Earthworms (Megascolecidae: Oligochaeta) from Western Australia and their zoogeography

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(With 8 figures in the text)

A new genus, Gralliphilus, is erected for the Western Australian section of Phutellus and five species-groups are defined within the new genus, at least two of which may merit elevation to generic rank. Two new species, G. georgei and G. secundus are referred to a southerly species-group of Gralliphilus while new material of Phutellus strelitzii Michaeelsen is assigned to a second, more northerly species-group. Redescription of type-material of P. candidus Jackson and of P. varieystis Jackson reveals that the former belongs to the strelitzii group and the latter to the georgei group. New material of Woodwardiella molaeleonis (Michaeelsen) is described and permits elucidation of the morphology of the excretory system of the genus. A very distinct new species W. acanthodriloides is described from the Frankland River far to the south of the Swan basin range of the callichaeta group to which W. molaeleonis belongs. The new genus Austrosethophila is erected for a new species from Cape Range. This genus is allied to Megasciridae but possesses protodoeal proctodaeal excretory ducts. The genus Pseudomatoscolex is erected for a new species, from the Pallinup River, which lacks the alimentary characteristics of Natoscolex. The zoogeography of the 11 megascolecid genera known from Western Australia is briefly discussed. The seven genera with endemic species have limited and distinctive distributions within the south-western province and this is shown to be true of the five species-groups of Gralliphilus. Three genera, possibly also Woodwardiella Stephenson, are endemic and it is expected that a higher endemcity will be demonstrated on revision of several genera. Ignoring the anthropochorous Pheretima, all but four, circummoundane, species of the 53 megascolecid species recorded from Western Australia are restricted to the subregion.

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Introduction

The megascolecid oligochaetes of south-western Australia have been described by Michaelsen (1907, 1910, 1935); Nicholls & Jackson (1926) and Jackson (1931). Only Michaelsen collected intensively and many areas remain to be investigated. It is probable, therefore, that total records to date represent only a small proportion of the megascolecid fauna of the south-west. That this is so is supported by the preponderance of new species in the small collection described in the present account. The remainder of Western Australia, and the whole of the Northern Territory remains terra incognita, the present paper containing the second record from the two areas.

The megascolecid species of south-western Australia have previously been assigned to the nine genera Eodrilus Michaelsen; Microscolex Rosa; Plutellus Perrier; Pontodrilus Perrier; Megascolides McCoy; Woodwardiella Stephenson; Notoscolex Fletcher; Megascolex Templeton and Pheretima Kinberg. All of these genera have also been reported from the eastern subregion of Australia and from regions outside Australia but, with the exception of Microscolex, Pontodrilus and Pheretima, the constituent species are endemic to their subregions, there being no species shared between the western and eastern subregions. The Australian representatives of the three exceptional genera are not endemic to Australia, those of Microscolex and Pheretima are probably anthropochorous while the Pontodrilus species are widespread in the marine littoral of many parts of the world.

The total lack of generic endemicity in south-western Australia is questionable, as is the very low endemicity for Australia as a whole. This paper continues the delineation of Australian endemic genera previously commenced by the author (Jamieson, 1970, 1971a, b, c, d) and briefly outlines the zoogeography of south west Australian megascolecid.

Systematics

Tribe Perionychini Jamieson, 1971b

*Graliophilus* gen. n.

Dorsal pores present. Setae commencing on II, in eight longitudinal rows which are sometimes irregular posteriorly; ventral setal couples moderately closely to widely paired
(IV) levis group

\[ a = 1.5 - 2 \text{ ab; } c = 1 - 1.1 \text{ bc; } d = 0.24 - 0.27 \text{ u. } \] Nephridia stomate, avesiculate holonephridia. Gizzard in V or VI; oesophagus calciferous gland like in XIV or (whistleri) segmentally dilated in VII–XVI; intestine (always?) commencing in XVIII; typhlosole absent. Spermathecae 3 pairs, in VI–IX, each with a single, simple diverticulum (rudimentary in dalgarangae).

Species. (1) Plutellus levis Michaelsen, 1907.
(2) Plutellus dalgarangae Jackson, 1931.
(3) Plutellus whistleri Michaelsen, 1935.

Remarks. The grounds for distinguishing these three species from others of Graliophilus and for associating them in a single group are the somewhat distinctive setal ratios (unknown, however, for dalgarangae) the 3 pairs of spermathecae, and the calciferous gland like modification of the oesophagus is XIV in levis and dalgarangae. G. dalgarangae is the only Western Australian plutelloid in which the spermathecal diverticulum is not strongly extramural. In the latter feature it resembles American plutelloids referable to Argilophilus.

(V) asymmetricus group

\[ a = 1.5 \text{ ab; } c = bc; d = 0.3 - 0.4 \text{ u. } \] Nephridia holonephridia. Gizzard in V(?) or VI(?); oesophagus segmentally dilated but lacking calciferous glands; intestinal origin (?); typhlosole? Spermathecae unpaired, in VIII and IX, each with a single diverticulum with sperm chambers in the walls.

Species. Plutellus asymmetricus Michaelsen, 1907.

Remarks. The distinctive but imperfectly known setal ratios together with the unpaired condition of the spermathecae are unique characters which, in conjunction with other characters mentioned in the diagnosis, exclude asymmetricus from other species-groups of Graliophilus.

Graliophilus georgei group

**Graliophilus georgei sp. n.**

(Figs 1(a) and 7(a))

*External morphology* (holotype; gross external and internal anatomy confirmed from a paratype). \( l = 80 \text{ mm}, w \text{(midclitellar)} = 2 \text{ mm}, s = 145. \) Form slender approximately circular in cross section throughout; precitellar segments at first simple to biannulate; but mostly triannulate; postclitellar segments with additional annuli. Pigmentless buff in alcohol but with the clitellum pigmented pale brown. Prostomium very slightly proepilobous. First dorsal pore 4/5. Setae 8 per segment, commencing on II; in regular longitudinal rows throughout with the exception that \( d \) becomes irregular at the posterior extremity; \( ab \) absent in XVIII.

Nephropores anterior in their segments, in \( c \) lines. Clitellum annular, strongly protuberant, concave ventrally, embracing XIII–XVII with lesser extension to 1/2 XVIII; interrupted ventrally by the male field; intersegments clearly visible; setae and nephropores less clear; dorsal pores obliterated. Male pores in XVIII in \( ab \) on a pair of ill-defined but large
in the other two species are the precise form of the holonephridia, presence or absence of modified nephridia and, for murrayensis, the intestinal origin and presence or absence of a typhlosole. The author has demonstrated a low dorsal typhlosole in candidus, as reported by Michalsen for woodwardi, but saw only pronounced intersegmental infolding of the intestinal wall in P. strelitzi in which Michalsen reported a spiral typhlosole.

![Diagram](image)

**Fig. 1.** Genital fields of: (a) Graliphilus georgei sp. n. (holotype); (b) G. secundus sp. n. (holotype). By camera lucida. Clitellum shaded. (Explanation of abbreviations see p. 504).

**III** mendilai group

\[ \begin{align*}
  aa & = 1.7 \ pm; \ cd = 1.3 \ pm; \ dd = 0.3 \ pm.
\end{align*} \]

Nephridia stomate, avesiculate holonephridia. Gizzard in VI; oesophagus dilated in XVI, with high internal lamellae; intestine commencing in XVII; dorsal typhlosole present. Spermathecae 2 pairs, in VIII and IX, each with a single, simple diverticulum; sperm chambers absent.

**Species.** Platellus mendilai Michalsen, 1907.

**Remarks.** The setal ratios of mendilai set it apart from all other species of Graliphilus. It approaches the strelitzi group in having calciferous glands in XVI and in possessing a dorsal typhlosole but differs in having simple spermathecal diverticula.
(IV) levis group

aa $\approx 1.5-2$ ab; cd $\approx 1.1$ bc; dd $\approx 0.24-0.27$ u. Nepridia stomate, avesiculate holonephridia. Gizzard in V or VI; oesophagus calciferous gland like in XIV or (whistleri) segmentally dilated in VII–XVI; intestine (always?) commencing in XVIII; typhlosole absent. Spermaticae 3 pairs, in VI–IX, each with a single, simple diverticulum (rudimentary in dalgarangae).

Species. (1) Plutellus levis Michaelsen, 1907.
(2) Plutellus dalgarangae Jackson, 1931.
(3) Plutellus whistleri Michaelsen, 1935.

Remarks. The grounds for distinguishing these three species from others of Graliophilus and for associating them in a single group are the somewhat distinctive setal ratios (unknown, however, for dalgarangae) the 3 pairs of spermaticae, and the calciferous gland like modification of the oesophagus is XIV in levis and dalgarangae. G. dalgarangae is the only Western Australian platellid in which the spermatic diverticulum is not strongly extramural. In the latter feature it resembles American platellids referable to Argilophillus.

(V) asymmetricus group

aa $\approx 1.5$ ab; cd $\approx bc$; dd $\approx 0.3-0.4$ u. Nepridia holonephridia. Gizzard in V(?) or VI(?); oesophagus segmentally dilated but lacking calciferous glands; intestinal origin?; typhlosole? Spermaticae unpaired, in VIII and IX, each with a single diverticulum with sperm chambers in the walls.

Species. Plutellus asymmetricus Michaelsen, 1907.

Remarks. The distinctive but imperfectly known setal ratios together with the unpaired condition of the spermaticae are unique characters which, in conjunction with other characters mentioned in the diagnosis, exclude asymmetricus from other species-groups of Graliophilus.

Graliophilus georgei group

Graliophilus georgei sp. n.

(Figs 1(a) and 7(a))

External morphology (holotype; gross external and internal anatomy confirmed from a paratype). $l = 80$ mm, $w$ (midelitellar) $= 2$ mm, $s = 145$. Form slender approximately circular in cross section throughout; preclitellar segments at first simple to biannulate; but mostly triannulate; postclitellar segments with additional annuli. Pigmentless buff in alcohol but with the clitellum pigmented pale brown. Prostomium very slightly proepilobous. First dorsal pore 4/5. Setae 8 per segment, commencing on II; in regular longitudinal rows throughout with the exception that $d$ becomes irregular at the posterior extremity; $ab$ absent in XVIII.

Nepropores anterior in their segments, in c lines. Clitellum annular, strongly protuberant, concave ventrally, embracing XIII–XVII with lesser extension to 1/2 XVIII; interrupted ventrally by the male field; intersegments clearly visible; setae and nepropores less clear; dorsal pores obliterated. Male pores in XVIII in ab on a pair of ill-defined but large
(aa = 1.5-4 ab); setae of the dorsal couples (cd) widely paired to distant (1.3-2.3 ab) usually smaller than, rarely equal to or slightly larger than the interval between the couples of a side (cd = 0.7-1.3 bc); dorsal median intersetal distance (dd) = 0.2-0.5 of the circumference. Penial setae present or absent. Nephropores inconspicuous, if visible; nephridia stomateng, avesiculate holonephridia, the ducts of which enter the parietes presetally in c or in d above, in a single series only on each side; present throughout the body or replaced in a varying number of anterior segments by coiled or tufted nephridia the ducts of which pass anteriorly and (always?) open into the mouth. Clitellum ending in XVII or XVIII. Pores of a pair of thickly tubular prostases and the vasa deferentia combined on XVIII. Accessory genital markings present (rarely absent?). Spermathecal pores 2 or less commonly, 3 pairs with the last in 8/9 or (asymmetricus) unpaired in 7/8 and 8/9.

Dorsal blood vessel single, continuous onto the pharynx; latero-oesophageal hearts present, the last in XII or XIII. Gizzard well developed in V (or sometimes VI?). Oesophagus simple or with vascularized dilatations or with true (internally lamellate) but sessile calceferous glands. Intestinal origin varying from XVIII-XIX; typhlosole present or absent. Testes in X and XI, 1-3 pairs of seminal vesicles present; testis-sacs absent. Ovaries in XIII; ovisacs sometimes present. Spermathecae each with one or two extramural diverticula; the diverticulum single chambered or its wall internally complicated to form seminal chambers.

Diagnosis. Combined male and prostatic pores a pair on XVIII. Setae 8 per segment; cd = 0.7-1.3 bc. Nephridia exonephric, stomateng, avesiculate holonephridia forming a single series on each side discharging in c or d or above these; sometimes replaced in a varying number of anterior segments by coiled or tufted nephridia with anteriorly directed (always buceal?) ducts. Calceferous glands present or absent. Spermathecae with extramural diverticula, sometimes with sperm-chambers in the walls but never multiloculate.

Distribution. Western subregion of Australia, Eyrean division, south western faunal province (Fig. 8).

Type-species. Graliophilus georgei sp. n. (p. 476).

Other species. See species-groups.

Remarks. Jamieson (1970, 1971e) has shown that Plutellus, to which the species of Graliophilus would formerly have been assigned, must be restricted to species in which nephridial bladders are present in e lines anteriorly, and further posteriorly alternate in b and d lines, which lack modified anterior nephridia, and which possess calceferous glands with long ducts, in X-XIII. Plutellus would thus contain only Plutellus manifestus (Fletcher), from New South Wales, and the supposedly Pennsylvanian, but probably Eastern Australian, P. heteroporus Perrier, the type-species. The genus cannot, however, be formally restricted until the status of other species of Plutellus s. lat. is determined. The genus Simsia Jamieson, 1971a, has been erected for some Victorian species formerly assignable to Plutellus which have avesiculate holonephridia; oesophageal dilatations in XV-XVII; multiloculate spermathecal diverticula and in which cd is usually very much smaller than bc. Simsia forms a morphologically and geographically homogeneous group to which Western Australian plutelli, though sometimes near, cannot be referred. The only other genus to which Western Australian plutelli might be assigned is Argiophilus Eisen, from the Western Nearctic (United States), at present unjustifiably supressed as a synonym of Plutellus. Argiophilus lacks extramural diverticula, typically (and commonly) has alternating or irregularly arranged nephropores and from these facts and its geographical
distribution appears to be distinct from the Western Australian species. Separate generic status is therefore proposed for the latter species under the anagram *Graliophilus*.

Distinct species-groups are discernible in *Graliophilus* and at least two of these are probably generically distinct one from the other although inadequate data on Michaeelsen's species and the refractory condition of the type material precludes formal definition of the additional genera.

The following species-groups are here recognized in the Western Australian plutelli; their zoogeography is discussed on p. 500.

(I) georgei group

\[ aa \pm 1-4-2-3 \; ab; \; cd \mp 0-8-1-1 \; bc; \; dd \pm 0-2-0-4 \; u. \]
Nephridia stomate, avesiculate holonephridia discharging in c lines; (astomate?) tufted (buccal?) nephridia sometimes present anteriorly. Gizzard well developed in V (or VI?); oesophagus simple, or dilated in 1–3 of segments XV–XVIII but not known to possess internal lamellae; intestine commencing in XVIII or XIX; typhlosole absent. Spermathecae 2 pairs, in VIII and IX, each with 1 or 2 simple diverticula, sperm chambers absent.

*Species.* (1) *Graliophilus georgei* sp. n. (p. 476).
(2) *Plutellus blackwoodianus* Michaeelsen, 1907.
(3) *Plutellus carneus* Michaeelsen, 1907.
(4) *Graliophilus secundus* sp. n. (p. 478).
(5) *Plutellus schumanni* Michaeelsen, 1907.
(6) *Plutellus termitophilus* Michaeelsen, 1907.
(7) *Plutellus varicystis* Jackson, 1931.
(8) *Plutellus wellingtonianus* Michaeelsen, 1907.

*Remarks.* The above diagnosis is based primarily on three species (1), (4) and (7) which have been examined by the author. Sufficient data are available on the other species to justify their inclusion in the group and setal ratios are known for all species. The data most often lacking are origin of the intestine, presence or absence of a typhlosole and the morphology of the nephridia.

(II) strelitzi group

\[ aa \pm 3 \; ab; \; cd \pm 0-7-0-8 \; bc; \; dd \pm 0-5 \; u. \]
Nephridia stomate, avesiculate holonephridia discharging in or above d lines; (astomate?) buccal nephridia present or absent anteriorly. Gizzard well developed, in V; oesophagus dilated and (always?) internally lamellate in XVI and/or XVII; intestine commencing in XVIII or XIX; dorsal or spiral typhlosole present. Spermathecae 2 pairs, in VIII and IX, each with a single diverticulum with sperm chambers in the walls.

*Species.* (1) *Plutellus strelitzi* Michaeelsen, 1907.
(2) *Plutellus candidus* Jackson, 1931.
(3) *Plutellus murrayensis* Michaeelsen, 1907.
(4) *Plutellus woodwardi* Michaeelsen, 1907.

*Remarks.* The author has seen only species (1) and (2). Setal ratios are, nevertheless, known for all species and the only characters in the group diagnosis which are not known
in the other two species are the precise form of the holonephridia, presence or absence of modified nephridia and, for *murrayensis*, the intestinal origin and presence or absence of a typhlosole. The author has demonstrated a low dorsal typhlosole in *candidus*, as reported by Michaelson for *woodwardi*, but saw only pronounced intersegmental infolding of the intestinal wall in *P. strelitzii* in which Michaelson reported a spiral typhlosole.

![Diagram](image)

Fig. 1. Genital fields of: (a) *Graliophillus georgei* sp. n. (holotype); (b) *G. secundus* sp. n. (holotype). By camera lucida. Clitellum shaded. (Explanation of abbreviations see p. 504).

(III) *mendilai* group

aa = 1.7 ab; cd = 1.3 bc; dd = 0.3 u. Nephridia stomate, avesiculate holonephridia. Gizzard in VI; oesophagus dilated in XVI, with high internal lamellae; intestine commencing in XVII; dorsal typhlosole present. Spermathecae 2 pairs, in VIII and IX, each with a single, simple diverticulum; sperm chambers absent.

Species. *Plutellus mendilai* Michaelson, 1907.

Remarks. The setal ratios of *mendilai* set it apart from all other species of *Graliophillus*. It approaches the *strelitzii* group in having calciferous glands in XVI and in possessing a dorsal typhlosole but differs in having simple spermathecal diverticula.
(IV) *levis* group

$aa = 1.5-2 \ ab$; $cd = 1-1.1 \ bc$; $dd = 0.24-0.27 \ u$. Nephridia stomate, averesiculate holonephridia. Gizzard in V or VI; oesophagus calciferous gland like in XIV or (*whistleri*) segmentally dilated in VII–XVI; intestine (always?) commencing in XVIII; typhlosole absent. Spermathecae 3 pairs, in VI–IX, each with a single, simple diverticulum (rudimentary in *dalgarangae*).

Species. (1) *Plutellus levis* Michaelsen, 1907.
(2) *Plutellus dalgarangae* Jackson, 1931.
(3) *Plutellus whistleri* Michaelsen, 1935.

Remarks. The grounds for distinguishing these three species from others of *Graliophilus* and for associating them in a single group are the somewhat distinctive setal ratios (unknown, however, for *dalgarangae*) the 3 pairs of spermathecae, and the calciferous gland like modification of the oesophagus is XIV in *levis* and *dalgarangae*. *G. dalgarangae* is the only Western Australian plutellloid in which the spermathecal diverticulum is not strongly extramural. In the latter feature it resembles American plutellloids referable to *Argiophilus*.

(V) *asymmetricus* group

$aa = 1.5 \ ab$; $cd = bc$; $dd = 0.3-0.4 \ u$. Nephridia holonephridia. Gizzard in V(?) or VI(?); oesophagus segmentally dilated but lacking calciferous glands; intestinal origin?; typhlosole? Spermathecae unpaired, in VIII and IX, each with a single diverticulum with sperm chambers in the walls.


Remarks. The distinctive but imperfectly known setal ratios together with the unpaired condition of the spermathecae are unique characters which, in conjunction with other characters mentioned in the diagnosis, exclude *asymmetricus* from other species-groups of *Graliophilus*.

*Graliophilus georgei* group

*Graliophilus georgei* sp. n.

(Figs 1(a) and 7(a))

*External morphology* (holotype; gross external and internal anatomy confirmed from a paratype). $l = 80 \ mm$, $w$ (midgelectellar) $= 2 \ mm$, $s = 145$. Form slender approximately circular in cross section throughout; preclitellar segments at first simple to biannulate; but mostly triannulate; postclitellar segments with additional annuli. Pigmentless buff in alcohol but with the clitellum pigmented pale brown. Prostomium very slightly proepilobous. First dorsal pore 4/5. Setae 8 per segment, commencing on II; in regular longitudinal rows throughout with the exception that $d$ becomes irregular at the posterior extremity; $ab$ absent in XVIII.

Nephropores anterior in their segments, in clines. Clitellum annular, strongly protuberant, concave ventrally, embracing XIII–XVII with lesser extension to 1/2 XVIII; interrupted ventrally by the male field; intersegments clearly visible; setae and nephropores less clear; dorsal pores obliterated. Male pores in XVIII in $ab$ on a pair of ill-defined but large
porophores which fill the segment longitudinally but are crossed by the setal annulus on which the pores are situated. Accessory genital markings a median unpaired low glandular papilla at 16/17 and 19/20, that in 19/20 flanked at least on the right side by a dark tumid circular area lateral of b line, the lateral and median markings lying in a common genital field which reaches from the setal arc of XIX to the posterior border of XX. Indistinct paired genital markings with depressed centres and very wide oval rims present in each of intersegments 12/13 and 13/14; the anterior pair contiguous mediunicily.

Female pores apparently a pair of medianly almost contiguous pores shortly in front of the setal arc of XIV. Spermathecal pores minute, paired in 7/8 and 8/9, median of a lines. Small papillae in 6/7, 7/8 (and 8/9?) are accessory genital markings. The postsetal annulus of VIII and the presetal annulus of IX slightly tumid midventrally.

**Interseal distances in Segment XII**

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<td>2-07</td>
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</tbody>
</table>

* Standardized to a circumference (a) of 100.

**Internal anatomy.** Septa: 5/6 slightly thickened; 6/7–12/13 moderately thickened; 12/13–18/19 slightly thickened. Last septal (pharyngeal) glands in IV. Dorsal blood vessel single, continuous on to the pharynx. Dorsoventral commissural vessels in VI–XIII; those in VI–IX very slender, dorsoventral only, and each giving off ventrally a lateral branch to the body wall; those in X–XIII wider, though never large, and at least in XI–XIII (and X?) each forming a latero-eosophageal heart, originating from the dorsal vessel and receiving a connective from the slender supra-eosophageal vessel. Supra-eosophageal obscured in VII–XIV. Subneural vessel absent. Gizzard large, firmly muscular and thickwalled in V; preceded in IV by a muscular, transparent proventriculus of similar width and not clearly demarcated from it. No free eosophagus in VI; in VII to XVIII the eosophagus somewhat moniliform, transparent and noticeably vascularized; in the paratype dilatation is most pronounced in XV and XVI and, to a lesser extent XVII; the intestine commences abruptly in XIX: typhlosole and muscular thickening absent. Purely holonephric; stomate, avesiculate exonephric holonephridia conspicuous in XIII posteriorly but traceable forward to III, diminishing in size anteriorly. Large testes, free sperm masses and large iridescent funnels in X and XI; racemose seminal vescicles in IX and XII, larger in XII. Flattened bushy ovaries and funnels in XIII; racemose ovisacs in XIV. Prostates very tortuous somewhat flattened tubes, with closely adpressed coils, in XVIII; each with a very short muscular duct; vas deferens joining the duct near the ectal end of the latter. Penial setae absent. Spermathecae 2 pairs, in VIII and IX, each with a well demarcated saeciform ampulla wider than long and a slightly shorter duct joined at its ectal extremity
by a somewhat longer, iridescent, clavate diverticulum; ducts enter body wall in a lines. Size uniform; length of right spermatheca of IX = 0.82 mm; ratio of total length spermatheca: length duct = 2.24; ratio of total length: length diverticulum = 1.27.

Material examined. A clitellate specimen, here designated the holotype and several aclitellate specimens, the paratypes. Dug from mud on sides of freshwater stream at old mouth of Mammoth Cave, 34°04' S, 115°02' E, south-western Australia, collector R. George, 31. i. 1961; W.A.M. 30–70.

Remarks. Graliophilus georgei is widely different from all south-western Australian "plutelli," with the exception of G. blackwoodianus (Michaelsen, 1907) and G. whistleri (Michaelsen, 1935), in the disposition of the accessory genital markings and in other characters. These markings nevertheless show in the latter species differences which taken with other features, indicate that they and G. georgei are specifically distinct although more closely related than they are to other species of the genus. Michaelsen's account is imperfect in several respects and it is not known whether blackwoodianus had hearts in XIII, as in georgei, a highly unusual condition. Some differences of the three species are listed below.

<table>
<thead>
<tr>
<th></th>
<th>G. georgei sp. n.</th>
<th>G. blackwoodianus (Michaelsen, 1907)</th>
<th>G. whistleri (Michaelsen, 1935)</th>
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<tbody>
<tr>
<td>Prostomium</td>
<td>Pro-epiplophous</td>
<td>Epiplophous 2/5</td>
<td>Tanylophous 5/6</td>
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<td>First dorsal pore</td>
<td>4/5</td>
<td>6/7</td>
<td>(9/10), (15/16),</td>
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<tr>
<td>Genital</td>
<td>6/7, 7/8, (8/97)</td>
<td>Constant in 11 specimens in 12/13, 16/17, 19/20,</td>
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<td>Markings</td>
<td>16/17, 19/20</td>
<td>16/17, 19/20</td>
<td>16/17, 19/20–21/22</td>
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<tr>
<td>Gizzard</td>
<td>12/13, 13/14 (19/207)</td>
<td>None</td>
<td>XVIII</td>
</tr>
<tr>
<td>Intestinal origin</td>
<td>In V</td>
<td>In VI (?)</td>
<td>In VI (7)</td>
</tr>
<tr>
<td>Penial setae</td>
<td>Absent</td>
<td>Present</td>
<td>XVIII</td>
</tr>
<tr>
<td>Ovisacs</td>
<td>Present</td>
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<td>Absent</td>
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<td>Spermathecae</td>
<td>2 pairs</td>
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<td>Not reported</td>
</tr>
<tr>
<td>Spermathecal diverticulum</td>
<td>Ental</td>
<td>Ental</td>
<td>3 pairs</td>
</tr>
<tr>
<td>Locality</td>
<td>Mammoth Cave</td>
<td>Bridgetown</td>
<td>Brancaster, near</td>
</tr>
<tr>
<td></td>
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<td>Dinninup</td>
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</tbody>
</table>

Graliophilus secundus sp. n.

(Figs 1(b), 6(a) and 7(b))

l = 50+ mm (posterior amputee), w = 2.5 mm, s = ? Form: circular in cross section throughout; first 5 segments simple, thereafter, in the forebody, triannulate; postelitellar segments with additional annuli. Pigmentless buff in alcohol. Prostomium epiplophous 1/3, closed, acute. First dorsal pore 5/6. Setae in 8 regular longitudinal rows (as far as the caudal amputation) commencing on II; ab absent on XVIII; a pigment spot present on each side in bc in the forebody, varying in position from b to c.

Nephropores visible almost only on the clitellum, inconspicuous anteriorly in their
segments in c lines. Clitellum only slightly protuberant, annular, XIV–XVIII; intersegmental furrows, dorsal pores and setae retained. Male pores shortly median of a lines, on a pair of medianly conjoined papillae which fill all but a small posterior portion of XVIII. Large ovoid accessory genital markings, extending from the ventral midline to shortly lateral of b line, paired in 9/10; unpaired, on the right side only, in 10/11; and paired in 16/17 and 17/18; each an ovoid tumid pad with pore-like centre which is situated in ab, nearer b. Female pores shortly anterioedian of a on a pair of low medianly conjoined papillae. Spermaphecal pores minute, concealed in intersegmental furrows 7/8 and 8/9, immediately median of a lines.

\[\text{Intersetal distances in segment XII}\]

<table>
<thead>
<tr>
<th>aa</th>
<th>ab</th>
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<tr>
<td>mm</td>
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<td>mm</td>
<td>st</td>
<td>mm</td>
<td>st</td>
<td>mm</td>
<td>st</td>
</tr>
</tbody>
</table>

Holotype 0·70 10·47 0·39 5·76 0·81 12·04 0·63 9·42 2·49 35·17 0·60 8·90 0·74 10·99 0·35 5·24
Intervals/ab 1·82 1·00 2·09 1·64 6·45 1·55 1·91 0·91

Septa: 5/6 and 6/7 moderately, 7/8–11/12 strongly, 12/13 and 13/14 slightly thickened; the remainder thin. Last septal (pharyngeal) glands in V. Dorsal blood vessel single. Dorsovential commissural vessels in VII–XIII; those in VII–IX slender, dorsoventral only; those in X–XIII forming 4 pairs of large latero-oesophageal hearts, each receiving a connective from the dorsal vessel and from a slender supra-oesophageal vessel which runs through VIII–XIII.

Gizzard small and globular, with muscular sheen but easily compressible, in V. Oesophagus well developed in VI; somewhat moniliform in VII–XVIII but with no special dilatations, though widest in XV and XVI. Intestine commencing in XIX, at first only about one and a half times the width of the preceding oesophagus; typhlosole and muscular thickening absent. Nephridia avesiculate stomatic exonephric holonephridia, the postseptal portions commencing in II; the slender duct of each entering the body wall preseptally in c.

Testes and iridescent sperm funnels in X and XI; large racemose seminal vesicles with many large rounded loculi in IX and XII. Ovaries consisting of many chains of oocytes, and funnels in XIII; ovisacs absent. Prostates moderately wide much coiled tubes restricted to XVIII; each with a very short narrow duct joined ectally by the vas deferens. Penial setae absent. Spermaphcae 2 pairs, opening anteriorly in VIII and IX, each with an ovoid ampulla poorly demarcated from an almost equally wide, longer duct which is joined, just before it narrows to the spermaphcal pore, by a clavate inseminated diverticulum. Size uniform; length of right spermaphca of VIII = 1·26 mm; ratio of total length: length duct = 1·95; ratio of total length: length diverticulum = 3·0.

Material examined. A single clitellate specimen here designated the holotype, from culvert on road to Thompson’s Bridge; approximately 34° 30' S 116° 02' E, collector ?, 24. xi. 1938; W. A. M. 33–70.

Remarks. Graliophillus secundus resembles G. candidus (Jackson, 1931), in location of the
last hearts in XIII. It differs from the latter species, and all other species assigned to *Graliophillus*, in the configuration of the accessory genital markings.

**Graliophillus varicystis** (Jackson, 1931)

(Figs 4(a), 6(b) and 7(c), (d))

*Platellus varicystis* Jackson, 1931: 92-93, Fig. 7, 8; Pt. XV, fig. 4.

Two post-clitellar amputees permit the following data to be added to Jackson's account (genital markings, only, are described for the second specimen).

**External morphology.** Form approximately circular in cross section; preclitellar segments weakly triannulate. Prostomium epilobous 2/3, with broad, closed dorsal tongue slightly narrowing posteriorly. First dorsal pore 4/5. Setae large, in 8 longitudinal rows, commencing on II; *ab* absent, *bc* present on XVIII.

**Intersetal distances in segment XII**

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<thead>
<tr>
<th></th>
<th>aa</th>
<th>ab</th>
<th>bc</th>
<th>cd</th>
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<td>3-93</td>
<td>1-43</td>
<td>1-64</td>
<td>0-79</td>
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</table>

Nephropores inconspicuous white spots in c lines, most clearly developed on the clitellum; not present on several of the anterior-most segments. Clitellum annular, posterior 1/3 XIII-XVII. A pair of combined male and prostatic pores on XVIII in *ab*, nearer a, on inconspicuous, small porophores but both lying in a common, transversely elliptical slightly tumid field which fills XVIII longitudinally, extends laterally to shortly above *b* lines, and posteriorly reaches the setal arc of XIX. Accessory genital markings; a triplet of conjoined eye-like markings one median, and 2 lateral in *ab* nearer *b* in intersegmental furrows 16/17; a pair of ventrally conjoined markings with knoblike pore-bearing central portion and tumid border, in *ab*, nearer *b*, in intersegmental furrow 11/12; and a similar unpaired marking at mid-*ab*, in 21/22 (first specimen) or (second specimen) all markings similar but that in 21/22 replaced by a pair in 20/21. Female pores clearly visible in XIV, anterior to and well median of setae *a*, in a common elliptical field. Spermathecal pores 2 pairs, on low mounds, in 7/8 and 8/9, with centres slightly median of *a* lines.

**Internal anatomy** (specimen 1 only). Some preclitellar segments moderately strongly thickened. Septal (pharyngeal) glands delicate, elongate lobed structures extending into V (and VI?) on each side of the gizzard. Dorsal blood vessel single; continuous onto the pharynx. Dorsoventral commissural vessels in VI-XIII; those in VI-IX slender and dorsoventral only; those in X-XIII forming 4 pairs of thick latero-oesophageal hearts arising from the wide distinct supra-oesophageal vessel, their connections with the dorsal vessel not verifiable. Supra-oesophageal vessel clearly developed in and limited to VII-XIII. Gizzard large cylindrical and firmly muscular in V (assuming a very delicate peritoneum-
like sheath to be septum 5/6) but occupying the entire length of segment VI; preceded by and anteriorly partly enfolded in a wide thick walled proventriculus. Oesophagus with obvious vascular striae and at least in the anterior segments moniliform, in VII–XVI, elongate but less vascular in XVII; intestine commencing with abrupt expansion in XIX; 

lymphatic and muscular thickening absent. Nephridia in II–VII much coiled and sending coalescent ducts far forwards into segment I in which they possibly open into the mouth or, if they are exonephric, closely approach this. By IX (VIII?) the nephridia are large, simple, stomate avesiculate holonephridia and are exonephric, with the slender duct entering the parietes presetally in e line. Testes, iridescent sperm funnels and free sperm masses in X and XI; racemose seminal vesicles in IX and XII, the posterior pair very large. Ovaries, bushy with large oocytes, and funnels in XIII; ovisacs absent. Prostates thickly tubular, tortuous, with once-looped, ectally widening muscular ducts which are joined at the ectal third by the vasa deferentia. Penial setae absent. Spermatozoea each with a large saccular ampulla broader than long; a wide, longer duct joined near its ectal extremity by a single iridescent (inseminated) stoutly elevate diverticulum; additional tumour-like structures on the duct of some spermatozoea appear to be accessory ampullae, size uniform, total length of left spermatozoea of VIII = 1.1 mm; ratio total length: length duct = 2.3; ratio total length: length diverticulum = 1.5. Spermatozoeal diverticulum inseminated; sperm chambers are absent but the ectal portion of the wall of the diverticulum has high laminar elevations of the lining epithelium extending far into the lumen.

Material examined. Two clitellite post-clitellar amputees of many otherwise aclitellar specimens “Probably type material,” Porongorups, Western Australia, 29.v.1927, W.A.M. 18–61.

Remarks. The post-clitellar accessory genital markings were not reported by Jackson.

**Graliophilus strepti**—group

**Graliophilus strepti** (Michaelson, 1907)

(Figs 2(c), (d), 6(c) and 7(f))

*Platellus strepti* Michaelson, 1907: 168–171, Fig. 3; Pl. I, fig. 11, 12.

*Platellus strepti*; Jackson, 1931: 86.

l = 95 mm; w (XV) = 5 mm; s = 171. Form moderately stout; approximately circular in cross section throughout; the first three segments biannulate, the remainder of the forebody strongly triannulate; the postclitellar segments with barely perceptible secondary annulation. Pigmentless buff in alcohol. Prostomium epitanylobous; closed wedge shaped to 1/3 peristomium but continued as a very narrow strip to intersegment 1/2. First dorsal pore 3/4 (imperforate); perforate from 4/5. Setae in 8 longitudinal rows, commencing in II; c and d lines irregular posteriorly; ab absent in XVIII.

Nephropores not certainly visible externally. Clitellum indistinct, annular (?) XIII–XVII and apparently part (or the whole?) of XVIII; stronger above than below b; intersegmental furrows, setae and dorsal pores retained but fainter than elsewhere. Male pores in XVIII in ab shortly median of b lines on small papillae. Eye-like accessory genital markings with centres median to a lines, paired in 15/16 and 16/17; a further pair in 19/20 with centres approximately in a lines. Suggestions of similar paired markings in ab in 17/18
Fig. 2. Genital fields of: (a) Woodwardiella acanthodrioides sp. n. (holotype); (b) Woodwardiella molaeleonis (Michaelsen, 1907), new material from Bibra Lake, specimen 2; (c), (d) Gallothilus streltzii (Michaelsen, 1907), new material from Mahogany Creek. All by camera lucida. Clitellum shaded. (Explanation of abbreviations see p. 504.)
and 18/19. Female pores very shortly in front of and almost imperceptibly median of a, in XIV. Spermathecal pores on small distinct papillae in a lines in 7/8 and 8/9, each in a transverse cleft.

**Internal anatomy.** Septa: 5/6 greatly attenuated by the gizzard; 6/7 slightly thickened; 7/8 moderately thickened; 8/9–13/14 strongly thickened; 14/15–15/16 slightly thickened; the remainder thin. First septal (pharyngeal) glands in III. Dorsal blood vessel single, continuous on to the pharynx. Dorsoventral commissural vessels a pair in each of segments IV–XII; those in IV–IX slender, dorso-ventral only, each giving off a lateral branch, ventrally, to the body wall; those in X–XII forming 3 pairs of large latero-oesophageal hearts, each receiving a very slender filamentous connective from the dorsal vessel and a wide connective from the supra-oesophageal vessel which extends through IX–1/2 XIII.

### Intersetal distances in segment XII

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<th>be</th>
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<th>dd</th>
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<td>0.95</td>
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<td>2.25</td>
<td>1.16</td>
<td>9.02</td>
<td>0.46</td>
<td>3.55</td>
</tr>
</tbody>
</table>

Intervals/ab

Subneural vessel absent. A large soft walled proventriculus in IV; gizzard very large, in V, and firmly muscular, widening slightly anteriorly where it is overlapped by folds of the proventriculus, extending posteriorly to the level of intersegment 9/10. Oesophagus suppressed in VI–VIII by backward extension of the gizzard; unmodified in IX; vascularized and slightly moniliform, sending paired vessels to the supra-oesophageal vessel, in X–XIII; narrow in XIV–XVII but in XVII bearing laterally a pair of very large true calciferous glands; globular and chloragogenous-looking in XVIII; intestine commencing, with abrupt expansion, in XIX; typhlosole and muscular thickening absent. Each calciferous gland (in XVIII) kidney-shaped though slightly trilobate viewed along the body axis, opening into the lateral face of the oesophagus by a narrow orifice and therefore well cut off from the oesophagus, extending dorsally of this almost to touch the gland of the other side, and extending also for a considerable distance ventrally of its connection with the gut; the interior filled by deep thin laminae arranged radially relative to the wall of the gland and coalescing towards the oesophagus.

Nephridia stomate avesiculate, exonephric holonephridia, in X posteriorly, with the preseptal funnel in a line, the postseptal body simple, like that of a lumbricid nephridium, and extending between a and d lines, the ectal, narrow duct longer than the nephridial body, extending far laterally to penetrate the parietes shortly below the mid dorsal line, slightly widening as it enters the body wall.

First nephridium in III, it and that in IV, much coiled, thickly tubular, but not tufted, preseptal funnel present; the narrow ectal duct opening into the mouth; those in V and VI sending ducts up around the pharynx which pass forwards to the junction of buccal cavity and body wall (whether exonephric or enteronephric not determinable); those in
VII also discharging far anteriorly; those in VIII and IX, still coiled appearing to discharge presetally in ı; those in X above ı.

Testes and non-iridescent large, pleated funnels free in X and XI; seminal vesicles racemose with many rather large loculi in IX and XII, the posterior the larger. Prostates tubular, coiled, restricted to XVIII each with a moderately long, slender, muscular duct; vas deferens joining the ectal extremity of the gland.

Penial setae present; follicles very conspicuous and long, extending far laterally in XVIII. Penial setae long, curved, attenuated and flexible; each ornamented distally by a series of approximately 15–20 long, sharp anteriorly directed spines on each side; few apparent across the seta, the spines on each side sometimes opposite, sometimes out of phase with those of the other side; the seta wider and flatter near the distal extremity which forms a broad shallow gutter. Length of two right penial setae = 3·8 and 5·0 mm, greatest width (near base of one) = 24 μm; width of shaft behind ornamented region = 14 μm; width of distal expansion = 15 μm. One of the setae is periodically scooped out so that its profile is very irregular, a condition apparently observed also by Michaelson. Ovaries (small thick folded laminae with few large terminal oocytes) and funnels in XIII; ovisacs absent. Spermathecae 2 pairs opening anteriorly in VIII and IX; lacking spermatozoal iridescence; each bipartite, with a short muscular duct, the larger median ramus identifiable with that considered by Michaelson to be the ampulla; the shorter ramus, apparently the diverticulum, subdivided internally into elongated oblique loculi. Size

Fig. 3. Male and spermathecal field of Gialiophilus candidus (Jackson, 1931) (probable syntype). By camera lucida. Clitellum shaded. (Explanation of abbreviations see p. 504.)
uniform; length of the right spermatheca of IX = 2·04 mm; ratio of total length of the spermatheca: length duct = 6·11; ratio of total length: length diverticulum = 3·05.

Material examined. A single clitellate specimen, Mahogany Creek, 31° 54' S, 116° 08' E, collector Mr de Graney, W.A.M. 40. 1944.

Remarks. The Mahogany Creek material is sufficiently close to P. streitzi to be considered conspecific. Differences in Michaelson's specimens were: prostomium pro-epilorous; d setal lines irregular throughout; no suggestions of genital markings in 17/18 and 18/19; intestine commencing in XVIII. None of these merits specific distinction and at least the latter difference may be fictitious as a globular swelling of the oesophagus in the Mahogany Creek specimen gave a spurious impression of being the intestinal origin. Agreement of the penial setae for the two localities is sufficiently close to support conspecificity though the widths given by Michaelson are smaller by a factor of 10 than those given here if 1 μm is taken to equal 1/1000 mm.

![Fig. 4. Genital fields of: (a) Gratiophilus varicystis (Jackson, 1931) (probable syntype); (b) Woodwardiella acanthodriloides sp. n. (holotype). By camera lucida. Clitellum shaded. (Explanations for abbreviations see p. 504.)](image-url)
Graliophilus candidus (Jackson, 1931)

(Figs 3, 6(d) and 7(c))

Plutella candidus Jackson, 1931: 90-92 Fig. 6, Pl. XV, fig. 9, 12, 13.

A brief examination of a much dissected specimen allows the following observations to be added to Jackson’s account.

Interseptal distances in segment XII

<table>
<thead>
<tr>
<th></th>
<th>aa</th>
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<td>1.33</td>
<td>1.33</td>
<td>1.42</td>
<td>1.67</td>
</tr>
</tbody>
</table>

Clitellum saddle-shaped, XIII-2/3 XVIII. Male pores in b lines of XVIII on inconspicuous medianly conjoined porophores. Accessory genital markings consisting of elliptical tuncences with depressed centres, a pair at each of intersegmental furrows 7/8 and 8/9, asymmetrically arranged; those on the right side located behind the intersegmental furrows and median to a lines; those on the left side in front of the furrows and in b lines. A pair of hemispheroidal accessory genital markings present in 16/17 and weakly represented in 18/19 in ab nearer b lines, a suggestion of similar markings being present in 17/18. An unpaired elliptical tuncence, bearing 2 pore-like markings, located midventrally in 19/20. Female pores a pair shortly anteromedian of setae a of XIV. Spermathecal pores not identified with certainty; a minute pore, with raised circular rim, observable within each of the left accessory markings at 7/8 and 8/9 is presumably a spermathecal pore.

Dorsal blood vessel continuous onto the pharynx. Latero-oesophageal hearts in X-XIII. Gizzard large and firmly muscular, in V; a muscular but easily compressed proventriculus present in IV. True but sessile calciferous glands in XVI, a pair of indistinctly separated dorsolateral pouches with longitudinal internal lamellae convergent to the ventrally situated oesophageal lumen; the laminae from anterior and posterior walls not contiguous across the gland. Intestinal origin not certainly determinable, apparently XIX, rather than XVIII cited by Jackson; a very low dorsal typhlosole present. Nephridia stomate, avesiculate, exonephric holonephridia throughout; post-septal bodies commencing in II. Nephridia in the forebody very large and thickly tubular but always simple, their terminal ducts correspondingly wide but not forming bladders, running laterally to enter the body wall preterially in d lines, anteriorly, then progressively more laterally so that by XVI the duct enters the parietes far dorsally of d line as at the posterior end of the body.

Prostates tubular, moderately tortuous, slightly lobulated and depressed. Spermathecae 2 pairs, discharging anteriorly in VIII and IX, each with a long clavate ampulla, a shorter saciform diverticulum, and a short conical duct; the internal walls of the diverticulum honeycombed by numerous long seminal chambers; size uniform, length of right spermatheca of IX = 1.47 mm; ratio total length: length duct = 7; ratio total length: length diverticulum = 2.5.
Material examined. A single clitellate specimen bearing a museum label, stating that it was collected in 1937, and is probably a type; W.A.M. 15–61. The type-locality, not specified, was Roleystone.

Genus Woodwardiella Stephenson, 1925

Woodwardiella molaeon (Michaelsen, 1907)

(Figs 2(b) and 7(h))

*Woodwardia molaeonis* Michaelsen, 1907: 195–196, Fig. 17; Pl. II, fig. 37, 38.

*Woodwardiella molaeonis*; Jackson, 1931: 103.

**External morphology.** \( l = 28–29 \text{ mm}, w \text{ (midclitellar)} = 1.5 \text{ mm}, s = 103, 98 \text{ (2 specimens).} \) Form moderately slender, circular in cross section throughout, lacking noteworthy secondary annulation; pigmentless buff in alcohol but the clitellum pigmented pale reddish brown. Prostomium epilobous, with broad dorsal tongue extending to half (1 specimen) or through almost the whole (2 specimens) of the peristomium. First dorsal pore 4/5 (3 specimens). Setae commencing on II, in 8 regular longitudinal rows throughout, or (1 specimen) \( b \) and \( d \) slightly irregular posteriorly; \( ab \) absent in XVIII.

**Intersetal distances in segment XII**

\[
\begin{array}{cccccccccc}
\text{aa} & \text{ab} & \text{bc} & \text{cd} & \text{dd} & \text{de} & \text{cb} & \text{ba} \\
\text{mm} & \text{st} & \text{mm} & \text{st} & \text{mm} & \text{st} & \text{mm} & \text{st} & \text{mm} & \text{st} \\
1 & 0.58 & 12.74 & 0.28 & 6.18 & 0.47 & 10.42 & 0.49 & 10.81 & 1.46 & 32.05 & 0.47 & 10.42 & 0.51 & 11.20 & 0.28 & 6.18 \\
2 & 0.58 & 12.13 & 0.30 & 6.25 & 0.51 & 10.66 & 0.46 & 9.56 & 1.60 & 33.46 & 0.54 & 11.40 & 0.51 & 10.66 & 0.28 & 5.88 \\
\text{Mean of st} & & & & & & & & & & & & & & & \\
12.44 & 6.22 & 10.54 & 10.19 & 32.76 & 10.91 & 10.93 & 6.03 \\
\text{Intervals/ab} & & & & & & & & & & & & & & & \\
2.00 & 1.00 & 1.69 & 1.64 & 5.27 & 1.75 & 1.76 & 0.97 \\
\end{array}
\]

Clitellum annular extending through the last \( \frac{1}{4}, \frac{1}{2} \text{XIII–XVII, intersegmental furrows and setae retained; dorsal pores almost obliterated; nephropores not visible. Male pores with protuberant penial setae in ab on small papillae in XVIII. Accessory genital marking a median transverse tumid pad in 11/12 reaching laterally almost to b lines and extending longitudinally between the setal annuli of adjacent segments (constant in 3 specimens). Spermathecal pores barely perceptible, in 7/8 and 8/9 in a lines.}

**Internal anatomy** (from a single specimen). Septa: Some thickened in the forebody 9/10–11/12 the strongest. First septal (pharyngeal) glands anterior in IV. Dorsal blood vessel single, continuous at least on to the gizzard. Dorsoventral commissural vessels in ?–VIII–XII; those in VIII and IX slender and dorsoventral only; those in X–XII forming 3 pairs of relatively large latero-oesophageal hearts; each receiving a connective from the drosal and from the very slender supra-oesophageal vessel.

Oesophagus dilated but thin walled in IV; gizzard large, elongate, widening to an anterior,
rim, firmly muscular, in V. Oesophagus notably dilated and vascularized in XVI and separately in XVII; intestine beginning with abrupt expansion in XVIII; a rather low rounded dorsal typhosole present, well developed segmentally, rudimentary or not certainly developed at the intersegmental constrictions of the intestine, beginning at about XIX.

First nephridia in III forming a few coils, and discharging on each side by a pair of separate but intertwining ducts above d lines, shortly anterior of intersegmental furrow 1/2. There are no separate nephridia in IV but in V and extending also into IV, is a group of about 5 thick meronephridial loops each of which sends a duct to join its fellows, in V or in IV, to unite as a single duct which runs anteromedianly to join the pharynx in II at its junction with the buccal cavity. In VI posteriorly there is in each segment a pair of simple avesciculate exonephric holonephridia each discharging by a very slender long duct pre-setally in e lines; attachments to the anterior septa observed in some segments indicate that the holonephridia are stomata. Testes and iridescent sperm funnels free in X and XI; racemose seminal vesicles in IX and XII the posterior pair much the larger. Ovaries (flat paddle-shaped laminae with small oocytes) and funnels in XIII; ovisacs absent. Prostates racemose, compact, restricted to XVIII, each with a narrow medianly directed duct; gland joined ectally by the two thick vasa deferentia.

Penial setae present; length of a fully developed seta, = 540 μm; greatest width near base = 12 μm, strongly bowed, tapering uniformly to the distal end which bears a few barely discernible anteriorly directed scattered spines closely applied to its surface; the ectal, unornamented region convoluted (artefact?) and terminally forming a small web. Spermamtheae relatively large, 2 pairs, opening anteriorly in VIII and IX, each with an elongate-ovoid to digitiform ampulla, and a short slender duct which is joined entally by a fairly large, clavate inseminated diverticulum. Length of right spermamtheae of IX = 1.24 mm, ratio of total length spermamthea: length duct = 8.87; ratio total length: length diverticulum = 2.29.

Material examined. Three citellate specimens from Bibra Lake, 32° 05' S, 115° 49' E, collector W.A.M. 10454.

Remarks. The above account largely confirms and considerably extends the account given by Michaelson (1907) for specimens from Lion Mill. The new material has allowed elucidation of the excretory system essential for determination of affinities with eastern seaboard species previously placed in Woodwardiella (see Jamieson, 1970).

Woodwardiella acanthodriloides sp. n.

(Figs 2(a), 4(b), 6(e) and 7(g))

External morphology (holotype and paratype). l = 70, 100 mm, w (midcitellar) = 2.5 mm, s = 130, 131 (holotype and paratype respectively). Form slender, circular in cross section, intersegmental furrows deep; lacking conspicuous secondary annulation although the preclitellar segments are weakly triannulate. Pigmentless buff in alcohol but with clitellum pigmented yellowish brown. Prostomium very broad, damaged but apparently epilobous 1/2, closed. Dorsal pores present including preclitellar segments but first pore indeterminable (holotype), first in 4/5 (paratype). Setae large and conspicuous, in 8 regular longitudinal rows throughout; setae ab absent in XVIII, present in XVII and XIX.
WESTERN AUSTRALIAN EARTHWORMS

Nephropores faintly visible anteriorly in the clitellar segments in c lines. Clitellum strongly protuberant, saddle shaped, judging from yellowish pigmentation, with ventral margins in b lines, although the epidermis is tumid below these; embracing the posterior 2/3 of XIII to XVII; intersegments obscured dorsally; dorsal pores obliterated; setae and nephropores retained.

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<th>Intersetal distances in segment XII</th>
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<td>Mean</td>
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<td>Intervals/ab</td>
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Male genital field: Male pores on hemispheroidal papillae in ab of XVIII, separated by longitudinal depressions from a prominent median longitudinal strip which extends from the setal papilla of XVII to that of XIX, giving a spurious impression of an acanthodrilin field. In the paratype there are paired presetal genital markings in XV and XVI, each elongate oval with a central papilla and a wide rim, setae ab being situated on the posterior aspect of the rim. Female pores anteromedian to setae a, about 1/3 aa apart, both in a common oval field. Spermatic pares 2 pairs, in 7/8 and 8/9 in mid bc, each pore with extremely large anterior and posterior lips which reach the setal annuli of the two adjacent segments.

Internal anatomy (holotype). Septa: 7/8-12/13 fairly strongly thickened. Last septal (pharyngeal) glands in IV or V. Dorsal blood vessel single, continuous in front of the gizzard. Dorsal blood vessels observed in IX-XII but not certainly absent in front of IX; those in IX slender and doreval only; those in X-XII forming 3 pairs of latero-oesophageal hearts, each receiving a connective from the dorsal vessel and from a supra-oesophageal vessel; extent of the latter vessel uncertain. Subneural vessel absent.

Gizzard large, firmly muscular in V; widening anteriorly where it is overlapped by a large collapsible proventriculus, in IV, which is not sharply demarcated from it. Oesophagus dilated in XI but not apparently modified; gut (oesophagus?) expanded, moniliform and conspicuously vascularized in XIV, XV and XVI, similar but narrower in XVII; severely macerated from XVIII, in which the intestine possibly commences.

Nephridia: The first pair forms a pair of large tufts in III discharging by a long wide duct anteriorly in d line. By IV, the nephridia are simple, though more coiled than further posteriorly, and send slender ducts to enter the body wall presetally in c line; the duct may have a very slight cylindrical dilatation in the ectal region but is to be considered avesiculate.

Testes and iridescent funnels in X and XI, racemose seminal vesicles in IX and XII, the posterior pair much the larger and composed of large discrete loculi. Ovaries (large stalked oval laminae composed of many large oocytes) and large funnels in XIII; ovisacs
absent. Prostates racemose, restricted to XVIII, each with a long slender muscular duct which receives a vas deferens in the ental half but far ectally of the gland. Penial setae absent.

Spermathecae 2 pairs, opening anteriorly in VIII and IX, in mid bc; each with a compact ovoid ampulla, a long slender duct and a long digitiform diverticulum with spermatozoa iridescence, approximately equal in length to the duct which it enters ectally. Size uniform; length of right spermatheca of IX = 0.98 mm; ratio of total length: length duct = 5:60 ratio total length: length diverticulum = 2:33.

Material examined. Two clitellate specimens, here designated the holotype and paratype, Frankland River. Between 34 and 35°S and 116°30′–117°00′ E, collector ?, 23. xi. 1939; W.A.M. 34–70.

Remarks. The highly distinctive male genital field and paired accessory genital markings distinguish this species from all other species of Woodwardiella.

Tribe Dichogastrini Jamieson, 1971b

Austrohoplochaetella gen. n.

Dorsal pores present. Setae in 8 longitudinal rows throughout, commencing with II. Ventral setal couples closely paired (ar≥ 5 ab); setae of the dorsal couples (cd) more widely paired, (nearly twice ab), significantly smaller than the interval between the couples of a side (cd ≥ 0.5 bc); dorsal median intersetal distance (dd) ≥ 0.6 of the circumference. Setae ab absent in XVIII. Nephropores not externally visible. Astomate exonephric meronephridia in II–IV; pharyngeal tufted nephridia in (V and ?) VI; behind this exon- phric meronephridia decreasing in number from 4 or 5 on each side in anterior segments to 2 on each side posteriorly and finally one stomatic megameronephridium on each side in each segment. The megameronephridia and a few preceding nephridia sending longitudinal excretory ducts to the proctodaeal region. Clitellum annular, including the segment (XVIII) bearing a pair of combined male and prostatic pores. Accessory genital marking present. Spermathecal pores 2 pairs, the last in 8/9. Dorsal blood vessel continuous onto the pharynx (?). Latero-oesophageal hearts present, the last in XIII. Gizzard large, in V. Calciiferous glands absent but oesophagus somewhat widened and relatively more vascularized in XIV–XVII; intestine commencing in XVIII; a high laminar dorsal typhlosole present. Testes in X and XI; 2 pairs of seminal vesicles present; testis-sacs absent. Ovaries in XIII; ovisacs present in XIV. Prostates thickly tubular. Spermathecal diverticula distinctly extramural.

Diagnosis. Combined male and prostatic pores a pair on XVIII. Ventral setal couples closely paired, dorsal setal couples more widely paired but much closer together than are the ventral and dorsal couples (cd ≥ 0.5 bc); dorsal median intersetal distance greater than half of the circumference. Meronephric; pharyngeal tufts present anteriorly; avesiculate exonephric (astomate ?) meronephridia present throughout, decreasing in number posteriorly, excepting some terminal caudal segments in which there is a pair of single stomatic megameronephridia only in each segment discharging (with some of the preceding meronephridia) into longitudinal excretory ducts which pass through several segments to the proctodaeal region. Gizzard present; calciiferous glands absent; dorsal typhlosole present. Prostates tubular. Spermathecae with extramural diverticula.
Distribution. Western Subregion, Eyrian division, Central northwestern faunal province, at Cape Range, a refuge area (Fig. 8).

Monotypic; Type-species. Austrohoplochaetella kendricki sp. n. (p. 492)

Remarks. Meronephric genera with tubular prostates were referred in the classification of Gates (1959) to the family Octochaetidae, for which this combination of characters was diagnostic. Only two autochthonous Australian genera were so characterized, viz. Megascolides and, supposedly, Spenceriella; both from Eastern Australia. The type-species of Megascolides, M. australis McCoy, has single stomate meronephridia median to astomate meronephridia on each side, in caudal segments, these nephridia discharging to the exterior in their own segments (Spencer, 1888). These characteristics of the excretory system place M. australis (and no other species previously referred to the genus) in the tribe Dichogastrini of the Megascoleciniae in the classification of Jamieson (1971b). They distinguish it from Austrohoplochaetella, as does the absence of a typhlosole. The type-species of

Fig. 5. Genital fields of: (a) Austrohoplochaetella kendricki gen. et sp. n. (holotype); (b) Pseudonotoascolus pallinum sp. n. (holotype). By camera lucida. Clitellum shaded. (Explanations of abbreviations see p. 504.)
Spenceriella also appears to have a dichogastin excretory system and has been shown to have racemose though elongate prostates, and to lack a typhlosole, differences which, with its perichaetial setal arrangement, set it apart from Austrohoplochaetella. The combination of tubular prostates with longitudinal interconnection of posterior stomate nephridia in Austrohoplochaetella is reminiscent of two oriental genera Hoplochaetella and Travoscolides and the African species Millsonia anomala Omodeo, 1955. Travoscolides has advanced enteronephry, with the longitudinal excretory ducts deeply embedded in the intestine and communicating with it in each segment and cannot be considered close to Austrohoplochaetella, Hoplochaetella, and Millsonia anomala on the other hand, show remarkable similarities to Austrohoplochaetella in the excretory systems, having extra-alimentary longitudinal excretory ducts. The stomate megameronephridia opening into these ducts are accompanied by (exonephric) micromeronephridia which were not demonstrated in Austrohoplochaetella but this does not appear to be an important difference in view of the presence in Austrohoplochaetella of meronephridia in preceding segments (though never in the large numbers seen in Hoplochaetella and M. anomala). Hoplochaetella is unique in the Megascolecidae in having two pairs of openings to the vasa deferentia while Millsonia is acanthodrilin with calciferous glands in XV and XVI and there is no doubt of their generic distinction from Austrohoplochaetella. Whether the longitudinal posterior excretory ducts in the three genera, which are known nowhere else in the Dicho- gastrini, have been acquired convergently or are evidence of a closer mutual relationship than that with other dichogastria genera cannot at present be decided. The longitudinal excretory ducts in Millsonia anomala differ from those in Hoplochaetella but possibly resemble those of Austrohoplochaetella in opening to the exterior in each segment.

Austrohoplochaetella kendicki sp. n.

(Figs 5(a), 6(f) and 7(i))

External morphology. l = 75, 52 mm, w (XV) = 1, 2 mm, s = 164, 139 (clitellate holotype, a clitellate paratype respectively). Form slender; circular in cross section in the forebody; in the hindbody with a midventral keel and dorsal canalicula; the caudal end concave dorsally; anus wide, almost bisecting the pygidium into lateral halves; lacking noteworthy secondary annulation. Pigmentless, almost white in alcohol; clitellum (holotype) slightly pigmented pale brown. Prostomium proepilobous but connected to 1/2 by a median groove. First dorsal pore 6/7. Setae minute, difficult to discern, in 8 regular longitudinal rows throughout, commencing on II; setae ab absent in XVIII and obscured in the holotype in XVI and XVII.

Nephropores not visible. Clitellum (holotype) annular, forming a conspicuous constriction of the body, XIV–XVIII; intersegmental furrows and setae retained; dorsal pores obscured.

Male pores in ab of XVIII each on a minute papilla, both lying in a common tumid field the arced lateral borders of which extend into bc. A very strongly protuberant, transversely oval accessory genital marking fills XVI and XVII longitudinally and extends laterally into bc, being transversely bisected by a deep wide depression corresponding with intersegment 16/17. Female pores minute, presetal in a lines of XIV. Spermathecal pores on small elliptical papillae in 7/8 and 8/9 slightly median of a lines.
Internal anatomy. Septa: 5/6 thin; 6/7–12/13 moderately thickened; 13/14–17/18 slightly thickened; the remainder thin. Last septal (pharyngeal) glands anterior in IV. Dorsal vessel single, not observed in front of segment VI, anteriorly very slender. Dorsoventral commissural vessels in VII (and further anteriorly?) to XIII; those in IX, anteriorly, very slender and dorsoventral only; those in X–XIII forming 4 pairs of moderately large latero-oesophageal hearts, each receiving a connective from the dorsal vessel and from the inconspicuous supra-oesophageal vessel.

**Intersetal distances in segment XII**

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<tr>
<td>mm</td>
<td>0.56</td>
<td>1.35</td>
<td>0.11</td>
<td>2.13</td>
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<td>1.83</td>
<td>28.97</td>
<td>1.83</td>
<td>3.16</td>
<td>1.16</td>
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</tbody>
</table>

Holotype

Intervals/ab

Gizzard, in V, large, firmly muscular, almost cylindrical but widening to a rim anteriorly which is continuous with a wide, collapsible proventriculus. Oesophagus narrow and unspecialized to XIII. Wider and apparently more vascularized in XIV–XVII; intestine commencing gradually at the anterior septum of XVIII, with a definite oesophageal valve, not widening greatly until XIX; a high laminar dorsal typhlosole present, first perceptible (weakly developed) in XVIII.

Nephridia. A few astomate exonephric avesiculate meronephridia on each side in II, III and IV, the median nephridium in II and III enlarged and penetrating the parietes presetally in b of the same segment. A single pair of very large tufts with many long nephridial loops in VI (and extending into V?) appears to open into the pharynx but this requires confirmation. Behind this there are 4 or 5 integumentary avesiculate exonephric meronephridia on each side, their locations apparently varying from segment to segment; in one intestinal segment 3 nephridia penetrate the parietes above d line (one of these very near the dorsal midline), 1 does so in d and another in b while in an adjacent segment one of the nephridia enters the body wall in c line. Caudally the number of nephridia progressively decreases in a posterior direction from 4 on each side, in b, c, d and above d, to 3 on each side for a few segments and then, at approximately 17 segments from the posterior end, 2 on each side; for the last 15 or so segments (excepting one or two rudimentary terminal segments) there is one large stomatomegamonephridium, without accompanying micromeronephridia, on each side in each segment. These megamonephridia send each a duct laterally and posteriorly, the ducts running posteriorly to the junction of rectum and body wall and coalescing en route so that there are only about 3 longitudinal ducts on each side; whether these longitudinal excretory ducts open to the exterior at the hind end or into the rectum is uncertain but it seems probable, from the large size of the proctodeal chamber that they enter the junction of rectum and body wall which this chamber represents. Sporadic but usually paired white spots above d lines in posterior segments may indicate that the longitudinal ducts also open to the exterior in each segment but no segmental integumentary ducts were detected; the minute size of the...
ducts and the bleached and softened condition of the specimens precludes more definitive elucidation of the excretory system. The lateral nephridia in the preceding segments with 2 nephridia on each side also send longitudinal ducts posteriorly to the anal region (holotype). The last one or two rudimentary segments appeared to have several micromeronephridia and no stomate nephridia (holotype). Only the posterior region of the paratype was dissected. In at least some of the segments containing stomate megameronephridia an inconspicuous astomate integumentary micromeronephridium was detectable entering the body wall in the same segment. The terminal one or two segments conformed with those of the holotype.

Fig. 6. Prostates in dorsal view, of: (a) Oralliphila secunda sp. n. (holotype); (b) G. varicepsis (Jackson, 1931) (probable syntype); (c) G. streltzi (Michaelsen, 1907), new material from Mahogany Creek; (d) G. candidus (Jackson, 1931) (probable syntype); (e) Woodwardella acanthodriloides sp. n. (holotype); (f) Austrohoplochaetella kendricki gen. et sp. n. (holotype); (g) Pseudonotoescole pallinnopsis gen. et sp. n. (holotype). All by camera lucida. (Explanation of abbreviations see p. 504.)
Testes, coagulated sperm masses and large iridescent sperm funnels in X and XI; seminal vesicles very large racemose sacs, linear structures with large loculi arranged pinnately and wrapped around the gut; in XI and XII. Ovaries (rather rudimentary) and funnels in XIII; ovisacs present in XIV. Prostates thickly tubular, coiled a few times, restricted to XVIII, each with a short narrow muscular duct which is joined near its ental end by the vasa deferentia. Penial setae absent. Spermathecae 2 pairs, opening anteriorly.

![Image of spermathecae](image)

**Fig. 7.** Spermathecae of: (a) *Grauligilus georgii*, sp. n. (holotype); (b) *G. secundus* sp. n. (holotype); (c), (d) *G. varicystis* (Jackson, 1931) (probable syntype) left spermatheca of VIII and IX respectively; (e) *G. candidus* (Jackson, 1931) (probable syntype); (f) *G. streniatus* (Michaelsen, 1907), new material from Mahogany Creek; (g) *Woodwardiella acanthodriloides* sp. n. (holotype); (h) *W. moaeleonis* (Michaelsen, 1907), new material from Bibra Lake, specimen 2; (i) *Austrohoplochaetella kendidii* gen. et sp. n. (holotype); (j) *Pseudonotoceola pallinsensis* gen. et sp. n. (holotype). The spermathecae are those for which dimensions are given in the text. All by camera lucida. (Explanation for abbreviations see p. 504.)
in VIII and IX, each with an ovoid ampulla which is wider than long and a longer well-demarcated duct which is joined at mid length by a short digitiform diverticulum. Size uniform; length (holotype) of the left spermaticca of IX (uninseeded) = 0.90 mm; ratio of total length of spermaticca: length duct = 1.34; ratio of total length: length diverticulum = 2.12.

Material examined. A clitellate and an acilitellate specimen, both with genital markings, here designated holotype and paratype respectively; in recent bone earth including water borne leaf mould at a depth of approximately 30 m, in a dark side chamber of a natural cave termed WAPET No. 4 deep well, Cape Range, 22° 15' S, 113° 55' E, collectors G. W. Kendrick and G. Hitchin, 15.v.1965, W.A.M. 37-70.

_Pseudonotoscolex_ gen. n.

Dorsal pores present. Setae in 8 longitudinal rows throughout, commencing with II; irregular posteriorly. Ventral setal couples widely paired (aa: 2.5-3.5 ab); the interval between the setae of each dorsal couple (cd) wide (cd: 3.5-5.5 ab) but somewhat narrower than the interval between the couples of a side (cd 4.5-5.7 bc); dorsal median intersetal distance (dd): 0.2 of the circumference. Setae ab of XVIII replaced by penial setae. Nephropores not visible. Avesiculate exonephric (astomate?) megameronephridia 4-5 on each side in each segment throughout most of the body; the medianmost nephridium on each side in posterior segments enlarged, with a preseptal funnel; succeeded by a few segments with as many or fewer, small apparently astomate nephridia on each side. A pair of very large buccal tufts present anteriorly. Clitellum annular, its last segment that of the male pores. Accessory genital markings present. Spermaticcal pores 2 pairs, the last in 8/9.

Dorsal blood vessel continuous on to the pharynx. Latero-oesophageal hearts present, the last in XIII. Gizzard large, in V. Calciferous glands absent but oesophagus dilated conspicuously in the region of XV-XVII and to a lesser extent in preceding segments; intestine commencing in XVIII; a low convoluted dorsal typhlosole present. Testes in X and XI; 2 pairs of seminal vesicles present; testis-sacs absent. Ovaries in XIII; ovisacs absent. Prostates racemose. Spermaticcal diverticula distinctly extramural.

_Diagnosis_. Combined male and prostatic pores a pair on XVIII. Meronephric; buccal tufts present anteriorly; avesiculate exonephric (astomate?) megameronephridia present throughout most of the body, few in number, the median most nephridium enlarged and with preseptal funnel in at least the posterior segments, excepting a few caudal segments which have a few astomate micromeronephridia only. Gizzard in V; calciferous glands absent; some oesophageal dilatations present; dorsal typhlosole present. Spermaticcalae with extramural diverticula.

_Distribution_. Western Subregion. Eyrean Division, South Western faunal province (Fig. 8).

**Monotypic; Type-species. Pseudonotoscolex pallinupensis** sp. n. (p. 497)

_Remarks_. _Pseudonotoscolex_ differs from _Notoscolex_, as exemplified by the type-species, _N. camdenensis_, from New South Wales, in the smaller number of meronephridia per segment; location of the gizzard in V; absence of calciferous glands; presence of a typhlosole; and the smaller dorsal intersetal distance (dd: 0.5 μ, compared with 0.2 μ in _Notoscolex_).
The status of Western Australian species assigned to *Notoscole* (s. lat.) by Michaelsen (1907) is uncertain. They are not sufficiently similar to *N. camdenensis* to appear congeneric with it and their affinities with *Psuedonotoscole* are uncertain as their morphology, especially that of the excretory system, is insufficiently known. Some differences from *Psuedonotoscole* and *Notoscole s. strict.* are: *cd* is equal to or, usually, greater than *bc*; and in posterior segments, so far as can be established from Michaelsen’s descriptions, there is (always?) a megameronephridium (holonephridium?) only on each side. Additional differences from *Psuedonotoscole*, but not from *Notoscole* are the numerous strewn meronephridia and the absence of a typhlosole.

**Pseudonotoscole paliinupensis** sp. n.

(Figs 5(b), 6(g) and 7(j))

*External morphology. l = ?* (posterior amputee), 80 mm, *w* (XV) = 3.5 mm, *s = ?, 141* (holotype and paratype respectively). Form moderately stout, circular in cross section; the first seven segments simple to biannulate; the succeeding triannulate. Pigmentless buff in alcohol. Prostomium broadly tanylobose, bisected by a faint longitudinal groove. First dorsal pore 4/5. Setae in 8 longitudinal rows throughout (e and d irregular posteriorly in the paratype) setae *ab* replaced by a medianly closely juxtaposed penial seta on each side.

**Intersetal distances in segment XII**

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<td>8.33</td>
<td>0.35</td>
<td>4.90</td>
<td>1.23</td>
<td>17.16</td>
<td>0.98</td>
<td>13.73</td>
</tr>
<tr>
<td>Mean st</td>
<td>9.51</td>
<td>3.79</td>
<td>17.93</td>
<td>13.36</td>
<td>21.26</td>
<td>13.41</td>
<td>17.22</td>
<td>3.54</td>
</tr>
<tr>
<td>Intervals/ab</td>
<td>2.51</td>
<td>1.00</td>
<td>4.73</td>
<td>3.53</td>
<td>5.61</td>
<td>3.54</td>
<td>4.54</td>
<td>0.93</td>
</tr>
</tbody>
</table>

Nephropores not visible. Clitellum annular, very weakly developed, embracing XIV–XVIII; intersegmental furrows, dorsal pores and setae retained. Male pores a pair of minute orifices very close together on XVIII on the posterior aspect of an unpaired low, transversely oval poropore; a pair of penisetal pores situated on the anterior aspect of the same poropore and somewhat wider apart. Accessory genital markings 3 pairs of white elliptical areas in 17/18, 19/20 and 20/21, the first pair centred lateral of *b* lines, the second pair in *ab* and the third pair median to *a* lines. Each marking cleft transversely by a narrow groove which connects or (20/21) almost connects the marking with that of the other side. The markings and the groove with dark glandular borders.

Female pores in XIV shortly anteromedian of setae *a*. Spermathecal pores on 2 pairs of small papillae anterior in their segments and close to the ventral midline, in 7/8 and 8/9.

*Internal anatomy* (holotype; gross anatomy confirmed in paratype). Septa: 5/6 thin; 6/7–7/8 moderately thickened; 8/9–11/12 increasingly strongly thickened although never
very strong; 12/13 and 13/14 moderately thickened; 14/15 and 15/16 slightly thickened; the remainder thin. Last septal (pharyngeal) glands anterior in IV. Dorsal blood vessel single, continuous onto the pharynx. Dorsoventral commissural vessels a pair in each of segments V–XIII; those in V–IX fairly slender and dorsoventral only; those in X–XIII forming 4 pairs of latero-oesophageal hearts, each receiving a connective from the dorsal vessel and from an inconspicuous supra-oesophageal vessel, which extends through 1/2 IX–1/2 XIV. Subneural vessel absent. Muscular proventriculus in IV almost as wide as the gizzard but flaccid; gizzard large, broadly fusiform, firmly muscular in V; suppressing the oesophagus in VI and abbreviating it in VII; oesophagus vascularized and with low longitudinal rugae in VIII posteriorly; especially dilated and vascularized, though still with simple central lumen, in each of XIII–XVI; most strongly dilated in XV or (paratype) XVI and XVII; white, globular and chloragogenous-looking in XVII or (paratype) in XIII posteriorly. Intestine commencing with abrupt expansion in XVIII (narrow in paratype); a much convoluted low dorsal typhloscole beginning in XXIV (both specimens), at first weakly developed.

Nephridia: avesiculate exonephric megameronephridia generally 4 or 5 on each side in a segment, their slender ducts entering the parietes preseptally in a, b, bc, c and d although the coiled bodies of the nephridia lie respectively in setal lines b (pore at a), bc (2 or 3; pore at b and bc or c), and below d (pore at d). In the first nephridial segment (III) and a few succeeding segments the median nephridium is enlarged with numerous coils, though still exonephric and independent of those of other segments. On each side of and closely applied to the pharynx is a very large body consisting of numerous tubules and sending sheaves of ducts forwards to the buccal cavity. This is apparently a buccal tufted nephridium as it is distinct from the glands investing the pharynx. Posteriorly, as far as the amputation, there are 4 nephridia on each side, much reduced in size and still displaced from the junction of their ducts with the parietes, here preseptally in a, b, c and d; the median one has a small preseptal funnel, as is perhaps the case anteriorly. At the hind end in the paratype, which is not posteriorly amputated, on each side in each segment there are 4 nephridia discharging preseptally in a, b, c and d but that discharging in c is enlarged to the size of a holonephridium and sends a very long neck medianly to a very large preseptal funnel which lies in a line. There is only one funnel on each side in a segment. In the last few small segments 2–4 small nephridia are present on each side and no funnels are observable.

Testes, large coagulated sperm masses and iridescent sperm funnels free in X and XI; elongate, saccular, slightly lobed seminal vesicles in IX and XII, larger in the posterior segment. Prostates racemose, moderately large, tongue-shaped, widening and then narrowing entally; the margins slightly lobulated; the duct medianly directed, short and muscular.

Retractors of the penisetal follicles very conspicuous and long, extending into XXII. Penial setae exceptionally long, filiform, very flexible; unornamented. Almost imperceptibly tapering throughout excepting a short distal region which is gently curved relative to the remainder, tapers more rapidly and terminates in a very fine sinus drawn out tip. Six setae present in the left follicle (including replacement setae); length of longest seta = 2.85 mm; width basal expansion = 13 μm; greatest width of remainder (near base) = 18 μm. Ovaries (palmate, terminally with many separate strings of large oocystes) and funnels in XIII; ovisacs absent. Spermathecae 2 pairs, opening anteriorly in VIII and IX,
each with a long, slender, digitiform ampulla and a much longer folded digitiform inseminated diverticulum of similar width; diverticulum and ampulla merging ectally to give a very short common region, about as wide as the ampulla, which may be considered a duct. The diverticulum of the right anterior spermatheca, though inseminated, is shorter and very slender. Length of the right spermatheca of IX = 1.19 mm; ratio total length spermatheca: length duct = 11.33; ratio total length: length diverticulum = 0.65.

Material examined. Two specimens here designated holotype (clitellate posterior

Fig. 8. Sketch map showing the known distribution in Western Australia of all genera and species-groups of the Megascolecidae which include species endemic in the area. Black circles indicate all published terrestrial sites at which oligochaetes have been sought with the exception of a few which cannot be located. The inset shows zoogeographical subdivisions of Australia recognized by Kikawa & Pearse (1969) and two additional collecting sites; the shaded area is that represented in the larger map. (Explanation of abbreviations see p. 504.)
amputee) and paratype (actinellate complete), Pallinup R., Western Australia, 34° 29' S, 118° 54' E, collector?; W.A.M. 3570 (previously 8960, part).

**Zoogeography**

Despite the supposed absence of genera endemic to the south western faunal province of Australia (terminology of Kikkawa & Pearse, 1969), the genera recognized by Michaelson as occurring in the province were shown by him to have limited and distinctive geographical ranges within it. An internal endemicity can therefore be discerned within the province. Figure 8 shows the known distribution of genera of the Megascoleidae with endemic species in the area and also indicates the published localities at which oligochaetes have been sought in Western Australia.

Subfamily Megascoleinae s. Jamieson, 1971b

Tribe Perionychini Jamieson, 1971b

**Gralilophilus**

This genus, which is relatively primitive in its holonephry, lumbricine setae and tubular prostates, has been found throughout almost the entire length of a coastal corridor extending between the north and south extremes of the south western province. No collections of oligochaetes are available from the remaining coastal areas of the province. Those from further inland have yielded no terrestrial oligochaetes. One species of the *levis*-group, *G. dalgarangae*, has been recorded shortly outside the province, at Yalgoo, in the central province of the same, Eyrean division. This and a record of *Australohoplochaetella* from the central north western province and of *Diploptema macleayi* (Fletcher, 1889) from the Timorian division represent the only known collections of megascoleids in Western Australia outside the south western province. The distribution of *Gralilophilus* and of other megascoleids beyond the south western province thus remains to be investigated.

The species-groups of *Gralilophilus*, on present information, occupy areas with varying degrees of distinctness, relative to each other, within the province. The observed distribution of the groups may well be altered by further collections however.

The *georgei*-group has the largest extent for the genus in the province, a western coastal area bounded inland by a line from Fernbrook (Lunenburg) to the vicinity of Albany. Its range thus lies within that of *Megascoleex* (q.v.).

The *streitzi*-group has a more northerly distribution than that of the *georgei*-group though overlapping the northern part of the range of the latter. It connects the ranges of *Woodwardiella* (callicheta-group) and of *Megascoleex* but is centred within the distribution of *Notoexolex*.

The *levis*-group includes the far northern *G. dalgarangae* and extends down, through much of the range of *Gralilophilus*, to Brancaster (Dinninup) but is not known from the Albany region.

*G. asymmetricus*, forming a monotypic species-group, lies in the Albany portion of the range of the genus, sympatrically with members of the *georgei*-group, while *G. mendili*, also a monotypic entity, occurs far north of the *georgei-* and *streitzi*-groups, at Eradu.
Western Australian Earthworms

Pontodrilus

Pontodrilus is circumboreal on sea shores in the warmer regions of the world, including the tropics, and extends into the fresh-water littoral in Lake Chilka, India. Records from Western Australia (Michael, 1907; Jackson, 1931) are of P. albanyensis Michael, 1907, from Albany, Normana, Herring Bay and the Swan River, which is currently regarded as a synonym of P. litoralis (Grube); and P. bermudensis Beddard, from Cottesloe and Denham.

Woodwardiella

Woodwardiella includes a callicheta-group of species which are endemic in a small area around Perth, records being from Jarrahdale, Subiaco, Lion Mill (Michael, 1907), Lismore (Jackson, 1931) and Bibra Lake (present study). It is of considerable interest that this area approximately corresponds with an area defined in a computer analysis of the distribution of the avian genera of Australia by Kikkawa & Pearse (1969) and which showed a close affinity with Tasmania. Segregation of the isolated area from a larger south western zone was regarded by Kikkawa and Pearse as a result of “misclassification” but the distribution of the callicheta-group, when considered with the occurrence of Woodwardiella in Tasmania, suggests that it may be a real division. The only species of Woodwardiella s. strict, recorded from Eastern Australia are two species, W. tesselatus (Spencer, 1895) and W. mortoni (Spencer, 1895), from Tasmania, and the Victorian W. healesi (Michael, 1932). Until these Eastern Woodwardielllas are reexamined their affinity with Western species must remain questionable however.* The new species of Woodwardiella, W. acanthodriloides, described in the present paper from the Frankland River, far to the south of the Perth area, reflects its widely disjunct distribution in its morphological distinctness from the very homogeneous callicheta group.

Tribe Dichogastrini Jamieson, 1971b

Notoscoleex

The genus with the second most restricted range in the south western province after the callicheta group of Woodwardiella is Notoscoleex sensu Michael. This has been recorded from an area larger than and adjacent to that of the callicheta-group, bounded by York and Murchison; Yarloop; and Bridgetown, to the north, west and south respectively.

Pseudonotoscoleex

The new genus Pseudonotoscoleex appears to be geographically distinct from Notoscoleex. It occurs in the south of the province, on the Pallinup River, east of Albany. As no collections have been described for the region between Bridgetown and a corridor extending north of Albany, the zoogeographical distinctness of the two genera requires confirmation, however.

* Cryptodrilus mortoni Spencer, 1895, has since been rediscovered in Tasmania by the author. It is a vesiculate, holonephric protuloid with tubular prostates and is not assignable to Woodwardiella.
Megascolides

Megascolides is known from Western Australia from a single species, *M. nokanaensis* Michaelsen, 1907, from Northampton, near the northern extremity of the south western province. It is centripetal but not certainly congeneric with the type-species of the genus, *M. australis* from Victoria. Its relative *Austrohoplochaetella*, at present appears to have a distinct, more northerly distribution, being known only from *A. kendricki* at Cape Range, a relict-refuge area which lies within the Central north western province of the Eyrian division.

Tribe Megascolecinus s. Jamieson, 1971b

Megascolex

In Fig. 8 the distribution indicated for *Megascolex* is limited to that of species with high endemicity within south western Australia, that is to say the ranges of individual species which are widely dispersed are omitted. The author, on present evidence, accepts the view of Michaelson (1935) that such species are to be regarded as peregrine beyond the true endemic range of *Megascolex* in south western Australia and that they have probable been distributed by man. The species are *Megascolex imparicystis* Michaelsen, known from Dongarra and the vicinity of Perth, both well to the north of the endemic range, and *M. longicystis* Nicholls & Jackson, found at two localities in the vicinity of Perth. The endemic area, and indeed Perth itself, lies well within a subdivision of the province distinguished by Kikkawa & Pearse (1969) in a computer analysis of distributions of avian genera. The latter subdivision occupied most of the province and showed its nearest generic affinity to lie within an area which included Adelaide and western Victoria. The latter area also includes species of *Megascolex*, and of *Woodwardiella* and species of *Platellus* s. lat., which may have special affinities with *Grallophilus*. Until revision of the Victorian fauna has progressed further caution is necessary, however, in regarding Western and Eastern Australian species as closely related.

Subfamily Acanthodorilinae s. Jamieson, 1971b

The Acanthodorilinae, which are a major element of the southern oligochaete faunas of South America, South Africa, New Zealand and of south temperate and subantarctic islands, are very poorly represented in Australia. Known Western Australian representation is confined to two species of *Microscolex* and two species of *Diplotrema* of which only the latter is endemic in the region.

Diplotrema

*Eodrilus cornigravei* Michaelsen, 1907, the type-species of *Eodrilus*, and *Acanthodorilus macleayi* Fletcher, 1889, are the only quadrirrostatic species known from Western Australia. It has been shown by Jamieson, 1970, that *E. cornigravei* is congeneric with the type-species of *Diplotrema*, *D. fragilis* Spencer, 1900, which was erroneously described as being biprostata. *Eodrilus* has thus passed into the synonymy of *Diplotrema*. *D. cornigravei* which is widespread in swamps on the Swan Coastal Plain (pers. obs.) and four species
from Queensland constitute the subgenus Diplothema. Three other Australian species of Diplothema are referable to the subgenus Notiodrilus and of these Notiodrilus (= Acanthodrilus) macleayi (Fletcher, 1889) is Western Australian, occurring at Napier Range, King Sound.

Microscolex

The circumposed M. dubius (Fletcher, 1888) is ubiquitous in coastal south western Australia occurring north to Dongarra, south to Albany, and inland to a line through Arrino- Moora- York- Albany. The similarly circumposed M. phosphoresus is known from the vicinity of Perth (Michaelsen, 1907). The focus of origin of the two species is obscure; they differ from the other members of the genus, which are restricted to southern temperate regions, in being biprostatic (microscocelins) rather than quadriprostatic (acanthodrilins) and a close relationship with the acanthodrilin species is questionable.

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REFERENCES


Abbreviations used in figures

| acc. sp. amp. | accessory spermathecal ampulla | pr. g. | glandular portion of prostate |
| g.m. | female pore | sp. amp. | spermathecal ampulla |
| g. | accessory genital marking | sp. d. | spermathecal duct |
| g po. | male porophore | sp. div. | spermathecal diverticulum |
| pr. d. | duct of prostate | sp. p. | spermathecal pore |
| | | v. d. | vas deferens |