

# Miscellaneous earthworm types in the Natural History Museum, London (Annelida: Oligochaeta: Megadrilacea: Eudrilidae, Lumbricidae, Megascolecidae, Moniligastridae, Octochaetidae)

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**Abstract.** Recently restored *Lumbricus terrestris* Linnaeus, 1758 neotype (NHM Register No. 1973.1.1) is described in greater detail. A lectotype is designated for *Amyntas morrisoni* (Beddard, 1892) and an informal *A. morrisoni* clonal species-complex is proposed. Once combined under *A. gracilis* (Kinberg, 1867), the nominal taxon is revised since its restoration and representation of *A. morrisoni* species-group *sensu* Sims & Easton (1972), now unwieldy with forty or so members. A restricted *A. morrisoni sensu stricto* is proposed with re-evaluation of its erstwhile synonyms based on types. Limited DNA COI barcode comparisons are appended. A lectotype for *A. barbadensis* (Beddard, 1892) now becomes a junior synonym of *Amyntas gracilis* removing it from nomenclatural consideration. Lectotypes of contenders, *A. mauritianus* (Beddard, 1892) itself closer to *A. gracilis*, and *A. insulae* (Beddard, 1896) appear separate from *A. morrisoni*. Next, *A. pallidus* (Michaelsen, 1892) is restored with retention of some of its synonyms, but *A. loveridgei* (Gates, 1968) syntype is maintained. An exotic species from Queensland, Australia is a new member of *A. morrisoni* species-group described as *Amyntas talus* sp. nov. Taxonomic ‘housekeeping’ of Queensland taxa requires re-allocation of *Terrisswalkerius leichhardti* Jamieson, McDonald et James, 2013 to prior *Perionychella* Michaelsen, 1907. New Zealand’s possibly extinct *Tokea? orthostichon* (Schmarda, 1861) and imperfectly known *Anisochaeta antarctica* (Baird, 1871) are revised in new combinations with slight revision of the genus *Tokea* Benham, 1904. Samples labelled as Hamburg syntypes of Japanese *Metaphire hilgendorfi* (Michaelsen, 1892) are briefly noted as are various other megadriles, such as divers pheretimoids and lumbricids, some also on loan, in the Museum’s collection.

**Keywords.** Historical collection, curation, taxonomy, typification, review.

## INTRODUCTION

During a short visit to the Natural History Museum in London, answers to several chronic yet immediate problems in earthworm taxonomy were sought that included restoration of *Lumbricus terrestris* Linnaeus, 1758 neotype, validating syntypes of *Amyntas diffringens* (Baird, 1869) and sinking lectotype of *Amyntas pingi* (Stephenson, 1925) as reported in Blakemore (2013b, 2013e). Inspections of types of species of type-genera also helped revision of world families (Blakemore, 2013d). The current work attempts resolution of separate issues based on types from Europe, Africa, America, Asia and Australasia held at the Museum, some loaned from other institutions.

Historically, Frank Evers Beddard (1858–1925) was Prosector at the Zoological Society of London and while there he received specimens of earthworms sieved from soil at Kew Botanic Gardens obtained with plants from around the Globe (see also Beddard 1906). In July, 1892, Beddard (1892b) published several pheretimoid (i.e. *Pheretima* auct.) species, mostly those intercepted at Kew; and, in 1896, he described species from Hawaii and elsewhere. Several of these have been subsequently reallocated as shown in Tables 1 and 2.

### The *Amyntas morrisoni* problem

Of particular concern is the status of *A. morrisoni* (Beddard, 1892), that was soon implicated with *A.*

Table 1 of Beddard's 1892 *Perichaeta* species from Royal Botanic Gardens, Kew

Beddard 1892 page	Original name	Currently	Notes
155; Pl IX fig. 4	? <i>Perichaeta sumatrana</i> Horst	<i>Metaphire californica</i> ?	Or <i>Duplodicrodrilus schmardae</i> ?
157; Pl IX, figs. 2, 8; Pl X, fig. 1	<i>Pe. dyeri</i>	<i>Amyntas rodericensis</i>	For W.T. Thistleton Dyer of Kew Gardens
158; Pl IX, figs. 3, 5; Pl X 2-4, 7-8	<i>Pe. sinensis</i>	<i>A. rodericensis</i>	
160	<i>Pe. bermudensis</i>	<i>A. gracilis</i> (or <i>A. bermudensis</i> ?)	Cf. <i>A. loveridgei</i> ?
163	<i>Pe. taprobanae</i>	<i>Polypheretima taprobanae</i>	First UK record
166; Pl IX, fig. 1	<i>Pe. morrisoni</i>	<i>Amyntas morrisoni</i>	Lectotype (missing)
167; Pl IX, fig. 6	<i>Pe. barbadensis</i> – a	<i>A. morrisoni</i> ?	No figure
167	<i>Pe. barbadensis</i> – b	<i>A. gracilis</i>	Actual fig. 6; new lectotype ( missing)
167; Pl IX, fig. 7	<i>Pe. barbadensis</i> – c	<i>A. pallidus</i> ?	Fig. 7 as stated
169	<i>Pe. hesperidum</i>	<i>M. californica</i>	
170; Pl X, figs. 5-6	<i>Pe. mauritiana</i>	<i>A. gracilis</i> (or <i>A. mauritiana</i> ?)	Spermathecae 7&8 so not <i>A. morrisoni</i>

Table 2 of Beddard's 1896 *Perichaeta* species from Sandwich Isles (Hawaii)\*

Beddard 1896 page	Original name	Currently	Notes
197	<i>Pe. indica</i> Horst	<i>Amyntas corticis</i>	
198	<i>Pe. perkinsi</i>	<i>A. corticis</i> ?	Types missing?
201	<i>Pe. molokaiensis</i>	<i>A. corticis</i> ?	Type missing?
201	<i>Pe. hawayana</i> Rosa	<i>Amyntas gracilis</i>	
203	<i>Pe. sandvicensis</i>	<i>Metaphire californica</i>	Types inspected by RJB VI.2013
204, fig. 2	<i>Pe. insulae</i>	<i>Amyntas insulae</i> ?	Types inspected by RJB VI.2013
205	<i>Pe. trityphla</i>	<i>Duplodicrodrilus schmardae</i>	**Types re-inspected
205	<i>Pe. trinitatis</i>	<i>A. rodericensis</i>	Type 1904:10:5:170 not located

\*Note that many specimens came from Mauna Loa Mountain where Keeling (1978) continuously recorded his atmospheric CO<sub>2</sub> readings. Soil preserved in the intestines of these worms from the time of collection is comparable to the current state of soils there.

\*\*BMNH types for *trityphla* catalogued as 1904.10.5.169 are actually 1904:10:5:69.

*hawayanus* (= *A. gracilis*) by Beddard (1895) but later restored and made representative of an *A. morrisoni* species-group by Sims & Easton (1972). This group has since become unwieldy gathering about 40 nominal species, but see comments in Blakemore *et al.* (2013).

The British Museum (Natural History) purchased Beddard's collection in 1904 (Coles 1981) and in the current study, Beddard's types were sought. The chequered history of *A. morrisoni* is here reviewed taxonomically – an urgency due to the tide of new names continuously added to its group.

**Chronology of *Amyntas morrisi* (Beddard, 1892) species-group**

- 1892b (July) Beddard published poor descriptions of *morrisei*, *barbadensis* and *mauritaniana*.
- [1892 (Sept.) Michaelsen published *pallida* for two probably separate species].
- [1894 Rosa describes *amazonica*].
- 1895: 394, 400, 411 Beddard (Monograph) re-describes *morrisei* adding only that the male pores are simple, not wide apart, and have minute glands opening in their neighbourhood (to explain presence of glands internally) but certainly makes no mention of there being distinct papillae there.
- [1895: 394, 391, fig. 44d, 400, 412 Beddard (Monograph) also revised *barbadensis* that has lateral male pores and variable GMs and he tabulates and describes mainly his example “a” that is possibly the same as *morrisei*. Note originally “a” and “b” were described as 4¼” long (= ~106 mm), specimen “c” was smaller at 84 mm with 64 segments. Although now missing, specimen “b” is here designated as lectotype in order to force problematical name *barbadensis* into synonymy of *A. gracilis*].
- [1895: 394, 400, 415 Beddard (Monograph) re-description of *mauritaniana* as 80 mm with 85 segments, markings on 18 and spermathecae in 7 & 8, i.e., different to *morrisei* but possibly same as *barbadensis* specimen “b” and thus a synonym of *hawayana* (= *gracilis*)].
- [1895: (overlooked on pg. 394) 397, 400, 415 Beddard (Monograph) comments on *pallida* Michaelsen 1892 with two or three spermathecae in 6,7,(8); GMs two pairs on 7, sometimes two or three papillae in 5/6 and 6/7 or 7/8, plus with 2–4 papillae around each male pore and a pair on 19, i.e., different to *morrisei* proper].
- 1896 Rosa re-describes *morrisei* on somewhat variable specimens from Padang, Sumatra. Markings are said mid-ventral in some of 6–8 and 18, sometimes with extra markings in 7 near the spermathecae. Intestinal caeca had no trace of lobulations but it is not certain that these were all *A. morrisei* proper.
- [1896 Beddard describes *insulae* as revised herein].
- [1900: 238, 244, 254 Michaelsen (Tierreich) has *Amyntas barbadensis* with syns. *pallida* Michaelsen, 1892: 227, *amazonica* Rosa, 1894: 14, *sanctijacobi* Beddard, 1895: 61, *cupulifera* Fedarb, 1898: 445 – but this is in error as only *barbadensis* specimen “c” compiles, so *pallida* should resume priority of this group].
- [1900: 238, 276 Michaelsen (Tierreich) maintains *Pheretima insulae* separately].
- 1900: 238, 287 Michaelsen (Tierreich) provides a good summary of *Pheretima morrisei* based on Beddard and Rosa’s accounts that was, for a time, reasonable and stable.
- 1900a: 420 Beddard (Hawaiiensis paper) places *bermudensis*, *barbadensis*, *morrisei*, *mauritaniana*, *mandhorensis*, *pallida*, *amazonica* and *cupulifera* in synonymy of *Perichaeta hawayana* Rosa, 1891 (= *gracilis*). This is obviously excessive.
- 1900b: 645 (May) Beddard (*Amyntas* paper) places same species in synonymy of *Amyntas hawayanus* (Rosa, 1891) (= *gracilis*) plus he adds *P. carnosus* Goto & Hatai and *P. insulae* Beddard, 1896: 204. Again somewhat excessive, although some names are now found to belong.
- 1905 Ude separated *morrisei* (page 434) and *hawayana* (page 457).
- 1931, 1933 Chen also separated *hawayana* and *morrisei*.
- 1920–1982 Gates made various contributions, many confused and contradictory, whilst also rejecting the proper genus *Amyntas* for a decade. His (1937) review of types did not provide definitive resolution and also failed to locate Beddard’s original types (his specimens from Hong Kong are obviously not syntypes).
- 1972 Sims & Easton treat synonyms equally with valid names in their study but made *Amyntas morrisei* a species-group exemplar, without justification as to its specific merits; they did not inspect the type thus their figures may not be correct.
- 1981, 1982 Easton retained the species but his figure may also be incorrect/composite.

- 1999 Sims & Gerard described *Amyntas morrisoni* with synonyms *barbadensis* and, the highly unlikely, *mauritanica*, their description is also composite.
- 2003 Blakemore (Japanese earthworms) listed *A. morrisoni* with syns. *barbadensis*; *?pallida*; *hawayana lineata* Gates, 1926.
- 2005: 21, 24 Shen & Yeo list synonyms of *A. morrisoni* as *barbadensis* (part.), *pallida* (part.), *amazonica*, *insulanae*, *cupulifera* and *hawayana lineata*.
- 2007/2008 Blakemore questioned synonyms *?barbadensis* (part.), *?mauritanica*, *?pallida* (part.), *?amazonica*, *?sanctijacobi* and *?cupulifera*, but accepted *hawayana* and *lineata*. Simultaneously, *A. insulanae* was maintained separately.
- 2009: 60 Chang *et al.* provide Taiwan description that seems to comply more with *pallida* or one of its junior synonyms rather than the currently restricted sense of *A. morrisoni* (see their figure from <http://clitellates.taibif.tw/pages/660>).
- 2009: Sun *et al.* provided four new species to the *A. morrisoni* group from Hainan.
- 2013: 41 Blakemore in Blakemore *et al.* (2013) questions some of Sims & Easton's inclusions being a part of the *A. morrisoni* species group as for several Korean species – rather they strictly comply with Sims & Easton's *canaliculatus*-group, as indeed does *A. tripunctus* (Chen, 1946).
- 2013a Zhao *et al.* provided two new species to the *A. morrisoni* group from Hainan.
- 2013b Zhao *et al.* provided three new species to the *A. morrisoni* group from Hainan.
- 2014 Jiang *et al.* provided four new species to the *A. morrisoni* group from Hainan.
- 2014 Shen *et al.* provided another new species to the *A. morrisoni* group from Taiwan.

The current paper aims to review and revise these earliest taxa based on their types for resolution of the several conflicts as noted above and in the synonymy of *A. morrisoni* below.

The chronic saga of the *Amyntas* Kinberg, 1876 vs. *Metaphire* Sims & Easton, 1972 polyphyly quandry that I thought had been solved (e.g.

Blakemore, 2003, 2010, 2013a: 62) lingers, missing the point that under ICZN the members of a genus comply with the type of that genus and thus *Metaphire javanica* (Kinberg, 1867) and its ilk having non-superficial male pores belong, regardless of whether these are within copulatory pouches or not – this only relevant for genera such as *Duplodicodrilus* Blakemore, 2008. Notwithstanding that anything above the species level (genera, family) is more a taxonomic 'convenience' construct – as was clearly stated by Sims & Easton (1972: 170) – it is yet phylogenetically reasonable to expect that any deviation of the primitive superficial male pore must be a "non-superficial" derivative, unless proven otherwise. Hence *Metaphire hilgendorfi* (Michaelsen, 1892) in the following review is again placed in its currently correct genus as per Blakemore (2003, 2013a) unlike by some contemporary Korean and Japanese workers who incorrectly keep it in *Amyntas* or even *Pheretima* as per Gates (1972, 1982).

## MATERIALS AND METHODS

Abbreviations are: GM – genital markings, rhs and lhs – right and left-hand-side, NZ – New Zealand; Qld. – Queensland; TP – tubercula pubertatis; "?" indicates taxonomic uncertainty. Taxa are arranged alphabetically except for *Amyntas morrisoni* spp-group which is chronological. Discussion is confined to remarks after species' accounts.

## TAXONOMIC RESULTS

Family EUDRILIDAE Claus, 1880

### *Eudrilus eugeniae* (Kinberg, 1867)

*Lumbricus eugeniae* Kinberg, 1867: 98. [Type locality humid mounts and valley of St Helena Island (British protectorate) in South Atlantic, by introduction. Types from Stockholm Museum now seemingly transferred to Natural History Museum London by Beddard and sometimes quoted as BMNH 1904.10.5.549 [that is actually Kinberg's *L. capensis*] or 1904.10.5.550 – this specimen now labelled: "*Lumbricus eugeniae* Kinberg 1867 TYPE sent to Dr Beddard by Professor Loven. St Helena",

Beddard's label with "*Lumbricus*" crossed out in favour of "*Eudrilus eugeniae* .... [illegible] 550 *St Helena* "; and a Swedish Museum label: "*Lumbricus Eugeniae Kinberg St Helena Swed. State Museum*." The specimen is coiled and seems a bit macerated but looks in moderate condition – pers. obs].

*Note.* Specimen not dissected further in order to preserve the type's integrity.

Family LUMBRICIDAE Rafinesque-Schmaltz,  
1815

***Aporrectodea caliginosa* (Savigny, 1826) s. strict.**

*Enterion caliginosum* Savigny, 1826. [Type locality in the Paris region. Types, claimed to be missing by some authors, listed by Reynolds & Cook (1976: 84) in Geneva: MHNG 3/77].

?*Lumbricus helenae* Kinberg, 1867: 98 [Type locality St Helena. Types moved from Stockholm to BMNH (pers. obs. RJB 20.VI.2013) labelled "*Lumbricus HELENAE Kinberg 1867 TYPES*", "1904:10:5:551 *Loc: St Helena Don: Swedish State Museum via Beddard Collection. Ref:* ". One mature dissected and in two parts in poor condition, plus an immature lumbricid].

*Notes.* Michaelsen (1900: 518) listed this species as *incertae sedis* but Gates (1977) placed it in his *caliginosa* species-complex that differs from that *sensu* Blakemore (2012b). A relatively common worm in temperate regions with many synonyms.

***Aporrectodea trapezoides* (Dugès, 1828)**

*Lumbricus trapezoides* Dugès, 1828. [Type locality Montpellier. Types missing, however, Gates (1972: 79), Reynolds & Cook (1976: 182) and Blakemore (2012b) all advocated recollection and designation of a Neotype].

?*Lumbricus Novae Hollandiae* Kinberg 1867: 99. [Locality Sydney. Types in Stockholm]. [Current correct spelling is "*novaehollandiae*".]

*Lumbricus capensis* Kinberg, 1867: 100. [Locality Cape of Good Hope (Cape Town) SA. Type moved from Stockholm to London: BMNH 1904:10:5:549 – "*Lumbricus CAPENSIS Kinberg 1867 TYPES*", "1904:10:5:549 *Loc: Cape of Good Hope Don: Swedish State Museum via Beddard Collection*

*Ref.*"; a single dissected specimen in poor condition – pers. obs. RJB 20.IV.2013].

*Notes.* A relatively common worm in mostly sub-tropical or Mediterranean climes.

***Eisenia fetida* (Savigny, 1826)**

*Enterion fetidum* Savigny, 1826. [Type locality Paris. Types in Paris Museum].

*Lumbricus annulatus* Hutton, 1876/7: 352. [From Dunedin, New Zealand - see Benham (1898) when material was in the Otago Museum; syntype now in BMNH: "1886:11:18:14 *Loc: DUNEDIN N.Z. Coll: OTAGO UNIVERSITY MUSEUM Ref:..*" with old Otago label "6:11:18:14"; one mature specimen in good condition tied to a film – dark with possibly lighter intersegments and paler in 9–11; clitellum 26–32 and TPs in 28–30,31½]. [Non *annulatus* Perel, 1975: 995 (= *L. polyphemus*)].

*Notes.* *L. annulatus* is just one of about fourteen taxa included in synonymy of *E. fetida* that have priority over *Eisenia fetida andrei* Bouché, 1972 (see Blakemore 2013c, Blakemore & Lee 2013: appendix).

***Lumbricus castaneus* (Savigny, 1826)**

*Enterion castaneum* Savigny, 1826: 180. [Type locality Paris. Types missing from Paris Museum]. [Non *L. castaneus* Risso, 1826 which is listed as *incertae sedis* in Michaelsen (1900: 518), see also Gates (1972: 115)].

*Lumbricus josephinae* Kinberg, 1867: 98. [St Helena. Types NHRS: 1928 with a specimen labelled "*Lumbricus josephinae Kinberg, 1867 PARA/ SYN-TYPE 1904:10:5:554 Loc; St Helena Coll: Natuh..Riksmuseet, Stockholm Ref:* ". One specimen in poor condition].

*Notes.* Widely distributed in holarctic and introduced to Australia and NZ.

***Lumbricus terrestris* Linnaeus, 1758**

(Figure 1)

*Lumbricus terrestris* (part) Linnaeus, 1758: 647. [Type locality Sweden. Neotype in British Museum (Sims 1973) – BMNH 1973:1:1 (as restored by Blakemore 2013e)]. [Note: Original spelling was as "*L. terrestris*" in older style long-s typography.

Linnaeus included in its early synonymy *Lumbricus laevis*, *L. terrestris minor*, *L. terrestris minor rubicundus*, *L. major*, *L. intestinorum teres* and *Lumbricus humanus* Vallisneri, the latter being the intestinal nematode worm – *Ascaris lumbricoides* (Linnaeus, 1758)].

[?Non *Enterion terrestre* Savigny, 1822– *sp. dub.* often misdated “1820”. Egypt].

*Enterion herculeum* Savigny, 1826: 180. [From Paris. Type in Paris claimed by James *et al.* 2010 to be a “cryptic species” of *L. terrestris* but other synonyms, as provided by Sims (1973: 28) not checked; note this species already maintained in *Lumbricus* by Garman (1888: 73) who says Eisen found it in New England, USA but these maybe misidentifications for *L. terrestris* or *L. friendi*].

*Lumbricus herculeus*: Dugès 1837 (cf. Sims 1973: 29); James *et al.* 2010 attempted restoration (but see Blakemore 2013e).

[Non *Lumbricus terrestris*: Dugès 1837: 17,18 (misid. of *A. longa* (Ude)].

*Lumbricus agricola* Hoffmeister, 1842. [From neighbourhood of Berlin. Types lost].

*Lumbricus infelix* Kinberg, 1867: 98. [From Port Natal. Type Stockholm, 1930].

*Lumbricus americanus* Perrier, 1872. [Type in Paris].

*Lumbricus studeri* Ribaucourt, 1896. [Types?].

*Lumbricus terrestris*: Johnston 1865; Michaelsen 1900: 511 (syn. *herculeum*, *agricola*, *infelix*, *americanus*, *studeri*); Sims & Gerard 1999: 106, figs. 1, 4, 6, 9j, 37, 38; Blakemore 1997; 2002; 2012b (syns. as above and all references cited); Csuzdi & Zicsi 2003: 188. [Non Tetry (1937: 151), nec Bouché (1970: 541), nec James *et al.* (2010)? – see Sims 1983; Blakemore 2013e].

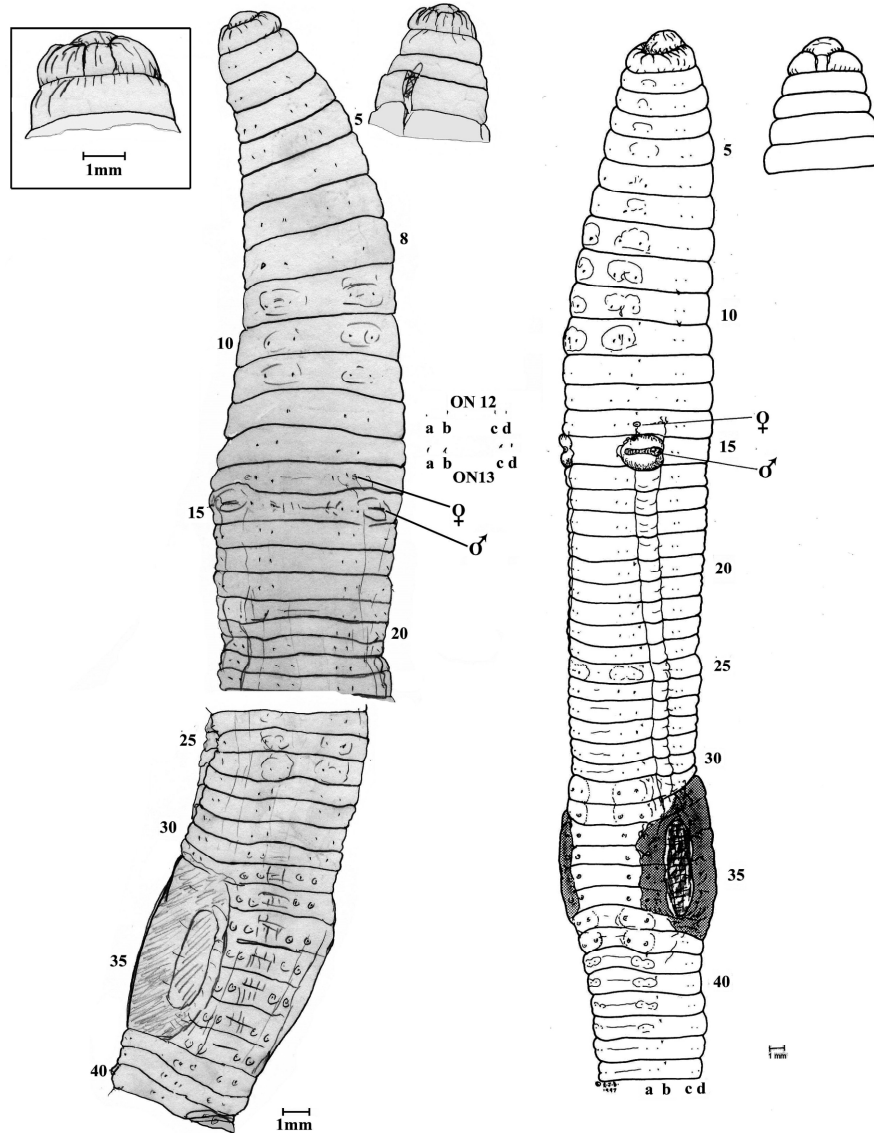
*Diagnosis.* Length 90–350 mm. Chestnut to violet brown above, paler below. Body cylindrical, posterior characteristically depressed and spade-shaped. Prostomium tanylobous. First dorsal pore 7/8/9. Spermathecal pores in 9/10/11 in cd lines. Clitellum saddle-shaped 32–37,  $\frac{1}{n}$ 38. Tuberculae pubertates longitudinal ridges on 32,33–36,37 lateral to *b* lines; tumescences around *ab* in some or all of 8–14, 24 and around clitellar region. Setae closely paired. Male pores lateral to *b* lines on 15 in prominent lips commonly impinging onto adjacent segments.

*Material examined.* NHM London neotype, a mature specimen previously dissected dorsally

with cuticle partly removed, in jar with three labels: “*Lumbricus terrestris* L. 1758 Neotype. Uppsala. 1973.1.1.”; “*Lumbricus terrestris* Linnaeus 1758 TYPE Loc. Uppsala”; “*Lumbricus terrestris* Linnaeus no longer contains NEOTYPE 1973.1.1 Loc: Uppsala. Note: Originally this number was designated for the *L. terrestris* neotype determined by R.W. Sims in 1973. Following examination by V. Pop (visiting at NHM, 2009) and S. James (James *et al.* PLOS ONE Dec 2010, vs, issue 12e15629) it was discovered that this jar no longer contains Sims’ described neotype, which must now be considered missing.”. Plus one label I added restoring its status as Neotype in 2013 (see Blakemore, 2013: fig. 1). Sims (1973: 32) gives details as collected from lawn close to the Botanical Garden, Uppsala, Sweden; 13<sup>th</sup> Oct. 1972, collectors B. Axelsson, U. Lohm and T. Persson. Preserved in formalin and 80% alcohol.

*Locality of other specimens.* Found by the author in supposedly 1,000 yr old paddock and organic field at Haughley farm in 1980 (Blakemore 2000). Numerous ‘middens’ seen at organic orchards at UC Davis, California in 2000 (also R.L. Bugg pers. comm). Launceston, north Tasmania; escaping over soil surface of suburban garden when digging drains to 1 m depth in black clay at 145 Holbrook St., Invermay; R.J. Blakemore, 29<sup>th</sup> June, 1997 (mature, complete specimen; fixed in 10% formalin, preserved in 80% ethanol in QVM collection). Found by author at Mt Wellington, Auckland in paddock soil (Blakemore 2012a); specimen in Auckland Museum (AMNZ 5265); also collected by RJB at Y Plas Machynlleth, Wales on 22<sup>nd</sup> VI 2013 (large specimen released in NHM gardens with help from Emma Sherlock).

*Distribution.* (Full citations in Blakemore 2012b). Holarctic: Greenland, Iceland, Scandinavia, Siberia, Russia, western Europe and British Isles including Isle of Man and Jersey, to the northeast of Iberian peninsula. Introduced to Azores, Madeira, USA (widespread but sometimes deliberately transported for fishing bait as noted by Gates 1972: 120), Canada (e.g. Alberta, British Columbia, New Brunswick, Newfoundland,



**Figure 1.** *Lumbricus terrestris* Linnaeus, 1758. Natural History Museum, London neotype (lhs with enlargement of tanylobous prostomium) compared to (rhs) first recorded Australian specimen from Tasmania after Blakemore (1997).

Nova Scotia, Ontario, Prince Edward Island, and Quebec although a report from Saskatoon, Saskatchewan is a mis-identification); temperate regions of Central and South America; India (and western Himalayas); South Africa [? Gates (1972: 119)]; N.Z. (Lee 1959), Tasmania – a new Australian record by (Blakemore 1997). Note, James *et al.* (2010) when attempting to restore the synonym state “*L. herculeus* has yet to be found outside of Europe” but overlooked earlier USA references noted in synonymy above.

*Habitat.* Mull soils, fields, pastures orchards and deciduous forests, mud flats, manure heaps, taiga, forests and steppes, common in grasslands (avoids pine/beech forests?). In alkaline soils of pH 6.2–10.0; especially abundant in clay. Sometimes caves, often in golf courses.

*Behaviour.* Nocturnal copulating and feeding on surface; posterior third assumes flattened spade-like shape when agitated and worms retreat backwards. Maintains permanent burrow systems

and forms 'middens' around entrances which may be clogged with leaves, feathers or other debris.

*Body length.* Anterior circular, posterior often dorso-ventrally flattened; 90–350 mm (neotype 155 mm but coiled and twisted; cf. 165 mm Sims 1973).

*Width.* 6–12 mm (neotype ca. 7–9 mm maximum).

*Segments.* Ca. 120–155 [neotype ~151 but with secondary schizo-metameres, see Blakemore (2013: fig. 2), cf. Sims (1973) 153 segments].

*Colour.* Anterior dorsum deep ruddy to gun-metal grey to *d* setal lines with blue iridescence, retained as dark mid-dorsal line to posterior; ventrum pale (pink in life); clitellum buff (yellow in life); preserved specimens uniform buff.

*Prostomium.* Tanylobous.

*Clitellum.*  $\frac{1}{2}$ 31, 32–37,  $\frac{1}{n}$ 38 saddle-shaped mostly to *bb* lines (neotype  $\frac{1}{2}$ 31, 32–37).

*Dorsal pores.*  $\frac{7}{8}$  small, from  $\frac{8}{9}$  larger.

*Setae.* 8 per segment, closely paired in regular rows; ratio aa:ab:bc:cd:dd:C ca. 6:1:5:1:22:0.5C, cf. 5:1.5:4:1:0.5C or 4:1.3:2.1 in neotype (Sims, 1973: 32).

*Nephropores.* Large at anterior margin of segment just lateral level of *b* setal lines on many segments (e.g. on right-hand side on 11–15, 20, 22–25, 28, 30–36, 39–44, etc.), irregularly alternating to between *d* and mid-dorsum (e.g. on rhs seen in dorsal position on 3–7, 9, 17–19, 21, 26–27, 29, 33–34, 37–39, 44–45); in some segments the pores appear to be in both positions on one side but reasons for this are unknown.

*Spermathecal pores.* In 9/10/11 in *cd* nearer to *c* lines; [Sims (1973: 32) says inconspicuous in *b* lines but I could not locate them there in the dissected neotype].

*Female pores.* Paired just lateral of *b* setae on 14.

*Male pores.* Towards lateral extremity of equatorial slits within tumid lips between *a* and *c* setal lines confined to 15; distinct mound tract (formed by parallel seminal duct grooves) extends from male pores to clitellum between *bc* lines on both sides.

*Genital markings.* Tubercula pubertatis as elongate smooth pads just median of *c* lines in

33–36; ventral setal couples within slightly tumid pads, especially 8,9–11, 25, 26, and 31,32 often to 37,38; Sims (1973: 32) has *ab* tumid on 25 and 26 as reconfirmed here.

*Septa.* 6/7/8/9 thickened; or none especially muscular.

*Hearts.* Paired in 7–11.

*Gizzard.* Muscular in 17–19.

*Calciferous glands.* Calciferous sacs opening posteriorly into the oesophagus of segment 10 ventrally and just in front of septum 10/11. Calciferous lamellae continued along lateral walls of the sacs in 11–12.

*Intestine origin* (caeca, typhlosole). In 14, swelling in 15–16 to form crop; caeca absent; typhlosole mid-dorsal beginning from about 21–23.

*Nephridia.* Holoic, bladders J-shaped.

*Male organs.* Testes/funnels holandric testis in sacs in 10 & 11; seminal vesicles paired in 9, 11 and 12, the latter pair may also fill 13.

*Ovaries.* Small, paired in 13.

*Prostates.* None.

*Spermathecae.* Two pairs in 9 & 10 as small globular sacs dorso-ventrally placed.

*Gut contents.* Depends on habitat and diet.

*Cocoons.* Ca. 4x7mm diameter but elongate (Sims & Gerard 1999: fig. 38b).

*Ecology, life-cycle, symbionts and parasites.* Provided by Gates (1972), etc.

*Notes.* *L. terrestris* is probably one of the main species about which Darwin (1881) wrote (cf. *A. longa*). A species that has, until relatively recently, been continually confused with *L. terrestris* is *Aporrectodea longa* (Ude) (see Gates 1972: 76).

Family MEGASCOLECIDAE Rosa, 1891 s.  
Blakemore 2000

Genus **Anisochaeta** Beddard, 1890

***Anisochaeta antarctica* (Baird, 1871) comb. nov.**

(Figure 2)

*Megascolex* (*Perichaeta*) *antarctica* Baird, 1871: 96.  
[From "New Zealand". Type BMNH 1845:6:18:1 – one of the first worm specimens from NZ, collected



by Dr Andrew Sinclair RN surgeon on Ross's ~1841–1844 'Lords of the Admiralty Antarctic Expedition' that had earlier specimens from Bay of Islands. Later Dr Sinclair was Colonial Secretary to NZ and founder of Auckland Museum].

*Diporochoeta shakespeari* Benham, 1906b: 254, figs. 7, Pl. XLI. [From bank of stream in dense bush, Little Barrier Island collected by W. B. Benham, 1906. Specimens "about a dozen individuals" but types Otago A. 43–48 (six?) at least one of which was inspected by Michaelsen (1916: 51); (syn. by Lee 1962: 177)].

*Spenceriella shakespeari*: Michaelsen 1907: 161.

*Megascolex shakespeari*: Michaelsen 1916: 51.

*Megascolex antarcticus*: Lee 1959: 348 (dates as "1871" and provides synonymy but classes as "incertae sedis" due to lack of information).

*Spenceriella antarctica*: Lee 1962: 177 (syn. *shakespeari*).

*Celeriella antarctica*: Blakemore, 2004; 2012a: 130 (syn. *shakespeari* as per Lee, 1962).

**Diagnosis.** The entire original description is "Body consisting of about 180 rings. Setae, surrounding the body, short, black, rather distant. Rings not keeled; larger and more distinct at the anterior extremity, closer at the posterior end, and all smooth. Length 7 inches. Hab. New Zealand." The type was inspected by Beddard and by Lee (1962) neither of whom dissected it, as here, since there was only a single unique specimen. Lee gave a length of 125 mm with 192 segments each with about 50 setae, but the specimen is now closer to 170 mm due to maceration. A sketch is for the first time provided confirming Lee's contention that its GMs are similar to those of *D. shakespeari* that is described in more detail by Benham, Michaelsen and subsequently by Lee (1959).

**Material Examined.** Lectotype BMNH 1845:6:18:1 a mature specimen, acitellate or the clitellum weak, with cuticle removed but otherwise in good condition apart from being macerated in the mid-body. Labelled: "45:6:18:1"; "*Megascolex antarctica* Baird, 1873 TYPE 1845:6:18:1 Loc; New Zealand Dr. A. Sinclair R.N. Ref. J. Linn. Soc. II, 1873, p. 96"; "Current name is *Spenceriella antarctica* (Baird), 1873 (Idet. Dr K.E. Lee 1961)". Note, sample jar also contains a myriapod

that is ca. 10 mm long with 70 legs, possibly the first one collected from N.Z. too. Lee (1959: 348) mistakenly has specimen as "1845.6.8.1". Other severely macerated and fragmented specimens labelled "B.M. [18?]40:5:27–9", "*Lumbricus?* sp.?, Bay of Islands, New Zealand; Antarctic Exped. the Admiralty" were identified by Lee (1962: 179) as *Megascolides* sp – these probably the actual first specimens collected from NZ.

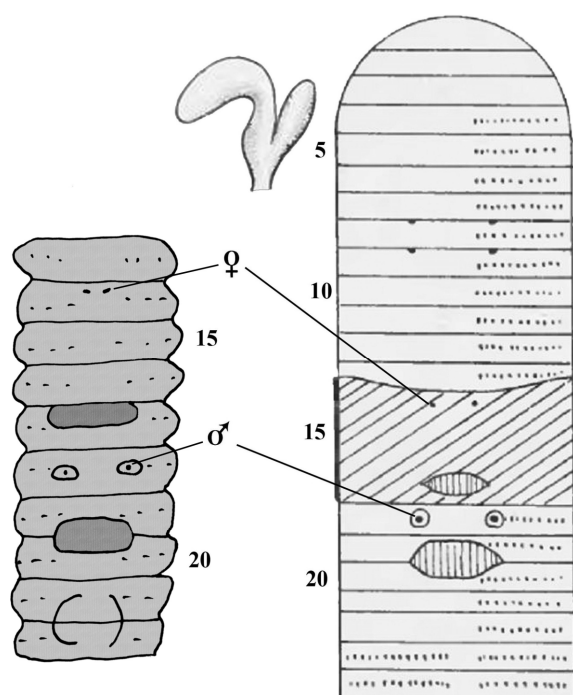
Under ICZN (1999: Art. 74.5) the lectotype designation is deemed by Lee (1962: 177, 179) where he says it "*becomes the type of Spenceriella antarctica*". The original article says published February 1870, but read on April 7, 1870 and the paper is most often dated 1871, e.g. by Lee (1959, 1962), whereas the Volume cover states published 1873; possibly preprints were issued thus the actual date of publication is currently uncertain.

**Distribution.** Widespread on North Island and Northland peninsular islands, NZ (Lee, 1959: 348 for *Diporochoeta shakespeari*).

**Notes.** Michaelsen (1916: 51) inspected a type specimen and found Benham incorrect to class the tubuloracemose prostates as "*tubular*" hence he reallocated the species to *Megascolex* Templeton, 1844 s, strict. that is now restricted for Indian taxa, whereas *Anisochaeta* Beddard, 1890 is available for Australasian taxa following its restoration by Blakemore (2000). Neither Lee (1962) nor Blakemore (2012a) had recognized Michaelsen's (1916) revisionary work on *Diporochoeta shakespeari* published a Century ago at the height of the 1914–1918 Great War, hence the previous generic misallocations.

Michaelsen (1916: 52) did not secure a specimen of *Megascolex giganteus*, but thought it so close to the previous species that he allowed for its prostates to essentially agree, thus it too is provisionally held as *Anisochaeta? gigantea* (Benham, 1906b) **comb. nov.** It is then most likely the two remaining *Celeriellas*, viz. Lee's 1959 *argillae* and *pallida* also comply as **combs. novae** in *Anisochaeta* which then entirely removes the genus *Celeriella* Gates, 1958 from NZ

although it apparently still resides in Australia. *Celeriella* is an Indian genus that by default received the residue of species from Australia and four from New Zealand actually having 'primitive' tubular prostates that were formerly part of *Spenceriella* Michaelsen, 1907, after removal of the type-species of the latter genus claimed with a non-tubular prostate to prior Australasian *Anisochaeta* Beddard, 1890 (see Blakemore, 1997b, 2000a, b). Other 'advanced' megascolecoid genera are Indian *Lampito* Kinberg, 1866 s. strict. and Oriental pheretimoids such as *Amyntas* Kinberg, 1867 itself revived by Sims & Easton (1972).



**Figure 2.** *Anisochaeta antarctica* (Baird, 1871) lectotype sketch (crease on 21–22 is just a fold not a marking) compared to synonym *Diporochoaeta shakespearei* Benham, 1906 (his figs. 7 of a spermatheca, and Pl. XLI exterior diagramatic).

**Genus *Amyntas* Kinberg, 1867**

***Amyntas gracilis* (Kinberg, 1867)**

(Figures 3a–b)

*Nitocris gracilis* Kinberg, 1867: 102. [Type locality Rio de Janeiro. Types in Stockholm Museum, 1944

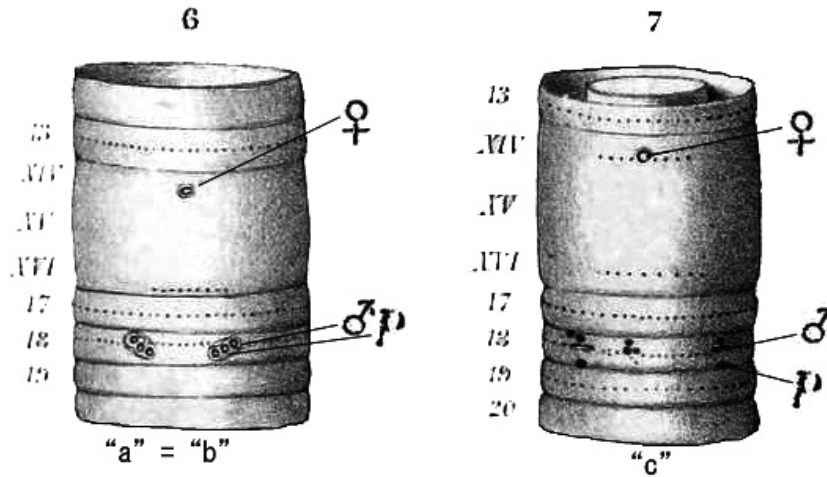
(Reynolds & Cook, 1976: 108), immatures (Sims & Easton, 1972: 214)].

*Perichaeta bermudensis* Beddard, 1892a: 160. [Thirty or forty spirit specimens from Surgeon-Major Windle of Bermuda (not from Kew Gardens). Syntypes British Museum: 1904:10.5.1362–65 (these inspected by Sims & Easton, 1972: 180 put in an *hawayana*-group and checked by RJB in June, 2013. Labels “*Perichaeta bermudensis* Beddard 1892 Types 1904:10.5.1362/65 Loc. Bermuda Beddard Coll Ref. Proc. Zool. Soc. Lond. 1892 p.160”, “*Perichaeta hawayana* 1904:10:5:1362–65”, “*Types of Perichaeta bermudensis*”. Jar contains many specimens, several found to be dissected, possibly of two or three different species, most look more like *A. corticis*); Beddard 1896: 208 (specimens from Hong Kong); 1900a: 410 he again confused description of *bermudensis* by saying “*Spermathecae* two pairs in VI, VII, VIII”!]. [Non *Pontodrilus bermudensis* Beddard, 1891].

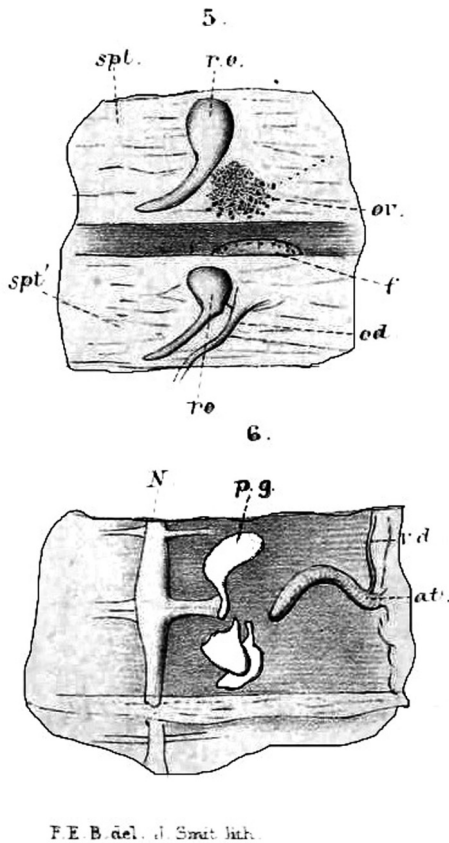
*Perichaeta barbadensis* (part., spec “b” which now = lectotype) Beddard, 1892a: 167. [Types British Museum 1904:10.5.11–13 inspected by RJB June, 2013 – see *A. morrisi* below. With spermathecal pores in 5/6/7/8 and shown in fig. 6 that was said to be specimen “a” by Beddard (p. 167), but is actually specimen “b”].

?*Perichaeta mauritiana* Beddard, 1892a: 170, Pl X, figs. 5–6 [From Kew originating in Mauritius. Types in British Museum 1904:10:5:203–5 (the numbers suggest three specimens although the original one was misplaced by Beddard 1900a: 425 and thus these specimens were not inspected by RJB). [Described with two pairs of spermathecae in 7 & 8 and genital markings median to male pores; cf. *A. morrisi*]; ?Beddard 1900a: 425 (he described a possibly different taxon?).

*Notes.* The above synonymy is partial, for full details and distribution, see Blakemore (2012b). I choose specimen 1904:10:5:12 as lectotype for Beddard’s (1892) *P. barbadensis*, this being the one he described as specimen “b” and figured (fig. 6 but mistakenly said it was specimen “a”). This specimen cannot now be traced in the Museum collection (pers. obs.) but it is reasonably accepted as *Amyntas gracilis* (Kinberg, 1867) and thus fixing the type to this specimen allows the name *barbadensis* to definitively enter synonymy of *gracilis*. The other two specimens, 1904: 10:5:11 & 13 – which are of two different and irrelevant taxa – now loose any nomenclatural



**Figure 3a.** *A. gracilis* (Kinberg, 1867) from Beddard (1892: Pl. IX, fig. 6-7) of his *A. barbadensis* – lhs of specimen claimed as “a” but actually “b” that is now lectotype and = *A. gracilis*; rhs specimen “c” of now irrelevant taxon (cf. *A. morrissi* group).



**Figure 3b.** *A. gracilis* after Beddard’s (1982: figs. 5–6) of his *P. mauritiana* showing two pairs of ovisacs (fig. 5) and three white glands marked “p.g.” median to the male pore on 18rhs (fig. 6). This taxon is a likely junior synonym of *A. gracilis*.

status with the restricted definition of *barbadensis* aiming to enhance the stability of nomenclature which has been highly confused for 120 years or so since Beddard (1872b).

***Amyntas loveridgei* (Gates, 1968)**

(Figure 4)

*Pheretima loveridgei* Gates, 1968: 257. [Type-locality Honey Lake, 5 Miles W of Greenville, Madison County, Florida, collected 27<sup>th</sup> May, 1966 by E.V. Komarek. Syntypes (many specimens, some dissected) in British Museum 1967:5:8:26 (Gates, Sims & Easton 1972: 181 and pers. obs. RJB 19.VI.2013) stated as “1967:5:8:28” (sic) and Tall Timbers Research Station #142 (Reynolds & Cook 1976: 130) – this later corrected and a transfer noted]; Gates 1982: 57.

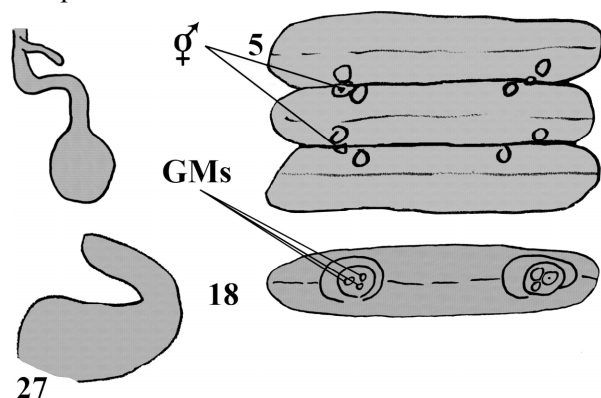
*Amyntas loveridgei*: Sims & Easton 1972: 236 (*A. morrissi* group).

**Diagnosis.** *Amyntas* with paired spermathecal pores ca. 1/2 body circumference apart in furrows 5/6/7. Length 90–110 mm. Segments 118–169. First dorsal pore 11/12. Male pores absent (or obscure). GMs as small discs in front of and behind spermathecal pores and as three sets of weak tubercles on each side of 18 in position of male pores and more medially. Prostates present or absent. Gates also reported loss of one or more spermathecae due to parthenogenesis.

*Material Examined.* “*Pheretima loveridgei* Gates, 1968 SYNTYPE”; “BMNH 1969.5.8/26 Loc. Greenville Madison Country (sic) Florida U.S.A 27<sup>th</sup> May 1966 Coll E.V. Komarck (sic) Ref. Gates 1968 J. nat. Hist. 2 p. 267”; “Cat. No. 142 Tall Timbers R.S. *Pheretima loveridgei* Fla. Madison Co. 5m W. Greenville 27 May 1966 E. V. Komarek, Sr TF 29” (there were two labels like this last). Sample jar contained many specimens, some dissected, most in reasonable condition. Smithsonian catalogue lists “Syntype” and records 30 specimens with Accession Number 382788 and USNM #136910

*Distribution.* USA (e.g. Florida, Georgia, Minnesota) and Rose Cottage, Sandy Bay, St Helena in South Atlantic. The original oriental homeland (and full synonymy?) for this transported species is unknown.

*Notes.* Gates noted much mucus in the body cavity. He separated this taxon from *A. morrisi* on the basis of its “GM pattern, number of segments, etc.” Gates (1968: 260) comments that the parthenogenetic method of reproduction, as in other pheretimas, permits more rapid accumulation of mutations than if reproduction had remained amphimictic. However the possibility remains that *A. loveridgei* is a synonym of some other taxon with spermathecal pores in 5/6/7 (or some similar combination!), e.g. the forty or so taxa listed under *A. morrisi* and cf. Gates’ own confused description of *Pheretima hawayana lineata* that is possibly retained on its distinctive male pores. *Amyntas infuscatus* Jiang & Sun, 2014 is similar except it lacks the markings around the spermathecal pores and it apparently retains spermathecal diverticula and prostates.



**Figure 4.** *Amyntas loveridgei* (Gates, 1968) rough sketch of a syntype showing for the first time the spermathecal and male fields, a spermatheca and the caecum.

### The *Amyntas morrisi* problem resolution

For the *A. morrisi* spp.-group, the conclusion is that the definition of *A. morrisi* is now restricted and compliant with Michaelsen’s (1900: 238) assessment where it is separated from “*P. barbadensis*” – which is now *A. pallidus* as explained below – mainly due to their papillae being, respectively, ventromedian and unpaired (in 6,7–8 and possibly 18 in *morrisi*) or variable, often paired in 6–8 and 18–19 (in *pallidus*). Also agreeing with Michaelsen (1900: 238) is separation of *Amyntas insulae* mainly due to its shorter, swollen spermathecal diverticulum and arrangement of GMs plus, newly, on the basis of its serrate intestinal caecum which has yet to be proven in the other two taxa (contrary to Sims & Easton 1972: fig. 1H).

### *Amyntas morrisi* species-group of Sims & Easton (1972)

[Cf. *A. browni* (Stephenson, 1912) and *A. loveridgei* (Gates, 1968)].

Tentatively included taxa having mid-ventral genital markings are:

- A. morrisi* (Beddard, 1892.)
- A. pallidus* (Michaelsen, 1892).
- A. insulae* (Beddard, 1896).
- A. incongruus* (Chen, 1933) Taiwan specimens have midline GMs on 18.
- A. lubricatus* (Chen, 1936) may be a synonym, lacking markings
- A. monoserialis* (Chen, 1938) has about 20 glands for each midline GM in 16–20.
- Amyntas tripunctus* (Chen, 1946) GMs mid-ventral in 6–8 and paired near male pores; spermathecal pores close to intersegments 5/6/7 but anteriorly in 6 & 7, i.e., strictly complying with Sims & Easton’s *canaliculatus*-group – (see Fig. 8b).

Several more recent Oriental taxa may also be implicated but DNA data are required for resolution, ideally based on published descriptions of topotypes or neotypes of these earlier species, as per Blakemore *et al.* (2010) (cf. limited data in Appendix).

Key to historical members of *A. morrisoni*-complex with spermathecal pores 5/6/7

1. Genital papillae mid-ventral in (6),7–8,(18) but not near male pores-----*A. morrisoni*  
– Genital markings (absent?) or with different arrangement ----- **2**
2. Spermathecal diverticulum longer, swollen (intestinal caecum form?) -----*A. pallidus*  
– Spermathecal diverticulum shorter, thin; intestinal caecum incised -----*A. insulanae*

***Amyntas morrisoni* (Beddard, 1892)**

(Figure 5)

*Perichaeta morrisoni* Beddard, 1892a (July): 166, Pl. IX, fig. 1. [From Kew Gardens from Penang type-locality (under ICZN, 1999: Art. 76.1.1). Types in British Museum 1904:10:5:199-201 “three or four specimens, of which only one was sexually mature”, and labeled as from Hong Kong according to Gates (1972: 203) but this contradicted by the current study – see Materials Examined. Types in British Museum 1904:10:5:199–201 inspected by RJB 19.VI.2013 and (missing) specimen 199 newly selected as lectotype]; ?non Beddard 1900a: 420, 423 (describing Hong Kong non-type specimens as part of *Amyntas hawayanus*; two of these were redescribed by Gates 1937: 361).

[? *Perichaeta mauritiana* Beddard, 1892a: 170, Pl. X figs. 5–6. From Kew in material from Mauritius. Types in British Museum listed as BMNH 1904: 10:5:203–205 suggesting three specimens, but the original misplaced by Beddard (1900a: 425) who described other supposedly similar specimens. Possibly a morph of *gracilis* since spermathecae are in 7&8 and markings only near male pores – three per side but shown as more horizontal rather than oblique as usual in *A. gracilis*]; Beddard 1900a: 425 (describing two other supposed non-type specimens with spermathecae in 6–8,9 one that was more similar to *gracilis*).

*Perichaeta morrisoni*: Beddard 1895a: 394, 400, 411; Rosa 1896: 516, figs. 2-3 (of proatate and spermatheca) [specimens from Padang, Sumatra reasonably expanded the definition to include mid-ventral markings in 6 and 18, and first dorsal pore in 10/11].

[*Amyntas barbadensis*: Michaelsen 1900: 254 (syn. *pallida* Michaelsen, 1892: 227, *amazonica* Rosa, 1894: 14, *sanctijacobi* Beddard, 1895: 61,

*cupulifera* Fedarb, 1898: 445 – I think this is in error as only *barbadensis* specimen “c” complies)].

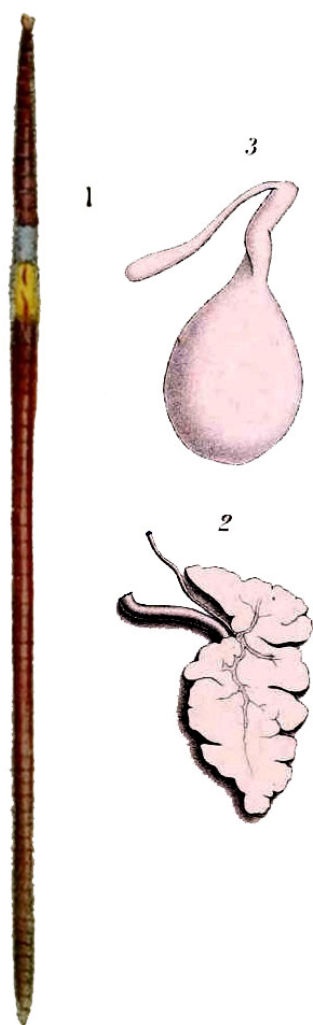
*Pheretima morrisoni* (part.?): Michaelsen 1900: 287; Ude 1905: 434; Chen 1931: 148; 1933: 267 [syn. *insulanae*, *hawayana lineata*, *browni*: Chen says *sensu* Gates 1932 (not 1931)]; Gates 1937: 361 (inspecting BMNH alleged Hong Kong types); 1939: 453 (syn. *insulanae*, *browni* part.); 1968: 253; 1972: 202 [syn. *browni* (part.) Stephenson 1912: 274 – this synonymy by Gates is obviously a mistake as *Pheretima browni* Stephenson, 1912 has spermathecal pores in 7/8/9 amongst other differences, cf. *Metaphire californica*; *hawayana lineata*]; Gates 1982: 59 (no synonyms listed just broad definition).

*Amyntas morrisoni* (part.?): Sims & Easton 1972: 236, figs. 1A (of 18rhs male pore of non-type), 1H (of incised caecum they call “complex” of non-type); Easton 1981: 55 (syn. *exiloides*: Ohfuchi, *elongata*: Ohfuchi); Easton 1982: 729, fig. 4c; Sims & Gerard 1985: 132, fig. 47a (syn. *barbadensis*, *mauritaniana*); Blakemore 2002, Blakemore 2003 [syns. *barbadensis*, ?*pallida*, *hawayana lineata*, *exiloides*: Ohfuchi, 1956 (non Chen, 1936), *elongata*: Ohfuchi, 1956 (non Perrier, 1872)]; Shen & Yeo 2005: 24 [syns. *barbadensis* (part.), *pallida* (part.), *amazonica*, *insulanae*, *cupulifera*, *hawayana lineata*]; Blakemore *et al.* 2006: 228 [syns.? *barbadensis* (parts ?“a” and “c”), *mauritaniana* (most likely a variety of *gracilis*), ?*pallida*, ?*amazonica*, ?*sanctijacobi*, ?*cupulifera*]; Blakemore 2008; 2010; 2012b (providing full synonymy citations as herein); Chang *et al.* 2009: 60, fig. 26 [photos with 26A of 18rhs male pore and GMs corresponding almost exactly with the supposed type 1904:10:5:199 (pers. obs.), therefore a likely misidentification and probably close to *A. cupuliferus* itself a probable synonym of *A. pallidus* as Michaelsen thought].

*Etymology*. Named for Sir Daniel Morris, Assistant Director at Kew Gardens from 1886–1898 before he became Imperial Commissioner of the West Indian Agriculture Department (where organic pioneer Sir Albert Howard also worked from 1899–1902).

*Diagnosis*. The type-description is short: Length stated as 52mm (natural size of 80mm shown in his fig. 1 as noted by Rosa), segments 93. Spermathecal pores 5/6/7, male pores 18 not separated by a very wide interval (with minute papillae assumed nearby since there are glands internally). “There are no papillae in the neigh-

bourhood of the male pores...” but “...in the neighbourhood of the spermathecal apertures” are central discs, mid-ventral, presetal in 7 & 8, plus Rosa found them mid-ventral in 6 in one and in 18 in two of his non-type specimens. Gizzard in septal space of 8–10; oesophagus in 10–14 dilated; intestinal caeca the usual pair. Spermathecae with diverticulum un-dilated about as long as the ampulla. Copulatory pouches absent (i.e., male pores simple). (Beddard thought the setae on clitellum were characteristic but these are likely due to maturity and interval after shedding and thus are irrelevant).



**Figure 5.** *A. morrisi* Beddard (1892, Pl. IX, figs. 1) from original of lectotype body and Rosa's (1896: figs. 2-3) of spermatheca and prostate, possibly of the same taxon as *A. morrisi*. The original description had no GMs around male pores.

*Material examined.* Natural History Museum, London 1904:10:5:199-201 labelled: “*Perichaeta morrisi* Beddard, 1892 TYPE 1904:10:5:199–201 Loc: Penang Island, west of Malakka, Sumatra (Padang). Ref. Proc. Zool. Soc. L. 9(1): 166”; “*Perichaeta Penang*”; plus a label from Beddard that is illegible. [NOTES: The location note “*Sumatra, Padang*” is seemingly a mistake (although it where Rosa (1896) recorded *morrisi* from), it is 700km from Malaysian Penang (5° 24'N 100°14'E) and far from Malacca; actually this location is copied from Michaelsen (1900: 287) who gives location: “*Insel Pinang westlich von Malakka, Sumatra (Padang)*”. Reynolds & Cook (1976: 149) mistakenly give this same registration number for *P. padasensis* (Beddard & Fedarb, 1895)]. Sample contains four specimens, none dissected, one is mature and three are ac clitellate. The mature specimen is figured here but cannot possibly be the type of *A. morrisi* as it is undissected and differs considerably; the other three sub-adults may be syntypes but were not used originally since Beddard (1892b: 166) says – “*Three or four specimens were forwarded to me, of which only one was sexually mature; the following description is based upon that specimen.*”

The lectotype is hereby designated as 1904: 10:5:199 under ICZN (1999: Art. 74 with amendment) it being the sole name-bearing individual on which the original *A. morrisi* description by Beddard was based having a (contracted) length of 52 mm with 93 segments and illustrated at natural size in his fig. 1 (as 80 mm) and even though this specimen is now misplaced, the objective being to define this taxon in the interest of nomenclatural stability. The three ac clitellate syntypes (1904:10:5:200–201) become paralectotypes only because Beddard mentioned them as “*three or four specimens*”, they formed no part of the description and neither did the mature specimen that was presumably added to the jar subsequently (here figured and traced to same batch as Hong Kong specimens 1904:10:5:106–116, in particular one described by Beddard 1900a: 424).

*Distribution.* Described from Kew but originating from Penang the following records all now

require verification. Possibly native to southern China, *A. morrisoni* is supposedly peregrine in: Myanmar, Thailand, Vietnam, Taiwan, Malaysia inc. Penang, Singapore, and Sumatra; and outside the *Pheretima* domain in: Hawaii, USA, Mexico, South America and Caribbean [e.g. Ecuador, Chile, Argentina, Brazil, Guayana, Mexico, Barbados and Peru also Guatemala (Gates 1982)], Diego Garcia, Spain, Italy, Pakistan, India (Gates 1972: 204), South Africa, PNG and Australia. Only one previous report in Australia – from the grounds of the old Queensland Museum, Brisbane (Easton 1982) may now be suspect. How many of these reports are *A. morrisoni* s. strict. is unknown as this distribution may now only refer to the *A. morrisoni* spp-group, and that in part only with the current restriction of names and resurrection of synonyms.

*Notes.* It is now necessary to restrict the definition of *A. morrisoni* to those specimens that agree with the original in having (paired or unpaired?) mid-ventral markings on 7 & 8 and none around male pores.

The listed NHM type is undissected and does not correspond to the original description by Beddard thus the samples have been mixed at some stage between 1892 and 1904 when they were lodged, or afterwards by Gates and/or Monro.

Gates (1937: 361) claimed to inspect British Museum material he cited as: “3 specimens labelled, ‘*Pheretima barbadensis* 1904:10:5:11–12. Barbados. coll. Beddard’ and 1 a clitellate and 1 partially clitellate specimen labelled ‘*Pheretima morrisoni*. 1904:10:5:106–116. Hongkong. coll. Beddard’”. These are obviously not types of *A. morrisoni*, but Gates goes on to say “The British Museum specimens from Hongkong are, according to Dr. C.C.A. Monro, the types of *P. morrisoni*.”

The single clitellate syntype of Beddard’s Penang species – now missing – was described with markings only mid-ventral in 7 & 8. Gates (1937: 362) described two Hong Kong pseudo-types, one partially clitellate with markings mid-ventral in 6, 7 & 8 and also with paired lateral

presetals each on 7, 18 & 19 along with two markings just median to each male porophore. This complies *exactly* with what Beddard (1900a: 424) said “it was very general to find” in several of his Hong Kong non-type specimens of “*morrisoni*” with one individual in particular having median markings on each of segments 6–8. Another one Beddard (1900a: 424) said “was anomalous by reason of the fact that the 7<sup>th</sup> segment had no less than six papillae arranged in an irregular line along the middle of that segment” – which is *exactly* what the mixed-type specimen (in jar 1904:10:5:199–201) now has – but this was not recorded by Gates. Gates (1937: 362) described the second a clitellate Hong Kong specimen with three marking on 7 and four on 18 but this does not comply with any of those given particulars by Beddard (1900: 424) and can be ignored too. The registration numbers (BMNH 1904: 10:5:106–116) suggest there were originally eleven specimens in the sample, and Beddard (1900: 424–245) provides details of ten or eleven of these Hong Kong specimens, thus it is unclear why Gates (1937: 361) could only record two specimens. Nevertheless, it seems Gates is mistaken in his assumption about these being *A. morrisoni* types. It is now important to try to trace the eight remainder of the eleven Hong Kong specimens as these may contain the actual missing type accidentally swapped with the one Hong Kong non-type material presently in jar BMNH 1904:10.5.199–201 [these numbers themselves indicating three specimens but actually comprised of four, with one being the Hong Kong non-type specimen, as noted above and in designation of a lectotype below].

Also often confused and contradictory in his work, Gates (1939: 446), for example, claimed to inspect BMNH non-types from Hong Kong labelled “*P. barbadensis* 1904.10.5.1219.1228” containing three specimens of “*Pheretima barbadensis* and varieties?” and “*P. morrisoni* 1904.10.5.453” that he said had four divers specimens; but a few pages later (Gates 1939: 453) said these two jars contained, respectively, 31 (!) specimens and just three specimens of “*Pheretima morrisoni*”. This whilst he placed the type of *A. insulanae* Beddard,

1896 and, even more unlikely, *A. browni* Stephenson, 1912 in synonymy of his confused concept of *A. morrиси*. Gates rarely provided figures for clarification.

Sims & Easton's (1972: fig. 1A H) was supposedly *A. morrиси* but the specimen concerned was not identified. Interestingly, Sims & Gerard (1999: 132, fig. 47a, after Easton 1982: fig. 4d) later said: "Amyntas morrиси (Beddard, 1892a: 166) originally recorded as *Perichaeta barbadensis* Beddard, 1892a: 167 and *P. mauritiana* Beddard, 1892a: 170" and their figure of "*A. morrиси*" had genital markings below and just median to line of spermathecal pores in 6,7 and 8 and paired midventral in 18 and 19 and just above male pores and in a similar position on 19 (i.e., 14 total, all presetal but no single central as in the original!). These authors did not inspect types of any of these three taxa and their mistaken characterizations are now highly suspect (see Figs. 8a–c).

There is no evidence to support *P. mauritiana* being the same as *P. morrиси* and thus Sims & Easton's (1972: 236, figs. 1A, 1H) plus Easton's (1982: fig. 4c) and Sims & Gerard's (1985, 1990: fig. 47a) are not representative of the type and are themselves probably composites. Ironically, Sims & Easton (1972) did not list type of *A. morrиси* in their study, and the specimen they figured is unknown, possibly a composite or one of the synonyms? Maybe it is from the *A. insulae* type (1904:10:5:86) as briefly redescribed below?

Unfortunately, since the single type of *P. morrиси* cannot be located in the Museum collection, the definition of this species presently remains unverified.

Beddard's (1892b: 170, fig. 6) *Pe. mauritiana* was yet thought by Michaelsen (1900: 316) and Gates (1972: 217) to belong to *hawayana* (= *gracilis*), or *barbadensis*, or *robustus*. Because of its markings around the male pores, *mauritiana* is a possible morph of *A. gracilis* lacking the anterior pair of spermathecae but this too needs confirmation. Cf. Sims & Gerard (1999) who oddly include it in synonymy of *A. morrиси* even though

its spermathecae are in 7 & 8 not 6 & 7 as in *morrиси*. Pending inspection of its type, it is perhaps judicious to retain it too as a *species incertae sedis*.

*Pe. mauritiana* was described on a single specimen with GMs on 18 only, three per side, below and median to the male pores, thus unlike those of *A. morrиси* but possibly the same as *A. gracilis*. If they are the same as *A. gracilis*, but lacking the first set of spermathecae having the pores in 6/7/8, this begs the question why Beddard did not recognize it as similar to his *Pe. barbadensis* specimen "b" although, as in typical *A. gracilis*, this has pores in 5/6/7/8? Probably it was because he put more weight on the setae retained on the clitellum even though this is not a valid characteristic of megadriles.

Probably Sims & Easton (1972) took Beddard (1900a: 424) too literally when he described two non-type specimens of *A. mauritianus* from Hong Kong that he likened to *A. morrиси*. The spermathecae of the single types of each: these being in 6 & 7 in *morrиси* and 7 & 8 in *mauritiana*, separate these two taxa regardless of subsequent embellishments. However the addition of the two Hong Kong specimens may account for the three registration numbers for *mauritiana* types (that were not found in the current study).

Beddard (1892a: 172) was further mistaken when he referred a single worm from Singapore via Kew as being similar to his *P. morrиси* and to his earlier "*Perichaeta ceylonensis*" as there is no such taxon and he probably meant his *Pe. ceylonica* that is now *Megascolex ceylonicus* (Beddard, 1886). The single Singapore specimen had intestinal caeca and a gland on the atrium that thus may qualify as a member of the genus *Manus* Blakemore, 2010 currently known only from Japan for type *Pheretima koellikeri* Michaelsen, 1928; thus quite different from *A. morrиси*.

Gates (1939: 454) had a table of setae and GMs in ten Szechwan specimens showing they are usually mid-ventral on 6–8 and paired laterally on 7 less often with only two specimens



having GMS on 18 and one of these on 19 too. But, because he footnotes that these all had a pair of markings next to the male pores, they no longer comply with *A. morrisoni* and probably represent one or more of its previous synonyms.

The previous broad definition of *A. morrisoni* had allowed genital markings very rarely lacking, usually small discs presetal unpaired median in some or all of 5–8 or 6–9 and 18; paired and just median of spermathecal pore lines or more mesially in some or all of 6–9; occasionally two or more in 18 or 19; and almost constantly two just median to each male pore but one pre- and one post-setal. Intestinal caeca simple but (always?) with incised or lobate ventral margin. This definition is now defunct and restricted, unless molecular evidence, such as that in the Appendix, can now show that specimens with mid-ventral GMS in 7 & 8 also have the variations as described for subsequent synonyms that are briefly presented below in chronological order.

**Past synonyms of *A. morrisoni* eligible for restoration progressively in date order**

***Amyntas pallidus* (Michaelsen, 1892)**

(Figure 6)

*Perichaeta pallida* Michaelsen, 1892 (Sept.): 227.

From Porto Alegre, Brazil. Berlin types 441, supposedly more than two specimens, missing according to Reynolds & Cook, 1976: 149. [It has two (or three?) pairs of spermathecae in 5/6/7(8) and GMS variable in male field and near spermathecal pores, also some mid-ventral too but probably referring to two different taxa].

*Perichaeta amazonica* Rosa, 1894: 14. [From Manaus, Brazil. Turin(?) types missing].

*Perichaeta sanctijacobi* Beddard, 1895. [From Santiago, Chile. Hamburg type missing. Specimen lacked GMS but thought similar to *A. morrisoni* because it had spermathecae in 6 & 7 but each with swollen diverticulum].

*Perichaeta cupulifera* Fedarb, 1898: 445, fig. 1. [From Dehra Dun in NW provinces, India. Types from Calcutta Museum? Cf. *A. gracilis* synonymy].

*Pheretima pallida*: Michaelsen 1900b: 254 (held in synonymy of *P. barbadensis* along with *amazonica*, *sanctijacobi*, *cupulifera*).

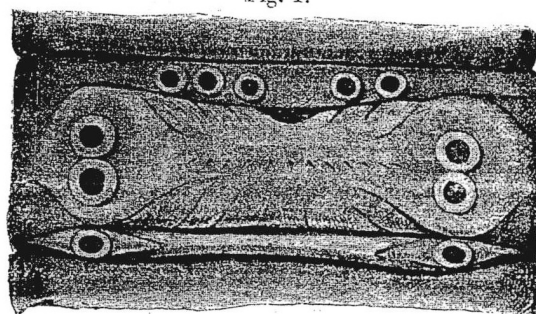
*Pheretima hawayana lineata* Gates, 1926: 154. [From Taungyi, Myanmar. Types lost. Gates described this species with spermathecae in 5/6/7 and with characteristic median preclitellar papillae (sometimes missing) and papillae internal to and either side of male pores plus a presetal pair on 19, *i.e.*, similar to *A. pallidus*].

?*Pheretima incongrua* Chen, 1933: 270. [From Linhai-hsien, Chekiang, China. Types in US National Museum 20175].

**Diagnosis.** Pale yellow-gold but pale brown dorsally (*sanctijacobi* greenish brown). Longest 125 mm by 5 mm with 95 segments. Setae 52–59 in midbody. First dorsal pore uncertain. Male pores widely separated on 18. Typically two pairs of spermathecae in 5/6/7 and GMS variable in male field and near spermathecal pores, also some mid-ventral too but possibly referring to different taxa. Michaelsen gives GMS as: two, three or four papillae particular to each of the male pores. Another pair just behind 18/19, close to each other and to the ventral midline, and two other couples on segment 7 in the ventral-median line. In other examples (different species?) those papillae near the male pores differed and papillae or groups (up to 3) were on the intersegmental furrows of 5/6 and 6/7 or 7/8. Gizzard occupies 9. Intestine in 14. Caeca from 26 (form not stated). Hearts 11–13. Holandric, metagynous. Prostates 18. Spermathecae in 6 and 7 (and sometimes 8?).

**Distribution.** Introduced to South America and India, probably from China. Its distribution is con-

Fig. 1.



Ventral surface of xviiiith segment of *Perichaeta cupulifera*, showing the cup-shaped papillae.

**Figure 6.** *A. pallidus* (Michaelsen, 1892) after Fedarb's (1898: 445, fig. 1) of *Perichaeta cupulifera* synonymy with GMS around male pores.

confused with that of *A. morrisoni* s. stricto and subsequently synonyms.

*Notes.* Michaelsen's specimens with three pairs of spermathecae in 5/6/7/8 should strictly be excluded from the definition; they possibly comply with *A. rockefelleri* (Chen, 1933) or some similar taxon. Having markings around the male pores currently disqualifies *A. pallida* as a synonym of *A. morrisoni* but unfortunately exact characterization is unavailable without access to the type of either taxon.

Because Michaelsen (1900b: 238, 244, 254) maintained a broadly defined *Pheretima barbadensis* with synonymy: *pallida*, *amazonica*, *sanctijacobi* and *cupulifera*, now that *barbadensis* is made synonym of *A. gracilis*, then these latter three should all probably now default as *A. pallidus* synonyms. Caeca are usually from 26 or 27, but the form in *A. pallidus* needs to be determined for comparison with *A. insulae*.

*P. cupulifera* was described with GMs a pair or a single papilla at the edge of the segment (7?) in line with spermathecal pores in 6/7; one worm from several was said to have two median papillae on 7 & 8 (as in *morrisoni*); and others had markings near male pores as in Fedarb's figure. The two pairs of spermathecae in 6 & 7 have a diverticulum swollen at the extremity. Fedarb's figure of segments 18–19 (presumably of the type) is also particularly close to male field of the type of *A. insulae*. However, the author made no mention of the state of the intestinal caeca thus, for the present as in the past, it falls under *A. pallidus* as per Michaelsen (1900b).

Parthenogenetic *A. incongruus* (Chen, 1933 as described by Chang *et al.* (2009: 52) from China and Taiwan may now be comparable to degraded forms of *A. pallidus* as may its possible synonym *A. lubricatus* (Chen, 1936) that lacks markings. GenBank COI barcode for "*A. incongruus*" agrees 98% with *A. morrisoni*, *A. aspergillus*, *A. triastriatus* and several other BLAST results, but with none of these identities confirmed.

Other possibly related species but lacking marking other than those immediately median to the male pores, is *A. infuscatus* Jiang & Sun, 2014 that may be the same as *A. pallidus*. Also similar is *A. endophilus* Zhao & Qiu, 2013 that is said to lack markings despite these being shown as a pair mid-ventral on 18 in their fig. 1.

### ***Amyntas insulae* (Beddard, 1896)**

(Figures 7a–c)

*Perichaeta insulae* Beddard, 1896: 205, fig. 2. [From Hong Kong. Type BMNH 1904:10:5:86 inspected by Gates 1939: 454, by Sims & Easton 1972: 180 and herein].

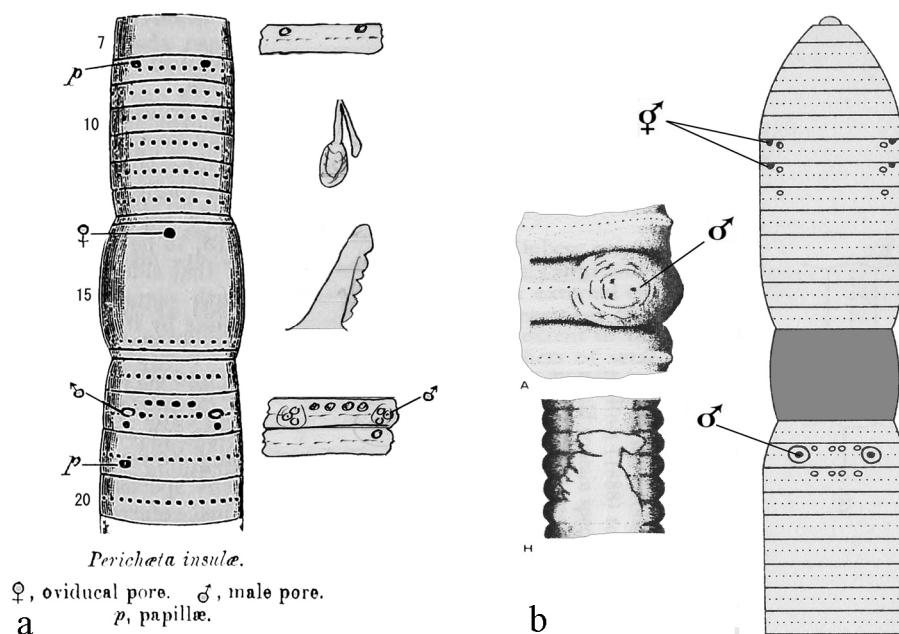
*Pheretima insulae*: Michaelsen 1900: 276.

*Amyntas insulae*: Sims & Easton 1972: 237 (*morrisoni* group); Blakemore 2008.

*Diagnosis.* (from Beddard and current inspection of type): 103 mm with 95 segments. Clitellum 14–16. GMs are described as papillae paired "*near the anterior margin on viith segment*" but figured by mistake on the 8<sup>th</sup>, here correctly shown on segment 7; eight papillae on 18 (but misfigured by Beddard compared to the current sketch) and a single papilla on 19 on "*left side of the body*" (actually on rhs as per current sketch). Glands correspond to the GMs internally on 18. Pharyngeal glands to the sixth segment. Septa 4/5–7/8 thin, those immediately after gizzard thicker. Seminal vesicles in 11 and 12. Prostates racemose. Spermatheca in 6 & 7 (opening to 5/6/7) with shortish, unswollen diverticulum as sketched. Intesine from 15, caeca in 27 newly found to be ventrally serrate/incised as sketched.

*Material examined.* BMNH 1904:10:5:86. Labels in jar state: "*Perichaeta insulae (Beddard) (Type?) 1904:10:5:86 Hong Kong Beddard Coll<sup>m</sup>*"; "*Perichaeta insulae Hong Kong*" in Beddard's hand; "*Probably the type of Perichaeta insulae Beddard but now = P. morrisoni*" in Gates' hand?; "*fide G.E. Gates*". Jar contains one previously dissected specimen in good condition with a separate vial containing a single spermatheca.

*Distribution:* Hong Kong, China.



**Figure 7a.** *A. insulæ* (Beddard, 1896) his fig. 2, with sketch of actual lectotype conditions of markings in 7 and 18–19 plus a spermatheca and distinctive serrated caecum. Possibly same as *A. pallidus* for which the condition of its caeca are unreported.

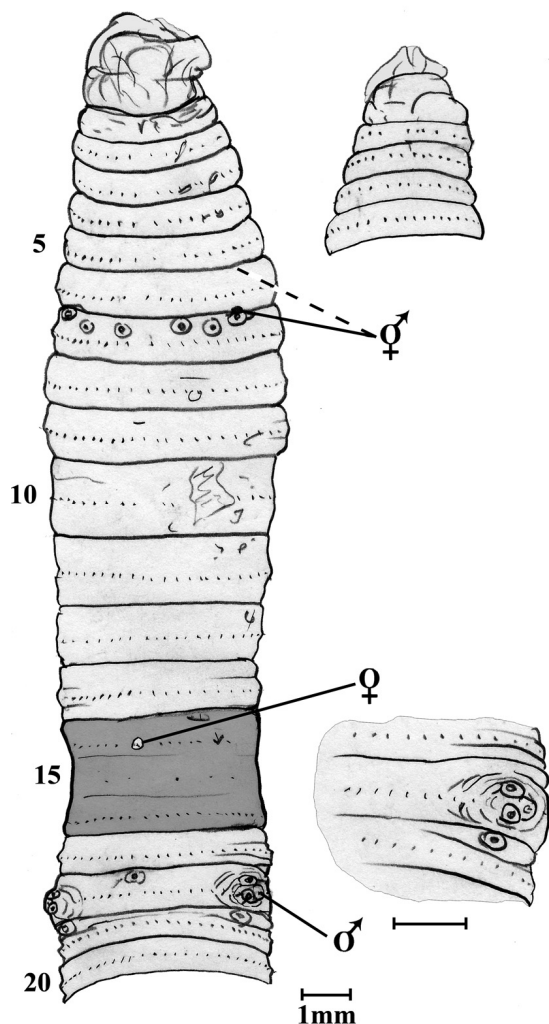
**Figure 7b.** Disparate “*Amyntas morrisoni*” figures after Sims & Easton’s (1972: figs. 1 A, H) enlargement of male pore and lateral view of an incised caecum that may be from specimen similar to either *A. pallidus* and/or to *A. insulæ*; alongside Sims & Gerard’s (1999: fig. 47a) sketch of “*A. morrisoni*” (that is the same as Easton, 1982: fig. 4d) and is more likely *A. pallidus* (or a composite of several species?) lacking preclitellar mid-ventral markings.

*Notes.* It seems that *A. insulæ* should be maintained separately from both *A. morrisoni* and *A. pallidus* based on its serrate intestinal caeca and shorter, thin spermathecal diverticulum. Sims & Easton (1972: fig. 1H) claim a similar ‘complex’ caecum in *A. morrisoni* from a non-type specimen that they fail to identify but this has yet to be confirmed. Furthermore, the precise arrangement of its GMs on 7 and 18–19 certainly differ from *A. morrisoni* proper whilst helping to define the current taxon.

#### Summary of *A. morrisoni* species-group revision results

- *Amyntas morrisoni* is restricted to its lectotype and the original type-description; efforts should be made to relocate this missing type and to analyse DNA samples, preferably from Penang topotypes that comply morphologically. Only then can its relation to other *A. morrisoni* group members be determined.
- *Amyntas barbadensis* is restricted to the lectotype which is specimen “b” that now complies with prior *A. gracilis* as its junior synonym.
- *A. mauritianus* may be provisionally restored although there is little to separate it from quadrithelial forms of prior *A. gracilis*. Certainly it is separate from the restricted *A. morrisoni*.
- The other previous synonyms of *morrisoni* that were questioned by Blakemore (2003, 2007, 2008) revert to the earliest name which is *Amyntas pallidus* that is also restored as per its original description. Whether species such as *A. insulæ* and *A. cupuliferus* actually agree may again be settled by inspection of types and progressive DNA analysis of taxa representatives.
- It is noteworthy that DNA sequences currently posted on GenBank (Appendix) show that samples identified by different authors under the name *A. morrisoni* represent different taxa – none of which may be the same as the current concept – thus there is justification for estab-

lishment of a species-complex and for urging further studies on actual species identities and boundaries of these in their Asian homeland and in translocated populations.



**Figure 7c.** Sketch of specimen 1904:10:5:199–201 from jar of “*A. morrisi* TYPE” is herein found exchanged: it cannot possibly be the same because it is undissected and its external characters do not agree. [This mature specimen is actually the anomalous specimen from Beddard’s (1900a: 424) Hong Kong samples (1904:10:5:106–116) themselves mistakenly redescribed as *A. morrisi* types by Gates (1937: 361). This specimen here figured is superficially similar to *A. insulae* type (as is Sims & Easton’s 1972: figs. 1A, 1H of “*A. morrisi*” non-type male pore and caecum!), whereas the remaining Hong Kong non-type sample descriptions are reminiscent of both *A. insulae* and several other members of the newly proposed *A. morrisi* spp-complex].

***Amyntas talus* sp. nov.**

(Figures 8a–b cf. 8c)

*Amyntas* “*morrisi* group” (Sims and Easton 1972):  
Blakemore 1994: 353, fig. 1.27.

**Material examined.** University of Queensland farm at Mt Cotton (27°53’S, 153°14’E), collected by RJB, 19.I.1993 from pasture and under *Albizia* spp. in reddish soil; other material collected by D. Mercer in 1975 and A. Wilkie in 1992 from the same site. Numerous mature and immature specimens those lodged in ANIC (RB.95.1.1) listed as H and P1 other, supposedly still in collection at Queensland University. Contemporary details of the Mt Cotton site soils and vegetation are provided by Gutteridge (1990).

**Habitat.** Under pasture; sandy soil of lower creek bank almost in gravels of water line, also in moister clay under trees and shrubs at 0-20 cm depth.

**Lengths.** Current 75-100 mm (cf. 45-120 Gates for *morrisi*).

**Width.** 3–4 mm.

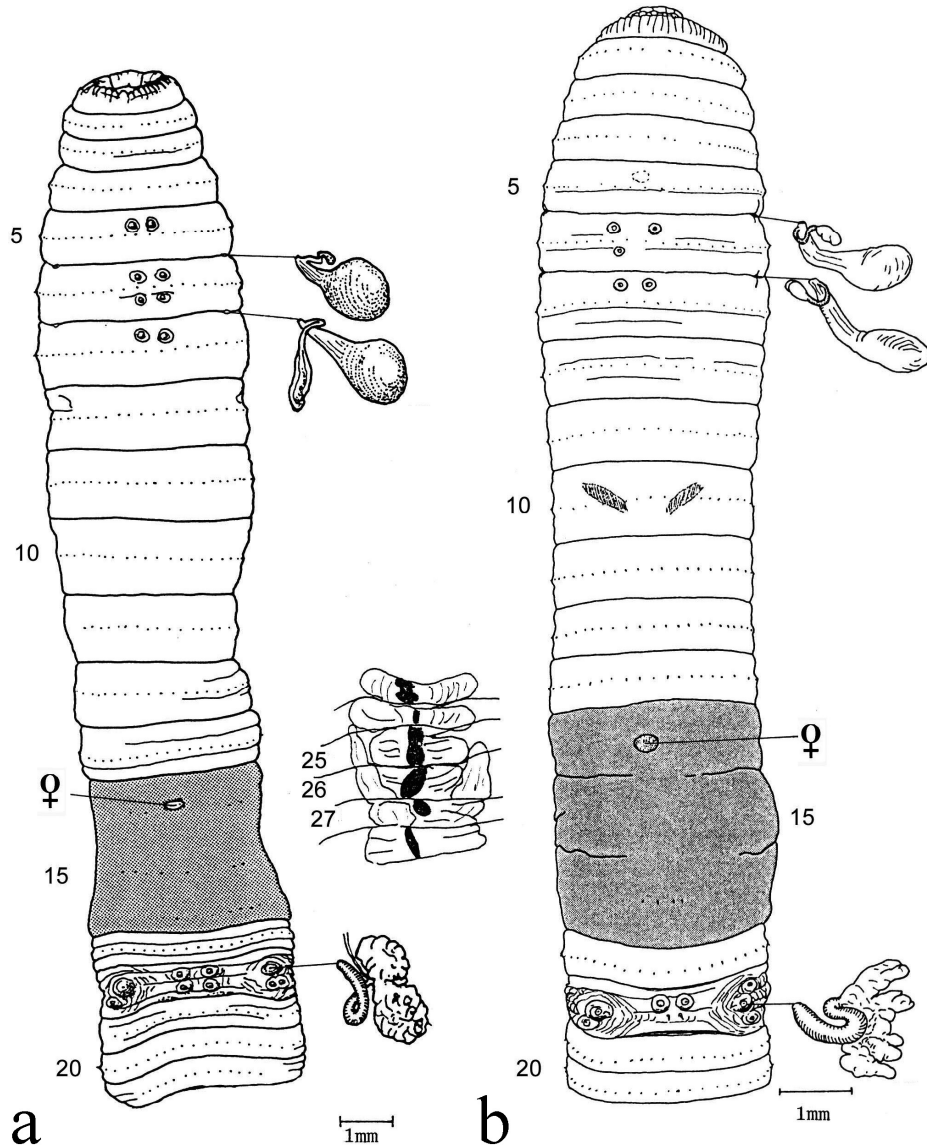
**Segments.** 122–156 body cylindrical anteriorly but tapering and becoming more trapezoid posteriorly, some secondary annulation in anterior, deep furrows in posterior. Segment 10 is wide and semi-transparent: paired ventral blood vessels show through.

**Colour.** Dark brown anterior and dorsum (but setal auriolae paler), paler ventrum, clitellum buff, after clitellum dark mid-ventral line. In formalin, a uniform buff but with deep puce clitellum.

**Prostomium.** Parallel open epilobous, often compressed.

**First dorsal pore.** 11/12 and then 12/13 but not on clitellum, although present subsequently and continuously to posterior.

**Setae.** Numerous ca. 40–50 per segment, ventral and dorsal gap slight if at all; only faintly retained ventrally on clitellum; typically setae occluded between male pores but in two specimens two larger (penial?) setae seen midventrally between male pores (figured).



**Figures 8a–b.** *Amynthus talus* sp. nov. from Mt. Cotton, Qld.; a = ventral view of H with spermathecae, intestinal caeca and prostate *in situ*; b = paratype with spermathecae and prostate *in situ* (note blood vessels showing in 10). Differs from other *A. morrisoni* spp.-group by GMs on 18 being outside male pores plus multiple, mid-ventral GMs paired in 5,6–7 and 18, (rather than 6,7 & 8), etc..

*Nephropores.* None visible.

*Clitellum.* Annular 14–16, furrows obliterated or faintly retained.

*Male pores.* 0.3 circumference apart on slightly raised equatorial porophores surrounded by several faint concentric grooves with markings nearby (see Genital markings).

*Female pore.* Single, central on 14 in small countersunk dish or in lateral groove.

*Spermathecal pores.* Two pairs in 5/6 and 6/7 lateral, ca. 0.4 circumference apart with slightly tumid lips concealed in furrows.

*Genital markings.* Variable as small mid-ventral paired (occasionally single, or quadruple) presetal discs in 5–7 or 6 and 7, and often a postsetal pair in 6 (and occasionally 5); plus always one pair mid-ventral and presetal on 18 between male pores, and often another pair post-

setally. Also immediately lateral to the porophores on 18 a pair (may be doubled) of small raised papillae anteriorly and posteriorly; or one or both of the anterior pair may be absent. In sub-adults only the male pores are present, papillae and genital markings are lacking.

*Septa.* 4/5/6–7/8 getting progressively thicker and displaced posteriorly, with tendons reaching to succeeding segmental walls; 8/9 membranous or absent, 9/10 aborted; 10/11–14/15 getting progressively weaker with tendons persisting.

*Dorsal blood vessel.* Single continuous to pharynx in 4.

*Hearts.* Weak in 7 then strong in 10 (from dorsal vessel), 11–13 (from supra-oesophageal vessel). Supra-oesophageal vessel from region of 10/11 to 14. Ventral blood vessel bifurcated under gizzard from 10. In 5 and 6 numerous small blood vessels appear clustered together.

*Gizzard.* Large, tubular to bell-shaped and muscular with evenly spaced longitudinal blood capillaries occupying space between 7/8 and 9/10.

*Calciferous glands.* Small oesophageal pouches which appear pink due to blood capillaries and have internal lamellae present in 10 (annular) 11–13 (ventrally pouched) and 14 (weakly annular). These outgrowths of the oesophageal wall are easily deformed and in section the walls are thick and squamous but calciferous granules were not seen. (Beddard found oesophagus in segments 10–14 thickened and whitish in *A. morrisoni*).

*Intestine origin* (caeca, typhlosole). Oesophageal valve in 14 or 15 opens into intestine in 15 or 16; caeca simple and extending from 27 to 24. At the region of the caecal origin, a large single lamelliform dorsal typhlosole commences.

*Nephridia.* Meroic, from 4–7 numerous tubules are obvious on the posterior septa, further anteriorly they are much larger, almost tufted; from segment 8 posteriorly micro-nephridia are equatorial on the body wall.

*Male organs.* Testes/funnels in membranous testis sacs in 10 and 11. Segments 7–14 are filled with white coagulum, but seminal vesicles (and pseudovesicles?) can be distinguished in 10–12 but not in 9.

*Ovaries.* Rather small pair ventrally from anterior septum of 13 as flattened palmate or

clustered egg strings with oviducts in the posterior septum.

*Prostates.* Racemose, bi- or tri- or multi-partite, from 17/18–19/20, large muscular ducts in single loops. Vasa deferentia enter the glands near the junction with the duct.

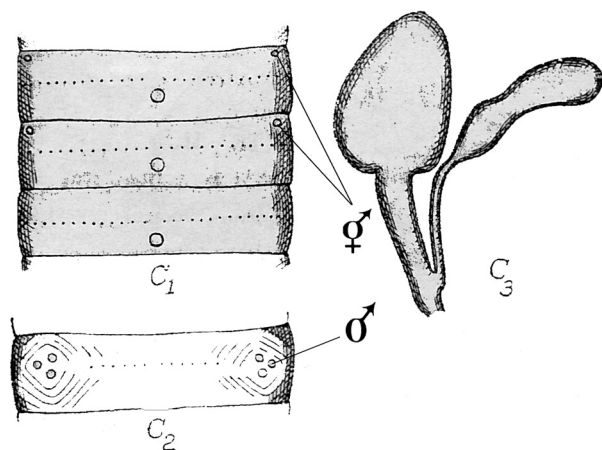
*Spermathecae.* Two pairs in 6 and 7 with long slender duct widening to sub-spherical (or flattened) ampulla, ectally a single diverticulum branches with a thin stalk and dilated bulb which is either elongate or lobular. The curved diverticula do not reach to the apices of the ampullae. Iridescence was generally not seen in the bulbs of the diverticula although some stalks possibly had an internal sheen; the ampullae were often filled with clear coagulum. In one specimen the spermathecae were noticeably heteromorphic: the ampullae of the anterior pair were flattened with small, bulbous (iridescent) diverticula on short stalks, whereas the posterior pair had larger, elongate diverticular bulbs filled with an opaque coagulum.

*Behaviour.* Two specimens (one with 135 segments) had autotomy of posteriors. Much ejected mucus adhered to dorsum in several specimens (see note below). Vigorous lashing escape response on being handled.

*Gut contents.* Fine soil and few pieces of organic debris suggesting a geophagous diet but possibly selective.

*Etymology.* From Latin *talus* for dice, after the GMs looking like dots on face of a dice.

*Notes.* Pharyngeal mass extends back to 5/6 obscuring the nephridial form. Internally, small, squat glands were associated with the genital markings, which were not clearly stalked but rather flattened to the body wall and were invested in a coagulum of sticky mucus. Mucus was also ejected onto the dorsal surface of several of the specimens and may be a natural defence against predators or desiccation, here activated by preservation. In the coelomic cavity the mucus may be a defence against parasites, e.g. Gates (1972: 203) reports spores and nematode eggs being discharged in coagulum through the most anterior dorsal pores in specimens he identified with *A. morrisoni*.



**Figure 8c.** *Amynthus tripunctus* (Chen, 1946) showing spermathecal and male fields and a spermatheca after Chen's original (the spermathecal pores are in segments 6 & 7 anteriorly thus strictly complying with *A. canaliculatus* spp. group of Sims & Easton, 1972). Note the similarity of male field to that of Sims & Easton's (1972: figs. 1 A)

*Remarks.* Queensland specimens described here comply with the *Amynthus morrisi* species-group of Sims & Easton (1972) for which *A. morrisi*, as diagnosed above, is the representative species. Considerable variation in the distributions of genital markings appears permissible within this species-complex, however, the current specimens are somewhat unusual in having more than 100 segments, closely paired mid-ventral anterior markings but with male field markings lateral of the male pores, plus a typhlosole that is well developed rather than rudimentary (*cf.* Gates' descriptions). It is therefore possible that they more closely resemble some other of the 30–40 nominal taxa within the *A. morrisi*-spp. group but no exact match has been found as yet from searches of the literature after twenty years.

I rejected the following possibilities of about 20 candidates, in order of priority: *morrisi* Beddard, 1892; *insulae* Beddard, 1896, *lalangi* or *silvestris* both by Michaelsen, 1923; *choeinus* Michaelsen, 1927; *incongruus* Chen, 1933; *alutus* Chen, 1936, *hainanicus*, *puerilis*, *sinuosus*, all by Chen, 1938; *gravis* or *sapinianus* Chen, 1946; *loveridgei* Gates, 1968; *nanulus* Chen & Yang, 1975 (only 51 mm long); *parvus* Chen & Zhifang; either of *A. campanoporophoratus* (Thai, 1982)

and *A. plantopapillatus* (Thai, 1982), or one of Hong & James', 2001: *draconis*, *naejangensis*, *piagolensis*, *taebaekensis*. But these should all now be compared with the revised version of *A. morrisi*, *A. pallidus* and some quadrithecal synonyms of *A. gracilis*.

A species that perhaps comes closest to the current is *Amynthus instabilis* Qiu & Jiang, 2014 just published in Jiang *et al.* (2014: 3, fig. 1) from Hainan and Guangdong, itself compared to parthenogenetic *A. incongruus* (Chen, 1933) from Taiwan and China and possibly to *A. tripunctus* (Chen, 1946) from China. It is similar in having only a few setae (0–2 stated, 0–3 figured) between the male pores but lacks the mid-ventral markings there (although it too has paired markings lateral to the male pores, in their holotype at least). Its spermathecal pores are each preceded by a small papilla, plus a postsetal papilla is mid-ventral in 6 and a presetal pair is mid-ventral in 7. This comparison also serves to indicate likely region of origin for *A. talus* in Hainan and/or Guangdong, China.

#### *Amynthus tokioensis* (Beddard, 1892)

*Perichaeta tokioensis* Beddard, 1892d: 762. [Published December, 1892 according to Michaelsen (1900: 272)]. [From Japan (probably Tokyo as in "tokioensis"). Lectotype in British Museum: BMNH: 1904.10.5.166 inspected and designated by Sims & Easton (1972: 181, 191) and re-inspected and re-figured by RJB when on loan to YNU in October, 2004 and again in NHM, London in June, 2013; the specimen was 65 mm long with 67 segments but looks like a posterior amputee as the last segment has setae and is blunt rather than tapering. It is brownish-grey in preservative and the clitellum is darker. The specimen had been dissected by Beddard and was slightly damaged: spermathecae in 8 were removed, only one remained in the jar that I put in a calcium vial along with a detached diverticulum, also the glands from 7rhs looked to have been removed, as was 18lhs prostate. The three labels inconsistently state:

"*Perichaeta tokioensis*";  
 "*Pheretima tokioensis* (Bedd.) 1892 1904:10.5.166 Loc? Coll Beddard";  
 "*Perichaeta tokioensis* Beddard, TYPE 1974.1.172 Loc. Japan Col. Mr Masataka Rokugo Ref. Zool. Jahrb. Syst. v6 p. 762"]

*Notes.* The same person collected Beddard's *P. masatakae* and *P. rokugo* (see *M. hilgendorfi*), perhaps also from Tokyo. As re-described by Blakemore (2010: fig. 2), nothing in the description of Korean *Amyntas sonjaesiki* Hong & James, 2009 separates this from prior *A. tokioensis*.

Genus *Duplodicodrilus* Blakemore, 2008

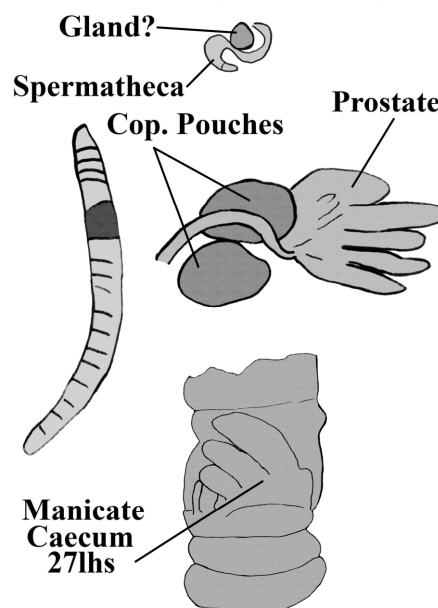
*Duplodicodrilus schmardae schmardae* (Horst, 1883)

(Figure 9)

*Megascolex schmardae* Horst, 1883: 194. [From "Japan". Syntypes in Leiden: 1818 (inspected by Sims & Easton 1972: 181 and 191 where the multiple = manicate condition of caeca was noted since Horst omitted its mention); types also (erroneously?) reported as in Vienna: 3970 by Reynolds & Cook (1976)]. [Non *Megascolex schmardae* Michaelsen, 1897. Since these taxa have not been considered congeneric after 1899, e.g. Michaelsen (1900) had them in separate genera, a replacement name is not required and prevailing usage is maintained (ICZN, 1999: Art. 23.9.5)].

*Perichaeta trityphla* Beddard, 1896: 205, [From Barbados. Types actually BMNH 1904.10.5:69 (listed as BMNH:1904.10.5.169) with labels: "*Metaphire schmardae* (Horst, 1883)"; "*Perichaeta trityphla* Beddard 1896 TYPE": "1904:10:5:69 Loc: BARBADOS W.I. REF:- BEDDARD 1896 PROC. ZOOL. SOC. LOND. 1886: 205"; "..... *trityphla* [crossed out] *schmardae* Type ...arbados" faded; and "*Perichaeta trityphla* Barbados". Jar contains a dark and brittle specimen about 35 mm long that had been dissected previously with several organs removed and floating in the jar; also included was the intestinal caecal section of another specimen]. [Note, name misspelt "trityphia" e.g. Sims & Easton (1972: 246), or "triphyla"].

*Remarks.* This species is included only to confirm that *trityphla* is a junior synonym of *schmardae* since the specimen had the copulatory pouches fore and aft of the prostatic duct internally and the intestinal caeca were clearly manicate. For some reason, this taxon is often mutually confused with *Metaphire californica* that lacks both structures.



**Figure 9.** *Duplodicodrilus schmardae* (Horst, 1883) sketch of type of *P. trityphla* Beddard, 1886 synonym showing outline of whole body, a spermatheca loosely attached in 7 or 8, 18rhs prostate with swollen copulatory pouches either side and manicate caeca around intestine from segment 27.

Genus *Metaphire* Sims & Easton, 1972

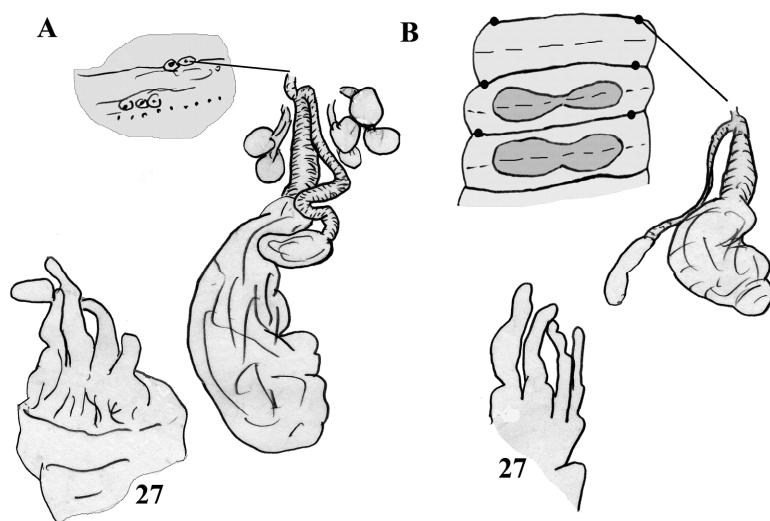
*Metaphire hilgendorfi* (Michaelsen, 1892)

(Figure 10)

*Perichaeta Hilgendorfi* Michaelsen, 1892: 235, fig. 15. [Published in September, 1892 therefore has priority over Beddard's December, 1892 *P. rokugo* and *P. tokioensis*]. [From 'Japan' (Hakodate, Yokohama and possibly another locality). Types of five specimens of the original seven specimens (i.e., two missing) in Zoological Museum, Berlin. In NHM, London are Hamburg Museum specimens marked with red tape to indicate type material (none of which are the two of five types missing from Berlin):

1. Sample V.314 labelled "*O. Meg V314 Pheretima Hilgendorfi Mich. Hilgendorf Japan*" comprises one previously dissected specimen with its intestines loose in jar; it lacks male pores and only has a spermathecal pore in 6/7rhs and GMs on 7lhs and 7rhs. This is here sketched, agreeing with *Amyntas vittatus* (Goto & Hatai, 1898).
2. Sample V.315 labelled "*O. Meg V315 Pheretima Hilgendorfi Mich. Hilgendorf Japan*" comprises





**Figure 10.** *Metaphire hilgendorfi* (Michaelsen, 1892) specimen V315 agreed; A = V314 specimen, actually *A. vittatus* as for V8505; B = V4008 specimens, actually *A. agrestis*.

one macerated, undissected mature; it lacks male pores and has spermathecal pores in 6/7/8 and GMs mid-ventrally on 8. This agrees with *Metaphire hilgendorfi* (Michaelsen, 1892).

- Sample V.4008 labelled “*O. Meg. V.4008 Pheretima Hilgendorfi Mich 2 XII [18]95 Linz Nakahama*” comprises four specimens two previously dissected one of which is sketched here, that all agree with *Amyntas agrestis* (Goto & Hatai, 1899) as figured by Blakemore (2010: fig. 3lhs, that of fig. 3rhs may be a different species as the caeca differ) and see also Blakemore (2013a: fig. 1).
- Sample V.8508 labelled “*O. Meg V8508 Pheretima Hilgendorfi Mich. Vega Exp. Japan Fujiyama*” comprises one previously dissected mature with its intestines loose in jar; it lacks male pores and only has a spermathecal pores in 6/7/8lhs and GMs 7lhs and 7rhs. This also agrees with *Amyntas vittatus* (Goto & Hatai, 1898).

*Perichaeta rokugo* Beddard, 1892d: 756, tab. 32, figs. 1–7 (published in December, 1892). [From “Japan” collected by Mr Masataka Rokugo, stated types BMNH 1904:10.5.144–145, actually apparently now also recatalogued as BMNH 1974.1.166–167 “1904:10:5 144/145 *Perichaeta rokugo* Beddard, 1892 Loc: Japan Coll: Mr Masataka Rokugo Ref. Zool Jahrb. Syst V6 p756” inspected by RJB 2010 and again in 2013 – three previously dissected specimens that are a composite of two species – one is

indeed *M. hilgendorfi* with GMs mid-ventral on 8, and two that have rows of two-three markings paired on 7 as found in *A. vittatus* (Goto & Hatai, 1898)].

Notes. Revision is by Blakemore (2003, 2010, 2012b, 2012c: fig. 3 of “*M. glandularis*” = *M. hilgendorfi*, 2013a: fig. 6), but full re-description based on types is yet in progress.

***Metaphire sandvicensis* (Beddard, 1896)  
*sp. incerti sedis.***

*Perichaeta sandvicensis* Beddard, 1896: 203. [From Lanai, 2000 ft; Mauna Loa, Hawaii, Molokai and from Hong Kong. Type material NHM 1904:10:5: 87–88 labelled: “1904:10:5:87-88 *Perichaeta sandvicensis* Bedd. 1996 ?SYNTYPES Lanai, Mauna Loa, olokai Ref P.Z.S. 1896: 194–211”; “*Perichaeta lanaiensis* (Lanai) cliff on Mauna Loa, Hawaii” – in Beddard’s hand; plus a note from Ed Easton dated 4/2/1974 that this latter is a probable MS name and that the “specimen” (sic) is *M. californica* whereas it actually contains two specimens. Both are dissected, with spermathecal pores in 7/8/9 no GMs and male pores everted or inverted in a small copulatory pouch, with simple intestinal caeca. This pers. obs. RJB June, 2013].

Note. The conclusion is possibly *M. javanica* but most likely *M. californica* Q.E.D.

Genus *Perionychella* Michaelsen, 1907

*Notes.* Type of genus is *Perichaeta dendyi* Spencer, 1893 from Victoria, Australia.

Taxonomic ‘housekeeping’ of recently described *Terrisswalkerius leichhardti* Jamieson, McDonald *et* James, 2013 with tubuloracemose prostates like in the type-species of that genus (viz. *Perichaeta canaliculata* Fletcher, 1887) requires it too to comply with *Perionychella* under ICZN (1999) Principle of Priority, as was clearly explained by Blakemore (2000: 292) and by Michaelsen (1907: 163) when he included *P. canaliculata* in his genus *Perionychella*. Some other taxa mistakenly placed in the congeries named *Terrisswalkerius* with actual tubular prostates belong in prior *Diporochoeta* Beddard, 1890 or in *Reflechtodrilus* Blakemore, 2005.

The description of *P. leichhardti* is confused as the key gives the spermathecae in 5/6/7 in *cd* lines, whereas the text has them in 5/6/7 in *f* lines or “opening anteriorly in VI and VII” (i.e., 6 & 7), whereas the sketch figure twice shows them in segments VII and VIII (i.e., 7 & 8). Moreover, the tubuloracemose prostates are misconstrued as “elongate racemose” contradicting the earlier stated generic diagnosis of “tubular or tubuloracemose prostates” that is of itself clearly unacceptable in a single genus.

Blakemore (2011b: 42–43, 2012a: 122) already remarks on oversights and shortcomings in recent cladograms by non-specialists from New Zealand cited in Jamieson *et al.*’s (2013) Queensland paper that there should be no need to repeat here save to remind that the types of neither the prior *Diporochoeta* nor *Perionychella* have yet been tested genetically thus there is no definitive conclusion as those authors imply (especially since several claimed taxa are clearly misidentifications as already explained).

Genus *Tokea* Benham, 1904 (1905?)

*Tokea* Benham, 1904: 240; Lee 1952: 26; 1959: 259, 284; Blakemore 2012a: 120.

*Remarks.* Of the N.Z. genus, Benham (1904: 284) said: “The genus *Tokea* (from the Maori *toke*, an earthworm) is very widely distributed over the North Island, as will be seen from the varied localities at which it has been collected from Ohaeawai at the north to Ruatahuna in the south-east portion of the island. It is probably the commonest earthworm in these parts, as two species occur in and around Auckland, three species at Ruatahuna, and from the majority of the other localities no other genus has been received. It is, so far, unknown in the South Island”. Its history and reasons for revival is described by Blakemore (2012a) who, after Lee (1959: 284), confirmed type fixation as *T. esculenta* Benham, 1904.

It should be here re-emphasized that the state of the prostates is key for morphological placement for all megascolecids (Blakemore, 2013d), as eruditely determined by Benham (1904: 262, 1941: 30), Michaelsen (1907: 160, 1916) and Stevenson (1923: 316). The “tongue-shaped” tubular form in *Tokea* has been discussed by Benham (1904, 1941) and Lee (1952: 26; 1959: 259) – as noted by Blakemore (2012a: 121) – and in greater detail with clarity of purpose by Michaelsen (1916: 48) from his inspection of the type specimen of *T. esculenta* and several other species such as *Tokea? orthostichon* as noted in the description of this latter taxon below.

The conclusion is building that Michaelsen was once again correct and that those prostates with small but generally unbranched offshoot ‘canalicules’ (or lacunae. later termed “mere evaginations” by Benham 1941: 31) are a derivation from the strictly tubular form as found in Ocneroдрilidae, Acanthodrilidae, Octochaetidae and ‘primitive’ members of the Megascolecidae such as *Plutellus* Perrier, 1873 *s. stricto*. Thus the prostates in *Tokea* may indeed be classed as first-stage, non-tubular derivatives as per Blakemore (2000a, b) – here termed ‘quasi-tubular’ (although ‘tubulo-lingual’ better defers to Benham’s classification) – and this again raises the possibility that the currently cohesive genus *Tokea* may merge with *Aporodrilus* Blakemore, 2000 that, nevertheless, is maintained on its more definitive tubulo-

racemose prostates as found in its Tasmanian type and most congeners there. This does not preclude the reallocation of the four New Zealand species currently placed in *Aporodrilus* to *Tokea* – in fact *Tokea equestris* (Benham, 1942), *T. aotea* (Blakemore, 2011) and *T. ponga* (Blakemore, 2011) **combs. novae** certainly comply leaving only *A. mortenseni* (Michaelsen, 1924) with more clearly tubuloracemose prostates remaining as a New Zealander *Aporodrilus*. Neither does *Tokea* require absorption with prior *Notoscolex* that has more definitive tubuloracemose to racemose prostates and typically retains dorsal pores in its members. It is still indeterminate which genus *Notoscolex napierensis* (Benham, 1941) belongs in, nor whether it is a NZ native. As noted by Michaelsen (1916: 54), only exotics in NZ have truly racemose prostates.

From reappraisal of *Tokea maorica* Benham, 1904 below, it appears the definition of the genus should be further amended from its having quasi-tubular prostates, to further allow dorsal pores sometimes present but in the segments posterior to the clitellum. Thus *Tokea reptans* (Ude, 1905) **comb. nov.** is now reallocated since it is described with “*Rückenporus vorhanden...Rückenporen sind als sehr kleine Öffnungen hinter dem Gürtel sichtbar*” (dorsal pores present behind clitellum) and ditto *Tokea unipapillata* (Ude, 1905: 426, fig. 4) **comb. nov.** which has “*Rückenporen habe ich hinter dem Gürtel erkannt*”. Then too *Tokea neglecta* (Congnetti, 1909: 327) **comb. nov.** is reallocated since it is described with “*pori dorsali irrecognoscibile*”, and also *Tokea fusca* (Lee, 1952: 32) **comb. nov.** should now likely be transferred since it is described with dorsal pores in every intersegmental groove posterior to the clitellum (*i.e.*, >18/19).

The only five N.Z. taxa now provisionally remaining in *Megascolides* are: *M.?* *albus* Lee, 1952: 35, *M.?* *irregularis* Lee, 1959: 299, *M.?* *raglani* Lee, 1952: 306, *M.?* *ruber* Lee, 1952: 28 [held as *Tokea?* *ruber* (*sic laps. pro T? rubra* by Blakemore, 2012a: 131)] and *M.?* *rubicundus* Lee, 1959: 309, for which the presence or absence of

their dorsal pores were not noted. Should their prostate glands also prove quasi-tubular, then there should be little reason to retain these latter species in that genus.

### *Tokea kirki* Benham, 1904

(Figure 11)

*Tokea kirki* Benham, 1904: 251. [From Ohaeawai in North Auckland. Five Otago syntypes (A.02.137), collected by Professor H.B. Kirk, re-examined by Lee, 1959: 301]; Benham 1905: 283; Blakemore 2012a: 131.

*Megascolides kirki*: Michaelsen 1907: 2.

*Notoscolex kirki*: Michaelsen 1916; Blakemore 2004; 2010; 2011.

*Megascolides kirki*: Lee 1952: 26; 1959: 301, fig. 312.

**Diagnosis.** Reddish. 80–100 by 6 mm with 110 segments. Spermathecae in 7/8/9. No GMs. Clitellum 13–17 saddle-shaped. Tanylobous. Setae evenly spaced. Gizzard in 5, oesophageal glands in 14. Last hearts in 12. Meroic. Holandric, seminal vesicles in 11 & 12 (*cf.* *T. morica* and *T.?* *orthostichon*). Prostates “*tubular*” (quasi-tubular?). Spermatheca with neither distinct nor muscular duct has small diverticulum (see fig.).

**Distribution.** Ohaeawai, near Kaikohe, NZ.

**Remarks.** This species is included to differentiate it from *T. maorica* next below.

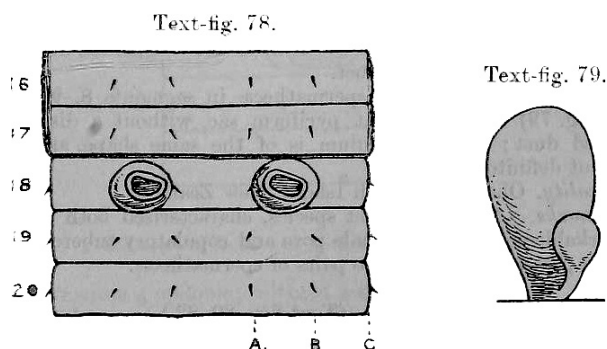


Figure 11. *Tokea kirki* Benham, 1904 from Benham's original text-figs. 78–79.

***Tokea maorica* Benham, 1904**

(Figure 12)

*Tokea maorica* Benham, 1904: 252, text-figs. 80–82. [From “neighbourhood of Auckland” in Waitakerei Bush and Nikau Palm Bush. Eight Otago syntypes (now A.04.97 two specimens according to Lee, 1959: 302), collected by Mr H. Suter, plus specimens “from the sheaths of nikau and *Astelia* leaves, Auckland (C. Cooper)” Benham 1906a: 241]; Benham 1906a: 240, figs. 1, 8–9 (part?).

*Tokea decipiens* Benham, 1906a: 241, fig. 2. [From Waitakerei Bush near Auckland (H. Suter) “some half-dozen specimens” apparently from the original eight Otago syntypes. One at least sent to Hamburg and inspected by Michaelsen (1916: 50)].

*Notoscolex decipiens*: Michaelsen 1916: 50.

*Megascolides maorica*: Lee 1952: 26 (syn. *decipiens*).

*Megascolides maoricus*: Lee 1959: 301, fig. 312 (syn. *decipiens*); Blakemore 2012a: 131.

*Notoscolex maorica*: Blakemore 2004; 2010; 2011 (syn. *decipiens*).

*Megascolides orthostichon*: (laps.) Lee 1962: 175, tab. (from inspection of same BM material as re-examined below).

*Material examined.* BMNH 1904.10.5:488–490 non-type specimens of unknown provenance from the British Museum ‘Beddard Collection’, (two clitellate matures, both having GM in 14 but one entire and one dissected along the dorsal mid-line (by Lee?), plus four aclitellate specimens, total six specimens, whereas Lee says five) labelled: “BMNH 1904.10.5 488–490 *Hypogaeon orthostichon* Schmarada, 1861 ?SYNTYPES Vienna Museum see Beddard Bibliog. ITEM 80”; “*Megascolides* [crossed out] *Megascolex orthostichon* - - - -9[8?]8 -0 [illegible]” (in Beddard’s hand?); “Current name is *Megascolides orthostichon* (Schmarada), 1861 (Idet. Dr K.E. Lee 1961)”. A small vial has Ken Lee’s label “*Megascolides orthostichon spermatheca*”.

*Notes.* Benham (1904) had eight original syntypes but Lee (1959) only found two remaining in Otago, and one syntype (by then was called *T. decipiens*) was sent to Michaelsen (1916: 50) in Hamburg (and returned?); hence there is a slight chance these six NHM specimens are missing syntypes. However, this is difficult to reconcile

with their registration date of “1904”. Cole (1981) says four Vienna specimens were inspected by Beddard (1892: 113–134) – this being referenced as “Bibliog. ITEM 80” in the sample jar’s label – that were probably *H. heterostichon* and, moreover, the number of current specimens (six of) contradicts this, plus it is more likely Beddard visited Vienna rather than just borrowed and, moreover, Beddard (1892) only saw one *H. orthostichon* type specimen in Vienna (as described under that species name below).

*Diagnosis.* [From Benham, Lee (in part) and pers. obs.]. Dark reddish-brown. From 25 x 2 to 75 x 4 mm with 75–90 segments (BM specimens are ca. 36 by 3.5 mm with 64–66 segments). Epilobic (Benham and pers. obs.) or tanylobic (Lee 1962). Setal ca. ab<cd<bc; bc=ab=aa; dd=2aa (Lee has slightly different ratios). Clitellum annular ½13,14–17. GMs as tumid central pads below female pores on 14 and around male pores on 18 with corresponding glandular mass internally (sometimes that on 14 missing in what was to be called “*decipiens*”). Spermathecal pores posterior in 7 & 8 (mistakenly said to be in 8 & 9 by both Benham initially and by Lee 1962). Dorsal pores absent from the anterior **are present**, “at least in the postclitellar region” (Benham, 1904: 254 but not noted by Lee nor found in these BM specimens). Last hearts in 12. Gizzard small distinct in 5; oesophageal glands absent (Benham 1906a) or in 13 (Lee 1962); intestine from 16. Meroic. Holandric (testis 10 & 11); seminal vesicles in 9 & 12 from generic definition (Benham 1904: 240) but in 9–12 in present dissected specimen (pers. obs. but cf. 11 & 12 by Lee 1962: 176). Prostates flattened, quasi-tubular reaching to segment 25rhs (pers. obs.). Spermathecae each with small pyriform diverticulum on broad duct in types (or narrower in BM specimens – see Figs.).

*Distribution.* Benham and Lee provide distribution around Auckland and nearby islands.

*Remarks.* It is unclear why Lee (1962) missed the overwhelming evidence of the London non-types, as re-examined here, being *Tokea maorica* in favour of what was then *N. orthostichon*.

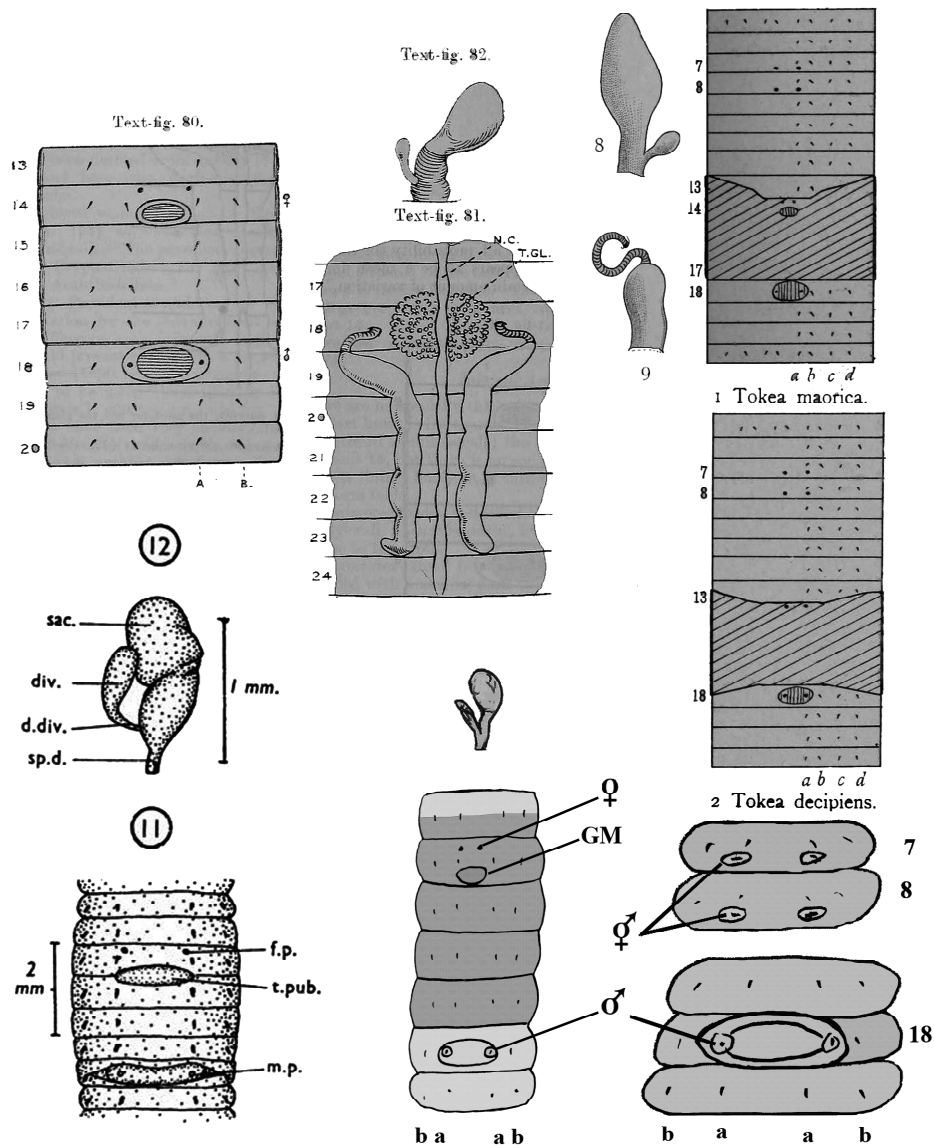


Figure 12. *Tokeia maorica* from Benham's originals (1904: figs. 80–82; 1906a, figs. 1–2, 8–9) and Lee's subsequent (1962: figs. 11–12 mislabelled as "*M. orthostichon*") plus on bottom rhs sketches of two of the same NHM specimens (that on lhs previously dissected that on rhs acitellate and lacking marking in 14) and both having spermathecal pores posteriorly in segments 7 & 8 (cf. Lee *laps.* in 8 & 9).

Possibly he was guided by the Museum labels by Beddard written at a time (1904) before the publication of Benham's species. Or perhaps because Lee's (1959) monograph omitted details of GMs and dorsal pores, the obvious compliance was lost. What is interesting is that the London specimens have some slight differences to the type description of *T. maorica*, however there is

insufficient evidence to attribute them to *T. orthostichon* for reasons given in the account of that taxon below.

This species is returned to *Tokeia* on the grounds that its overall similarity is with other member of the genus and, furthermore its (vestigial?) dorsal pores, although stated by Benham

to be at least postclitellar in the type, were not located in the present specimens that undoubtedly agree on most other points. Whereas *Tokea kirki* Benham, 1904 has intersegmental spermathecal pores in 7/8/9, *Tokea maorica* has them segmentally in posterior of 7 & 8, and **not** 8 & 9 as Benham originally stated and inadvertently retained by Lee (1959: 302). [This correction according to Benham (1906a: 240, pl XL, figs. 1–2, 8–9) or where Benham unconventionally records segments 7 & 8 as “7/8” and 8 & 9 as “8/9”]. Lee (1962: 176) apparently also erred in having spermathecal pores at anterior margins of 8 & 9 since my reinspection of the same BM specimens clearly locates them posteriorly in 7 & 8 (see Figs.).

*Tokea maorica* was originally described by Benham (1904), but then divided into two taxa by Benham (1906a: 240) who said in his first account the external features were for the smaller specimens (*maorica*) and the internal characters for larger specimens lacking the distinctive markings in 14 that he separated off as *decipiens*; both were recombined by Lee (1952; 1959) and put in genus *Megascolides* whereas Michaelsen (1916), on inspection of a type of *decipiens*, had it in *Notoscolex*. Lee (1962) was seemingly unconvinced of Michaelsen’s (1916) reallocation of *decipiens* to *Notoscolex* but this is where its senior synonym also then belonged, and both are now combined and returned to their original genus following Blakemore’s (2012a) restoration of *Tokea*.

***Tokea? orthostichon* (Schmarda, 1861)**

(Figure 13)

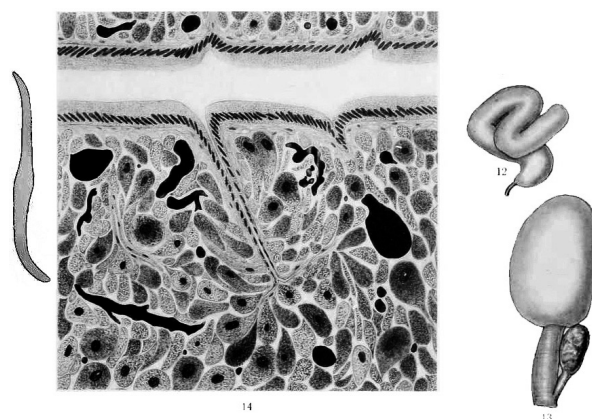
*Hypogaeon orthostichon* Schmarda, 1861a: 12, Pl. 18, fig. 159. [From Mt Wellington Auckland, not Tasmania (see Blakemore 2012a). Syntype in Vienna inspected by Beddard (1882) and later deemed lectotype by Beddard (1895: 495) who said “...I had only the type of SCHMARDA, which it was necessary to respect.” before its transfer to Hamburg as ZMUH 8615 where Michaelsen (1916) said it was by then poorly preserved].

*Megascolides orthostichon*: Beddard 1892a: 130; 1895: 496; Lee 1959: 349; (non Lee 1962: 175–176, figs. 11, 12 of non-types of a different species – see

below); Blakemore 2000: 261–263, fig. 105; 2010; 2011; 2012a: 121.

*Notoscolex orthostichon*: Michaelsen 1900: 189; Benham 1904: 255; 1916: 38–40, figs. 12–14.

*Other material*. None known. Coles (1981) reports: firstly, that Beddard (1892a) re-inspected Vienna Museum type specimens of *Hypogaeon orthostichon* [4 specimens (= syntypes?) but this probably a mistake for *Hypogaeon heterostichon*]; and secondly, that he found *Perichaeta vitiensis* Beddard, 1892 [= *Pheretima (Pheretima) montana* Kinberg, 1867] had a single specimen in the Vienna Museum mislabeled as “*Hypogaeon orthostichon* Schm. Viti Ins. [= Fiji].” Interestingly, this was the species described by Beddard (1892a: 131) immediately following his description of *M. orthostichon*, perhaps accounting for the mislabelling. Lee (1962) described several specimens in NHM, London as *Megascolides orthostichon* but this in error as noted above (under *T. maorica* description) and also below in current account.



**Figure 13.** *Tokea? orthostichon* after Schmarda’s original text-fig. magnification of a seta (far lhs) and Michaelsen’s (1916: vol. 52 No. 13, Tafel 1, figs. 12–14) of: 12 - the prostate (X12), 13 - a spermatheca (X25) and 14 - part of a horizontal section through a prostate gland in the plane of the central channel (X500) [cf. Benham’s (1941: figs. 9–11) of prostate sections of *T. esculenta* that are similar].

Original description (in full). “*Hypogaeon orthostichon*. Schmarda. Taf. XVIII Fig. 159. Char.: Corpus teretiusculum cingulatum. Segmenta 60. Octo series setarum paralellae. Der Körper ist drehrund. Der Kopflappen ist etwas zugespitzt. Der Gürtel beginnt hinter dem 13

Ringe. Seine Ringelung ist undeutlich; hinter ihm stehen 48 Ringe. Die Länge ist bis 80mm, grösste Breite 4mm. Die Farbe ist dunkelroth. Die Borsten stehen in 8 Reihen und sind rückwärts am deutlichsten. Der festsitzende Theil ist stärker gekrümmt und abgerundet, der freie Theil wenig hakenförmig gekrümmt, von der Mitte gegen das Ende allmählig verschmächtigt. Neu-Seeland, Mount Wellington in der Dammerde.”

**Diagnosis.** (From Schmarda, Beddard, and Michaelsen). Dark red. Prostomium pointed. Dorsal pores? Length 80 (Schmarda, Michaelsen) or 180 (lapsus by Beddard) by 2.5–4 mm. Segments 65. Setae 8 in equidistant rows in the anterior, in the posterior Michaelsen gives ratio aa:ab:bc:cd:dd = 5:3:4:4:6. (Spermathecae in 7/8/9 or 7 & 8?). Clitellum annular  $\frac{1}{2}$ 13,14–17. Male pores on 18 on moderately roundish porophores in line with missing setae *a*. No GMs (but Michaelsen thought they may have rudiments posteriorly on 17). Gizzard in 5. Nephridia meroic but also with meganephridia in the last eleven segments (Michaelsen 1916). Seminal vesicles in 10–12 (Beddard). Ovaries in 13; ovisacs in 14. Prostates flattened quasi-tubular (described in detail by Michaelsen (1916) who found them with significant multiple and minute side branches to the lumen). No penial setae noted. Spermathecae two pairs in 8 & 9 each with a small, pyriform diverticulum (see Michaelsen’s figure).

**Distribution.** Only from Mt Wellington, N.Z., possibly extinct (Blakemore 2012a).

**Remarks.** For the male pores Michaelsen (1916: 39) said: “Die männlichen Poren liegen ungefähr (genau?) an Stelle der fehlenden Borsten am des 18 Segments auf je einem kleinen dunklen, von einem mässig breiten hellen Bande eingefassten Feldchen. Das männliche Geschlechtsfeldchen der rechten Seite ist fast kreisrund und nimmt ungefähr eine halbe Segmentlänge ein, das der linken Seite zeigt hinten einen schmalen Vorsprung und ist fast ohrförmig. Von akzessorischen Pubertätsorganen ist nichts zu erkennen; doch erscheint es mir fraglich, ob nicht etwa am ventralen Hinterrande des 17 Segments etwaige Papillen oder Grübchen gewesen und postmortal

zerstört sein mögen”. He thus indicates that the male pores are on separate dark and roundish porophores which are interconnected by a wide lighter band, and that GMs are absent nearby, which is perhaps a different configuration to the male field of the either of the two *Tokea* species described above with which it was compared (as noted below).

As noted by Benham (1904: 284) Schmarda’s worm may indeed belong in his genus *Tokea* Benham, 1904 since Michaelsen (1916: 39) described the fine branching details of the prostates being similar to those already noted by Lee (1952: 26) in *Tokea* as restored by Blakemore (2012a: 121) and wherein this species is also summarized. Also similar, but not unique, is the posterior meganephridia. Lee (1962) had apparently overlooked Michaelsen’s (1916) type redescription as he omitted citing this key paper.

The present uncertainty of *orthostichon* placement is due to the required reduction of dorsal pores in *Tokea* allowing default to *Megascolides* (if with tubular prostates) or less likely to *Notoscolex* (if tubuloracemose-racemose rather than current interpretation from Michaelsen as ‘quasi-tubular’). Its similarities were discussed by Benham (1904) and by Lee (1962: 176) who thought the non-type BM specimens he inspected resembled *Tokea kirki* Benham, 1904 (originally and currently in *Tokea* after Blakemore (2012a: appendix II). However, Lee’s non-type specimens as redescribed above are actually much closer to *Tokea maorica*.

The type of *Tokea? orthostichon* still requires confirmation and comparison with both *T. kirki* and *T. maorica* especially with regards nature of its spermathecal, male, and dorsal pores in order for its extinct status to be confirmed.

Family MONILIGASTRIDAE Claus, 1880

Genus ***Drawida* Michaelsen, 1900**

**Type-species.** *Moniligaster barwelli* Beddard, 1886 by original designation.

***Drawida barwelli* (Beddard, 1886)**

*Moniligaster barwelli* Beddard, 1886: 94, figs. 4–6. [Type locality “from the neighbourhood of” Manila, Luzon, P.I.; Gates (1937: 307) said the twenty acitellate syntypes were either dissected, sectioned or mounted between 1886–1891 and he questioned whether any were undispersed. Types in British Museum (BMNH 1904:10:5:522–3) were disputed by Easton (1984: 112) who re-described the species from new material after finding that the type series, that he labelled “(BMNH: 1904:10.5.2–3)”, comprised a posterior portion and an associated slide that produced no useful data (although DNA is retained?).]

**Material Examined.** In May, 2010 I received the BMNH types in Tokyo, apparently re-numbered 1974.1.101–102 and labelled: “*Moniligaster barwelli* TYPE 1974.1.101–102 Loc. Manila, Philippines Coll. Mr H[erbert]. E. Barwell Ref. Ann. Mag. Nat. Hist. 5 xvii p. 74” and “Beddard 1886 Manila, Phillipines [sic] Collector: H.E. Barwell” plus another note: “These fragments are far too large to be types of *M. barwelli* which is less than 40 mm long EGE[aston] April, 1981”. This material comprised one tail portion with the anterior end cleanly cut (length = 35mm, segments = 152) and one mid-portion that is cleanly cut at both ends (length = 30mm, segments = 198), both blackened and neither yielding useful information but small tissue samples were taken from each for COI barcoding (JET002-10 <http://www.boldsystems.org>) that was unsuccessful with current technology on such old material.

**Note.** This material was reinspected and details confirmed, they are yet possibly syntypes and were previously commented on by Blakemore & Kupriyanova (2010).

Family OCTOCHAETIDAE Michaelsen, 1900

**Type-species.** *Octochaetus multiporus* (Beddard, 1885: 813) from Dunedin, NZ.

**Note.** An unregistered old jar on the museum shelf has label “*Octochaetus multiporus* [Duplicates]” contains four immature specimens (syn-

types?) without any further information. Reynolds & Cook (1976: 142) have types BMNH 1904:10:5:877, other types are supposedly 1904:10:20:47–55, 58–60 and Hamburg 7314 (lost). Lee (1959: 116) was unsure the type was in London and gave registration only as “1904:10”.

**Dedications** – This paper is dedicated to two renowned Soil Ecologists: Dr Gregor W. Yeates (1944–2012) of Palmerston North, N.Z. who very kindly sent me a copy of Lee’s 1959 Earthworm book and also to Ken Lee (1927–2007) who himself passed down to me his copy of Michaelsen’s 1900 *Tierreich* given him by Sir W. B. Benham (1860–1950). These three gentleman scientists greatly inspired revisionary work on NZ earthworms.

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**Appendix I.**  
DNA (barcodes)

From ENA ([www.ebi.ac.uk/ena/data/search?query=amynthas%20morrisi](http://www.ebi.ac.uk/ena/data/search?query=amynthas%20morrisi)) and GenBank ([www.ncbi.nlm.nih.gov/genbank](http://www.ncbi.nlm.nih.gov/genbank)).

1). “Four new earthworm species of the genus *Amyntas* Kinberg (*Oligochaeta: Megascolecidae*) from Hainan and Guangdong Provinces, China” Jiang J., Sun J., Zhao Q., Qiu J. (2014) |KF021247.1 *Amyntas morrisi* voucher Sichuan, China SC201006-03 cytochrome c oxidase subunit I (COI) gene, partial cds; mitochondrial. : Location: 1..700

2). Shen (2012) “Three new earthworms of the genus *Amyntas* (*Megascolecidae: Oligochaeta*) from eastern Taiwan with redescription of *Amyntas hongyehensis* Tsai and Shen, 2010.” J. Nat. Hist. 46: 2259–2283; JX290441-5 eg. |JX290441.1 *Amyntas morrisi* voucher mor1 cytochrome c oxidase subunit I (COI) gene, partial cds;mitochondrial. Location: 1...658

3). “Molecular phylogeny and systematics of Japanese pheretimoid earthworms (*Oligochaeta: Megascolecidae*).” Minamiya et al. Submitted (JAN-2010) AB542516-8 from Okinawa eg: AB542516.1 *Amyntas morrisi* mitochondrial COI gene for cytochrome oxidase subunit 1, partial cds, isolate: Amor-1242. Location: 1...637

4). Huang, et al. (2007) “Identifying earthworms through DNA barcodes.” Pedobiologia 51: 301–309: |EF077578 – EF077590 *Amyntas morrisi* voucher 06-252 from China cytochrome c oxidase subunit I (COI) gene, partial cds; mitochondrial. : Location: 1...602

5). >HY14|*Amyntas gracilis* - Jeju1 from Blakemore *et al.* 2014 (in press).

GAGCAGGAATAAGACTACTTATTCGAATTGAGCTCAGACAGCCGGGATCGTTTCTGGGAAGAGATCAAT  
TATATAATAACAATTGTAACAGCTCATGCATTTCGTAATAATTTTCTTTCTAGTAATACCAGTATTCATTGGTG  
GATTTGGAAACTGACTACTACCTCTAATGCTGGGTACACCAGACATAGCATTTCCGCGGCTTAATAATATA  
AGATTTTGGCTACTCCCCCGTCACTTATCTTACTAGTAAGATCCGCGGCCGTTGAAAAGGGGGCGGGA  
ACTGGATGGACAGTATATCCCCGCTGGCAAGAAATATTGCACATGCTGGTCCATCAGTAGATCTAGCAA  
TCTTCTCACTACACTTAGCAGGGGCATCATCTATTCTTGGGGCCATTAACTTTATTACAACCTGTAATTAAT  
ATGCGATGATCTGGATTACGGCTAGAGCGAATCCCCCTATTTGTATGGGCCGTAGTAATTAAGTGTAGT  
ACTTCTACTATTATCTCTACCTGTACTAGCCGGAGCTATTACTATACTATTAACAGATCGAAACCTTA  
ACACATCATTCTTTGATCCCGCTGGAGGTGGAGACCCTATTCTATATCAACACCTATTT

**Blast result:** *Amyntas gracilis* (AB542489.1 & 542491.1 from Japan), 100%.

July, 2013 **BLASTn** and **megaBLAST** ([www.ncbi.nlm.nih.gov/BLAST/](http://www.ncbi.nlm.nih.gov/BLAST/)) comparisons; Max Identities:

	1	2	4
1, KF021247	–		
2	601/658 (91%)		
3a, AB542516	636/637 (99%)		
3b, AB542517	580/637 (91%)		
3c, AB542518	580/637 (91%)		
4, EF077579	601/602 (99%)		
5	520/614 (85%)	525/614 (86%)	85%

I.e., both “*morrisi*” haplotypes different to *A. gracilis*.

It appears that genetic data differ so at least some (if not all) identifications must be incorrect for *A. morrisi* thus it is beholden on Chinese/Taiwan and Japanese workers to confirm their species and/or vouchers against the types.