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A new species of *Diplotrema* (Acanthodrilinae, Metagynophora, Crassiclitellata, Oligochaeta) from the Einasleigh Uplands Bioregion of Queensland

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ABSTRACT

Descriptions are provided of a new species of Acanthodrilinae, *Diplotrema anomala*, with anomalous segmentation. ❒ *new species, Diplotema, Queensland.*

This account of a new species of the earthworm genus *Diplotrema,* collected in the Australian Einasleigh Uplands Bioregion in March 2007, augments the CD of Dyne and Jamieson (2004), on all known *Acanthodrilinae* (Megascolecidae) of Australia. The specimens were collected as part of an ongoing study of molecular phylogeny of the Oligochaeta.

The Acanthodrilinae + Megascolecinae were shown to be jointly part of the sister group of Ocnerodrilidae in the molecular analysis of Jamieson *et al.* (2002). Therefore, as the familial status of the Ocnerodrilidae was accepted, the former two groups were correctly accorded subfamilial status. However, Csuzdi and Mischis (2010) accord familial rank, as the Acanthodrilidae. In a molecular investigation of earthworm phylogeny James and Davidson (2012) advocated an Acanthodrilidae *sensu lato* that corresponded to the Acanthodrilinae *sensu* Jamieson (2000, 2001) and Jamieson and Ferraguti (2006). This concept of Acanthodrilidae supressed the Octochaetidae and Exxidae in the Acanthodrilidae, and recognised within it the subfamily Benhamiinae. These changes, including rejection of the Octochaetidae, as in Dyne and Jamieson (2004), are accepted here but subfamilial rank for the Acanthodrilinae is retained as the molecular analysis confirmed the sister status of the family Ocnerodrilidae relative to the Megascolecidae *sensu lato*.

Acanthodrilinae

Diplotrema Spencer, 1900

Type species. *Diplotrema fragilis* Spencer, 1900: 31 (Gayndah, Queensland).
Eodrilus Michaelsen, 1907: 141. (Australian species only).
Diplotrema; (part. excluding *Notiodrilus* and *Microscolex*) Jamieson, 1971: 100–102.
Microscolex (Diplotrema); Jamieson and Dyne, 1976: 447–448.
Diplotrema; Dyne, 1987, 1997: 1; Dyne and Jamieson, 1998: 487–493.
Dyne and Jamieson, 2004: 20.

Generic Diagnosis. Setae 8 per segment. Prostates 2 pairs, tubular, rarely tubuloracemose to racemose, their pores on XVII and XIX; rarely a single pair, on XVII; male pores a single pair, on XVIII, occasionally in 17/18, or rarely, combined with the prostatic pores on XVII; exceptionally, with prostatic pores in XVII, and male pores at 17/18 or (*D. anomala*), where I and II are fused, appearing to be translocated forward by one segment. Spermathecal pores 2 pairs, at 7/8 and 8/9, ventrolateral, or a single pair at 8/9; rarely transposed to 8/9 and 9/10; exceptionally (*D. anomala*) appearing to lie in 6/7 and 7/8. Nephropores in a single series on each side, or, exceptionally, alternating regularly between *cd* and a point far dorsal of *d*. Gizzard usually well developed, muscular, in V (or, rarely, in VI). Calciferous glands present or absent. Holonephric, avesiculate. Holandric or rarely metandric. Testis-sacs absent. Penial setae invariably present; genital setae usually present. Nephridial bladders absent.

Distribution. *Australi*a: coastal and adjacent inland Queensland; ranging from the vicinity of Narrabri in New South Wales to northern Queensland and across northern Australia to the Kimberley region of Western Australia; with a single species in south-western Australia. The precise northerly limit of the genus in Cape York Peninsula is unknown, the most northerly record being from the vicinity of Weipa. It is thus uncertain whether *Diplotrema* is replaced by the meronephric *Neodiplotrema* further northwards. However, the two genera are sympatric in the Cape Melville National Park and McIlwraith Range (Jamieson 1997; Dyne 1997). *Extralimital*: Two Mexican acanthodriles with a single gizzard but otherwise referable to *Diplocardia* were reasonably placed by James (1990) in *Diplotrema* on morphological grounds but their close relationship to Australian species is questionable. Fragoso and Rojas (1994) have erected *Kaxdrilus* for *Diplotrema*-like species of Mexico and Central America with calciferous glands in the region of VII–XII but it is perhaps questionable that the 'pebbly internal texture' in this region in the two species of James (1990) qualifies to be considered calciferous.

For keys to species, see Dyne and Jamieson (2004). The new species is distinguished from all other species of *Diplotrema* in fusion of the peristomium and first setigerous segment so that the prostate pores are in patent segments XVI and XVIII. However, in the following account and illustrations the fused peristomium and first setigerous segment is designated I & II and the segments of the prostate porophores are designated XVII and XIX, as usual for acanthodriles.

Diplotrema anomala nov. sp.
(Figs 1–6)

Material Examined. Holotype. Einasleigh Uplands Bioregion of Queensland, 18°19'21"S 145°24'10"E, Girringun National Park, Princess Hills section, 3.1 km by road from main entrance gate towards Princess Hills Ranger Station. Melaleuca and Eucalypt woodland on gentle slope with moist, lateritic, sandy soil. Earthworms were in the upper 20 cm and above the water table. Altitude 625 metres, PFA fixation, K.R. McDonald, 5 Mar 2007. QM G231042.

Paratypes. Same locality, 5 specimens, 100% ethanol, QM G231043–231047.

Non-types. Same locality, 15 specimens, mostly clitellate.

Description. Length (Holotype) 114 mm; width (midclitellum) 4 mm. Segments approximately 246. Colour in life unpigmented, pinkish (Fig. 1A–C); in preservation, light brown with dark brown clitellum. Prostomium (Fig. 2) epilobous 1/3 (relative to fused peristomum and first setigerous segment), squarish, demarcated posteriorly and laterally by a straight groove. Dorsal pores minute apparently commencing in 11/12, sometimes not observable until the caudal end. Setae 8 per segment, closely paired, but the lateral pair (*c*,*d*) much narrower than the

ventral pair (*a*,*b*), the ventral pair being larger; setal ratios (mm) *aa*:*ab*:*bc*:*cd* = 1.3:0.21:1.3:0.11. Nephropores in *c* lines. Clitellum weakly developed, annular, XII–XVIII. Prostate pores two pairs, in segments 16 and 17 by external counting but these here designated XVII and XIX (Figs 1A–B, 3, 4), on small elliptical papillae, in *ab*; male pores not certainly visible. Accessory genital markings (holotype): a faint circular protuberance visible in the anterior two-thirds of VIII anterior to the spermathecal pore of 8/9 (Fig. 3). Female pores anteromedian of setae *a* of XIV. Spermathecal pores 2 pairs, indistinct, in 7/8 and 8/9, in *b* lines.

Last hearts in XII. Gizzard large, firm, globular, in VI. Oesophagus with dorsal vascularized swelling in XIII. Intestine commencing in XIX(?), Holonephric, with stomate, avesiculate nephridia. Sperm funnels large, in XI only, giving rise to a clearly visible vas deferens, egress of which distally was not determinable. Very large racemose seminal vesicles in XII. Ovaries not seen. Prostates two pairs, in XVII and XIX; tubular, those in XVII on left extending across the gut to the other side and almost straight; those in XIX short and winding; both sets of prostates with slender muscular ducts each accompanied by a penisetal follicle. Penial setae (paratype QM G231047) filiform, bent in a gentle arc (Fig. 5A); the tip in the form of a shepherd's crook, i.e. strongly curved on itself and then reflexed in the opposite direction; the shaft with fairly regular transverse cicatriciing but the terminal bend with only a few pit-like markings (Fig. 5B, C); lengths of three penial setae 16.97–18.55 (mean 17.6) mm. Spermathecae two pairs, in VIII and IX, each with a subspherical ampulla and a diverticulum of size and shape similar to the ampulla, which is sessile on the duct which it obscures and which contains iridescent sperm balls. Spermathecae in IX each preceded by a curved follicle containing two spermathecal setae. Each seta (Fig. 6) moderately stout, gently curved and with a pointed tip; the distal region of the seta with periodic incisions in profile, each of which extends for approximately half of the circumference and confers a toothed appearance on the profile; lengths of the two

FIG. 1. *Diplotrema anomala* sp. nov. **A, B**, Anterior, genital region of a live specimen, showing the male genital field with two pairs of protuberant male porophores; **A**, Lateral view; **B**, Ventral view; **C**, Lateral view of an entire worm.

FIG. 2. *Diplotrema anomala* sp. nov. Anterior region of paratype QM G231047 to show form of prostomium.

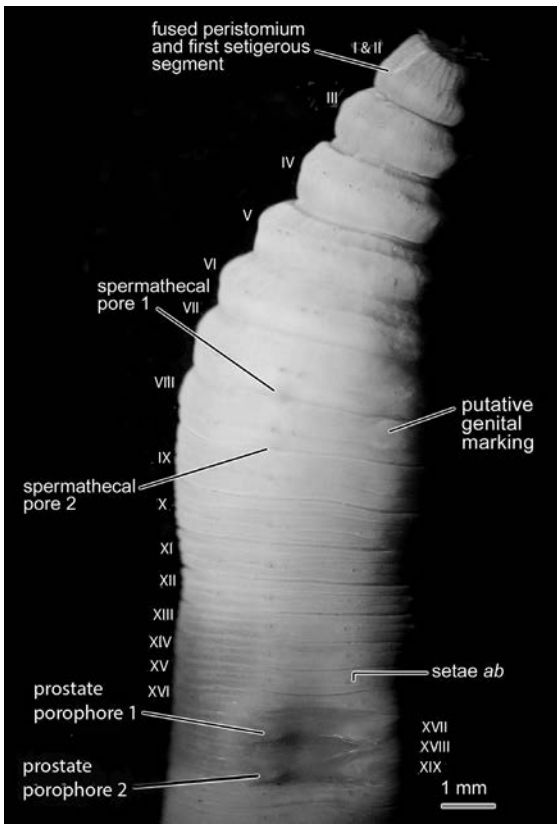

FIG. 3. *Diplotrema anomala* sp. nov. Ventral view of anterior, genital region of holotype, QM G231042.

left setae, measured in a straight line from base to tip, 0.873 and 0.933 cm.

Etymology. '*anomala*' referring to the anomalous segmentation.

Remarks. In the above description the first observable 'segment', consisting of the peristomium fused with the first setigerous segment, is designated segment I & II. That it is the result of such fusion is shown by its possession of setae in its posterior half. No other species of *Diplotrema* is known to show this segmental fusion. If apparent segments are counted externally, the spermatheca, female, and prostate pores therefore appear to be translocated anteriorly by one segment, though not by homeosis.

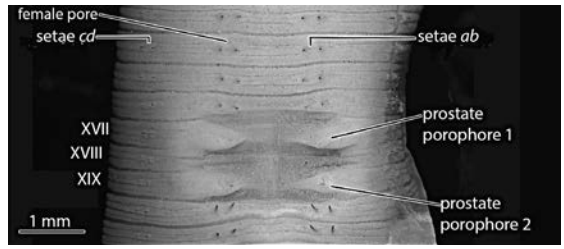

FIG. 4. *Diplotrema anomala* sp. nov. Detail of male genital field of holotype, QM G231042.

The spermathecal (genital) setae in the type genus of the Acanthodrilinae, *Acanthodrilus*, are almost straight and exhibit rows of deep scallops (notches); the posterior lip of each notch forming a crescent (Jamieson & Bennett 1979). This type of spermathecal seta is also seen in the Queensland genus *Kayarmacia* and in many species of *Diplotrema* (references in Dyne & Jamieson 2004), illustrated by scanning electron microscopy for *D. ridei*, *D. shandi* and *D. socialis*. The spermathecal setae of *D. anomala* differ from this form in lacking the deep gauging (notching) of the setae but have a fine denticulation. The notched setae may represent a symplesiomorphy for *Acanthodrilus* + *Diplotrema* + *Kayarmacia* (while being a synapomorphy of a common ancestor) and the alternative form of setae, seen in *D. anomala*, may provide grounds for taxonomic distinction of such species as possess it.

The large, subspherical diverticulum seen in *D. anomala* spermathecae also occurs in the type-species *D. fragilis*, in *D. armifera* and *D. cornigravei* but those species differ from *D. anomala* in having typical acanthodrile scalloped genital setae and in lacking anterior segmental fusion.

In the Melaleuca areas where *D. anomala* is found, when the water table rises to the surface it is possible to locate them under logs with their posterior ends above the water. When touched the exposed end is withdrawn below the water surface and ground. Later, when the water table drops, the earthworms are found in the upper surface of the soil horizon above the water table (K.R. McDonald, pers. ob.).

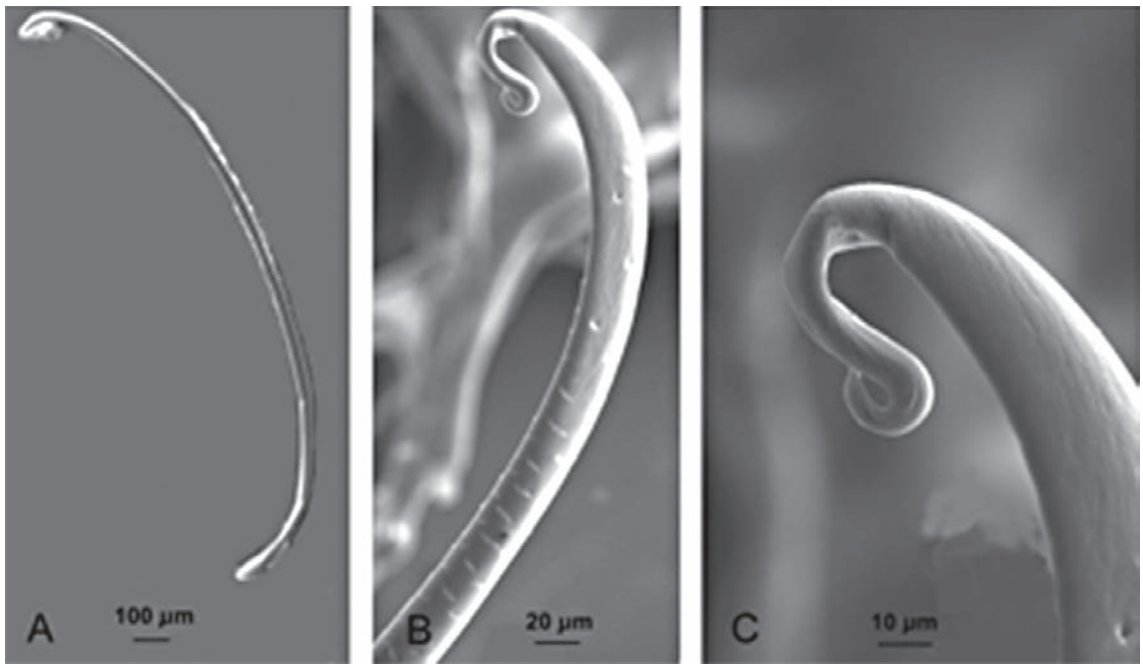

FIG. 5. *Diplotrema anomala* sp. nov. Scanning electron micrographs of penial setae of paratype QM G231043. **A**, whole seta; **B** and **C**, Detail of anterior region of seta.

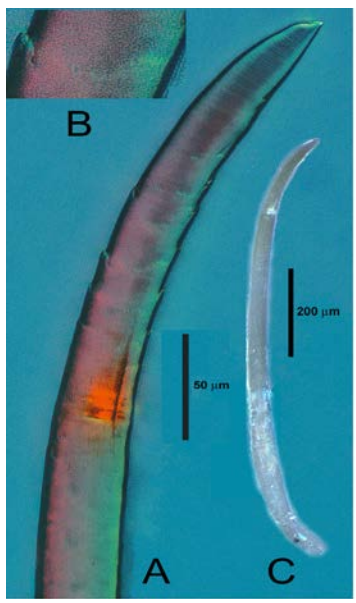

FIG. 6. *Diplotrema anomala* sp. nov. Left spermathecal seta of holotype QM G231042. **A**, Distal region; **B**, Detail of denticulation; **C**, Whole seta.

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