

A few new Western Australian earthworms (Oligochaeta: Megadrilacea: Megascolecidae *sensu* Blakemore, 2000)

R. J. BLAKEMORE

Robert J. Blakemore, VermEcology, Yokohama, Japan. E-mail: rob.blakemore@gmail.com

Abstract. Earthworm samples, apparently collected in the 1980's from the northern Jarrah (*Eucalyptus marginata*) forests of Western Australian and deposited in the London Natural History Museum, were studied. Due to limited time and budget only a few of the hundred samples were inspected. Description of just five new taxa are reported here.

Keywords. Soil biodiversity, Australasia, Perth region, earthworm taxonomy, new species.

INTRODUCTION

The only broadly systematic survey of south-western Australian earthworms was nearly one hundred ten years ago by Michaelsen (1907) as reviewed by Jackson (1931). Thirty years ago, in the early 1980's, native earthworms were collected in parts of the northern Jarrah (*Eucalyptus marginata*) forests of Western Australia (Abbott 1985), but unfortunately taxonomic identification was not budgeted in the study and the samples were simply sent to London for storage. A brief visit to London gave the opportunity to inspect some of these specimens in the Natural History Museum's collection but, due to limited time and resources, only a few of the hundred plus samples were inspected resulting in description of just five new taxa herein.

MATERIALS AND METHODS

Dr Ian Abbot (pers. comm. email 19th June, 2013) informs: "*I looked up my 1985 paper, and find that all the collection sites use the Forests Dept. grid ref system. State forest is divided up into forest blocks, each named e.g. Chandler, and of c. 5 kha in size. I suggest that Chandlers Block 16 probably refers to Chandler block, compartment 16.*"

Chandler Block of the northern Jarrah Forest is located *ca.* 10 km north-east of Jarrahdale township (32.339°S, 116.062°E) itself 45 km south-east of Perth in the Darling Range with online WA Forestry map available giving Chandler co-ordinates approximately Lat. -32.26922 Long. 116.18561 (here: www.fpc.wa.gov.au/content_migration/_assets/documents/native_forests/harvest_plans/2013/Indicative_2013_harvest_plan_map_swan.pdf). Myara block is about 15 km due South of Jarrahdale.

Material was fixed in 4% formalin (Allan Wills pers. comm.) which combined with age of samples means that DNA extraction and analysis is unlikely with current methods.

Taxonomy uses Michaelsen's (1907: 160) excellent regulation table (also presented by Jackson 1931: 84) to determine genera that are updated to follow the most recent taxonomy from species/genera reviews by Blakemore (2000: tab. 1, 2005, 2008, 2012).

Abbreviations are: DPs – dorsal pores; GMs – Genital Markings; l/rhs – left/right-hand-side viewed from above; NHM – Natural History Museum, London; WA – state of Western Australia.

TAXONOMIC RESULTS

Family MEGASCOLECIDAE Rosa, 1891 *sensu*
Blakemore, 2000

Genus *Graliophilus* Jamieson, 1971

Graliophilus chandleri sp. nov.

(Figures 1a, b)

Material Examined. H, holotype NHM Accession No. 415 one mature of ten specimens (a posterior amputee, here dissected and figured) from “Chandler block 4 (Burnt 1976)”, “Species A”; remainder of batch were five matures (paratypes P1–5), three subadults and an immature (P6–9). Sample 416 with nine specimens (P10–18) and sample 417 with one mature specimen (P19) had same location labels.

Description. Pale unpigmented with yellow clitellum when preserved. Body length (H) 42+ with 81+ segments; paratypes were (P1) 60 mm with 137 segments, and (P19) 58 mm with 138 segments; other mature paratypes were 50–60 mm. Prostomium tanylobous. Setae small, lumbricine in series (sensory papillae on equators of all non-clitellar segments). First dorsal pore 5/6. Nephropores not found. Clitellum 13–18 mostly saddle-shaped. Spermathecal pores in 7/8 & 8/9 in a-lines. Female pores on 14 in a-lines. GMs are paired, mid-ventral discs in 16/17, single pads in 17/18 and 18/19 and unilateral or paired in a-lines in 19/20; in paratypes GMs were as in H except they were paired in 19/20 (P1, P19) or sometimes missing and P1 uniquely had extra paired markings in 20/21. Male pores superficial with penial setae protruding in position of missing *ab* in mid-*ab*-lines.

Septa mostly thin. Gizzard large, muscular in 5. Spermathecae in 8 & 9 with short duct branching at joint of large, leaf-shaped and possibly multiloculate diverticulum (iridescent = inseminated) and larger, saccular ampulla itself on a short stalk. Oesophagus dilated but no clear evidence of calciferous glands in 14–16. Intestinal origin 17. Male organs holandric, seminal vesicles in 9 & 12; testes (iridescent) in 10 & 11. Dorsal blood-vessel single. Hearts in 10–12. Ovaries as delicate sheets in 13

without obvious ovisacs in 14. Prostates tubular in 18 on short, thin duct with long (*ca.* 3 mm) penial setal ensheaved. Nephridia avesculate, holoic but their exit duct not noted. Gut contains soil (geophagy); no typhlosole found.

Distribution. Jarrahdale, Western Australia.

Etymology. Named after type-locality.

Remarks. Michaelsen (1907) described nine WA *Plutellus* species (here *Graliophilus*) with spermathecal pores paired in 7/8/9, viz.: *P. termitophilus*, *P. wellingtonianus*, *P. strelitzi*, *P. woodwardi*, *P. murrayensis*, *P. mendilai*, *P. blackwoodianus*, *P. schuemanni* and *P. carneus*. Closest match, with similar leaf-shaped spermathecal diverticulum, is with *Graliophilus strelitzi* (Michaelsen, 1907: 168) from Lion Mill that has an annular clitellum, slightly different GMs, calciferous glands in 17 and a small typhlosole. Next similar, especially with regards its spermathecal pores and lack of calciferous glands, is *G. woodwardi* (Michaelsen, 1907: 171) from Collie with GMs paired in 15/16/17 & 18/19/20. Then, somewhat similar to the last two, *G. murrayensis* (Michaelsen, 1907: 175) from Jarrahdale has GMs mid-ventral in 8 & 9 amongst other differences. In contrast, *G. blackwoodianus* (Michaelsen, 1907: 179) from Bridgetown has closely paired spermathecal and male pores and usually unpaired GM pads in 12/13, 16/17 & 19/20; while *G. candidus* (Jackson, 1931) from Roleystone typically has GMs in or near anterior of 8 & 9 as well as markings widely paired in 16/17 & 18/19. Having several features in common, *G. wellingtonianus* (Michaelsen, 1907: 168), however, is differentiated on its twin spermathecal diverticula.

All comparable taxa also share long penial setae. Unique combination of features in this relatively small species are tanylobous prostomium (*cf.* canaliculate prololobous in *G. candidus*, mostly epilobous in others), saddle-shaped clitellum (as in *G. candidus*, mostly annular in others), lack of calciferous glands (as in *G. woodwardi*, in 16 and/or 17 in others) plus the distribution of the GMs and the distinctive spermathecal shape (as figured).

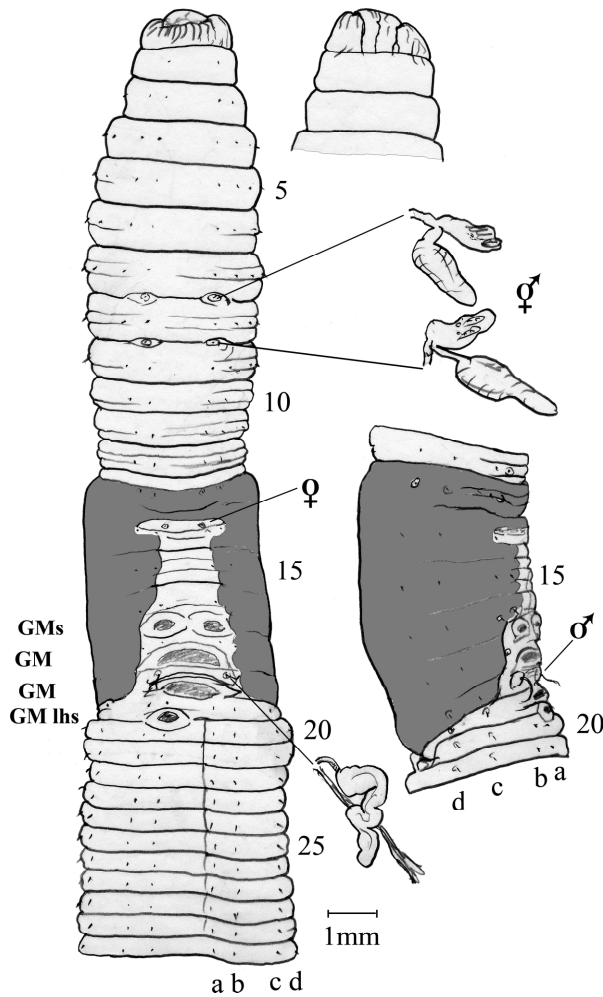


Figure 1a. *Graliophilus chandleri* sp. nov. holotype, H.

***Graliophilus myara* sp. nov.**

(Figure 2)

Material Examined. H, holotype NHM Accession No. 418-1 one mature (here dissected and figured) from "Myara block 16", "Species B"; paratype (P1) 419-1 only mature from batch of four specimens (419) that agrees superficially from "Chandler's block Chandler Rd 8/8/83", "Species B"; other three specimens are an immature posterior-amputee, (P2) 419-2, possibly the same taxon, and two acelitellates that are of a taxon described separately below.

Description. Unpigmented yellowish when preserved. Body length 77 mm with 161 segments.

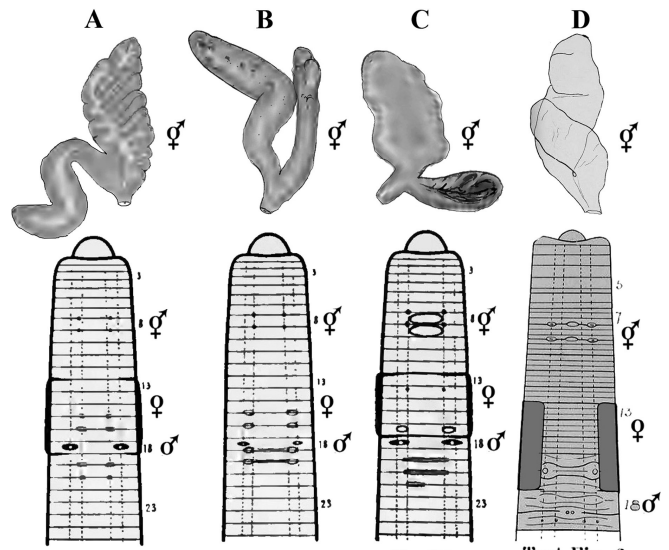


Figure 1b. A = *Graliophilus streltzi*, B = *G. woodwardi*, C = *G. murrayensis* and D = *G. candidus* compared after Michaelsen's (1907) and Jackson's (1931) original figures (not to scale and sketches of penial setae omitted).

Prostomium tanylobous. Setae lumbricine in series but converge in 25-30 where body narrows. First dorsal pore 4/5. Nephropores not found. Clitellum 14-17, saddle-shaped. Spermathecal pores, each appearing doubled but this not confirmed, in 7/8 & 8/9 in *ab*-lines. Female pores on 14 just anterior to setae *a*. GMs are paired, median to *a*-lines in 8-11, in 16/17 & 19/18 with less distinct mid-ventral pads in 17/18, (18/19) & 20/21. Male pores on small papillae slightly median to position of missing *ab*.

Septa mostly thin. Crop large in 4, gizzard muscular in 5. Spermathecae in 7 posteriorly and 9 anteriorly with particularly long and thin duct leading to junction of saccular ampulla and almost equi-sized diverticulum (inseminated). Note that each pair of spermathecae are con-joined and compressed within a shared saccular sheath or septal pocket. Oesophagus narrow in 12-14, calciferous gland annular in 15. Intestinal origin 16. Male organs holandric, seminal vesicles absent from 9, present in 10 anteriorly and in 11 & 12; testes (iridescent) free in 10 & 11. Dorsal blood-vessel single. Commissurals in 8-9, hearts in 10-12. Ovaries as delicate sheets in 13; ovisacs absent. Prostates convoluted tubular in

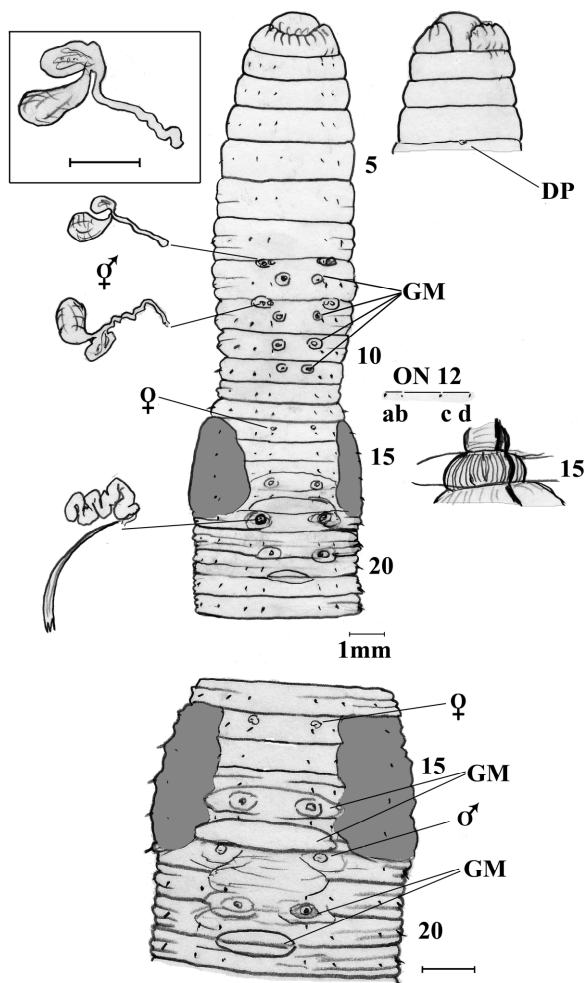


Figure 2. *Graliophilus myara* sp. nov. H with enlargement of male field and 7lhs spermatheca.

18 on short duct with long (ca. 4.5 mm) penial setae. Nephridia avesculate, holoic. Gut contains fine, yellow soil (geophagy); no typhlosole found.

Distribution. South and east of Jarrahdale, Western Australia.

Etymology. Non-declining noun in apposition derived from type-locality name.

Remarks. This species is close to the previous one differentiated on its distinctive spermathecal pores (possibly doubled or accompanied by gland pore or related to intromission of partner's penial

setae), spermathecae with their long duct, the presence of curved penial setae (near concomitant length to the duct plus diverticulum) and on the arrangement of its GMs (paired mid-ventrally in 8–11, 16/17 & 19/20 with pads in intersegments adjacent to male pores and in 19/20). It differs from *G. mendilai* (Michaelsen, 1907: 177) from Eradu and *G. candidus* (Jackson, 1931) that have spermathecal pores in *b*-lines plus GM discs paired in 11/12/13 & 20/21/22 or 16/17 & 18/19, respectively. *G. murrayensis* or *G. carneus* (Michaelsen, 1907: 182) from Albany have spermathecal pores in *a*-lines and GMs unpaired in 8, 9 & 19/21/22 or paired in 10/11 & 16/17/18/19, respectively. The current species has an annular calciferous gland in 15, unlike in *G. mendilai* and *G. candidus* in 16 or *G. strelitzii* where they are paired, sessile in 17.

Genus *Notoscolex* Fletcher, 1886

Notoscolex ajax sp. nov.

(Figure 3)

Material Examined. H, holotype BMNH Accession No. 419–3 an acitellate mature (here dissected and figured) from “Chandler's block Chandler Rd 8/8/83”, “Species B”; P, paratype, 419–4, also an acitellate specimen with same details; other two specimens in the jar are listed under the previous species.

Description. Pale colour. Body length 75 mm. Prostomium tanylobous. Setae lumbricine. First dorsal pore 4/5. Nephropores not found. Clitellum not formed. Spermathecal pores appear in 7/8 & 8/9 in *ab*-lines. Female pores on 14 just anterior to setae *a*. GMs single, mid-ventral in 7 & 8 and elongate pads in *b-b*-lines in 17/18 & 18/19. Male pores on small papillae slightly lateral to *b*-lines but setae *ab* deleted on 18 (penial setae not found).

Spermathecae vestigial in 8 and paired in 9 with short duct leading to multi-lobed spermatheca with diverticulum closest to the duct and iridescent and ampulla largest of other appendages. Oesophagus dilated in 12–16 but not calciferous, narrow in 17–18. Intestinal origin 19. Male organs holandric, seminal vesicles in 9, 11 & 12; testes (iridescent)

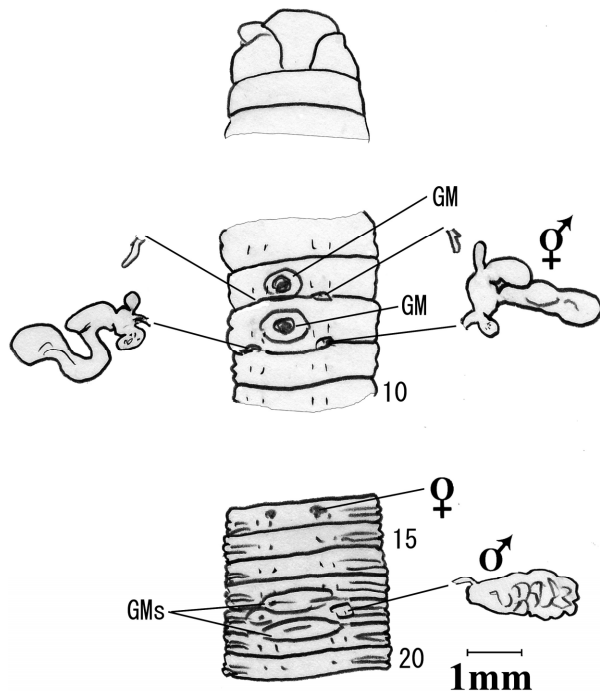


Figure 3. *Graliophilus ajax* sp. nov. H, prostomium, spermathecal and male fields.

free in 10 & 11. Last hearts in 12. Ovaries in 13; ovisacs absent. Prostates tubuloracemose in 18 on short ducts; penial setae absent (even though setae deleted). Nephridia avesciculate meroic, but some enlarged in anterior; in posterior three or four 'fatty bodies' per segment indicate location of nephridia. No trace of parasitism noted.

Distribution. Jarrahdale, Western Australia.

Etymology. For nickname of Ada Acraman Jackson (aka Mrs. William Fawcett) of Perth.

Remarks. This is a species 'in transition' losing its anterior pair of spermathecae. Michaelsen (1907) described six species of *Notoscolex* from WA, viz.: *N. maecenatis*, *N. hortensis* (also found at and around Jarrahdale), *N. prestonianus*, *N. modestus*, *N. rubescens* and *N. suctorius*, plus Jackson (1931) described *N. leios* (specimens also acelitellate). All have spermathecal pores in 7/8/9 without vestigial spermathecae in 7/8 and their GMs differ from the current species although *N. leios* lacked markings. The description is brief but the current species is

distinct in the shape of its single pair of functional spermathecae. It is perhaps closest nonetheless to *N. modestus* from Yarloop and York or *N. rubescens* from Pickering Brook that also have elongate GM pads, respectively, in 7/8–9/10 plus 17/18–20/21 or in 15/16, 16/17–19/20; neither has mid-ventral GM discs in 7 & 8 of the current species.

***Notoscolex michaelsoni* sp. nov.**

(Figure 4)

Material Examined. H, holotype BMNH Accession No. 420 mature (here dissected and figured) from "Chandler's block 4 Burnt 1976", "Species C", "Plutellus ? sp 7/8/9"; paratypes P1–2, two matures 421–422, and P 3–4 two immatures 423, with same details. [Note sample jar labelled "Chandler block 3 burnt 19??", "Species D" contained seven specimens (424) possibly similar but smaller and seem to have dried out during storage].

Description. Pale unpigmented in alcohol. Length H 36 mm with 105 segments; P1 35 mm; P2 38 mm. Prostomium Y-shaped tanylobous (possibly interpreted as cleft epilobous), ventral peristomium also cleft. Setae lumbricine widely spaced laterally. First dorsal pore in 5/6. Nephropores not found. Clitellum saddle-shaped 14–17. Spermathecal pores in 7/8 in *a*-lines and in 8/9 just lateral of *a*-lines. Female pores on 14 just anterior to setae *a*. GMs paired, elliptic pads lateral in *ab*-lines in 10/11/12/13, in *b*-lines in 15/15/16/17 and in *ab*-lines in 19/20; P1 the same except not in 12/13 nor 14/15 but present in all of 15/16–20/21 the latter pair conjoined midventrally; P2 has the same arrangement as H. Male pores in small slits in position of deleted setae *ab* on 18 (penial setae not found).

Septa all thin. Gizzard in 5 but displaced to 6 with septum 5/6 traced to below its midriff. Spermathecae in 8 & 9 with particularly wide duct and small, clavate diverticulum (iridescent) at junction with saccular ampulla. Holandric seminal vesicles in 10, 11 & 12; testis (iridescent) in 10 & 11. Ovaries in 13 with largish eggs visible; no ovisacs found. Dorsal blood vessel single; last hearts in 12. Oesophagus moniliform dilations in 11–14 (not calciferous), valvular in 15 with intestine from 16. Prostates circular racemose with short duct and no

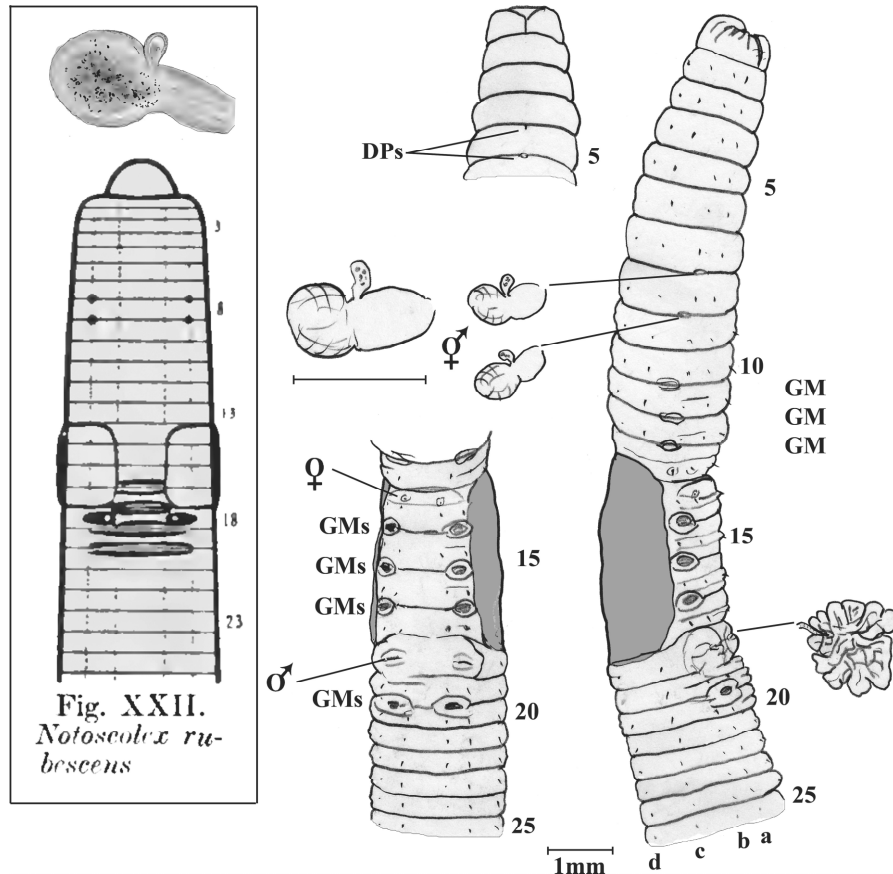


Figure 4. *Notoscolex michaelsoni* sp. nov. H lateral views with 8lhs spermatheca enlarged and boxed sketch comparison of *N. rubescens* from Michaelsen's (1907) original figures (its GMs stated in 15/16–19/20 but shown in 16/17–19/20).

penial setae in 18. Nephridia avesciculate meroic. No typhlosole found to 30. Gut contains yellow soil with charcoal and coarse organic matter (from soil A-horizon?).

Distribution. Jarrahdale, Western Australia.

Etymology. Named after Professor Wilhelm Michaelsen of Hamburg.

Remarks. This species is perhaps most similar to *Notoscolex rubescens* Michaelsen, 1907 that has similar shaped spermathecae opening in *b*-lines and elongate GM pads only in 15/16–19/20, (described) or 16/17–19/20 (figured) amongst other differences. *N. suctorius* Michaelsen, 1907 from Bridgetown has spermathecal pores paired mid-ventrally with paired markings only in 15/16/17, while *N. prestonianus* Michaelsen, 1907 from Donnybrook has

spermathecal and male pores lateral to *b*-lines and widely-paired markings in 15/16/17 & 19/20/21 (described) or 20/21/22 (figured). Spermathecae of both the latter species are also quite different. *Notoscolex leios* Jackson, 1931, its description based on a single immature worm from Murchison, has three pairs of vesicles in 10, 11 & 12 too, but shares few other characteristics with the current species.

Genus ***Woodwardiella* Stephenson, 1925**
nom. nov. pro Woodwardia Michaelsen, 1907
 (praeocc.)

***Woodwardiella michaelsoni* sp. nov.**

(Figure 5)

Material Examined. H, holotype BMNH Accession No. 425 mature (dissected and figured) from

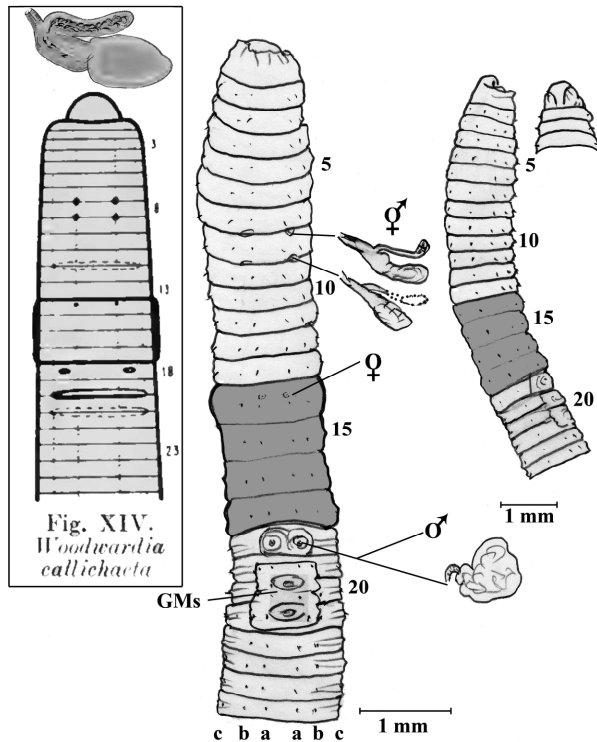


Figure 5. *Woodwardiella michaelsoni* sp. nov. H ventral and lateral views (9ths spermathecal diverticulum accidentally sectioned) and boxed sketch comparison of *W. callichaeta* from Michaelson's (1907) original figures.

"Chandlers block 4 Burnt 1937 I", "Species E"; P1-3, paratypes 426, one mature and two subadults with same details.

Description. Pale colour. Length 28 mm with 105 segments; P1 27 mm. Prostomium essentially tanylobous. Setae lumbricine widely spaced laterally. First dorsal pore 5/6. Nephropores not found. Clitellum annular 14-17. Spermathecal pores in 7/8/9 just lateral of *a*-lines. Female pores on 14 just anterior to setae *a*. Male pores on small porophores in *a*-lines on 18; setae *ab* deleted but penial setae not found. GMs in H single, mid-ventral papillae in 19/20 & 20/21 in common tumid pads in 1/2 19-1/2 21 as wide as *b*-lines; in P1-3 only in 19/20.

Septa all thin. Gizzard muscular in 5. Spermathecae in 8 & 9 with short duct to branch of elongate diverticulum (terminal bulb iridescent) after which there is slight bulge before saccular ampulla. Holandric seminal vesicles weak in 9 & 12; testis (iridescent) in 10 & 11. Ovaries in 13; no ovisacs

found. Last hearts in 12. Oesophagus dilated in 15 & 16, striated but not necessarily calciferous; intestine from 17. Prostates circular racemose with short duct and no penial setae in 18. Nephridia avesculate holoic. No typhlosole. Gut contains yellow soil with charcoal flakes (from soil A-horizon?).

Distribution. Jarrahdale, Western Australia.

Etymology. Named after Professor Wilhelm Michaelson of Hamburg.

Remarks. Michaelson (1907) described four WA *Woodwardia* species (here *Woodwardiella*), viz.: - *W. affinis*, *W. callichaeta*, *W. libferti* and *W. molaeleonis*, all similar in having spermathecal and male pores near *a*-lines and GMs anteriorly and in some of 19-20,21. The current species differs from *Woodwardiella affinis* (Michaelson, 1907) from Jarrahdale (with possibly synonyms *W. libferti* from Subiaco and *W. magna* Jackson, 1931 from Lesmurdie) as it lacks the distinctive GM pad mid-ventrally in 11/12, or *W. molaeleonis* (Michaelson, 1907) from Lion Mill with GM pad in 10/11. *W. callichaeta* (Michaelson, 1907), the type of the genus, also from Jarrahdale is perhaps closest although it too has markings in 11/12 (sometimes) as well as in 19/20 and (sometimes) 20/21. In Michaelson's fig. 14 the pores and markings appear much broader but this may relate more to state of preservation and drawing style. Its main morphological differences being an epilobous prostomium, paired oesophageal dilations in 13 and the form of the spermathecae. Michaelson gave setal ratios as (aa:ab:bc:dd = 5:3:5:4:10) but dorsal pores were found only after the clitellum in *W. callichaeta*, moreover it has distinct penial setae 1.2 mm long that were absent from the present species. None of the previous species have such long spermathecal diverticula approaching the tip of the ampulla.

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