitude, the most northerly spot being Ohaeawai, practically in latitude 35° south, and the most southerly spot, Ruatahuua, is south of 38°.

The really striking fact illustrated by these seven new species is the presence in the North Island of New Zealand of a Cryptodriline genus as an important, and apparently predominating, element in the Earthworm fauna.

Hitherto, as I have remarked, our knowledge of this fauna in New Zealand has been derived from a study of the South Island representatives, and here the predominating element is the Acanthodriline series.

This was recognised some years ago by Beddard, who in his 'Monograph' (p. 154) says:—"New Zealand is essentially different from Australia. The prevalent forms in Australia are Perichætidæ and Cryptodrilidæ; the most abundant worms in New Zealand are Acanthodrilidæ."

I have, in my Presidential Address to Section D of the Australian Association for the Advancement of Science ('02, b), dealt with this difference very fully, and little thought that the North Island would present so different a set of Earthworms.

Beddard, indeed (1890, p. 285), suggests that "the North Island may prove to be more 'Australian' in its character when it comes to be known"; but the grounds for this statement at that time seem to have been very slender, for only one worm had been recorded from that island, viz. Schmarda's "*Hypogoeon orthostichon*," of which nothing was known beyond the few facts of its external appearance recorded by that zoologist, and sufficient of its internal anatomy noted by Beddard to indicate its Cryptodriline affinity. So characteristic, indeed, is the Acanthodriline group of worms, that doubt has been thrown upon the occurrence of this species in New Zealand. Captain Hutton ('79) doubted it on geographical grounds, for Schmarda gives the locality as "Mount Wellington, New Zealand"; and Hutton, knowing that there was no mountain of any size called by this name in New Zealand, stated that probably some confusion with "Mt. Wellington," Hobart, Tasmania, had crept into Schmarda's notes. In my Presidential Address, I omitted it entirely from the list of earthworms occurring in this Colony, and even so far as to read a note ('02, c) attributing it to Tasmania. But, in view of the undoubted occurrence of Cryptodriline worms in New Zealand, this doubt is itself rendered somewhat doubtful and

possibly premature. No such mountain occurs on ordinary maps of New Zealand as "Mt. Wellington," and I therefore consulted Prof. H. B. Kirk, who has an extensive first-hand knowledge of the geography of the North Island: in response to my query, he informs me that "Mt. Wellington is one of the small volcanic cones just out of Auckland. It is, now, under grass, and is in a fully cultivated district."

The geographical doubt is thus set at rest; for Schmarda visited Auckland, and at that period (1860, about) it is probable that little or no cultivation had then been carried on on this small mountain; and, in light of these new observations of mine, it seems that we must now admit into our fauna Schmarda's species.

Our knowledge of its internal anatomy is due to Beddard ('92), who recognised that it belonged to the genus *Megascolides*, as he understood it, but by Michaelsen it is placed in Fletcher's genus *Notoscolex*; but as we did not know the condition of the nephridia in the posterior end of the body, it is impossible to be sure of the correctness of the genus. (See later.)

*N. orthostichon* appears—from the necessarily brief account given by Beddard—to differ from the species of *Tokea* only in the size of the prostate, which that zoologist states is "short and tubular." He says nothing as to whether it is confined to one segment or extends beyond it; but presumably it does not exhibit the characteristic disposition found in *Tokea*, though, as we see, in *T. huttoni* this gland is "short" as compared with its length in the other species, as it only traverses three segments.

It is remarkable, however, that it differs from all the other species of *Notoscolex*, in which the clitellum covers fewer than ten segments, and in which the arrangement of the chaetæ is unchanged at the posterior end of the body (Michaelsen, '00), in that the chaetæ are equidistant (*i. e.* the formula is  $ab = bc = cd$ ), as is the case with several of my species; and if we suppose that it does belong to the same genus as do the seven new species herein described, it might be suggested that one or other of the latter is identical with *N. orthostichon*, especially as I have obtained two species from Auckland.

Let us, then, examine such characters which appear to be specific as Beddard mentions. Firstly, it has two pairs of spermathecae, in which it agrees with *T. kirki* and *T. maorica*—the latter of which came from the Auckland district. The other Auckland species, *T. suteri*, is out of court, as it possesses three pairs of spermathecae. The two species to which it presents this resemblance have very different forms of spermathecae. Unfortunately, Beddard's description is too meagre to allow us to judge whether in *N. orthostichon* the organ resembles either of them; for, he says, "each [spermatheca] has a small diverticulum, pyriform in shape like the main pouch." Such a general description applies to several of the above species.

Now, in *T. maorica* the duct of the spermatheca is very wide;

and if such a duct exists in *N. orthostichon*, it seems unlikely that it would have escaped Beddard's notice. Moreover, in *T. maorica* the chaetal formula is different, whereas in *T. kirki* it is similar to that of *N. orthostichon*, and the spermatheca is without a distinct muscular duct. The only other characters are the extent of the clitellum and its size.

Beddard gives the former as occupying segments 14 to 17 inclusive, whereas in my species it begins at segment 13; and as to size, Schmarda gives it as 80 cm.  $\times$  4 cm., with 60 segments—distinctly smaller than *T. kirki*, though approximately that of *T. maorica*.

It appears, then, to be distinct from either of the two species possessing only two pairs of spermathecae; for, apart from any similarities, the prostate in those two species is of considerable length. But it agrees more closely with *T. huttoni*, in size, in chaetal formula, extent of clitellum, and small size of prostate; but in that species there are three pairs of spermathecae.

So far, then, as our information allows us to judge, Schmarda's species is distinct from any of those described in the present paper; and we have not sufficient information to allow us to say definitely that it even belongs to the genus *Tokea*, although it appears not improbable that it does so; but Beddard states that the sperm-sacs number three pairs, and occupy segments 10, 11, 12—an unusual arrangement, even in *Notoscolex*, where 11, 12 is the more general position.

#### *Remarks on the Genera Megascolides and Notoscolex.*

It is very evident that this new genus *Tokea* is nearly allied to the Cryptodriline genera *Megascolides* and *Notoscolex*; but it appears to me to differ in details from either of them. It is notoriously difficult to define these Australian genera; and it is unfortunate that the opinions of our two leading systematists, Beddard and Michaelsen, are absolutely at variance as to the characters and limitations of the genus *Megascolides*.

This name was given by Prof. M'Coy in 1878 to a worm, *M. australis*, which, at a later period, received full anatomical treatment at the hands of Baldwin Spencer (1888); and this it is which Michaelsen (1900) takes as the type of the genus, of which he gives this diagnosis (p. 182, translation): "Eight chaetae; clitellum beginning at or before segment 14 and extending over 6 to 9½ segments. One pair of female pores; spermathecal pores 2 to 5 pairs, the last being on 8/9. Gizzard 5 or 6, or 5 and 6. Excretory organs consist of diffuse nephridia, to which is added a pair of meganephridia in each of the posterior segments. Prostate tubular (sometimes lobate)." (Italics are Michaelsen's.)

It will be seen, then, that in some of the above characters the new genus agrees with *Megascolides*, and notably in the co-existence, in the hinder segments, of meganephridia with micro-

nephridia. But it differs in that the clitellum in my new species is less than that characteristic for the above.

The only difference between *Megascolides* and *Notoscolex* upon which Michaelsen lays special stress is the presence of meganephridia posteriorly. The diagnosis of the latter genus he gives (p. 187) as: "Chætæ 8. Clitellum, beginning at or before segment 14, extends over  $3\frac{3}{4}$  to  $10\frac{1}{2}$  segments. The female pores are usually 1 pair, seldom unpaired [median]. *Spermathecal pores* 2 pairs in the intersegmental furrows 7/8. 8/9; rarely shifted backwards on to the 8th and 9th segments. One gizzard in 5 or 6. *Plectonephric*; nephridia diffuse. Prostate usually lobate, sometimes tubular." (Italics are Michaelsen's.)

The two distinguishing characters, then, are the limited number of spermathecae and the diffuse nephridia, without the posterior meganephridia. It is unfortunate that in a considerable number, perhaps the majority, of the species included in *Notoscolex* the condition of the posterior nephridia is unknown.

If, then, we depend on these formal diagnoses, we should no doubt refer my new species to the genus *Megascolides*, especially if they had been found in Australia.

On examining the anatomical details of the only species of *Megascolides* the anatomy of which is thoroughly known, viz. *M. australis*, we note several differences from *Tokea*; amongst others:

- (a) The chætæ are in couples, all ventral.
- (b) The prostates are compactly coiled, cylindrical tubes, similar in general shape to those of true Acanthodriline worms; they are, too, situated laterally, and confined to segment 18.
- (c) The sperm-ducts open into the duct of the prostate in the substance of the body-wall; which is also the case in the only other species of the genus that has been investigated by means of sections, viz. *M. illawarræ* (see Sweet, p. 113).
- (d) The spermatheca has quite peculiar rosette-shaped diverticula.

But the above statements do not apply to each of the other three species included in the genus; for the prostates are flattened and more or less lobate; the spermatheca in *M. cameroni* is similar to that of many other Cryptodriline species. Nevertheless, in all of them the chætæ are distinctly coupled; i. e., the spaces *aa* and *bc* are greater, much greater in some cases, than *ab*, whereas in *Tokea* these spaces are more or less equal and the "coupling" is quite unnoticeable. It is not probable that any of these characters by themselves are of generic value. And, as a matter of fact, when we come to look into the anatomy of these four species we find numerous differences—which, in the case of other genera, Michaelsen has considered as of sufficient importance to deserve generic rank. I refer, for instance, to the fact that *M. insignis* and *M. cameroni* have only *one* pair of testes, and this in segment 11. But it is clear that the only characters

which these four species have in common, and in which they agree with *Tokea*, is the coexistence in the posterior segments of meganephridia and micronephridia.

Let us turn to Beddard's conception of the limits of the genus *Megascolides* (= *Notoscolex* Fl.) and *Cryptodrilus* Fletcher (the history of which is well given in his Monograph, pp. 445 *et seq.*). He draws attention to the fact that in nearly all the worms described by Spencer, and in a considerable number of those described by Fletcher (at any rate in such cases in which sufficient information is given to enable a comparison to be made), there is a correlation between certain of the internal organs (p. 447), viz. that "they have either (1) paired nephridia, tubular spermiducal glands, and last pair of hearts in the 12th segment; or (2) diffuse nephridia, lobate glands, and last heart in the 13th segment." He decides to regard those species with the first set of characters as belonging to the genus "*Megascolides*," and those with the second group as "*Cryptodrilus*." He admits that there are exceptions to these correlations.

It thus comes about that Michaelsen uses the generic name *Megascolides* for "micronephric," whereas Beddard employs the same name for "meganephric" worms. But the meganephric species are placed by Michaelsen in the genus *Plutellus*, which is thus extended to include species previously attributed to *Argilophilus* of Eisen, *Megascolides* of various authors, *Cryptodrilus* of Fletcher, as well as *Plutellus* of Perrier and Benham.

Thus we have this unfortunate confusion in the employment of generic names:—

- Megascolides* M'Coy, in Michaelsen's sense,  
= *Notoscolex* (part) Fletcher,  
= *Cryptodrilus* (part) Beddard;
- Notoscolex* Fletcher, as used by Michaelsen,  
= *Notoscolex* Fl. + *Cryptodrilus* Fl.  
= *Megascolides* (part) Spencer;
- Cryptodrilus*, in Beddard's sense,  
= *Cryptodrilus* Fletcher,  
= *Megascolides* (part) Spencer,  
= *Notoscolex* (part) Fletcher;
- Megascolides*, in Beddard's sense,  
= *Cryptodrilus* (part) Fletcher, Spencer,  
= *Megascolides* (part) Spencer,  
= *Argilophilus* Eisen,  
= *Plutellus* Perrier.

It is natural that in a group like Earthworms a mixture and confusion of this sort is likely to arise as knowledge advances; and it remains for Prof. Baldwin Spencer with the large stock of material in his possession, to endeavour to find some more satisfactory method of discriminating between genera than those usually employed.

Of course the correct name that should be applied to the genera

depends on the law of priority ; and there can be little doubt but that *Megascolides australis* is the "type" of *Megascolides* M'Coy ; but it does not seem quite so clear as to whether the word *Notoscolex* or *Cryptodrilus* should be retained to apply to the other genus. But this thorny matter of nomenclature I regret that I have not time to discuss thoroughly.

Having thus cleared the ground, satisfactorily as it seems, of the meganephric species, there remain the large series of micro-nephric species to be dealt with ; and it becomes a question whether Michaelsen's characters are good, viz. :

- (a) Absence or presence of meganephridia posteriorly ; and
- (b) A limited number (two pairs) or a greater number (up to five pairs) of spermathecae.

In regard to the first, it is admitted that in many species we are ignorant as to whether the large nephridia are or are not present.

In the second case, in other genera—e. g., *Pheretima* and *Megascolex*—the number of spermathecae has not been used as a generic character\*.

Since, therefore, the seven species of New-Zealand worms here described agree very closely with one another, and except in one respect differ from those species referred to *Megascolides* by Michaelsen, and since, too, I am not in a position to rearrange the generic characters of these allied genera, it seems to me better to erect a new genus. It may be that it is only of subgeneric rank ; but for the present less confusion will arise, I think, if we regard it as a distinct genus.

The genus *Tokea* differs from *Megascolides*, as defined by Michaelsen, in the following points:—

- (a) The limited extent of the clitellum, in which only 4 or 5 segments are involved, whereas his minimum is six.
- (b) The widely separated chætæ, of which the coupling is not recognisable.
- (c) The form and position and size of the prostate.
- (d) The position of the point of entrance of the sperm-duct into the prostate-duct.
- (e) The existence throughout the body of nephridial funnels, although in the greater part of the worm these have no connection with the nephridia.

These are truly small points of difference on which to form a new genus ; but not smaller than that on which *Megascolides* is distinguished from *Notoscolex*, viz., the presence in the former of meganephridia in the hinder segments of the body †. In my opinion, this is by no means a good line of distinction ; and even

\* The same remark applies to the position of the last heart, utilised in diagnosing the genera by Beddard ; for in *Plagiochæta* and *Octochætus*, as in *Tokea*, we find species in which it is in the 12th, and others in which it is in the 13th segment.

† Or, *Macridrilus* from *Notiodrilus*, in having nephridiopores alternate, instead of in line

the separation of *Plutellus* from these two genera, merely on account of the presence of meganephridia only depends on a point quite as small.

I have already described a species of *Plagiochaeta*, viz. *Pl. rossi*, in which micronephridia replace the meganephridia of the other half-dozen species; and embryology has taught us that the one is derivable from the other condition—that, at any rate in the genera *Megascolides* (Vejdovsky) and *Megascolex* (Bourne), the earlier meganephridium breaks up into numerous micronephridia.

Is not the separation of the genera according to the condition of the excretory system a remnant of my own unfortunate attempt to classify the families of Earthworms into “Plectronephrica” and “Meganephrica”?

But without entering upon the laborious task of essaying to rearrange the “Cryptodriline” genera, I will express the opinion that a careful study of the form and structure of the prostate (together with other characters) may be more likely to lead us in the right direction. And, firstly, it seems to me profitable to distinguish the “tubular”-*cylindrical* prostate, such as occurs in *Megascolides ambialis*, from the flatter, elongated “tongue-shaped” form of gland that occurs in *Tokea*, some species of *Plutellus*\*, and others, and the “flattened, lobed, and compact” organ characteristic of such genera as *Pheretima* and *Megascolex*. That these may form a developmental series, Miss Sweet’s work (1900) has rendered probable; but they also appear to have structural differences that may turn out to be of diagnostic character. At any rate, they are easily recognised macroscopic characters; whereas the study of a worm from which the posterior end has been accidentally destroyed will not enable me to decide, in all cases, whether it belongs to the genus *Megascolides* or to *Notoscolex* as defined by Michaelsen.

It is not difficult to imagine the way in which the genus *Tokea* has developed from an Acanthodriline stock, in which the cylindrical prostate, instead of being coiled compactly and confined to its proper segment, has burst away from this limited position, and elongating backwards has not only become flatter but has lost somewhat of its smooth external surface. Such a form of “tongue-shaped” gland occurs in *Notiodrilus aucklandicus*, in which each prostate extends through five or six segments. From such a form *Rhododrilus* may have developed—the posterior gland has disappeared, and the sperm-duct has shifted forwards so as to open close to the anterior gland; whereas in *Tokea* the anterior gland appears to have gone, and the posterior gland to have moved forwards to meet the sperm-duct and to open externally in the 18th segment.

\* In looking through the descriptions of new species of Australian worms published by Spencer (Proc. Roy. Soc. Victoria in 1892, 1895, and 1900), I find that the only species that possess elongated “tongue-shaped” prostates (he calls them “tubular,” but the figures show them to be like those of my species) extending through several segments belong to the meganephric genus *Plutellus* in Michaelsen’s sense.

The occurrence of a prostate in *Megascolides australis*, similar to that of a typical Acanthodrilid, seems to indicate that the confinement to a single segment is related to the cylindrical form; and it is admitted by Michaelsen that these "Cryptodriline" worms, belonging to the subfamily Megascolecinæ, are derived from the subfamily Acanthodrilinæ. And, on the other hand, the peculiar form of the gland in *Notiodrilus aucklandicus* illustrates the relation between a looser structure and the extension of the gland through several segments. But, although this transition of form between the "tongue-shaped" and "cylindrical" tubular prostates seems to occur, yet the flattened form appears a still later development; it occurs, for example, in the more modified genera, such as *Pheretima*.

Miss Sweet has pointed out that in the "tubular" prostate there is a lumen running the whole length of the gland; whereas in the lobate form of this organ there is, typically, no central lumen, and when it exists it is not only very small, but it has no epithelium. Unfortunately, the species examined by her do not belong to the genera under dispute, with the exception of *Megascolides illavarræ*, in which the prostate is a "somewhat long and flattened" organ, and has a structure intermediate in some respects between a truly "lobate" gland, such as exists in *Megascolex*, and a "tubular" gland, such as occurs in *Plutellus* and others; for the species referred by her to "*Megascolides*" belong to the genus *Plutellus* in Michaelsen's sense.

If I have dwelt so much on the form of the prostate, it is because it seems to me that Michaelsen has not laid sufficient stress upon this organ in shuffling the members of the "Cryptodriline series." It alone, I admit, will not serve for generic distinction; but it may possibly be useful in the formation of subgenera.

Dunedin, April 10, 1904.

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November 29, 1904.

G. A. BOULENGER, Esq., F.R.S., Vice-President, in the Chair.

Dr. Walter Kidd, F.Z.S., exhibited a drawing of the extensor surface of the hand of a Chimpanzee and made the following remarks:—

In the course of an examination of the papillary ridges in some specimens of Anthropoid Apes and Monkeys certain groups of ridges were found on the extensor surface of the terminal phalanges of the hand, apparently identical with those of the palmar and plantar surfaces. Three specimens of Chimpanzee living in the Society's Menagerie were examined, of the ages 1 year 8 months, 2½ years, and 6 years. In the oldest of these, "Mickie," the ridges were definite and well-developed on the 2nd, 3rd, and 4th digits on both hands; in the youngest specimen, "Jack," they were absent; and in "Jimmie," 2½ years old, they were small and ill-defined, as if in the process of development.

*Direction of Ridges.*

*Mickie.* Ridges longitudinal and reaching to the matrix of the nail on the 2nd, 3rd, and 4th digits.