AUSTRALIAN MUSEUM SCIENTIFIC PUBLICATIONS

Jamieson, B. G. M., 1973. Earthworms (Megascolecidae: Oligochaeta) from Mount Kosciusko, Australia. *Records of the Australian Museum* 28(11): 215–252. [12 January 1973].

doi:10.3853/j.0067-1975.28.1973.408

ISSN 0067-1975

Published by the Australian Museum, Sydney

EARTHWORMS (MEGASCOLECIDAE: OLIGOCHAETA) FROM MOUNT KOSCIUSKO, AUSTRALIA

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Figures 1–7

Manuscript received 16th August, 1971

SUMMARY

Earthworms collected for the Australian CSIRO from the Mt Kosciusko region of the Australian Alps are described and the zoogeography of the fauna is discussed. Of the known indigenous elements of the Australian Megascolecidae, Mt Kosciusko lacks Acanthodrilinae but harbours all tribes of the subfamily Megascolecinae, *viz*. the tribes Perionychini, Dichogastrini and Megascolecini. The Perionychini are represented by *Diporochaeta pheretima* sp. nov., *Graliophilus montiskosciuskoi* sp. novd *G. woodi* sp. nov., *Cryptodrilus fastigatus* Fletcher, 1889, *C. tenuis* Fletcher 1889, and by two species of the new genus *Vesiculodrilus*, namely *V. frenchi* (Spencer, 1892) and *V. purpureus* sp. nov. Other species, not from Mt Kosciusko, which are transferred to *Vesiculodrilus* as new combinations, are *Cryptodrilus gippslandicus* Spencer, 1892; *C. hobartensis* Spencer, 1895; *C. insularis* Spencer, 1895; *C. tanjilensis* Spencer, 1892; *Megascolides tisdalli* Spencer, 1900; *Plutellus uncinatus* Stephenson, 1933; *Cryptodrilus victoriae* Spencer, 1900, and *Megascolides volvens* Spencer, 1900. *Diporochaeta pheretima* sp. nov. is considered to have close affinities with *Vesiculodrilus* but must be placed in *Diporochaeta* pending revision of that genus. The Dichogastrini are represented on Mt Kosciusko by *Notoscolex montiskosciuskoi* sp. nov. and the Megascolecini by *Oreoscolex imparicystis* gen. et sp. nov. and *Megascolex celmisiae* sp. nov.

Evidence is presented for restriction of *Graliophilus montiskosciuskoi* to subalpine and alpine zones, a rare phenomenon in the Australian fauna. Zoogeographically the earthworm fauna of Mt Kosciusko has close affinities with surrounding southeastern Australia and its tertiary isolate, Tasmania.

INTRODUCTION

Mount Kosciusko includes the highest peak (7,316 feet) in Australia. It forms part of the Australian Alps, a southerly portion of the Great Dividing Range which extends from Cape York Peninsula to southeastern Australia and re-emerges in Tasmania. It is snow-capped in winter and has formerly been extensively glaciated. It holds particular interest, with other peaks in the Australian Alps, in supporting the only alpine herbfield on the Australian mainland and of thereby having the potentiality to harbour a cold-adapted endemic fauna.

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Although many species of earthworms have been described from New South Wales and Victoria, including parts of the Great Dividing Range (reference in Jamieson, 1971a), none has previously been described from Mt Kosciusko. The only taxonomic account of the Oligochaeta of Mt Kosciusko is that of Benham (1907) describing aquatic oligochaetes from the Blue Lake. All known native Australian earthworms belong to the family Megascolecidae.

In this paper earthworms from Mt Kosciusko collected for the Commonwealth Scientific and Industrial Research Organization by Dr T. G. Wood will be described and their zoogeography discussed. Because much of the material is in poor condition and many specimens were rejected as useless for taxonomic purposes, no attempt is made to estimate the relative abundance of each species in those localities in which it occurs. Some additional material from collections in the Australian Museum, Sydney, is also described. All specimens identified are clitellate or at least have well developed accessory genital markings.

Localities sampled in the CSIRO study are listed in Table 1, in which a numerical code to the localities is given. This code is used in the species-descriptions. Abbreviations for institutions in which collections have been lodged are: A.M. (Australian Museum); B.M. (British Museum); B.J. (author's collections); CSIRO (Department of Soils, Glen Osmond). Abbreviations for specimens are H (holotype); P (paratype) and A (additional specimens not designated types). Explanations of terminology used may be found in Michaelsen (1900) and (nephridia) in Jamieson (1971c).

SYSTEMATICS

Ten species, assignable to the subfamily Megascolecinae *sensu* Jamieson, 1971a, are present in the Mt Kosciusko collections. They are described in alphabetical order under their genera, which, in turn, are grouped according to the tribes to which they belong. A key to the ten species follows. For correct identification agreement with the illustrations cited is required.

KEY TO THE EARTHWORM SPECIES OF MT KOSCIUSKO

1. Nephridia two per segment throughout the body 2

— Nephridia more than two per segment throughout or in all except the caudal segments 6

2. (1) Nephridia with ectal bladders 3

— Nephridia lacking bladders 5

3. (2) Setae more than 8 per segment. Female pore unpaired ..... *Diporochaeta pheretima*, p. 217. Fig. 2C

— Setae 8 per segment. Female pores one pair 4

4. (3) Midventral, postsetal, unpaired accessory genital markings in the region of segments VIII–XI ..... *Vesiculodrilus purpureus*, p. 227. Fig. 2B

— Paired presetal accessory genital markings in line with the ventral setal couples in IX, X–XI ..... *Vesiculodrilus frenchi*, p. 225. Fig. 2A

5. (2) Spermathecae 2 pairs ..... *Graliophilus woodi*, p. 221. Fig. 1A, B

— Spermathecae 5 pairs ..... *Graliophilus montiskosciuskoi*, p. 219. Fig. 4A

6. (1) Nephridia with ectal bladders 7

— Nephridia lacking bladders 8

7. (6) Prostate glands racemose (lobate), the duct branched externally to the gland ..... *Cryptodrilus fastigatus*, p. 229. Fig. 3

— Prostate glands slenderly tubular, with externally unbranched duct..... ..... *Cryptodrilus tenuis*, p. 233. Fig. 4B

8. (6) Setae 8 per segment 9

— Setae more than 8 per segment ..... *Megascolex celmisiae*, p. 242. Fig. 5C

9. (8) Median nephridium on each side with a preseptal funnel in caudal segments. Spermathecae 4 pairs..... *Notoscolex montiskosciuskoi*, p. 236. Fig. 4C

— Caudal nephridia with numerous preseptal funnels in each segment. Spermathecae unpaired, in VIII and IX. . *Oreoscolex imparicystis*, p. 239. Fig. 5B.

Subfamily **MEGASCOLECINAE SENSU** Jamieson, 1971a

Tribe **PERIONYCHINI** Jamieson, 1971a

This is the only group of the Megascolecinae in which holonephridia are present. It was defined as purely holonephric, or with meronephridia in a varying number of segments anterior to holonephridia. Jamieson (1972c) has shown, however, that the genus *Cryptodrilus* has vesiculate meronephridia, a condition previously unknown, and that the genus has perionychin affinities. As there mentioned, erection of a new tribe, the Cryptodrilini, for *Cryptodrilus*, deserves consideration. In the present account *Cryptodrilus* is tentatively included in the Perionychini, as the nephridial vesicles and evidence of setal ratios previously demonstrated indicate close affinity. The definition of the Perionychini given in Jamieson (1971a) must therefore be augmented by the clause "If wholly meronephric, nephridia vesiculate".

Genus **Diporochaeta** Beddard, 1890

Diporochaeta pheretima sp. nov.

Fig. 2C; 6 I, J; 7 I

l = 20 mm, w (midclitellar) = 2.4 mm, s = 70 (apparently an old posterior regenerate). Form circular in cross section, moderately stout; secondary annulation absent. Pigmentless in alcohol excepting the yellowish clitellum. Prostomium broad, epilobous 1/2, open; canaliculi absent. Dorsal pores present but position of first indeterminable owing to damage. Setae perichaetine, commencing on II; 12l/12r in V, XII and XX; 14l/14r 10 segments from posterior end; setal lines mostly regular; the setal ring clearly interrupted in the ventral midline (*aa* ≒ 2 *ab*) but no significant interruption occurring mid-dorsally (*zz* ≒ *yz*).

Nephropores small but readily seen, at the anterior margins of their segments in a single straight series on each side, first certainly visible in III (shortly behind intersegment 2/3); ventrolaterally situated, in line with the 6th seta from the ventrum in III–V, the 7th seta in VI as far as the caudal region; and the 8th seta in the latter region.

Clitellum strongly protuberant; sharply demarcated anteriorly and posteriorly; annular, embracing XIV–XVI; dorsal pores, intersegmental furrows, setae and nephropores retained, although the intersegments are not as distinct as elsewhere.

Male pores equatorial in *b* lines of XVIII, each on a circular moderately protuberant porophore which fills the segment longitudinally. Accessory genital markings a pair of small approximately circular presetal areas with pore-like centre, in each of segments VII, VIII and IX in *ab;* a midventral pit at the hind border of the clitellum, in 16/17, with tumid posterior margins extending to include setae *a;* a midventral transverse elliptical depressed area, in each of intersegmental furrows 17/18 and 18/19, extending lateral of *a* lines, each crossed by the furrow. Female pore unpaired, midventral on a slight prominence shortly presetal in XIV. Spermathecal pores not externally visible (see internal anatomy).

Some preprostatic septa thickened, none strongly. Last septal (pharyngeal) glands in IV but projecting over the oesophagus in V. Dorsal blood vessel single; last hearts in XII; supra-oesophageal vessel present (visible at least in XII); no subneural vessel detectable. Nephridia stomate, exonephric, vesiculate holonephridia throughout, the first nephridial body in II; the bladder a long, wide, convoluted tube changing little in form throughout the body.

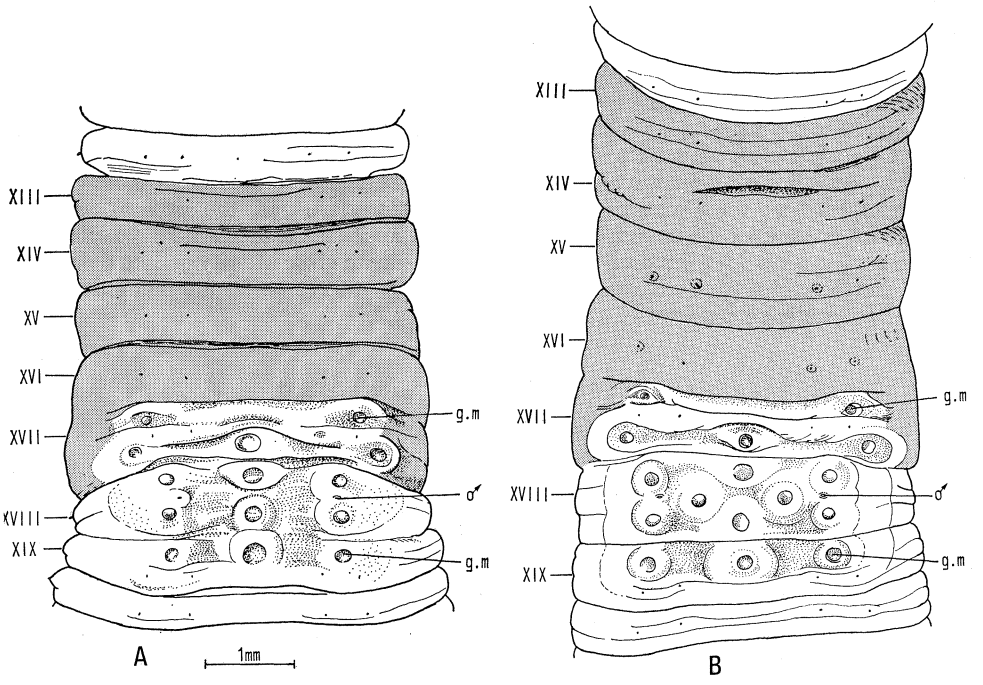

Figure 1.—Male genital fields of *Graliophilus woodi* sp. nov. A, holotype, 19/2. B, paratype 1, 19/6. By camera lucida. Clitellum shaded.

The following abbreviations are used in all the figures in this Record: ♀, female pore; g.m, accessory genital marking; ♂, male pore; ♂, po, male porophore; n.d, nephridial duct; n.ves, nephridial vesicle; np, nephropore; pr.d, duct of prostate; pr.g, glandular portion of prostate; sp. amp, spermathecal ampulla; sp.d, spermathecal duct; sp.div, spermathecal diverticulum; sp.p, spermathecal pore; v.d, vas deferens; v.n.c, ventral nerve cord. Numerals given after specimen or field-type identifications (e.g., 19/1) refer to localities of CSIRO samples.

Oesophagus in IV thin-walled but dilated; in V forming a small, readily compressible gizzard with muscular but not strongly thickened transparent walls. Oesophagus simple in VI-IX; widened and with circumferential vascular striae in X–XII; much dilated and with thick, deep, wavy longitudinal internal rugae in XIII and XIV; narrower but still rugose in XV; thin-walled and dilated but not internally rugose in XVI–XVII; intestine beginning anteriorly in XVIII, but the wide, well developed oesophageal valve evaginated into the cavity of the oesophagus in XVII; intestine not, however, widening and not thin-walled until anterior XXI; thereafter spiral; typhlosole and caeca absent.

Testes, copious sperm masses and large almost globular iridescent sperm funnels in X and XI; relatively very large racemose seminal vesicles in IX and XII, the posterior pair the larger. Ovaries large, laminar, consisting of several fused and separate egg chains, and large fleshy funnels in XIII; the oviducts entering the parietes separately; ovisacs absent. Prostates very thickly and indistinctly tubular; almost racemose in appearance, as the few coils of the gland are poorly demarcated; the gland in XVII–XIX; the duct of each fairly long and, excepting entally, with a muscular sheen. Penial setae 6 in the left bundle, each hair-like and flexible, with a few short stout spines scattered sparsely along the ectal extremity; greatest length (following the curvature) = 1.2 mm, greatest width (near base) ÷ 10 μ.

Spermathecae 5 pairs opening anteriorly in their segments in *b* lines, each with a slender, clavate to widely sacciform ampulla and a somewhat larger duct which receives a subspherical almost sessile inseminated uniloculate diverticulum laterally near its ental end; anterior spermathecae more slender than the posterior but length approximately the same; length right spermatheca of IX = 0.8 mm; ratio total length: length duct = 1.8; ratio total length: length diverticulum = 3.0.

Material examined: 12/3 Holotype (A.M., W. 4727).

Remarks: Diporochaeta pheretima, so named because of its striking external resemblance to species of the megascolecin genus *Pheretima*, including the unpaired intraclitellar female pore and trisegmental clitellum, shows clear affinities with some vesiculate species of *Diporochaeta* from neighbouring Victoria. Differences from them include the genital fields and it is the only species of *Diporochaeta* with a single female pore. The heterogeneity of the genus is discussed by Jamieson 1971c.

Resemblance of *D. pheretima* to species of *Perionyx* is also close, and includes the unpaired female pore, but in *Perionyx* the spermathecae lack diverticula.

Genus **Graliophilus** Jamieson, 1971e

Graliophilus montiskosciuskoi sp. nov.

Fig. 4A; 6A, C; 7A

l = 42 mm, w (midclitellar) = 4.5 mm, s = 77. Form moderately stout, circular in cross section excepting the male genital region. Pigmentless in alcohol. Prostomium tanylobous with very indistinct lateral margins, acute. Dorsal canalicula absent throughout the body. First dorsal pore 4/5. Setae in 8 regular longitudinal rows throughout, commencing on II.

INTERSETAL DISTANCES IN SEGMENT XII

IN *Graliophilus montiskosciuskoi*

	aa		ab		bc		cd	
	mm	st	mm	st	mm	st	mm	st
Holotype	1.19	11.22	0.32	2.97	1.79	16.83	1.05	9.90
interval/ab ..		3.78		1.00		5.67		3.33

	dd		dc		cb		ba	
	mm	st	mm	st	mm	st	mm	st
Holotype	3.33	31.35	0.98	9.24	1.65	15.51	0.32	2.97
interval/ab ..		10.56		3.11		5.22		1.00

Clitellum annular XIV–XVII, strongly tumid but narrower than the forebody; dorsal pores, intersegmental furrows and setae distinctly visible. Male pores minute on small medianly confluent papillae, each pore located median to *a* line and visible by virtue of an externally projecting penial seta; flanked laterally by a tumescence which extends almost to *c* line. Accessory genital markings present intersegmentally in 17/18–21/22, consisting of pairs of eye-like markings in *a* lines with tumid anterior and posterior lips which extend longitudinally to unite with those of adjacent segments and are confluent medianly so as to form transverse midventral tumid bands; the eye-like centres clearly visible in 19/20–21/22 not detected with complete certainty in 17/18 and 18/19 although tumid lips are present adjacent to these furrows; those in XVIII forming the already mentioned tumescences lateral to the male pores. Additional accessory genital markings present in segments IX to XII, each consisting of a very strongly protuberant unpaired midventral transverse pad which laterally extends almost to setae *b*, the anterior pad leaving the anterior third of segment IX free. Female pores inconspicuous in XIV, anteromedian to setae *a* at approximately 1/3 *aa*, both in a common transverse field. Spermathecal pores 5 pairs on inconspicuous papillae well median to *a* lines, in 4/5–8/9.

Septa 10/11 and 11/12 fairly strongly thickened; 12/13 and 13/14 moderately but decreasingly thickened; other septa slightly thickened or thin. Last septal glands anterior in IV.

Dorsal blood vessel single, continuous onto the pharynx; commissural vessels heart-like only in X–XII, in which they form 3 pairs of latero-oesophageal hearts, each of which receives a connective from the dorsal vessel and one from the supra-oesophageal vessel; the latter vessel slender, present in IX–XII. A pair of latero-oesophageal vessels extending from the pharynx to VIII median to the commissural vessels becomes suboesophageal by IX.

Gizzard very large and firmly muscular, almost cylindrical though widening slightly anteriorly; restricted to V but displacing posterior septa so that its posterior end lies approximately at the level of intersegment 9/10, oesophagus supressed by it

until VIII in which it is well developed although slender. Oesophagus moderately expanded, moniliform and with circumferential vascular striae in IX to XIV; similar although narrower and apparently less vascularized in XV and XVI; intestine commencing gradually in XVII. No typhlosole detectable but maceration precludes certainty that it is absent.

Nephridia stomate holonephridia commencing in III; ducts avesiculate, penetrating the parieties in *c* lines; tufted nephridia absent.

Testes and iridescent seminal funnels free in X and XI; seminal vesicles racemose in IX and XII. Ovaries not recognizable; ovisacs absent.

Prostates a single pair, thickly tubular, describing several coils laterally from the ducts and restricted to XVIII; ducts sinuous and muscular, bulbous ectally; vasa deferentia of each side joining the prostate gland considerably ental of the duct. Penial setae present in XVIII; that on the right moderately stout, almost straight though slightly bowed entally; tapering to a fine point which is terminally, however, hollowed out and widened in the form of a spatula; ornamentation restricted to a few anteriorly directed spines on the curved side of the profile near the ectal end (only two spines distinguishable with certainty). Length = 575 μ; greatest width of shaft = 10 μ.

Spermathecae 5 uniform pairs, discharging anteriorly in segments V–IX, each with an elongate ovoid to sacciform ampulla and a short, poorly muscularized duct which bears a lateral digitiform, slightly clavate diverticulum near its junction with the ampulla; length of the left spermatheca of IX = 1.8 mm; ratio of total length : length duct = 3.3; ratio of total length : length diverticulum = 3.6.

Material examined: 9/1 Holotype (A.M., W. 4740).

Remarks: This species, which formerly would have been placed in *Plutellus*, is not congeneric with the type-species of the latter genus (see Jamieson, 1971d) but is placeable in *Graliophilus*, a genus erected by Jamieson (1972b) for Western Australian plutelloids. It is nearest to the *georgei*-species group but differs from all species currently referred to *Graliophilus* in having 5 pairs of spermathecae. The genital field distinguishes it from all other oligochaete species.

Graliophilus woodi sp. nov.

Fig. 1A, B; 6B; 7B

External morphology (Holotype and paratypes indicated):

l = 60–85 mm (mean of 5 = 77 mm), w (midclitellar) = 4–4.5 mm (mean of 5 = 4.2 mm), s = 147–151 (mean of 4 = 149). Form circular in cross section, blunt and very slightly clubbed at anterior and posterior ends, segments of the forebody at first simple, then biannulate but mostly triannulate; postclitellar segments weakly triannulate. Pigmentless in alcohol excepting the pale brown pigmented clitellum. Prostomium broadly tanylobous, parallel sided, bisected longitudinally by a moderately developed dorsal furrow which is not continuous onto the body (holotype and 5 paratypes). First dorsal pore 5/6, but probably not perforate until 6/7 (holotype and 4 paratypes), or doubtfully perforate at 6/7 but perforate at 7/8 (1 paratype). Setae in 8 regular longitudinal rows throughout, commencing on II; setae *a* and *b* absent in XVIII (holotype and 7 paratypes).

INTERSETAL DISTANCES IN SEGMENT XII

In *Graliophilus woodi*

Nephropores faintly visible in *c* lines near the anterior margins of their segments (holotype and 5 paratypes). Clitellum annular, well developed although not strongly protuberant, weaker on XIII than elsewhere; intersegmental furrows, setae and nephropores retained; dorsal pores obscured (holotype and 5 paratypes).

	aa		ab		bc		cd	
	mm	st	mm	st	mm	st	mm	st
Holotype	1.44	13.53	0.39	3.63	1.26	11.88	1.12	10.56
Paratype 1 ..	1.33	12.42	0.42	3.92	1.19	11.11	1.19	11.11
2 ..	1.40	11.87	0.53	4.45	1.37	11.57	1.33	11.28
3 ..	1.58	12.47	0.53	4.16	1.58	12.47	1.30	10.25
4 ..	1.44	12.81	0.53	4.69	1.30	11.56	1.12	10.00
5 ..	1.33	9.84	0.63	4.66	1.65	12.18	1.33	9.84
6 ..	1.44	13.02	0.39	3.49	1.40	12.70	1.09	9.84
7 ..	1.40	12.50	0.35	3.13	1.54	13.75	1.02	9.06
mean		12.31		4.02		12.15		10.24
interval/ab ..		3.06		1.00		3.02		2.55

	dd		dc		cb		ba	
	mm	st	mm	st	mm	st	mm	st
Holotype	3.54	33.33	1.12	10.56	1.26	11.88	0.49	4.62
Paratype 1 ..	3.79	35.29	1.09	10.13	1.30	12.09	0.42	3.92
2 ..	4.07	34.42	1.26	10.68	1.33	11.28	0.53	4.45
3 ..	4.25	33.52	1.33	10.53	1.58	12.47	0.53	4.16
4 ..	3.93	35.00	1.12	10.00	1.30	11.56	0.49	4.38
5 ..	5.12	37.82	1.19	8.81	1.65	12.18	0.63	4.66
6 ..	3.79	34.92	1.16	10.48	1.40	12.70	0.39	3.49
7 ..	4.00	35.63	1.02	9.06	1.54	13.75	0.35	3.13
mean		34.99		10.03		12.24		4.10
interval/ab ..		8.70		2.50		3.04		1.02

Male pores minute on XVIII, in *ab*. Circular pore-like accessory genital markings with tumid borders have a variable configuration, but in the holotype and 6 paratypes studied in detail the following arrangement was constant (illustrated): a pair anterior to, and a pair posterolateral to setae *b* of XVII; presetal and postsetal in *ab* of XVIII; presetal in *ab* of XIX; four midventral, unpaired markings present: postsetal in XVII, pre- and post-setal in XVIII and presetal in XIX. The greatest development of the field is seen in paratype 5 (locality 18); in addition to the constant arrangement this has a postsetal triplet in XVI and in XX; a presetal midventral marking in XVII, a unilateral (left) presetal marking in XVI and 2 additional, equatorial markings on each side in XVIII, one median to, the other lateral to, the male pores; in addition, the left-presetal and postsetal paired marking in XVII is replicated. None of the other 6 specimens has as full a development or shows any significant departure from this arrangement. A further paratype is, however, exceptional in lacking the paired presetal markings in XVII which are constant in

the type-specimens described above. Female pore(s?); precise location indeterminable, situated in a transverse groove spanning *aa;* apparently single and midventral in paratype 1. Spermathecal pores minute, on 2 pairs of inconspicuous low papillae in 7/8 and 8/9 in *a* lines (holotype and 5 paratypes).

Internal anatomy (holotype, H, and paratypes P1 and 6).

Septa: 5/6 very delicate, attenuated by backward extension of the gizzard; 6/7 thin; 7/8 moderately thickened, 8/9–12/13 fairly strongly; 13/14–16/17 decreasing from moderately to slightly thickened; the remainder thin. Last septal glands filling III; perhaps extending slightly into IV.

Dorsal blood vessel single, continuous onto the pharynx. Dorsoventral commissural vessels in VII (or further anteriorly?) –XII; those in IX forming slender dorsoventral hearts; those in X–XII forming 3 pairs of moderately wide latero-oesophageal hearts, each arising from the dorsal vessel and receiving a slender connective from the supra-oesophageal vessel. Supra-oesophageal vessel occupying VII–XII (H); observed with certainty only in X–XII in the paratype. Subneural

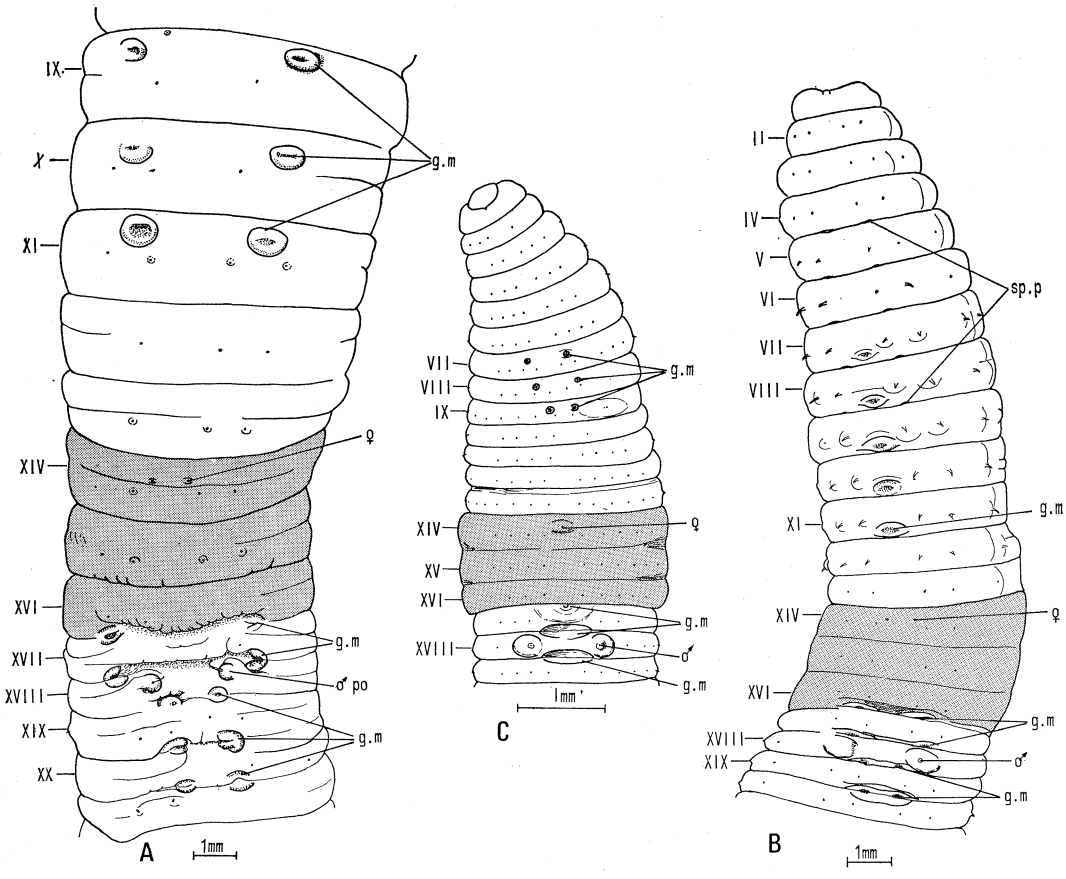

Figure 2.—Genital fields of: A, *Vesiculodrilus frenchi* (Spencer, 1892), specimen 1, 17/2. B, *Vesiculodrilus purpureus* sp. nov., holotype, 5/1. C, *Diporochaeta pheretima* sp. nov., holotype, 12/3. By camera lucida. Clitellum: haded.

vessel absent. Gizzard large and strongly muscular, in V, widening anteriorly to a rim-like expansion which is continuous with a thin walled crop-like proventriculus in IV. Oesophagus supressed in VI by backward extension of the gizzard; evidently vascularized and slightly moniliform in VIII–XVI; widest in XV and, especially, XVI but never conspicuously modified or enlarged; narrow in XVII and XVIII (H, P1). Vascularized part with internal rugae which are thinner and more laminar in XV and XVI (P6, holotype not sectioned). Intestine commencing at 1/2 XVIII, not greatly enlarged until XIX. A rather low narrow (laminar) convoluted dorsal typhlosole visible from XXI in the holotype or XIX in paratype 2.

Nephridia avesiculate simple holonephridia throughout; the post-septal bodies commencing in III; preseptal funnels demonstrated from XIV but presumably present further anteriorly; ducts entering the parietes in c lines throughout, with the exception (P1) that the ducts of those in III pass forwards to enter the parietes anteriorly in II above *d* lines.

Testes large iridescent sperm funnels and sperm masses free in X and XI. Seminal vesicles small, elongate-ovoid on the posterior wall of IX; elongate sacs curving dorsally around the gut on the anterior wall of XII; slightly lobulated. Ovaries (extensive laminae with many conjoined chains of large oocytes) and funnels in XIII; ovisacs absent in holotype but present, pendant posteriorly from septum 13/14, separate from the oviducal funnel, in paratype 1. Prostates compactly coiled, dorsoventrally depressed, tubular, restricted to XVIII; duct narrow, muscular and tortuous; each joined entally by the two vasa deferentia of its side.

Penial setae absent. Genital markings corresponding internally with large, rounded sessile glandular masses.

Spermathecae 2 pairs, discharging anteriorly in VIII and IX; each with an elongate-ovoid ampulla and slightly longer, poorly demarcated narrow duct which is joined entally by a clavate anteriorly directed diverticulum. Size uniform; length (right spermatheca of IX, holotype) = 3.7 mm; ratio total length: length duct = 1.8; ratio total length: length diverticulum = 5.1.

Material examined: *14* P9, A1; *17/1* P3, 4; *17/2* P5; *17/3* P6 (schizoparatype); *17/4* A1; *18* P7, 8 A3; *19/2* Holotype; *19/6* P1; *21* P2. (H, A.M., W. 4701; P1–5, A.M., W. 4696–4700; P7, 8, B.M.; P6, 9, A, B.J.; A, CSIRO).

Remarks: The genital field of this species distinguishes it from all other species assignable to *Plutellus* s. lat. The combination of other characters is also unique. Although it is placeable in the genus *Graliophilus* Jamieson, 1971e, it does not conform precisely with the difinitions of any of the species-groups, all from Western Australia, which have been recognized in that genus.

Genus **Vesiculodrilus** nov.

Setae 8 per segment. Combined pores of vasa deferentia and a pair of tubular prostates on XVIII. Gizzard in V; extramural calciferous glands absent although the oesophagus may be dilated and vascularized; typhlosole absent. Nephridia stomate, exonephric, holonephridia with large ectal bladders in a single longitudinal

row on each side, in *c* lines; those in the first few segments sometimes tufted but retaining the bladder (and nephrostome?). Spermathecae 5 pairs, with single, uniloculate diverticula.

Distribution: Kosciuskan Division, Southern Faunal Province of Australia. Tasmania.

Type-Species: Cryptodrilus frenchi Spencer, 1892.

Other Species: Cryptodrilus gippslandicus Spencer, 1892; *C. hobartensis* Spencer, 1895; *C. insularis* Spencer, 1895; *Vesiculodrilus purpureus* sp. nov.; *C. tanjilensis* Spencer, 1892; *Megascolides tisdalli* Spencer, 1900; *Plutellus uncinatus* Stephenson, 1933; *Cryptodrilus victoriae* Spencer, 1900; *Megascolides volvens* Spencer, 1900.

Remarks: Definition of *Vesiculodrilus* is restricted above to a brief diagnosis as an account of the genus, with a revision of its species, is in preparation. These species were formerly assignable to *Plutellus* (see Jamieson, 1971c).

Australian genera resembling *Vesiculodrilus* in having nephridial bladders in a single straight line on each side are *Diporochaeta* (part.) Beddard, 1890 and *Fletcherodrilus* Michaelsen, 1891. *Diporochaeta* is distinguished in being perichaetine. The anatomy of the type-species, *D. intermedia* (Beddard, 1888), from New Zealand, with calciferous glands in X and XI and intestine commencing in XV, precludes placing the species here referred to *Vesiculodrilus* in *Diporochaeta*. Nevertheless, some vesiculate, Australian species of *Diporochaeta* s. lat. including *D. pheretima*, show close affinities with *Vesiculodrilus*. *Fletcherodrilus* differs from *Vesiculodrilus* in the very large ratio *dd: u* (approx. 0.5), midventral unpaired spermathecal and male pores and the remarkably dorsal location of the nephropores (in *d* lines).

Vesiculodrilus frenchi (Spencer, 1892)

Fig. 2A

Cryptodrilus frenchi Spencer, 1892: 135–136, Pl. XIV, fig. 10, 11, 12; Pl. XIX, fig. 66.

Megascolides frenchi; Beddard, 1895; 493.

Plutellus frenchi; Michaelsen, 1900: 175; Sweet, 1900: 116; Jamieson, 1971c: 87.

External morphology:

l = 122 mm; w (midclitellar) = 6 mm; s = 112 (specimen 4). Form circular in cross section throughout, moderately stout; segments after the first 2 or 3 biannulate; a faint dorsal canalicula present in the forebody. Peristomium bifid ventrally. Pigmentless buff in alcohol. Prostomium tanylobous, dorsal tongue narrow and parallel-sided and canaliculate; first dorsal pore 3/4 (imperforate); 4/5 perforate (Specimens 1–3). Setae in 8 longitudinal rows, commencing on II; all rows irregular at the caudal extremity; setae *a* and *b* replaced by penial setae in XVIII (4 specimens).

INTERSETAL DISTANCES IN SEGMENT XII

In *Vesiculodrilus frenchi*

	aa		ab		bc		cd	
	mm	st	mm	st	mm	st	mm	st
Specimen .. 1 ..	1.79	9.29	1.07	5.58	2.00	10.41	2.14	11.15
2	2.00	9.93	1.00	4.96	2.14	10.64	2.29	11.35
3	1.93	9.75	1.07	5.42	2.21	11.19	2.21	11.19
4	1.86	10.35	0.88	4.88	1.82	10.16	1.82	10.16
mean		9.83		5.21		10.60		10.96
interval/ab ..		1.89		1.00		2.03		2.10

	dd		dc		cb		ba	
	mm	st	mm	st	mm	st	mm	st
Specimen .. 1 ..	7.00	36.43	2.14	11.15	2.00	10.41	1.07	5.58
2	7.14	35.46	2.29	11.35	2.29	11.35	1.00	4.96
3	6.86	34.66	2.21	11.19	2.21	11.19	1.07	5.42
4	7.05	39.26	1.82	10.16	1.82	10.16	0.88	4.88
mean		36.45		10.96		10.78		5.21
interval/ab ..		7.00		2.10		2.07		1.00

Nephropores not externally visible. Clitellum annular, XIV–XVI; intersegmental furrows and setae retained; dorsal pores absent. Male pores equatorial in *ab* of XVIII, on fairly small but strongly protuberant papillae; a penial seta projecting from each pore. Five pairs of intersegmental genital markings present: in *b* lines in 16/17 and 17/18 and in *a* lines in 18/19, 19/20 and 20/21 (specimens 1–3). Three pairs of oval-oblong genital markings present a pair in each of segments IX–XI, presetally in *ab;* each marking with narrow raised margins; these markings present only in X and XI in specimens 2 and 3 and unilateral only, on the right, in 3. Female pores, on slight swellings, shortly anteromedian of setae *a* of XIV. Spermathecal pores minute, inconspicuous, 5 pairs in 4/5–7/8, at the anterior margins of their segments in *a* lines.

Internal anatomy (Specimen 4):

Septa: 4/5 thin; 5/6 slightly thickened; 6/7 moderately; 7/8–13/14 strongly thickened; 14/15 and 15/16 slightly thickened; the remainder thin. Last septal (pharyngeal) glands in IV. Dorsal blood vessel single, continuous onto the pharynx. Dorsoventral commissural vessels in V–XII; those in V–IX slender and dorsoventral only, each giving a lateral branch to the parietes before joining the ventral vessel; sufficiently enlarged in IX to be termed hearts; those in X–XII forming 3 pairs of large latero-oesophageal hearts, each arising from the dorsal vessel and receiving a connective from the supra-oesophageal vessel but not branched ventrally. Supra-oesophageal vessel in IX–XIII; very thin in XIII but elsewhere almost as wide as the dorsal vessel; distinct from the oesophagus. Latero-oesophageal vessel on each side of the gut observable in IV to IX, becoming sub-oesophageal in IX. Subneural vessel absent.

Oesophagus thin-walled and moderately wide in IV; gizzard large and strongly muscular though easily compressible, in V, widening to a rim like anterior expansion. Oesophagus slender and intersegmentally slightly constricted in VI–VIII; wider and evidently vascularized in IX–XV; much elongated and sinuous in XIV and XV; narrow, long and non-vascular in XVI; intestine commencing and about twice as wide as oesophagus in XVII; typhlosole absent. Nephridia stomate, vesiculate holonephridia throughout, postseptal bodies commencing in II; bladder elongate-ovoid narrowing ectally to a slender stalk (terminal duct) which enters the parietes presetally in *c* lines; the bladder receiving the slender nephridial tubule slightly subterminally. Nephridia of II and III appearing more coiled than elsewhere but not tufted and not notably enlarged. Testes, iridescent sperm funnels and sperm masses free in X and XI; seminal vesicles 3 pairs, on the posterior walls of IX and X and the anterior wall of XII, decreasing in size posteriorly; slightly lobulated; those in IX elongated dorsoventrally but sessile on the septum throughout their lengths. Ovaries consisting of a few chains of small oocytes in XIII; oviducal funnels not visible; ovisacs absent. Prostates one pair, tubular, compact and much wound, occupying XVII–XIX; the slender convoluted muscular duct restricted to XVIII. Penial setae (right seta of specimen 4) slightly bowed, tapering to a fine point, the ectal region of the shaft bearing a few anteriorly directed inconspicuous spines produced by notching of the margins, widely spaced lengthwise and not forming circlets; length = 1.6 mm, maximum width (near base) = 15 μ. Spermathecae 5 pairs, basically elongate ovoid with short, poorly demarcated duct which is joined entally by a small shortly clavate iridescent diverticulum; the right spermatheca of VII aberrant, having several small supernumerary pouches which are non iridescent and apparently ampullary.

Material examined: *17/1*, 1 (specimen 4) (CSIRO); *17/2*, 3 (specimens 1–3) (A.M., W. 4691–4693); *17/3*, 2 (B.J.).

Wider distribution: Croajingolong (East Gippsland) (Spencer, 1892).

Remarks: Agreement with the type description (Spencer, 1892) is close. Differences in Spencer's description from the Mt Kosciusko specimens are: the epilobous prostomium; spermathecal pores apparently in *ab;* restriction of accessory genital markings to X and XI; location of the posterior markings of XVIII in *ab* and extension of markings to 21/22, and restriction of seminal vesicles to IX and XII.

Vesiculodrilus purpureus sp. nov.

Fig. 2B; 6D; 7C, H.

External morphology (Holotype, H, and 2 paratypes, P1 and 2, unless otherwise stated):

l = 65 mm, w (midclitellar) = 4.5 mm, s = 111 (H). Form circular in cross section throughout with no conspicuous secondary annulation. Purplish brown pigmentation present dorsally. Dorsal canalicula present in the hindbody (H, P1). Prostomium narrowly epilobous 3/4 (P1). First dorsal pore 3/4 (H, P1). Setae in 8 regular longitudinal rows throughout, commencing on II; *a* and *b* absent in XVIII.

INTERSETAL DISTANCES IN SEGMENT XII

In *Vesiculodrilus purpureus*

	aa		ab		bc		cd	
	mm	st	mm	st	mm	st	mm	st
Holotype	1.23	11.29	0.74	6.77	1.37	12.58	1.09	10.00
Paratype 1 ..	1.07	10.34	0.57	5.52	1.29	12.41	1.07	10.34
Paratype 2 ..	1.02	9.29	0.67	6.09	1.33	12.18	1.37	12.50
mean		10.31		6.13		12.39		10.95
interval/ab ..		1.68		1.00		2.02		1.79

	dd		dc		cb		ba	
	mm	st	mm	st	mm	st	mm	st
Holotype	3.26	30.00	1.09	10.00	1.37	12.58	0.74	6.77
Paratype 1 ..	3.29	31.72	1.14	11.03	1.36	13.10	0.57	5.52
Paratype 2 ..	3.19	29.17	1.37	12.50	1.33	12.18	0.67	6.09
mean		30.30		11.18		12.62		6.13
interval/ab ..		4.94		1.82		2.06		1.00

Nephropores minute, faintly visible anteriorly in their segment in *c* lines, commencing on II. Clitellum annular, XIV–XVI, strongly tumid, intersegmental furrows fainter than elsewhere, dorsal pores suppressed at 14/15 and 15/16, setae clearly visible; faint glandularity of the posterior two thirds of XIII may be clitellar modification. A pair of combined male and prostatic pores equatorial in XVIII in *ab* on low papillae which fill *ab* and the length of the segment. Paired eye-like accessory genital markings present in 16/17 in *ab* nearer *a*, in 17/18 in mid *ab*, 18/19 slightly median to *a* and in 19/20 further medianly, the two markings in each furrow medianly contiguous, and those in 19/20 broadly united. Additional markings (H, P2) consisting of midventral, postsetal elliptical protuberances with depressed centres one in each of segments VII–XI (X and XI in paratype 1, anterior segments amputated). Female pores minute, anteromedian of setae *a* of XIV. Spermathecal pores 5 pairs of minute depressions in 4/5–8/9 in *a* lines.

Internal anatomy (Holotype; gross anatomy confirmed in the paratypes):

Septa 5/6 thin, 6/7 and 7/8 moderately thickened (7/8 the stronger); 8/9–13/14 strongly thickened, 12/13 the strongest; 13/14 and 14/15 slightly thickened, the remainder thin. Last septal glands in IV(?) but enveloping the gizzard in V.

Dorsal blood vessel single, traced to the brain. Dorsoventral commissural vessels in VI–XII; those in VI–IX slender and dorsoventral only; those in X–XII forming 3 pairs of large latero-oesophageal hearts, each receiving a connective from an indistinct supra-oesophageal vessel and from the dorsal vessel. Supra-oesophageal indistinct, only distinguishable from the oesophageal vascularization in X–XII. Nephridia stomate vesiculate exonephric holonephridia throughout (the single, preseptal funnels of the nephridia of III posteriorly recognizable in the segment anterior to the nephridial body; nephridia of II each with a neck to the anterior incomplete septum and funnel presumably present though not demonstrable).

Anterior bladders elongate-ovoid, becoming progressively more elongate an donce bent, the bend sometimes projecting medianly but no true diverticulum present; slender ectal duct of nephridium joining the apex of the bladder or very slightly subapical; bladders again shorter (elongate-ovoid) in caudal segments; tufted nephridia absent.

Gizzard in V though displacing septa to approximately 1/2 VIII, strongly muscular but slender and easily compressible. Oesophagus in VI–VIII moniliform, thin-walled and not evidently vascularized; in IX–XV more swollen, moniliform and with conspicuous circumferential vascular striae; slender and appearing non-vascularized in XVI. Intestine beginning abruptly, with well developed oesophageal valve, in XVII; typhlosole and muscular thickening absent. Testes, sperm masses and very large iridescent funnels free in X and XI; seminal vesicles in IX and XII, those in IX ovoid and undivided; those in XII elongate and transversely incised. Ovaries, large, tongue-like with many large oocytes, and funnels in XIII; ovisacs absent. Prostates thickly tubular, winding posteriorly from XVIII to XXII; each with a long sinuous muscular duct; vas deferens joining the gland well ental of the duct. Penial setae present (H, P1); the right seta of paratype 1 very slender, almost straight, drawn out to a delicate point, ornamented ectally with three widely spaced sets of two or three coarse spines. Length 1.44 mm, greatest width (near base) 10 μ.

Spermathecae 5 pairs, discharging anteriorly in their segments, each with a slender, clavate ampulla, a shorter duct and a bulbous narrow-stalked inseminated diverticulum joining the ental end of the duct; size uniform, length of the right spermatheca of VIII = 2.2 mm; ratio of total length: length duct = 4.2; ratio of total length: length diverticulum = 3.2.

Material examined: *5/1* Holotype (A.M., W. 4695); *5/9* Paratype *1* (B.J.); *13/2/B* Paratype 2(CSIRO).

Remarks: In having midventral, unpaired accessory genital markings in anterior segments, this species resembles *V.* (= *Cryptodrilus*) *victoriae* (Spencer, 1892), from which, however, it differs in the postsetal location of the markings and in the form of the penial setae (strongly hooked in a paralectotype of *victoriae*, Nat. Mus. Vict. G. 1410). It also closely resembles *V. frenchi* (Spencer, 1892), described above, but differs from that species in the unpaired condition of the anterior accessory genital markings and, their postsetal location. With the doubtful exception of *dd*, setal ratios in samples of *V. frenchi* and *V. purpureus* from Mt Kosciusko do not appear to differ significantly but the small number of specimens precludes rigorous demonstration of this.

Genus **Cryptodrilus** Fletcher, 1889

Cryptodrilus fastigatus Fletcher, 1889

Fig. 3

Cryptodrilus fastigatus; Fletcher, 1889a: 1541–1543.

Trinephrus fastigatus; Beddard, 1895: 483; Michaelsen, 1900: 185.

Cryptodrilus fastigatus; Jamieson, 1972b:161–166, fig. 5A, B; 6A, B; 7A.

Augmented diagnosis: Prostomium tanylobous. First dorsal pore 4/5. Setae in 8 regular longitudinal rows throughout; *aa: ab: bc: cd: dd: u* = 10.8: 7.2: 12.4: 16.6: 16.8:100 (mean of 5, Illawarra–Burrawang population); 14.1: 6.7:12.1: 15.8:16.7:100 (mean of 71, Mt Kosciusko population) (see p. 232). Nephropores in *a*, *c* and *d* lines in each segment, commencing anteriorly in II. Clitellum annular, XIV–XVII. A pair of combined male and prostatic pores, on small papillae, in the setal arc in XVIII, shortly lateral of *a* lines.

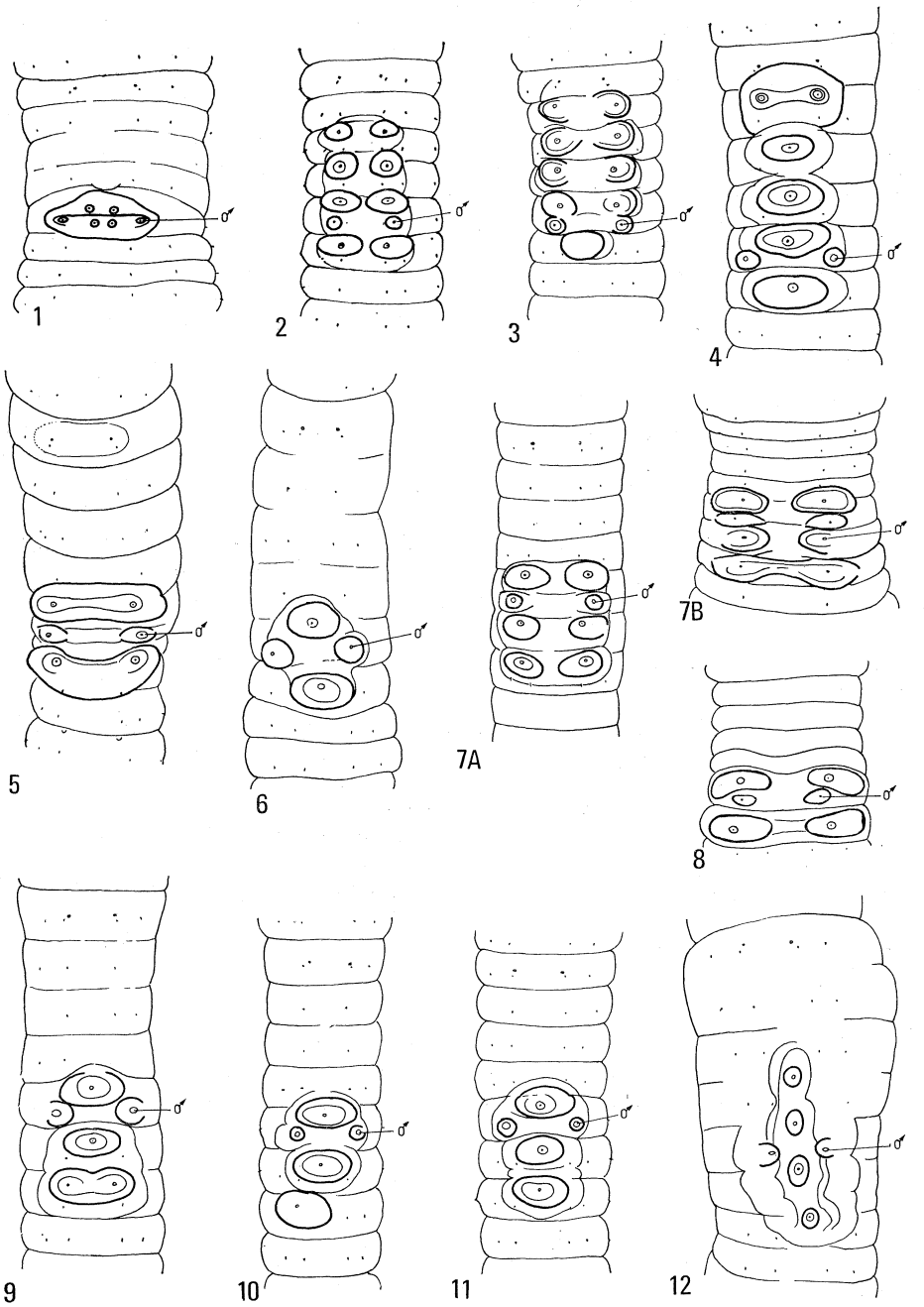

Figure 3.—Major variants of male genital fields in the Mt Kosciusko population of *Cryptodrilus fastigatus* Fletcher, 1889. Field: 1, Typical field, 18. 2, Kiandra Track. 3, Rawson's Pass (Aust. Mus. W. 2654). 4, Kiandra Track. 5, Rawson's Pass (Aust. Mus. W. 2654). 6, Mt Kosciusko Road (Aust. Mus. W. 2662). 7A, same locality. 7B, 17/2. 8, 17/4. 9, Mt Kosciusko Road (Aust. Mus. W. 2662). 10, same locality. 11, same locality. 12, 13/2/B.

Genital field consisting typically of an approximately elliptical tumescence surrounding the male pores, reaching from the anterior region of XVIII to the anterior margin of XIX, and traversed by a deep narrow depression which includes the male papillae at its lateral limits and carries a pair of accessory genital markings (small rounded papillae, each with a pore-like centre) on its anterior wall and a further pair on its posterior wall well median of *a* lines (Fig. 3, 1). Extreme variations in the field occur (Fig. 3, 2–12), of which the chief are as follows (in all variants the male porophores maintain their location lateral to *a* lines but the surrounding tumescence and typically located accessory markings are absent): (Fig. 3, 2) 4 pairs of accessory presetal genital markings, in XVI, XVII, XVIII and XIX; (3) 4 pairs of presetal genital markings, in XV–XVIII with a midventral unpaired marking in XIX; (4) paired but medianly united presetal markings in XV and midventral unpaired markings in XVI, XVII, XVIII and XIX; (5) paired but medianly united presetal markings in XVIII and XIX; (6) midventral unpaired markings in XVIII and XIX; (7) 3 pairs of presetal markings, in XVIII, XIX and XX; (8) presetal paired markings in XVIII and XIX only (type 8 is the commonest condition on Mt Kosciusko, occurring in more than 50 per cent of all specimens); (9) midventral, unpaired presetal markings in XVIII and XIX, paired but medianly united presetal markings in XX; (10) as (9) but the marking in XX unilateral; (11) midventral, unpaired presetal markings in XVIII, XIX and XX; (12) midventral, unpaired, intersegmental markings in 16/17, 17/18, 18/19 and 19/20. Female pores shortly anteromedian of setae *a* of XIV. Spermathecal pores at the anterior margins of VIII and IX, in *a* lines.

Dorsal blood vessel single; last hearts in XII. Gizzard rudimentary in V; oesophagus strongly dilated in XIV–XVI. Intestine commencing in XVIII; typhlosole absent. Nephridia 6 per segment, each with an elongate to subspherical bladder; the median (*a*) nephridium on each side in the mid and hind body with a preseptal funnel and caudally enlarged. Testes and funnels free in X and XI; seminal vesicles in XI and XII. Prostates large and racemose, each with an anterior and posterior portion; the duct branching and with 2 main rami external to the glandular portions. Penial setae absent. Ovaries and funnels in XIII; ovisacs absent. Spermathecae each with 2 subspherical diverticula near the ental end of the duct, which is almost 0.6 of the total spermathecal length.

Remarks:

The Mt Kosciusko material of *C. fastigatus* reveals a variability in the configuration of the male genital field which is unparalleled intraspecifically elsewhere in the known Oligochaeta. That the variability is intraspecific rather than supraspecific is indicated by the following evidence:

(1) Specimens with all field types have the same internal anatomy.

(2) The different field types (Fig. 3) can be interrelated in ways which suggest that they are the expression of relatively small genetic variations of a basic genotype or represent individual variations (also perhaps genetically determined) in a not highly canalized morphogenesis (ontogeny).

(3) In other Megascolecidae it has been shown that setal ratio parameters differ between different intraspecific populations (e.g., Jamieson and Bradbury, 1972, for *Didymogaster sylvaticus*). Setal ratios in *C. fastigatus* are summarized below.

INTERSETAL DISTANCES IN SEGMENT XII

In *Cryptodrilus fastigatus*

Locality	aa		ab		bc		cd		dd		No.
	mean	S.D.*	mean	S.D.*	mean	S.D.*	mean	S.D.*	mean	S.D.*	
Kosciusko 2	12.0	..	7.0	..	12.0	..	17.0	..	16.0	..	1
5	13.4	1.2	6.1	0.8	12.6	1.1	16.3	1.1	16.6	1.6	9
8	14.0	..	6.0	..	14.0	..	16.0	..	14.0	..	1
9	14.5	..	7.0	..	12.0	..	15.5	..	16.5	..	2
12	13.5	0.5	6.3	0.5	12.8	0.4	16.2	0.7	15.8	1.6	6
13	13.6	1.4	6.9	0.6	12.1	0.7	16.1	0.7	16.2	1.9	9
17	14.8	1.2	6.7	0.6	11.8	0.6	15.5	0.9	17.0	1.9	26
18	14.0	1.2	7.0	0.5	11.9	1.2	15.7	0.5	16.9	2.9	9
22	15.0	..	6.0	..	12.0	..	16.0	..	17.0	..	1
23	14.5	..	7.0	..	11.5	..	15.0	..	18.5	..	2
25	15.0	..	6.5	..	12.0	..	14.5	..	17.0	..	2
Total	14.1	1.3	6.7	0.6	12.1	0.9	15.8	0.9	16.7	2.0	68
Illawarra–Burrawang	10.8	0.7	7.2	0.4	12.4	0.5	16.6	0.5	16.8	0.7	5
Rawson Pass	14.3	..	7.0	..	11.7	..	15.7	..	17.0	..	3

* S.D. — Standard deviation.

The five major groups, representing localities 5, 12, 13, 17 and 18, are not significantly different one from the other or from the total CSIRO collection as judged by the means and standard deviations of their setal ratios. Groups 5 and 17 consist of 89 per cent and 85 per cent field-8 specimens, respectively, and indicate that at least field-8 worms from Mt Kosciusko have setal ratios which form one population. The other groups (12, 13 and 18) contain a mixture of fields (50% field-10/0% field-8/33% field-8/mixture; 44% field-8/44% typical field, respectively) but their ratios form one population with groups 5 and 17, indicating that field types are not correlated with setal ratios. Furthermore, a subsample consisting of five specimens with typical fields was not significantly different from the total CSIRO sample (nor from any single locality with a sufficiently large sample) at the 2 per cent level of significance by a Wilcoxon two-sample test (two-tailed). In addition, a sample from Rawson's Pass, Mt Kosciusko, collected independently in 1929 with a number of variants of field-3, was shown to possess ratios from the same population as the CSIRO specimens. The fact that the specimens from Mt Kosciusko have only one population of setal ratios and that there is no correlation with field-types support the conclusion, above, that the great variation in the genital field is intraspecific.

It should be noted that conspecificity on Mt Kosciusko of possessors of the typical field (field-1) with those with other genital fields has been demonstrated primarily from consideration of setal ratios as the typical field does not show as convincing an intergradation with other fields as do the latter with each other. On the other hand, conspecificity of the total Mt Kosciusko sample with the Illawarra type-specimens of *C. fastigatus* rests on the exact conformity of field-1 on Mt Kosciusko with that of the type-specimens as the setal ratios of the latter show relatively poor agreement with Mt Kosciusko material. Thus, in the Wilcoxon Test, *aa* in the type-specimens (combined with Burrawang specimens which have similar ratios) is different at the 1 per cent level of significance from the total CSIRO Kosciusko sample and at the 5 per cent level from Kosciusko specimens with the typical field.

(4) The distribution curve for individual intersetal distances (e.g. *aa*) for all specimens measured is unimodal and approximately symmetrical, approximating a normal curve. Bi- or polymodality would be expected if the samples represented a mixture of populations.

Material examined:

CSIRO material: *2/2* 2; *5/1* 3; *5/5* 5 (1 B.M.); *5/7* 1; *5/8* 3 (CSIRO); *8/1* 1; *9/1* 7 (1 B.J.); *10/1* 1; *11/1* 1; *12/2* 5; *12/4* 2; *12/8* 1; *13/1* 1 (B.M.); *13/2* 1; *13/2/A* 1; *13/2/B* 2 (1 B.J.); *13/3* 10; *14/1* 5; *17/1* 3; *17/2* 13; *17/3* 4 (2 B.M.); *17/4* 4; *17/5* 9 (1 CSIRO); *17/6* 3 (1 B.J.; 1 CSIRO); *18* 9 (1 B.M.; 1 B.J.; 1 CSIRO); *21/1* 2; *22/1* 1; *23/1* 3 (1 B.M.); *25* 2. All specimens in the Australian Museum (W. 4582–4661) except where indicated. Other material: 14 specimens, 2 mile post (near) Mt Kosciusko Rd, (below Etheridge Ridge) 6,600 ft, 11.I.1929, W. Boardman, A.M. W. 2662. 11 specimens, bank of small stream which crosses Kiandra track near Mt Kosciusko, N.S.W. 7.I.1929, W. Boardman, A.M. W. 2663 13 specimens, Rawson's Pass, Mt Kosciusko, N.S.W., 6,800 ft, 7.I.1929, W. Boardman, A.M. W. 2654.

Cryptodrilus tenuis Fletcher, 1889

Fig. 4B; 7D

Cryptodrilus tenuis Fletcher, 1889: 1543–1544.

Trinephrus tenuis; Beddard, 1895: 483.—Michaelsen, 1900: 185.

Cryptodrilus tenuis; Jamieson, 1972b: 159–161; Fig. 4B, 6F, 7D.

Augmented diagnosis: l = 85–99 mm, w = 2.5 mm, s = 156, 196.

Prostomium tanylobous. First dorsal pore 9/10 or more posterior. Setae in 8 regular longitudinal rows throughout; *aa: ab: bc: cd: dd: u* = 14.8: 5.9:16.8:11.2:17.6:100 (mean of 2 paralectotypes; Braidwood); 11.9: 5.3:15.0:11.5: 24.2:100 (mean of 3, Kosciusko). Nephropores in *a, bc* and *d* lines in V posteriorly and in *a* and *d* lines in II–IV. Clitellum annular, XIII, 1/3 XIII–XVII, XVIII (= 4 2/3-6 segments). A pair of combined male and prostatic pores on large or indistinct papillae, in the setal arc of XVIII, in *ab*. Accessory genital field consisting typically of paired eye-like glandular areas or tumescences in *a* lines, in 17/18, 18/19 and 19/20 with (Kosciusko) 3 pairs of additional markings, in 15/16 and 16/17 and posteriorly in IX. Female pores shortly antero-median of setae *a* of XIV. Spermathecal pores in 7/8 and 8/9, in *a* lines.

Dorsal blood vessel single; last hearts in XII. Gizzard moderately well developed in V; oesophagus with annular, medianly grooved calciferous(?) dilatations in XIV and XV. Intestine commencing in XVII; typhlosole absent (?). Nephridial bladders one at each pore, elongate-ovoid, some of which receive more than one nephridial duct in X anteriorly; tufted vesiculate nephridia present in II–VI. Nephrostomes unknown. Testes and funnels free in X and XI; seminal vesicles in IX and XII. Prostates slenderly tubular each with a simple duct which is joined by the vas deferens at some distance from the gland. Penial setae absent. Ovaries and funnels in XIII; ovisacs present in XIV. Spermathecae 2 mm long, duct approximately half of this; clavate diverticulum joining the midlength of the duct and one fourth or less of the total length of the spermatheca.

Material examined: 2, 3 severely macerated posterior amputees (A.M., W. 4694. CSIRO).

Wider distribution: Braidwood, New South Wales.

Remarks: The Mount Kosciusko material differs from the type-specimens from adjacent Braidwood in the smaller extent of the clitellum (1/3 XIII–XVII), in the additional genital markings and the smaller male porophores.

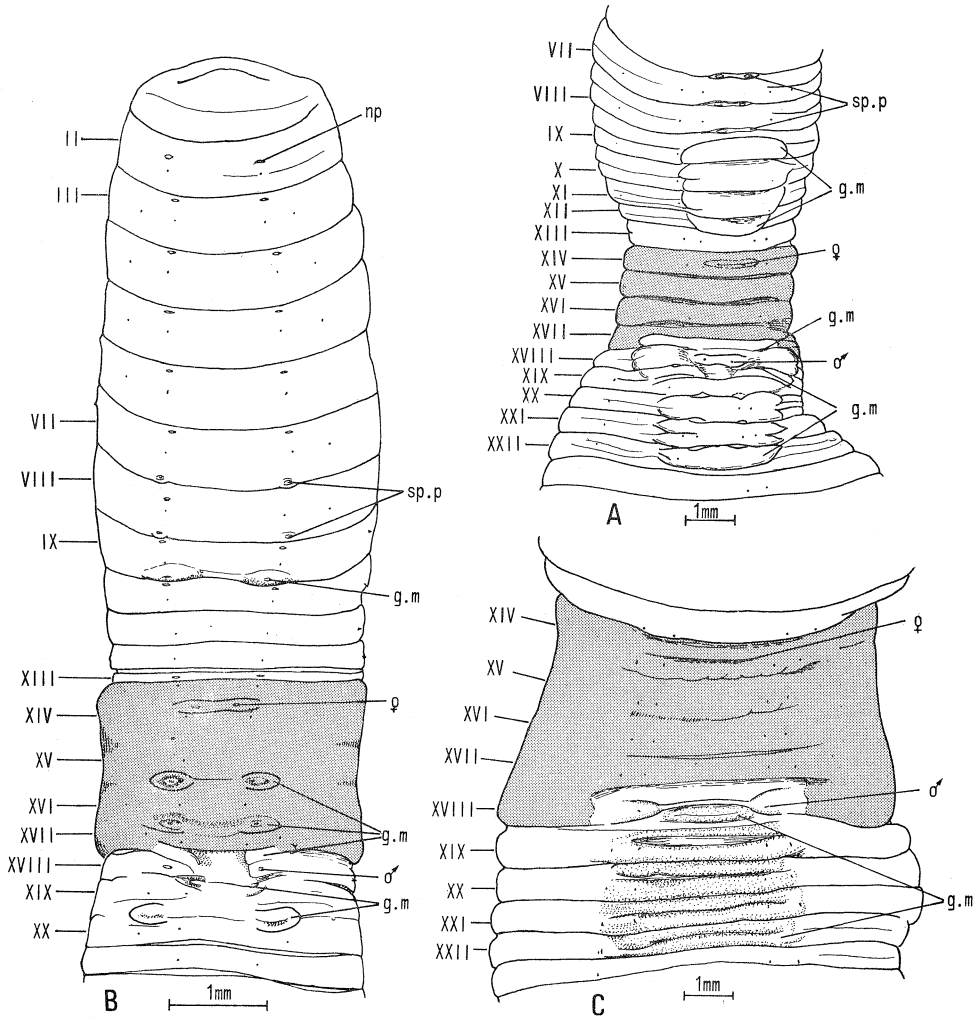

Figure 4.—Genital fields of: A, *Graliophilus montiskosciuskoi* sp. nov., holotype, 9/1. B, *Cryptodrilus tenuis* Fletcher, 1889, specimen 1, 2. C, *Notoscolex montiskosciuskoi* sp. nov., holotype, 12/2. By camera lucida. Clitellum shaded.

INTERSETAL DISTANCES IN SEGMENT XII
In *Cryptodrilus tenuis*

	aa		ab		bc		cd	
	mm	st	mm	st	mm	st	mm	st
Specimens 1 ..	0.91	11.06	0.42	5.11	1.19	14.47	0.91	11.06
2 ..	0.95	12.68	0.42	5.63	1.12	15.02	0.88	11.74
3 ..	0.88	11.96	0.39	5.26	1.19	16.27	0.88	11.96
mean		11.90		5.33		15.25		11.59
intervals/ab ..		2.23		1.00		2.86		2.17
mean, paralecto-types 1 and 2.		14.79		5.88		16.98		11.35
intervals/ab ..		2.52		1.00		2.89		1.93

	dd		dc		cb		ba	
	mm	st	mm	st	mm	st	mm	st
Specimens 1 ..	2.28	27.66	0.91	11.06	1.19	14.47	0.42	5.11
2 ..	1.68	22.54	0.88	11.74	1.12	15.02	0.42	5.63
3 ..	1.65	22.49	0.84	11.48	1.12	15.31	0.39	5.26
mean		24.23		11.43		14.93		5.33
intervals/ab ..		4.55		2.14		2.80		1.00
mean, paralecto-types 1 and 2.		17.55		11.03		16.58		5.88
intervals/ab ..		2.98		1.88		2.82		1.00

General anatomy in samples from the two areas conforms and, with the doubtful exception of *dd*, setal ratios are not significantly different. It is probable that the two samples are drawn from the same infraspecific population.

Dorsal pores were not observable, presumably because of maceration. Internal anatomy in the single Kosciusko specimen dissected (locality *2*) agreed in all respects with the description of Jamieson (1972c) but the macerated condition of the specimen precluded elucidation of dorsoventral commissural vessels anterior to VIII and, although an exact agreement in distribution of nephridial bladders was found, the finer morphology of the nephridia was not investigated. Dimensions of the right spermatheca of IX (illustrated) are: length 1.6 mm; ratio total length : length duct 1.8; ratio total length : length diverticulum 5.1, small variations from the types. The Kosciusko specimen provides the additional information on junction of vasa deferentia and prostate ducts.

Tribe **DICHOGASTRINI** Jamieson, 1971a

Genus **Notoscolex** Fletcher, 1887

The author (Jamieson, 1971c, 1972a) has drawn attention to heterogeneity in *Notoscolex* which exceeds that to be expected in a genus. In the latter paper, in which the type-species, *N. camdenensis*, was redescribed, a basis was presented for restriction of the genus. Of four species which it was suggested might be included with *N. camdenensis* in a restricted *Notoscolex*, *Cryptodrilus fastigatus* must be removed as re-examination has shown (Jamieson, 1972b) that it is referable to a reinstated genus *Cryptodrilus* Fletcher, 1887 which is diagnosed by multiple nephridial bladders.

Formal restriction of *Notoscolex* is, however, deferred pending revision of at least the Australian species. The following Mt Kosciusko species is placed, therefore, in *Notoscolex* s. lat. as it conforms with the superficial diagnosis of the genus in having 8 setae per segment, prostates with branched ducts, and meronephridia while not showing sufficient differences from the type-species to unequivocally warrant establishment of a new genus on present evidence. Location of calciferous glands in IX–XIII nevertheless excludes it from the group of species to which *N. camdenensis* belongs (calciferous glands in XIV–XVI) and may later support generic distinction.

In the present account a further species which conforms with the above-mentioned diagnosis of *Notoscolex* can confidently be excluded from the genus as it shows the megascolecin condition of the nephridia and not the dichogastrin condition seen in *N. camdenensis* and *N. montiskosciuskoi.*

Notoscolex montiskosciuskoi sp. nov.
Fig. 4C; 6E; 7E

l = 80, 99 mm, w (midclitellar) = 9 mm, s = 151, 149 (holotype and paratype 1 respectively). Form stout, the anterior end clubbed though apically tapering, the clitellar region constricted; circular in cross section throughout; segments weakly biannulate, excepting the first few which are simple. Pigmentless buff in alcohol with the exception of the clitellum, which is pigmented pale brown. Prostomium tanylobous (holotype and 3 paratypes), or epilobous 1/2 with the peristomium much grooved (6 paratypes) with very narrow, posteriorly narrowing dorsal tongue. First dorsal pore 3/4 (9 specimens). Setae minute, in 8 longitudinal rows, commencing on II, becoming scattered posteriorly; *a* and *b* absent in XVIII.

INTERSETAL DISTANCES IN SEGMENT XII
In *Notoscolex montiskosciuskoi*

	aa		ab		bc		cd	
	mm	st	mm	st	mm	st	mm	st
Holotype	2.21	10.44	0.57	2.69	2.64	12.46	2.71	12.79
Paratype 1 ..	3.36	11.35	0.64	2.17	3.57	12.08	3.07	10.39
2 ..	2.43	8.72	0.64	2.31	2.64	9.49	4.21	15.13
3 ..	2.07	11.20	0.50	2.70	2.43	13.13	1.57	8.49
4 ..	1.36	6.55	0.57	2.76	2.64	12.76	2.50	12.07
5 ..	2.14	10.10	0.71	3.37	2.93	13.80	1.50	7.07
6 ..	2.14	10.24	0.50	2.39	2.43	11.60	2.43	11.60
mean		9.80		2.63		12.19		11.08
interval/ab ..		3.73		1.00		4.63		4.21

	dd		dc		cb		ba	
	mm	st	mm	st	mm	st	mm	st
Holotype	7.21	34.01	2.79	13.13	2.50	11.78	0.57	2.69
Paratype 1 ..	11.64	39.37	3.07	10.39	3.57	12.08	0.64	2.17
2 ..	10.93	39.23	3.50	12.56	2.86	10.26	0.64	2.31
3 ..	6.93	37.45	2.07	11.20	2.43	13.13	0.50	2.70
4 ..	8.14	39.31	2.36	11.38	2.57	12.41	0.57	2.76
5 ..	8.43	39.73	1.86	8.75	2.93	13.80	0.71	3.37
6 ..	8.29	39.59	2.21	10.58	2.43	11.60	0.50	2.39
mean		38.38		11.14		12.15		2.63
interval/ab ..		14.59		4.24		4.62		1.00

Nephropores not externally visible. Clitellum annular, well developed but constricted relative to adjacent segments, embracing XIV–XVIII; intersegmental furrows retained only ventrally; dorsal pores visible but occluded; setae retained (holotype and 6 paratypes). Male pores on inconspicuous papillae in *a* lines (holotype and 4 paratypes). Genital markings consisting of ill defined transverse slightly tumid strips one in front of, the other behind the equators of segments XVIII–XXII; those in XVIII between the male papillae; those in XIX–XXII including setae *b* (holotype; paratype 7 very similar; in other paratypes less developed or more or less obscured by maceration). Female pores paired anteromedian to setae *a* (holotype and 5 paratypes). Spermathecal pores 4 pairs in 5/6–8/9, on small papillae in *ab* nearer *a* (holotype and 2 paratypes).

Internal anatomy (Holotype and paratype 2):

Septa: 4/5 delicate; 5/6 thin, backwardly displaced by the gizzard; 6/7 slightly thickened; 7/8 moderately thickened; 8/9–13/14 strongly thickened; the remainder thin. Last septal (pharyngeal) glands in IV. Dorsal blood vessel paired segmentally, unpaired at the septa and anterior to the commissurals of V; bifurcating to each side behind the brain. Dorsoventral commissural vessels in V–XII; those in V–IX dorsoventral only; very slender in V–VIII; forming slender hearts in IX; those in X–XII forming 3 pairs of large latero-oesophageal hearts, each arising from a transverse vessel which encircles the corresponding calciferous gland shortly before this vessel joins the supra-oesophageal vessel; origin from the dorsal vessel not certainly demonstrated. Supra-oesophageal vessel occupying VIII–XIII, receiving a pair of vessels in each segment from the calciferous glands; 2 pairs of vessels from the oesophagus in XIV join the dorsal vessel. Subneural vessel absent.

Gizzard large, globular, muscular but easily compressible, preceded by a swollen thin-walled proventriculus in V. Oesophagus in VI–VIII thin-walled and not appreciably vascularized; in each of segments IX–XIII bearing laterally a pair of calciferous glands each of which is approximately semicircular viewed in the body axis and is sessile on the oesophagus; the lumen of each gland traversed by very numerous densely packed delicate lamellae which occupy all but the central third of the lumen; the lumen continuous with that of the oesophagus via a circular constricted but fairly large orifice. Oesophagus in XIV and XV narrow and thin walled. Intestine commencing, with abrupt expansion, in XVI; typhlosole absent.

Meronephric (holotype and paratype 2); nephridia commencing in III; those in III–V forming very large tufts with composite ducts which pass forwards to open into the pharynx and buccal cavity, i.e., enteronephric tufted micromeronephridia. Those in VI posteriorly forming transverse bands of very numerous separate exonephric integumentary micromeronephridia. Posteriorly with transverse rows of astomate, integumentary micromeronephridia with, on each side of the nerve cord, a median stomate exonephric megameronephridium (holotype). Large iridescent sperm funnels and copious sperm masses free in X and XI; testes not detectable; small slightly lobulated seminal vesicles in IX and XII. Ovaries undetectable funnels in XIII; ovisacs pendant from the anterior septum of XIV (ovisacs not developed in paratype). Prostates externally intermediate between the racemose and tubular types; each (schizoparatype) with a main central lumen, bounded by a definite epithelium, which is surrounded by lobuli composed of groups of glandular cells which in some cases appear to radiate from narrow lumina lacking epithelia; the central lumen has numerous evaginations of its walls into the gland but these extend only a very short distance below the general level of the basement

membrane and it was not possible to demonstrate continuity of the short lumen of each with the intercellular lumina in the gland. Each gland elongate and sinuous but ectally wide and lobulate, with a short slender duct; the vasa deferens joining the gland at its junction with the duct (holotype).

Penial setae gently bowed, ectally tapering, the ectal end drawn out into an indefinite flattened or ribbon-like flexible tip, most setae giving the appearance that the ectal end is degenerating; a few circlets of cicatricing present near the tip, consisting of minute ectally directed serrations produced by notching of the seta; the cicatricing in some setae hardly appreciable; length of a well developed penial seta = 0.94 (holotype) — 1.72 mm (mean of 5 specimens = 1.4 mm), greatest width (near base) = 23 — (holotype) 28 μ (mean of 5 specimens = 25 μ). Spermathecae 4 pairs opening anteriorly in their segments, each with an elongate-ovoid pointed ampulla, a poorly demarcated duct of approximately the same length, and a clavate iridescent diverticulum which joins the ectal end of the duct; size uniform, length of right spermatheca of IX = 3.2 mm; ratio total length: length duct = 2.1; ratio total length: length diverticulum = 3.9.

Material examined: *12/2* Holotype; *1/1* P2; *5/1* P3; *5/9* P4 A1; *9/1* P5 A2; *10/1* A2; *11/1* A1; *12/4* A1; *12/9* P6 A1; *17/6* A3; *22/1* A2; *23/1* P1. (H, A.M., W. 4683 P1–4, A.M., W. 4684–4687; P5, B.M., P6, B.J.; A, B.M., B.J., CSIRO).

Remarks: Four species approach *N. montiskosciuskoi* in general anatomy (*C. campestris* Spencer, 1895; *C. illawarrae* Fletcher, 1889; *C. mudgeanus* Fletcher, 1889 and *C. wellingtonensis* Spencer, 1895) but these have fewer pairs of spermathecae and differ in other respects including the male genital field which distinguishes *N. montiskosciuskoi* from all other species of *Notoscolex*.

Tribe **MEGASCOLECINI** Jamieson, 1971a

Genus **Oreoscolex** nov.

Setae 8 per segment commencing on II. Ventral setal couples moderately closely paired; dorsal couples (*cd*) widely paired, *cd* being only slightly smaller than the interval between the couples of a side (*bc*). A pair of combined male and prostatic pores on XVIII; accessory genital markings present in segments in their vicinity. Female pores on XIV, anteromedian of setae *a*. Spermathecal pores unpaired, midventral, posteriorly in VII and VIII. Latero-oesophageal hearts in X–XII, commissurals anterior to these purely dorsoventral. Supra-oesophageal vessel present, subneural absent. A large gizzard in V; oesophagus lacking extramural calciferous glands; intestine commencing in XVIII; a low dorsal typhlosole present. Nephridia numerous astomate, avesiculate exonephric micromeronephridia commencing in II, with in IV and V large (enteronephric?) tufts and smaller tufts in III (and in II?); caudally with numerous preseptal funnels in each segment (and enteronephric?). Testes and funnels in X and XI; testis-sacs absent; seminal vesicles in XII. Ovaries in XIII; ovisacs present. Prostates racemose, bipartite. Spermathecae unpaired, diverticulate.

Diagnosis: Combined pores of vasa deferentia and racemose prostates on XVIII. Gizzard in V; extramural calciferous glands absent. Nephridia astomate, avesiculate, exonephric micromeronephridia associated in anterior segments with (enteronephric?) tufts; caudally with numerous preseptally stomate (enteronephric?) micromeronephridia in each segment.

Distribution: Kosciuskan Division, Southern Faunal Province of Australia (Mt Kosciusko, New South Wales).

Monotypic. Type-species: *Oreoscolex imparicystis* sp. nov.

Remarks: Lumbricin setae, racemose prostates and meronephridia would formerly have warranted inclusion of the type-species in *Notoscolex* Fletcher. However, it has been suggested (Jamieson, 1972a) that *Notoscolex* should be restricted to species with extramural calciferous glands in segments XIV–XVI; a stomate nephridium median to micromeronephridia on each side in posterior segments (the Dichogastrin arrangement) and no intestinal typhlosole. The multiple caudal nephrostomes of *Oreoscolex* place it in the tribe Megascolecini.

The unpaired condition of the spermathecae is rare in the Megascolecidae but whether it is a generic character (as in *Fletcherodrilus*) or a merely specific character (as in *Pygmaeodrilus*) can only be decided if further species of *Oreoscolex* are found.

Oreoscolex imparicystis sp. nov.

Fig. 5A, B; 6G; 7G

External morphology (Holotype and paratypes 1–3 unless otherwise indicated):

l = 122–152 mm; w (midclitellar) = 5 mm; s = 120–188 (paratypes 2 and 3). Form slender, circular in cross section, secondary annulation significantly developed in the hindbody only; pigmentless in alcohol excepting the pale brown clitellum. Prostomium epilobous 1/3, forming an indistinctly marked equilateral triangle. Dorsal or other canalicula absent. First dorsal pore 3/4. Setae small, in 8 longitudinal rows; all setae of XVIII retained.

INTERSETAL DISTANCES IN SEGMENT XII
In *Oreoscolex imparicystis*

	aa		ab		bc		cd	
	mm	st	mm	st	mm	st	mm	st
Holotype	1.86	14.29	0.43	3.30	2.07	15.93	1.57	12.09
Paratype 2 ..	1.14	12.03	0.43	4.51	1.21	12.78	1.29	13.53
mean		13.16		3.91		14.36		12.81
interval/ab ..		3.37		1.00		3.67		3.28

	dd		dc		cb		ba	
	mm	st	mm	st	mm	st	mm	st
Holotype	3.00	23.08	1.71	13.19	1.93	14.84	0.43	3.30
Paratype 2 ..	2.50	26.32	1.29	13.53	1.21	12.78	0.43	4.51
mean		24.70		13.36		13.81		3.91
interval/ab ..		6.32		3.42		3.53		1.00

Nephropores not externally visible. Clitellum annular, moderately tumid in XIV–XVII but also occupying the posterior half of XIII; some clitellar modification of XVIII also appearing to be present in the holotype; dorsal pores retained at 13/14 and 17/18, at which the intersegmental furrows are clearly discernible, absent in the intervening region in which intersegmental furrows are almost inappreciable. A pair of combined male and prostatic pores situated near the posterior limit of XVIII median of *a* lines, each with slightly tumid lips which hardly constitute a porophore but lying in a glandular area which medianly approaches the ventral midline and laterally joins the corresponding accessory genital markings. The genital markings in the holotype consisting of 4 pairs of low but conspicuous approximately oval tumescences, a pair in each of intersegments 17/18, 18/19, 19/20 and 20/21 in *ab*, each marking bearing 2 dark, translucent pore-like depressions, one anterior to, the other posterior to the intersegment; the intersegmental furrows contiguous with the lateral border of the marking or incising it more or less deeply, 18/19 forming a deep trench-like depression separating the marking into anterior and posterior portions which are discrete except for median confluence with the glandular area around the male pores.

Of 11 specimens, from the four samples, in which the genital markings were examinable, all had the anterior portion at 17/18 and anterior and posterior portions at 18/19 and 19/20; 3 lacked the posterior portion at 17/18, and 5 lacked both the anterior and the posterior portions at 20/21. In several the anterior and posterior portions of a side at an intersegment were more widely separated than in the holotype. In some of the specimens, additional minor pores were present on the anterior portion of the marking at 18/19.

Female pores minute, a pair anteromedian of setae *a* of XIV, at approximately 1/3 *aa*. Spermathecal pores one in each of segments VII and VIII, each distinctly visible on a low, midventral, circular, domed porophore which is located in the posterior fourth of its segment but does not reach the posterior intersegment.

Internal anatomy (Holotype (H) and, where noted, paratypes 2 and 3).

Some preclitellar septa thickened; last septal (pharyngeal) glands in III, projecting into IV (H,P2, 3). Dorsal blood vessel single, continuous onto the pharynx. Dorsoventral commissural vessels in V (H)–XII, all valvular (H,P2, 3), those in X–XII forming 3 pairs of latero-oesophageal hearts; supra-oesophageal single in VII, VIII–1/2 XIII, weakly developed in XIII (H,P2,3) and in VII (P2). Slender latero-oesophageals, median to the hearts, in VII anteriorly become a pair of suboesophageals in VIII; no blood glands detectable (H). Subneural vessel absent (H). Gizzard in V very strongly muscular, firm, and cylindrical, unusually large, extending posteriorly as far as intersegment 8/9; attenuating and posteriorly deflecting septa 5/6–7/8 (H,P2, 3). Oesophagus moniliform and vascularized in VIII–XVII but lacking extramural calciferous glands; in VII virtually, and in more anterior segments totally supressed by development of the gizzard (H,P2, 3); especially swollen and vascularized in XIV–XVI in paratype 3. Oesophagus narrow to 1/2 XVIII at which the intestine begins; a low dorsal typhlosole present from about XX (H,P2, 3). Nephridia: very numerous, astomate, avesiculate exonephric integumentary micromeronephridia throughout most of the body with, median to these, in IV and V a large (enteronephric?) tuft on each side consisting of numerous spiral loops. Similar but much smaller tufts present in III and aggregations which may be tufts in II (H,P2, 3). Caudal segments with numerous micromeronephridia attached at the junction of septa and body wall anteriorly in their segments and with approximately 40 preseptal funnels on each side; possibly enteronephric as no ducts to the body wall were demonstrated (Paratype 3).

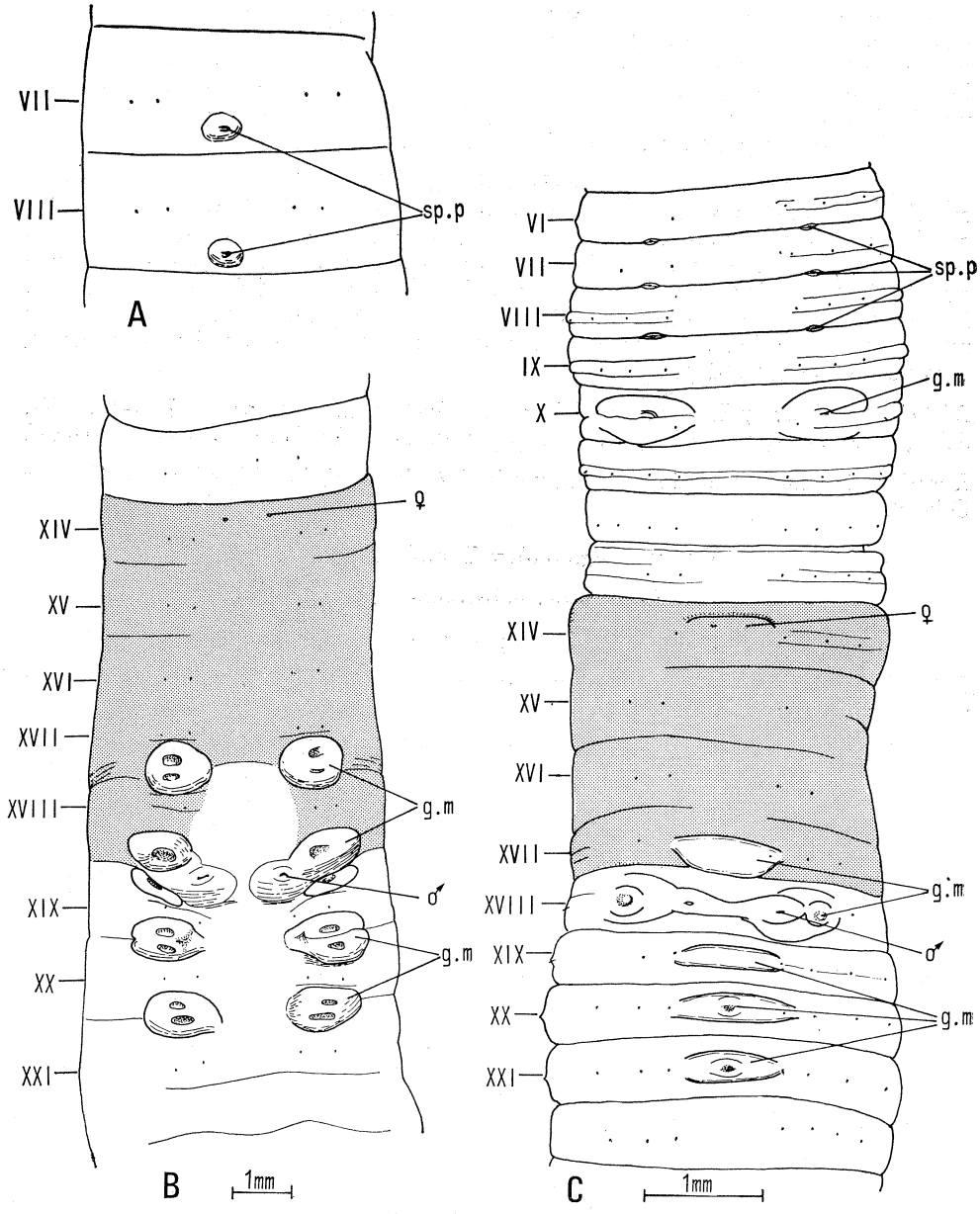

Figure 5.—*Oreoscolex imparicystis* sp. nov., holotype, 7. A, spermathecal pores. B, male genital field. C, male genital field of *Megascolex celmisiae* sp. nov., holotype, 19/8. By camera lucida. Clitellum shaded.

Testes? funnels? and iridescent sperm masses in X and XI (H, severely macerated); funnels iridescent in X and XI in paratypes 2 and 3; racemose seminal vesicles in XII only. Ovaries and funnels in XIII (H, P2, 3); racemose masses dependent from septum 13/14 into XIV in paratype 2 only, may be ovisacs. Prostates racemose, restricted to XVIII; the long duct bent posteriorly to enter the body wall immediately anterior to septum 18/19; the glandular part racemose and subdivided into an anterior and posterior portion, each with a number of distinct, themselves much-lobulated lobes; the duct bifurcated for a short ental region where it leaves the two main portions (H,P2, 3). Penial setae absent.

Spermathecae unpaired, in VIII and IX, each entering the body wall at the anterior border of its segment but preceded in the segment in front by a glandular cushion which corresponds with the low external porophore. Each spermatheca elongate, clavate, the ental swelling constituting a poorly demarcated ampulla; 2 subspherical diverticula sessile bilaterally at the anterior limit of the duct (H, P2,3). Length of the anterior and posterior spermatheca = 3.9 and 3.7 mm respectively; ratio total length:length duct = 1.8 and 1.9; ratio total length: mean length diverticulum = 6.8 and 7.4.

Material examined: 7 Holotype and P1; *12/1* P2, 3; *12/2* P4–9; *10* P10–12. (H. A.M., W. 4688 P1, 4–9, A.M., W. 4689–4690; P2, B.J.; P3, B.M.; P10–12, CSIRO).

Remarks: The male genital field of *Oreoscolex imparicystis* distinguishes it from all other Oligochaeta.

Genus **Megascolex** Templeton, 1844.

Megascolex celmisiae sp. nov.

Fig. 5C; 6H; 7F

External morphology (Holotype and paratypes 1 and 2, with additional specimens where indicated):

l = 42–54 mm (mean of 3 = 47.3 mm), w (midclitellar) = 3 mm, s = 99–111 (mean of 3 = 107). Form circular in cross section throughout; secondary annulation absent, or weakly developed behind the clitellum; prostomium epilobous >5/6, almost tanylobous; peristomium bifid ventrally; first dorsal pore 3/4. Setae commencing on II; numbers per segment 18–20 (mean = 19) on V; 20–21 (mean = 20) on XII; 19–20 (mean = 20) at 15–20 segments from the posterior end; *aa* a clearly recognizable interruption in the setal circle, *zz* not apparent as an interruption owing to its similarity to the distances between adjacent dorsal setae in each segment; setae *a* and *b* absent in XVIII.

INTERSETAL DISTANCES IN SEGMENT XII

Megascolex celmisiae

	aa		az		zz		za	
	mm	st	mm	st	mm	st	mm	st
Holotype	0.93	12.75	2.86	39.22	0.64	8.82	2.86	39.22
Paratype 3 ..	0.50	11.86	1.79	42.37	0.29	6.78	1.64	38.98
Paratype 4 ..	0.64	12.50	2.07	40.28	0.21	4.17	2.21	43.06
mean		12.37		40.62		6.59		40.42

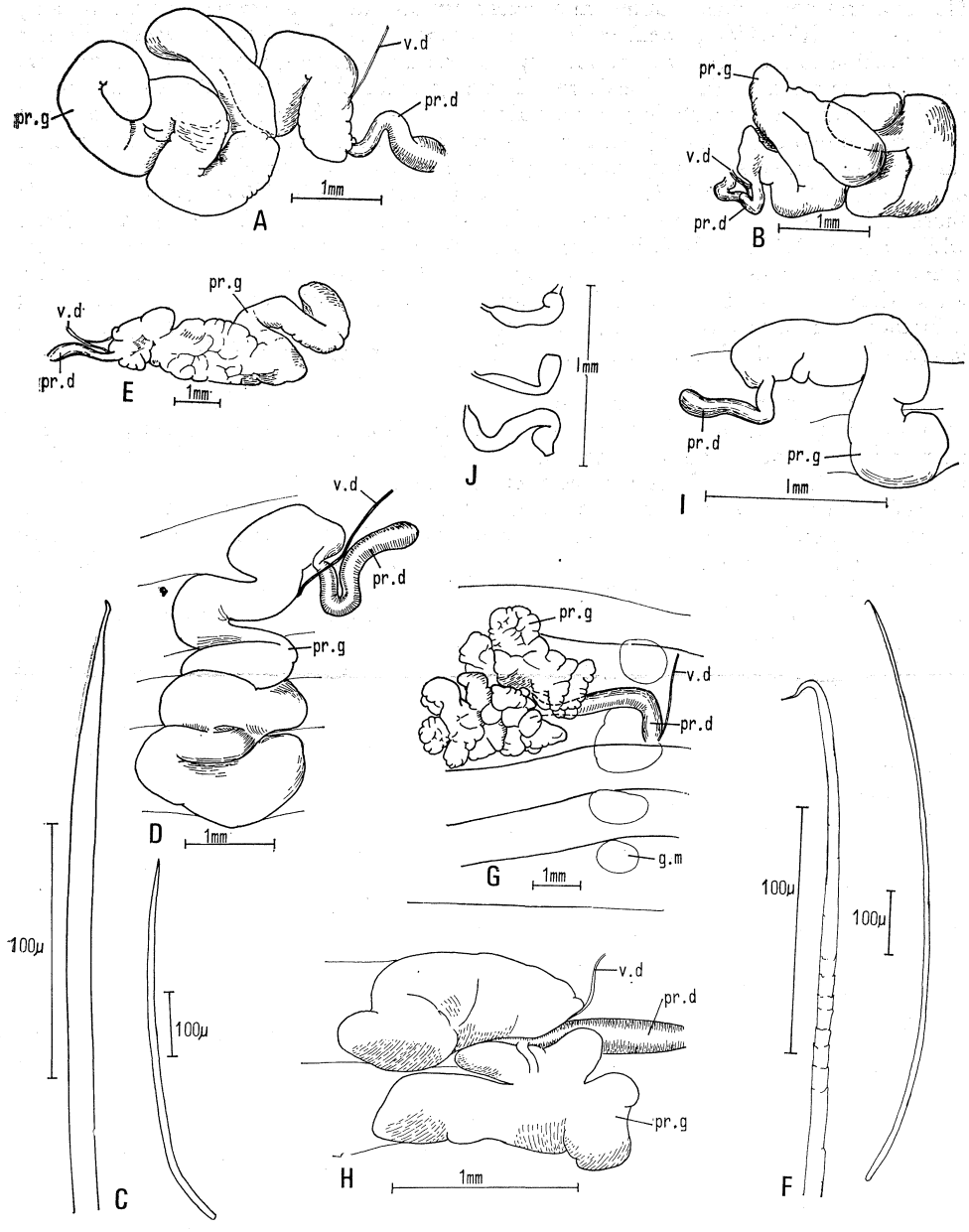

Figure 6.—Prostate glands, penial setae and nephridia of: A, *Graliophilus montiskosciuskoi* sp. nov., holotype, 9/1. B, *G. woodi* sp. nov., holotype, 19/2. C, *G. montiskosciuskoi* sp. nov., holotype, 9/1 (penial seta). D, *Vesiculodrilus purpureus* sp. nov., holotype, 5/1. E, *Notoscolex montiskosciuskoi* sp. nov., holotype, 12/2. F, penial seta of same. *G. Oreoscolex impariсystis* sp. nov., holotype, 7. H, *Megascolex celmisiae* sp. nov., holotype, 19/8. I, *Diprorochaeta pheretima* sp. nov., holotype, 12/3. J, nephridial vesicles of the same (pore to right) in, from top to bottom, VII, XIV and caudally By camera lucida.

Nephropores not visible. Clitellum annular, tumid but not appreciably protuberant, embracing XIV–XVII, weaker in the posterior half of XVII; weak clitellar modification to 1/2 XIII present dorsally; dorsal pores absent, intersegmental furrows and setae less visible than elsewhere. Male genital field (holotype): small slit-like combined male and prostatic pores a pair on XVIII in *ab* nearer *a*, each on a small papilla, the two papillae conjoined midventrally; accessory genital markings unpaired midventral transverse bands, extending laterally to include or almost reach setae *a*, one in each of segments XVII, XIX, XX and XXI; that in XVII mostly postsetal; those in XIX–XXI each mostly presetal; those in XVII and XIX smooth surfaced while those in XX and XXI have each a pore-like centre; a pair of accessory genital markings present in XVIII, immediately lateral to the male pores, each circular with a pore-like centre and lying on a low prominence which includes the male porophore; a further pair of low prominences present on X, centred on *ab*, filling the segment longitudinally, and with a presetal pore-like marking median to *b* line.

Variation in the distribution of accessory genital markings in the holotype and 26 paratypes, from most localities is shown in Table 2. To summarize, the only markings constant for all specimens are the smooth, midventral markings in XVII and XIX. Location of male pores was also constant. Midventral markings with pore-like centres may occur as far forward as XV or as posteriorly as XXII; the paired markings lateral of the male pores may be as in the holotype or may extend as longitudinal ridges ("circular" or "ridges" respectively in Table 2), or rarely may be transposed to lie in front of the male pores; additional paired pore-like markings may be present postsetally behind the presetal markings in X and, rarely, a pair of equatorial markings may be present near the ventral midline in XI. It is noteworthy that absence of midventral pore-like markings is strongly correlated with the presence of lateral ridges in XVIII and of postsetal markings in X. Animals exhibiting this correlation show no significant anatomical differences from, nor are they geographically segregated from, other specimens. They do, however, show a tendency to be larger and, if larger, have a better developed gizzard which deflects succeeding septa posteriorly. Female pores a pair of small but distinctly visible orifices shortly in front of the setal arc of XIV, median to *a* lines at about 1/3 *aa*. Spermathecal pores 3 pairs, in 6/7–8/9, in *ab* nearer *a*, not apparent unless the intersegmental furrow is held open (holotype).

Internal anatomy (Holotype, H, and paratype, P1):

Septa (H and P1 respectively where different): 3/4 thin; 4/5 and 5/6, or 4/5, slightly thickened; 6/7 to 13/14 or to 12/13 fairly strongly thickened; 14/15 moderately thickened and the remainder thin, or thin from 13/14 posteriorly. Paired large flocculent masses on each side of the alimentary canal in IV to VII (H) or to VIII (P1) are attached at the anterior septa.

Dorsal blood vessel single, continuous under the brain. Dorsoventral commissural vessels in VII–XII; those in X–XII forming 3 pairs of large latero-oesophageal hearts, each receiving its main connective from the supra-oesophageal vessel and a thin, filamentous connective from the dorsal vessel; commissurals in IX, anteriorly, slender and decreasing in width forwards. Supra-oesophageal vessel thin, in X to XII or (H) to anterior XIII, poorly developed.

Gizzard in V, globular, about one and a half times the width of the adjacent oesophagus, muscular but easily compressible, not displacing the septa of its segment. Oesophagus in VI–VIII, narrow, not evidently vascularized or moniliform; in IX–XIII much widened, moniliform and with circumferential vascular striae which are especially conspicuous in segment XII and XIII (H) or XIII (P1), probably

owing to engorgement with blood at fixation and not structurally distinct; the entire vascularized region with numerous thick high internal folds, each fold surrounding an extension of the peripheral blood sinus; calciferous glands absent. Oesophagus narrow and not appreciably vascularized in XIV and XV. Intestine commencing, with abrupt expansion, in XVI; muscular thickening, typhlosole, and caeca absent.

Nephridia meronephric throughout; those in II–VI aggregated to form a group on each side, the group in V being especially large and forming a definite tufted nephridium the ducts of which, in the holotype, can be seen to run forward in a sheaf to join the lateral wall of the pharynx in segment III, being, therefore, enteronephric, astomate, pseudo-tufted nephridia; whether tufts in II–VI are exonephric or enteronephric has not been determined. Astomate (?), avesiculate integumentary micromeronephridia approximately 20 per segment in VII through the precaudal intestinal region; replaced in the posterior segments of the hindbody by stomate septal micromeronephridia, attached to the anterior septa of their segments and with several large ciliated preseptal funnels on each side in each segment; the ducts of these septal nephridia not traceable to the body wall but appearing to run medianwards in the septa and presumably enteronephric.

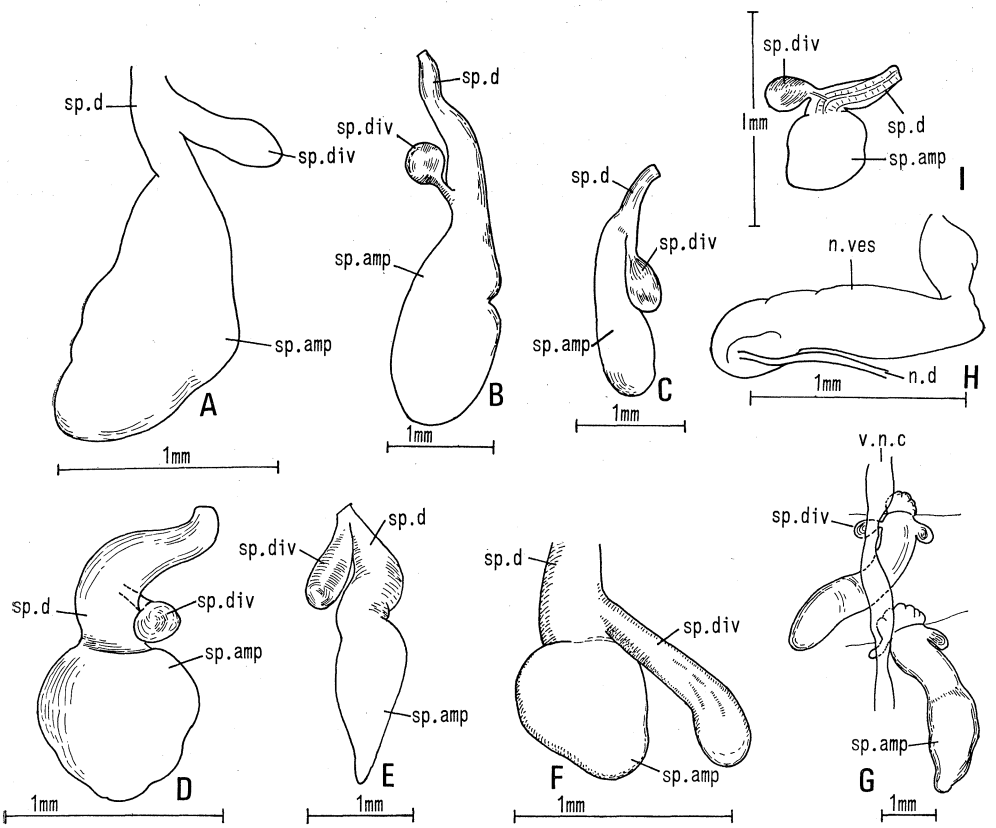

Figure 7.—A–G. Spermathecae of: A, *Graliophilus montiskosciuskoi* sp. nov., holotype, 9/1 (left IX). B, *G. woodi* sp. nov., holotype, 19/2 (right IX). C, *Vesiculodrilus purpureus* sp. nov., holotype, 5/1 (right VIII), D, *Cryptodrilus tenuis* Fletcher, 1889, 2 (right IX). E, *Notoscolex montiskosciuskoi* sp. nov., holotype, 12/2 (right IX). F, *Megascolex celmisiae* sp. nov., holotype, 19/8 (right IX). G, *Oreoscolex imparicystis* sp. nov., holotype, 7 (VIII and IX). H, left nephridial vesicle in XIV of *Vesiculodrilus purpureus* sp. nov., holotype. I, *Diporochaeta pheretima* sp. nov., holotype, 12/3 (right IX). By camera lucida.

Testes and large, weakly (if at all) iridescent sperm funnels free in X and XI; seminal vesicles racemose, with large loculi, in IX and XII, the anterior pair the larger. Ovaries large and conspicuous with several strings of oocytes, and funnels in XIII; ovisacs large, multiloculate, on the posterior face of septum 13/14. Prostates racemose, and bipartite, each consisting of 2 main lobes of which one lies in XVIII the other in XIX, the posterior lobe deeply incised in places but neither lobe with surface lobulations nor loculi; the wide medianly directed muscular duct almost as long as the transverse extent of the gland; vas deferens joining the anteromedian aspect of the anterior lobe. Penial setae absent. Spermathecae 3 pairs (H; only the right spermatheca of VII developed in P1), in VII–IX, each with a smoothly ovoid ampulla and a well demarcated, almost equally long narrow duct which is joined near its ental end (H) or further ectally (P1) by a lateral, elongate, terminally bulbous inseminated diverticulum which is only slightly shorter than the spermatheca. Length of the right spermatheca of IX (H) = 1.14 mm; ratio of total length:length duct = 2.41; ratio of total length:length diverticulum = 1.18.

Material examined: *19/8* Holotype; *5/9* P3; *6/1* A1; *11/1* P25, 26; *12/1* P9, 10 A3; *12/8* P11 A2; *13/1* P4 A2; *13/3* P5, 6, 7 A3; *13/4* P8; *14/1* P22 A1; *16/1* A3; *17/2* A1; *18/1* P21; *19/2* P1, 2 A2; *19/4* P12 A2; *19/5* P13, 14; *19/8* P15, 16 A1; *20/1* P19, 20 A8; *21/1* P17, 18 A4; *23/1* P23, 24 A5. (H, P1–20, A.M., W. 4662–2682; P21–23, +A, B.J.; P24, 25 + A, B.M.; P26 + A, CSIRO).

Remarks: *M. celmisiae* is distinguishable from all other species of *Megascolex* by its male genital field. It is unlikely that it is congeneric with the type-species of the genus, *M. caeruleus* Templeton, 1844, from Ceylon, which has rudimentary spermathecal diverticula and apparently lacks caudal enteronephry, but it must be referred to *Megascolex* pending revision of this large genus.

ZOOGEOGRAPHY

Suprageneric affinities

Of the three subfamilies of the Megascolecidae recognized by Jamieson (1971a), the Acanthodrilinae and Megascolecinae are indigenous in Australia though well represented elsewhere. The only Australian representative of the Ocnerodrilinae is the circummundane *Eukerria saltensis* (Beddard). The Acanthodrilinae, a subfamily of southern land masses and with very few extensions into the holarctic (Jamieson, 1971b), is poorly represented in Australia, where it is known only from the genus and small endemic subgenus *Diplotrema* and a few species of its second subgenus *Notiodrilus*, by two circummundane species of *Microscolex* and an endemic subantarctic species on Macquarie Island, and by a single Queensland species of the predominantly New Zealand genus *Rhododrilus*. No endemic Acanthodrilinae are known from Mt Kosciusko or neighbouring areas.

In contrast, the three tribes of the subfamily Megascolecinae are well represented in Australia and on Mt Kosciusko. The tribe Perionychini, which is more strongly represented in numbers of genera and species in Australia than elsewhere in its wide global range, is correspondingly well represented in the earthworm fauna of Mt Kosciusko and contains the great majority of its species. These species are assignable to the genera *Diporochaeta* Beddard, *Graliophilus* Jamieson, *Vesiculodrilus* gen. nov. and *Cryptodrilus* Fletcher.

The tribe Dichogastrini, of which only a small proportion of genera is indigenous in Australia is represented on Kosciusko only by *Notoscolex montiskosciuskoi*. The generically small tribe Megascolecini is a conspicuous element in the Australian fauna in numbers of species, but generic representation remains to be determined as the great majority of species are at present referred to the Ceylonese genus *Megascolex* with which they poorly accord. Until the erection of *Oreoscolex* in the present paper, none of the numerous Australian megascolecin species had been placed in an endemic genus. Apart from *Megascolex* s. lat. and *Oreoscolex*, each of which has a single species on Mt Kosciusko, the other Australian megascolecins are the non-dichogastrin portions of *Perissogaster* Fletcher (typical part), of *Notoscolex* Fletcher (excluding the type-species) and a single supposedly native Queensland species of the large Asian genus *Pheretima*.

Generic and specific affinities

A consideration of the distribution of the genera represented on Mt Kosciusko will elucidate the zoogeographic affinities of the fauna of the mountain with the remainder of the Australian earthworm fauna.

Diporochaeta

The single species of this genus known from Mt Kosciusko shows its closest affinities with several species of the genus from Victoria (which in turn are phenetically close to *Vesiculodrilus*) and it appears to have no close relationship with species occurring outside southeastern Australia. Beyond the Australian mainland, this heterogeneous and unsatisfactory genus is known from Tasmania, New Zealand and its associated islands and South India (Jamieson, 1971c).

Graliophilus

Graliophilus was erected by Jamieson (1971e) for Western Australian species of the genus *Plutellus*. The New South Wales species *Plutellus semicinctus* (Fletcher) appears to have close affinities with it and two Mt Kosciusko species are referable to it although showing distinctions which may later be considered generic. One, *G. montiskosciuskoi*, is known from only a single specimen collected in dry sclerophyll forest at 5,000 feet and the other, *G. woodi*, is common in, and restricted to, sub-alpine woodland and alpine herbfield between 5,800 and 6,900 feet. The distribution of *G. woodi* suggests that it is a cold-adapted species, a rare phenomenon in any group of Australian animals. Furthermore, as alpine conditions occur only in the Australian Alps, it is likely that this species is restricted to these mountains. Whether it is a glacial relict or a product of speciation in the alpine–subalpine zones is indeterminable. *G. montiskosciuskoi* may also be endemic in the Australian Alps.

Vesiculodrilus

This genus is restricted to Tasmania, Victoria and southern New South Wales, the Mt Kosciusko species being the only record from the latter State. Although *V. frenchi* is known only from a single site on Mt Kosciusko, at 6,200 feet in the alpine herbfield, it has also been recorded from adjacent East Gippsland in Victoria. Whether the new species, *V. purpureus*, known from the dry sclerophyll forest and subalpine woodland, occurs elsewhere than Mt Kosciusko is not known.

Cryptodrilus

Both Kosciusko species of *Cryptodrilus* have long been known elsewhere in New South Wales: *C. tenuis* from nearby Braidwood and *C. fastigatus* from Burrawang and Illawarra. This interesting genus, unique in the Oligochaeta in having more than two, and sometimes many, nephridial bladders in a segment, is restricted to Tasmania,

Victoria and southern New South Wales, like *Vesiculodrilus*. The closest relatives of the genus appear to be those perionychins with vesiculate holonephridia. In Australia these are limited to the same regions or extend (*Heteroporodrilus*) into southern Queensland or (*Fletcherodrilus; Diporochaeta*) far north onto Cape York Peninsula.

The unparalleled diversity in the male genital field in *C. fastigatus* on Mt Kosciusko, which exceeds variation known in any other oligochaetes, merits further investigation. Possibly polytypic variation between isolates segregated by ice flows from the former cap glacier has survived as intra-population polymorphism following introgression of the former isolates. The occurence of this species above the winter snowline is remarkable.

Notoscolex

Jamieson (1971c) has drawn attention to the artificiality of the distinction between *Notoscolex* and *Megascolides* as currently defined, although confirming that the type-species are not congeneric, and has demonstrated the heterogeneity of each genus. The single species from Mt Kosciusko, *N. montiskosciuskoi*, resembles the type-species in being dichogastrin but the location of the calciferous glands excludes it from the same species-group and may later be shown to warrant exclusion from the same genus as the type-species. Of the four species which most closely resemble *N. montiskosciuskoi* anatomically, two occur in nearby parts of New South Wales and two in Tasmania. This reflects the zoogeographic affinities seen in other genera from Mt Kosciusko.

Oreoscolex

The megascolecin condition of the nephridia in the new genus *Oreoscolex* separates it widely from *Notoscolex*, in which *O. imparicystis* would formerly have been placed. Its affinities with the remainder of the Australian fauna are, however, little known, as few supposed *Notoscolex* species have been examined for the condition of the meronephridia and the latter genus is widespread in Australia.

Megascolex

Species assignable to this genus, as currently defined, have been found in all parts of Australia from which significant samples of earthworms have been obtained and therefore the presence of *M. celmisiae* on Mt Kosciusko tells us little of the faunistic affinities of the mountain. It must be noted, however, that as there is no evidence that the Australian species of *Megascolex* are congeneric with the Ceylonese type-species of the genus, close affinities of any part of Australia with the Oriental region must not be assumed. This is not to deny the possibility of a closer affinity between *Megascolex* in Australia and Oriental megascolecin oligochaetes than exists between it and non-megascolecin, e.g., dichogastrin, worms.

M. celmisiae has been almost as widely collected on Mt Kosciusko as *Cryptodrilus fastigatus* and, like the latter species, occurs in all vegetational zones. This suggests that it, too, may occur in other areas.

Conclusions

The zoogeographic affinities of Mt Kosciusko lie with the Southeast Australian mainland (adjacent New South Wales and Victoria) and Tasmania. The genera represented form a majority of the genera known from Tasmania. The latter island shares fewer genera with Western Australia and inclusion of Tasmania in the Western Subregion of Australia demonstrated numerically for the avifauna by Kikkawa and Pearse (1970) is not therefore supported by the distribution of earthworms. The earthworm fauna of Mt Kosciusko and that of Tasmania are an integral part of the Southern Province Faunula of the Kosciuskan Division of Australia's Eastern Subregion.

ACKNOWLEDGMENTS

The author is indebted to Dr T. G. Wood for the invitation to study the CSIRO collection and to Miss Elizabeth Pope for making available specimens from the collections of the Australian Museum. Thanks are due to Mr E. Bradbury for assistance in numerous respects. This work was made possible by tenure of Australian Research Grants Committee Grant No. 239280–R–ZOOL–ARGC–120–71.

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Table 1

Localities sampled on Mt Kosciusko

(CSIRO collections)

Station		Diporochaeta pheretima	Graliophilus montiskosciuskoi	Graliophilus woodi	Vesiculodrilus frenchi	Vesiculodrilus purpureus	Cryptodrilus fastigatus	Cryptodrilus tenuis	Notoscolex montiskosciuskoi	Oreoscolex imparicystis	Megascolex celmisiae
	Dry Sclerophyll Forest										
1 and 2	*Eucalyptus pauciflora—E. stellulata—E. rubida*, 3,100 ft, near junction of Snowy and Thredbo Rivers—1/1, 16.v.1966; 2/A1, 12.v.1968; 2/A, 30.xi.1968.						+	+	+		
3	*Eucalyptus pauciflora—E. dives*, 3,750 ft, 30.xi.1968.										
4	*Eucalyptus pauciflora—E. dalrympleana*, 4,000 ft, Sawpit, soil and litter.										
5	*Eucalyptus pauciflora—E. dalrympleana*, 4,230 ft, near Sawpit. 5/1, 15.v.1965; 5/2, 18.xii.1966; 5/3, 20.iv.1967; 5/5, 10.xi.1967; 5/7, 15.ii.1968; 5/8, 25.viii.1968; 5/9, 30.xi.1968.					+	+		+		+
6	*Eucalyptus pauciflora—E. dalrympleana*, 12 m. East of Island Bend, 4,400 ft, 5.iii.1969.										+
7	*Eucalyptus pauciflora—E. dalrympleana*, 6 m. East of Island Bend, 4,400 ft, 5.iii.1969.									+	
8	*Eucalyptus pauciflora—E. dalrympleana*, 4,590 ft, near Wilson's Valley, 16.v.1966.						+				
9	*Eucalyptus pauciflora—E. dalrympleana*, 5,000 ft, 30.xi.1968.		+				+		+		
	Wet Sclerophyll Forest										
10	*Eucalyptus delegatensis*, 5 m. East of Island Bend, 4,000 ft, 5.iii.1969.						+		+	+	
11	*Eucalyptus delegatensis*, 3 m. East of Island Bend, 4,450 ft, 5.iii.1969.						+		+		+
12	*Eucalyptus delegatensis*, Wilson's Valley, 5,000 ft, 12/1, 15.v.1966; 12/2, 18.xii.1966; 12/3, 20.iv.1967; 12/4, 31.vii.1967; 12/7, 18.v.1968; 12/8, 25.v.1968; 12/9, 30.xi.1968.	+					+		+	+	+

Table 1 (*continued*)

Station		*Diporochaeta pheretima*	*Graliophilus montiskosciuskoi*	*Graliophilus woodi*	*Vesiculodrilus frenchi*	*Vesiculodrilus purpureus*	*Cryptodrilus fastigatus*	*Cryptodrilus tenuis*	*Notoscolex montiskosciuskoi*	*Oreoscolex imparicystis*	*Megascolex celmisiae*
	Sub-alpine Woodland										
13	*Eucalyptus paucifiora* with ground cover of *Poa-Celmisia*, Daner's Gap, 5,450 ft, 13/1, 16.v.1966; 13/2, 15.ii.1968; 13/2/A, 15.ii.1968; 13/2/B, 15.ii.1968; 13/3, 30.xi.1968; 13/4, 5.iii.1969.					+	+				+
14	*Eucalyptus paucifiora*, 5,850 ft, 5.iii.1969			+			+				+
15	*Poa—Celmisia* herbfield in *Eucalyptus paucifiora*, below Charlotte's Pass, 16.v.1966.										
16	*Eucalyptus paucifiora*, 6,050 ft, 5.iii.1969										+
	Alpine Herbfield										
17	*Poa caespitosa—Celmisia longifolia*, near Snowy River, 6,200 ft, 17/1, 20.iv.1967; 17/2, 10.xi.1967; 17/3, 15.ii.1968; 17/4, 19.v.1968; 17/5, 25.viii.1968; 17/6, 30.xi.1968.			+	+		+		+		+
18	*Poa—Celmisia*, 6,400 ft, 5.iii.1969 ..			+			+				+
19	*Poa caespitosa—Celmisia longifolia*, near Seaman's Hut, 6,500 ft, 19/2, 20.iv.1967; 19/4, 10.xi.1967; 19/5, 15.ii.1968; 19/6, 19.v.1968; 19/8, 30.xi.1968.			+							+
20	*Poa—Celmisia*, 6,750 ft, 5.iii.1969 ..										+
21	*Poa—Celmisia*, 6,900 ft, 20.iv.1967			+			+				+
22	*Poa caespitosa—Celmisia longifolia*, 6,990 ft, Rawson's Pass, 16.v.1966.						+		+		
23	*Poa—Celmisia*, 7,000 ft, 5.iii.1969 ..						+		+		+
24	*Poa—Celmisia*, 7,100 ft, 5.iii.1969 ..										
	Alpine Humus Soils on Granite										
25	6,000–6,400 ft, 10.ii.1968						+				

Table 2

DISTRIBUTION OF GENITAL MARKINGS IN THE HOLOTYPE AND 26 PARATYPES OF

Megascolex celmisiae

H — Holotype; P — Paratype

Genital Marking	Specimen	Total Number of Specimens
Paired porelike presetal in X	H P1, 4–6, 8–12, 14, 15, 17–19, 24–26.	18
Paired porelike postsetal in X	P3, 5, 6, 8, 10, 11, 26	7
Paired porelike midventrally in XI	P7	1
Midventral porelike in XV	P9	1
Midventral porelike in XVI	P4, 7, 9, 12–16, 18–20, 22–25	15
Midventral smooth in XVII	H P1–26	27
Paired porelike in *ab* of XVIII	P19	1
Paired porelike lateral to male pores in XVIII	H P1–4, 7, 9, 12–18, 20–25	20
Paired ridge lateral to male pores in XVIII	P5, 6, 8, 10, 11, 26	6
Midventral smooth in XIX	H P1–26	27
Midventral porelike in XX	H P1, 2, 4, 7, 9, 12–25	20
Midventral porelike in XXI	H P1, 2, 4, 7, 9, 12–21, 23–25	19
Midventral porelike in XXII	P4, 14	2