

***Megascolides napierensis*, a New Species of Earthworm.**

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IN April of 1939 I received from the Plant Research Bureau for identification an earthworm which was "found in a nurseryman's glass-house at Napier." From its general colouration and certain external features I expected that it would belong to the genus *Tokea* which I had established some years ago for certain species occurring in the North Island, but the dissection at once showed me that it is either a member of the genus *Notoscolex* or of *Megascolides*; and the microscopic structure of the prostate or "spermiducal gland" indicates that it belongs to the latter genus.

***Megascolides napierensis* n.sp.** Pl. 4, figs. 1-11.

EXTERNAL FEATURES.

A striking peculiarity is its colour when alive—a rich chocolate with a violet tinge, which is uniformly dark over the entire surface, ventrally as well as dorsally, posteriorly as well as anteriorly. In this respect it differs from the majority of earthworms, in which the ventral surface is distinctly paler than the dorsal, while the colour fades towards the hinder end of the body. When, however, the animal was killed in weak alcohol much of the pigment was extracted and the colour turned to a greyish-violet. The median region ventrally now becomes somewhat paler than the rest of the circumference, though the posterior region still remains deeply pigmented.

The *clitellum* is not evident in the living worm, though this is no doubt due to its immaturity: even in the preserved condition this organ is not swollen, though it has a slightly darker and brownish tinge, contrasting with the violet of the rest of the body. The *clitellum* extends from $\frac{1}{2}$ xii to the end of xviii.

The *length* is 550 mm. measured after death. It is cylindrical, not tapering much posteriorly, the average diameter being 10 mm. till almost at the end, which is 5 mm. at the last segment.

The *prostomium* is "epilobic"; that is, it is inserted into the first segment for about one-third the length of the latter.

The *anus* is a vertical slit surrounded by a paler zone of the last segment.

The eight *chaetae* are spaced as follows in the preclitellar region: the pair of ventral ($a-a$) are distant from one another by about thrice that separating $a-b$. The space $b-c$ is about equal to $b-c$, and the uppermost chaeta d is below the lateral line. In the posterior segments the interchaetal spaces are more nearly equal. $a-b=c-d$; and $b-c$ is half $a-a$.

Accessory Sexual Glands.

In each of segments xvii and xix is a pair of large sub-circular structures defined by a distinct rim enclosing a depressed centre. These are what Stephenson terms "genital markings" or, better, "accessory sexual glands" so frequent in this family of Oligochaeta. They lie in line with chaetae b . (Fig. 2.)

The *male pores* are on low papillae in segment xviii in the same line as the above-mentioned glands. In the preserved worm these six structures lie in a very pale pink area, square in shape and quite well defined.

The *oviducal pores* in xiv are situated in a narrow transverse pale area extending between the chaetae *a—a*. The pores lie just ventrad of the chaetae and slightly anterior to the line joining them.

The pores of the *spermathecae* (Fig. 1) occupy a quite unusual position; for instead of being intersegmental as in the vast majority of earthworms they are in the middle of the segments vi, vii, viii, and ix lying between the chaetae *b* and *c*. Each pore is a short linear slit parallel to the segmental margin, and from some pores two radial lines leave the edge of the slit at right angles. This "segmental" position has been recorded only in a few species, and among others, e.g., *Tokea maorica* and *T. decipiens* Benham (1906, p. 240) and in *Notoscolex ceylanensis* Michaelsen, where the pores are situated "on the hinder part of the segment."

INTERNAL ANATOMY.

The body wall is unusually thick. The first septum is between segments iv and v; the septa separating segments ix/x, x/xi, and xi/xii are noticeably thicker than the others and are close together, so that the cavities of the segments are reduced greatly in extent; this comes about in this way—ix/x has shifted back nearly to the intersegmental line of x/xi; septum x/xi has slipped back to the middle of segment xi (Fig. 3).

Genital Organs.

There are four pairs of spermathecae attached to the body wall near the middle of each of the segments vi, vii, viii, and ix. Each consists of two sub-spherical sacs, a larger "ampulla" and a smaller "diverticulum." The former, usually situated posteriorly to the latter, presents one or two small rounded saccules on its surface. The rather broad muscular duct receives the diverticulum. (Fig. 5.) There are two pairs of *spermsacs* lying in segments ix and xii; they are relatively small, due probably to the immaturity of the individual. Each is a rounded, compact sac which gives origin to two or more slender tapering outgrowths. (Fig. 6.)

The paired prostates or "spermiducal glands" in segments xvii and xix are relatively small. The organ is roughly oval, lying transversely; the surface is slightly roughened and the margin incised here and there. The duct is very short, entering the body wall immediately after leaving the gland. (Fig. 7.)

The shape of the organ then is "lobate," and this led me to expect that it would present a system of branching canals within, which is characteristic of this form of prostate; but to my surprise the examination of serial sections, which luckily were nearly median, show that there is a single unbranched lumen, traversing the mass of gland cells from base to almost the tip (Fig. 9); into this canal open groups of gland cells at intervals, much as is figured by Miss Sweet (1900, pl. 15, fig. 17) for *Megascolides intermedius*. That is, at the point of entry of each group of cells the epithelium lining the axial canal is slightly evaginated (Fig. 10). This epithelium consists of

elongated columnar cells with slightly granular contents and an oval nucleus near the base. It is surrounded by a little loose connective tissue. The axial canal leaves the base of the gland at a notch close to the body wall, and the duct which issues is thus extremely short. The two sperm ducts, which have travelled from the funnels in x and xi, run side by side till this xviiiith segment. They now pierce the parietal coelomic epithelium, enter the layer of longitudinal muscles of the body wall, and here unite with one another. The common sperm duct so formed runs outwards alongside the prostate duct, which it joins just beyond an enlargement as it pierces the circular layer of muscles. This "male duct" opens to the exterior at the apex of a very low papilla. (Fig. 8.) The epithelium of the sperm duct consists of much shorter cells. Indeed, they are about half the height of those of the prostate epithelium.

The Alimentary Tract. (Fig. 3.)

The small gizzard is confined to segment vii. There are no oesophageal glands as distinct outgrowths or thickenings of the wall, but in segments xiv, xv, and xvi the wall of the gut is highly vascular, much more so than in the neighbouring region. In the next segment the thin-walled intestine commences, which extends throughout the worm till near the hinder segments, when it presents a peculiarity which I do not recall having seen referred to in any other earthworm, and no mention of such a feature is made in Stephenson's exhaustive monograph. The gut wall in the last eighteen segments becomes suddenly thick and muscular, and the lining is thrown into a number of longitudinal folds or "rugae," thus constituting a true *rectum*. (Fig. 4.) This extends through the last eighteen segments or so and opens by the anus. The wall of the anal region occupying the last segment is quite pale in colour, quite without pigment, and seems to mark a "proctodaeum"; another feature hitherto overlooked by previous authors. The segments of this rectal region are successively shorter till they become about half the length of the preceding ones and the closely-set septa constitute a series of radiating muscles for the wall of the rectum.

The worm is *micronephric* throughout; there being a row of minute tubules arranged in a line across the middle of each segment accompanied by a transverse "ventro-lateral" blood vessel. The nephridia are best developed in the genital segments. In the most posterior region, alongside the rectum, these tubules are larger, and at first I supposed them to be "meganephridia" until they were studied microscopically.

As to the *vascular system*, there is little that is diagnostic (Fig. 3). The dorsal blood trunk is single; there are commissural vessels in the segments vi to x; enlarged hearts in xii and xiii which arise partly from the dorsal trunk and partly from the network on the intestinal wall. This plexus is especially well developed in segments to which I have already referred, viz., xiv, xv, and xvi, so that the wall is here distinctly red in the fresh worm, which suggests that this region represents the oesophageal glands of other worms. The vessels in the anterior part of the body were gorged with blood when freshly examined, but posteriorly to segment xviii the dorsal trunk is empty.

DISCUSSION.

In my article on "Some Edible Earthworms" in 1905 I referred on p. 257 to the confusion that existed as to the limits of certain genera, namely *Notoscolex*, *Megascolides*, and *Cryptodrilus*, as defined by various authors, and therefore established a new genus *Tokea* which did not seem to fit into either of these, though evidently related to the two former. The present worm differs from *Tokea* in the following features: the gizzard in vii instead of in v; the absence of meganephridia in the hinder segments; the "lobate" form of the prostate in place of the elongated "tongue-shaped" form; and in the fact that there are four pairs of spermathecae instead of two or three. The resemblances are fewer—its extensive colouration; the lack of penial chaetae and of definite oesophageal outgrowths; and in the presence of only two pairs of spermsacs.

Miss Sweet had in 1900 shown that in certain worms the prostate has a central or axial canal, whereas in others there is a system of branching canals traversing the gland; that in the former case the form of the gland is "tubular," in the latter "lobate" or compact.

In my article I laid stress on the importance of the form of the prostate as being of greater value in determining the genus than was the character of the nephridia upon which the late W. Michaelsen had at that time laid stress; but he later (1907) accepted my view, which the late J. Stephenson (1923) also adopted. The point at issue, then, is that a tubular or "tongue-shaped" prostate has a single axial canal without definite branches, such as occurs in *Megascolides* and in my genus *Tokea* (which is probably to be regarded as a subgenus); while, on the other hand, a compact or "lobate" gland has a system of branching canals, without this axial canal, as in *Notoscolex*.

But in the present species, *M. napiensis*, we are met by this anomaly—an apparently "lobate" prostate traversed by a single axial canal. Hence it appears that one must not judge by the external shape of the gland; this is not the important thing, but its internal structure. We may look on this "lobate" outward form in this worm as really a laterally extended, flattened and shortened "tongue-shaped" prostate.

The present worm agrees more nearly with *Megascolides* in its general anatomy than with *Notoscolex*, as may be judged from a comparison with the diagnosis of each genus as given by Stephenson (1923), which is almost word for word with that of Michaelsen (1907):—

"*Megascolides*.

"Setae 8 per segment. Spermathecal pores 1-5 pairs, the last at 7/8 or 8/9 or in ix. One gizzard in the region of v or vi. Micronephridia in anterior part of the body. Prostates tubular with simple unbranched canal.

"*Notoscolex*.

"Setae 8 per segment. Spermathecal pores one, two or three pairs, the last in 8/9. One gizzard in v or vi. Micronephridia present, sometimes with meganephridia also. Prostates with branched canal system."

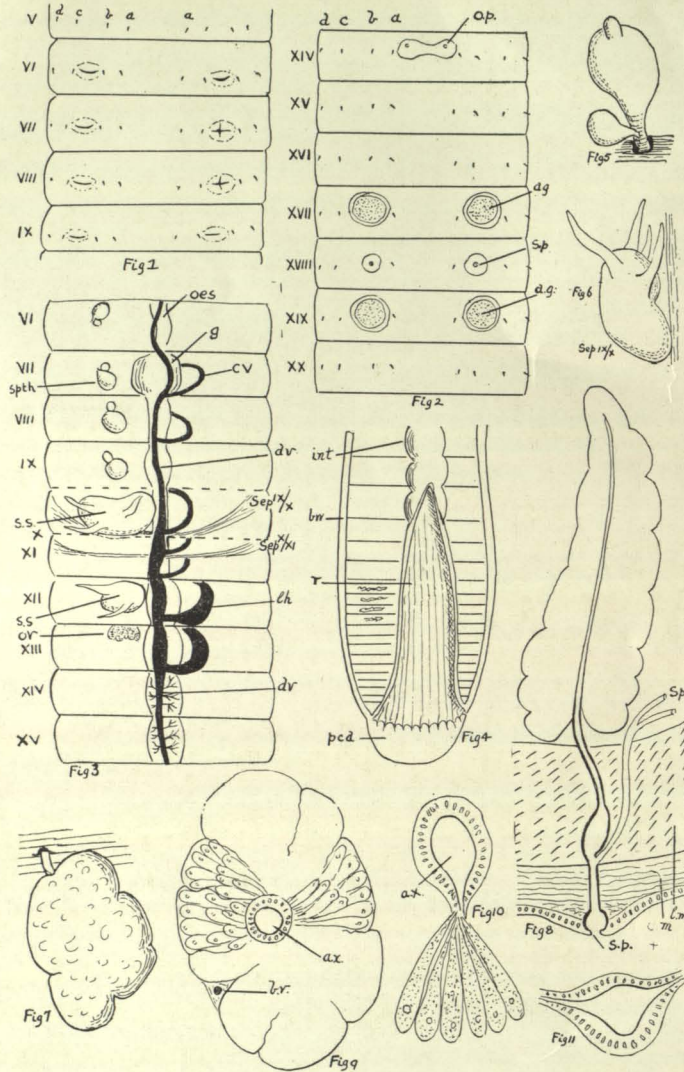


FIG. 1—Ventral surface of the anterior region of *Megascolides naperiensis* showing the apertures of the Spermathecae in the middle of their segments. *a*, *b*, *c*, *d* are the four chaetae.

FIG. 2—Ventral surface of the other genital segments; *a.g.*, accessory sexual gland; *o.p.*, oviducal pore; *s.p.*, spermiducal pore. N.B.—The outline of the accessory glands is represented as more circular than they really are.

FIG. 3—Dissection of the genital region (somewhat diagrammatic). On the right side the blood vessels are shown; on the left the genital organs, which are, of course, paired. Note the shifting backwards of the septa between segments ix/x and x/xi, the limits of which segments are indicated by dotted lines. *c.v.*, commissural vessels; *d.v.*, dorsal blood trunk; *g.*, gizzard; *l.h.*, lateral hearts; *oes.*, oesophagus; *ov.*, ovary; *sp. th.*, spermatheca; *s.s.*, spermsac.

FIG. 4—The rectum, opened to show the rugae of its lining; *b.w.*, body wall; *int.*, intestine; *pcd.*, proctodaeum; *r.*, rectum.

FIG. 5—A spermatheca.

FIG. 6—One of the spermsacs, with its peculiar digitiform outgrowths. *ix*, segment ix. 9-10 septum between the two segments.

FIG. 7—The prostate or spermiducal gland.

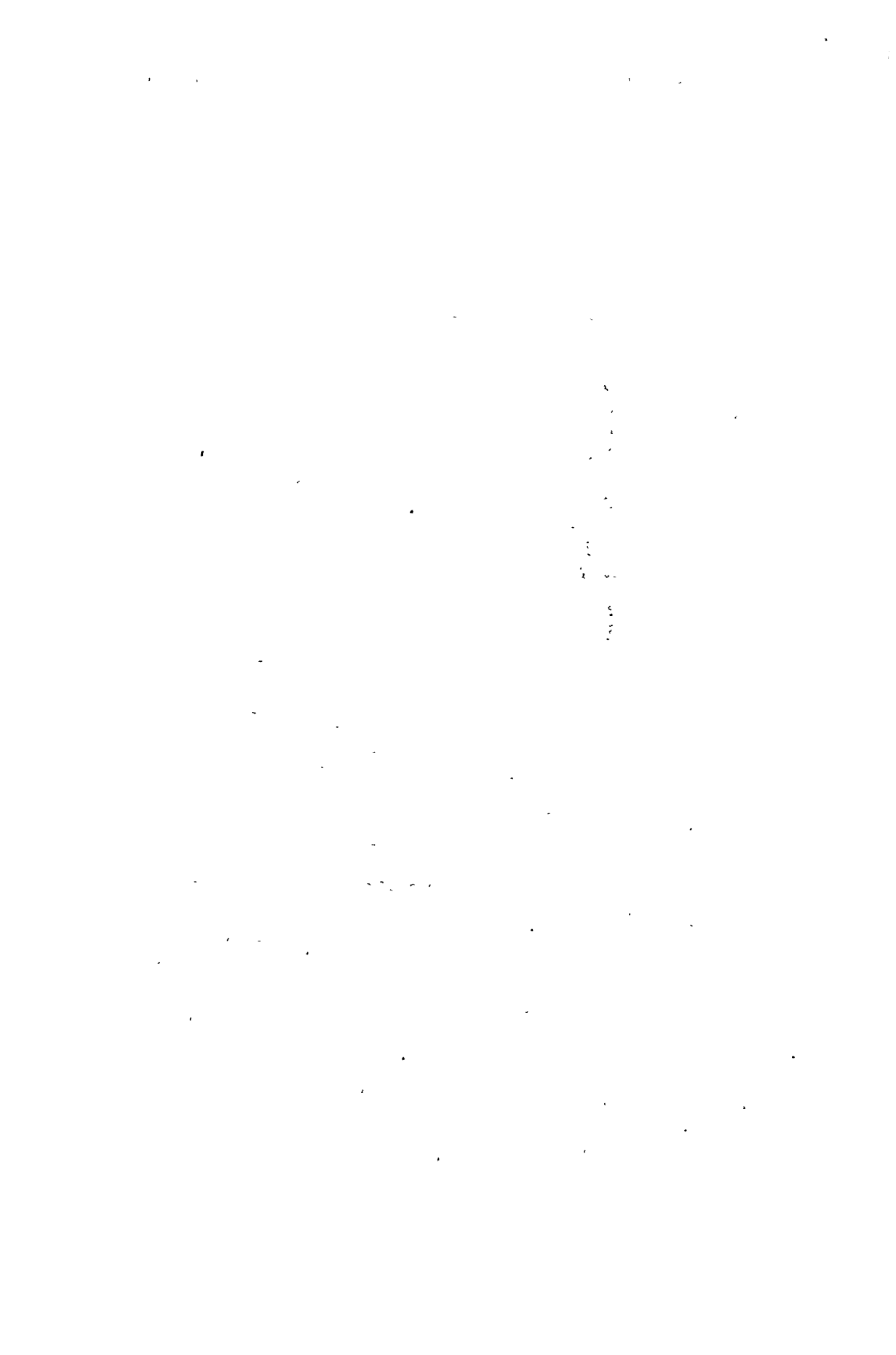
FIG. 8—Longitudinal section of the prostate (the details of the glandular tissue are omitted) showing the diagnostic axial canal, its duct and the spermiducts (*sp.*) entering it. *c.m.*, circular muscles of the body wall; *l.m.*, longitudinal muscles. (A camera outline of the prostate, the ducts are constructed from serial sections.)

FIG. 9—*Tokea esculenta*. Transverse section of prostate; *ax*, axial canal; *b.v.*, blood vessel in its wall.

FIG. 10—*T. esculenta*. A section of the prostate canal showing a group of gland cells entering the axial canal by a "canalicule" or evagination of the epithelium. (Camera outline.)

FIG. 11—The same. Another section of the canal with two "canalicules."

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It will be seen at once that the differences between these two genera are extremely slight, and they have become less and less as research has proceeded and as new or old species have been more carefully anatomised, till the above diagnoses have resulted.

As Stephenson remarks: "The differentiation of the genera is difficult, and however effected is bound to be arbitrary"; later on he writes: "the only reason for keeping the two genera distinct must be one of convenience."

The whole matter is greatly confused, as may be gathered from the amount of space Stephenson gives to the discussion in 1923 on pp. 193 *et seq.* And in regard to *Tokea* he expresses two contradictory opinions in 1930, for on p. 658 he refers to the edibility of "*Tokea* (*Megascolides*)"; while on p. 837 he writes: "*Tokea* must now go into *Notoscolex*," a view adopted also by Michaelsen.

The reason the latter included *Tokea* in *Notoscolex* seems to have been a misunderstanding of my account of the prostate; in spite of the fact that I described and figured a longitudinal dissection of the prostate as being traversed by a single axial canal. It is true that I said that this canal "receives small canalicules around which the gland cells are grouped and into which they open" and referred to Miss Sweet's work and her illustration, so that it should have been evident that what I intended by the term "canalicule" was merely the slight evaginations of the epithelium of the canal wall, rather than definite tubes. It was an unfortunate word to employ, as it certainly, taken by itself, seems to imply "little canals."

I add to the figures illustrating *M. napiereensis* others which show more clearly what I intended to imply. I have again studied transverse sections of this gland in *Tokea esculenta*, which I did not figure in my article of 1905, and these show the so-called "canalicules" as mere evaginations of the epithelium at the point of entry of groups of gland cells. (Figs. 9, 10, 11.)

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