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On Opening a Box of Worms (Oligochaeta, Megascolecidae) — Historical Earthworm Specimens Transferred to Tokyo from the Saito Ho-on Kai Museum of Natural History in Sendai

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Abstract A box discovered at the National Museum of Nature and Science, Tokyo held historical specimens from Saito Ho-on Kai Museum dating from 1920–1930s coincident with author Dr. Shinkishi Hatai's tenure and likely identified by him or his assistant, Mr. Shinryo Ohfuchi. A syntype is newly recognized for *Amynthas maculosus* (Hatai, 1930) comb. nov., no others could be unequivocally proven so. However, several are candidates for neotypification under current ICZN (1999) rules as a first step to resolving zoological complexities of parthenogenesis and of taxonomic confusion persisting for >112 years. Neotypes are explicitly designated herein for *Amynthas vittatus* (Goto and Hatai, 1898), *Duplodicodrilus acinctus* (Goto and Hatai, 1899) new combination (synonym *yezoensis* Kobayashi, 1938), and for topotypes of *Amynthas*? *yunoshimensis* (Hatai, 1930) itself a probable synonym of *Metaphire hilgendorfi* (Michaelsen, 1892), and of *M. yamadai* (Hatai, 1930) that is retained separately from *M. soulensis* (Kobayashi, 1938). *Metaphire soulensis* synonyms (*shinkeiensis* Kobayashi, 1938 and *aokii* Ishizuka, 1999) are re-stated. Details are presented of two recently unearthed syntypes at the University of Tokyo Museum (UMUTZ), viz. *Metaphire communissima* (Goto and Hatai, 1899) herein designated the lectotype, and *Amynthas levis* (Goto and Hatai, 1899) itself a probable synonym of *A. tokioensis* (Beddard, 1892). Neotypification is flagged both of *Amynthas micronarius* (Goto and Hatai, 1898), and of *Amynthas carnosus* (Goto and Hatai, 1899) that is now separated from other synonyms of the *A. corticis* (Kinberg, 1867) species-complex. *Metaphire hilgendorfi* (Michaelsen, 1892) is confirmed in its proper genus based on material labelled "*Ph. glandularis*." Unfortunately, mtDNA COI gene barcoding failed to provide conclusive results on these older, formol-fixed samples.

Key words : neotypes, syntypes, natives, invertebrate biodiversity, taxonomic history.

Introduction

While no *Pheretima* Kinberg, 1867 sensu stricto are known from Japan (Sims and Easton, 1972; Easton, 1981; Blakemore, 2003a, b), the first scientifically named Japanese pheretimoids, i.e., *Pheretima* auct. species now in various genera, are shown in chronological order in Table 1.

Thus only about ten Japanese species were reported when Prof. Seitaro Goto (1867–1928) and his Assistant Shinkishi Hatai (1876–1963) working from the First High School near Ueno in Tokyo that was to become integrated as the Komaba campus of University of Tokyo in later years, purported to describe "new or imperfectly known species of earthworms collected from various parts of the Japanese Empire" (Goto and Hatai, 1898, 1899). The first publication was "Printed September 30th, 1898." Both publications were flawed. Naming 28 "new" species, their descriptions were so inadequate and/or confused that most soon went directly into synonymy or *incertae sedis* in Michaelsen (1899) and in his classical review in Das Tierreich

Table 1. Original and current names of earliest Japanese pheretimoid species.

No.	Original name	Current combination/synonym
1	**Megascolex sieboldi* Horst, 1883	*Metaphire sieboldi* (Horst, 1883)
2	**Megascolex japonicus* Horst, 1883	*Amynthas japonicus* (Horst, 1883)
3	*Megascolex schmardae* Horst, 1883	*Duplodicodrilus schmardae* (Horst, 1883)
4	**Perichaeta ijimae* Rosa, 1891	*Amynthas corticis* (Kinberg, 1867)
5	*Perichaeta hilgendorfi* Michaelsen, 1892	*Metaphire hilgendorfi* (Michaelsen, 1892)
6	*Perichaeta divergens* Michaelsen, 1892	*Amynthas corticis* (Kinberg, 1867)
7	*Perichaeta rokugo* Beddard, 1892	*Metaphire hilgendorfi* (Michaelsen, 1892)
8	*Perichaeta nipponica* Beddard, 1892	*Amynthas corticis* (Kinberg, 1867)
9	*Perichaeta masatakae* Beddard, 1892	*Amynthas robustus* (Perrier, 1872)?
10	*Perichaeta tokioënsis* Beddard, 1893	*Amynthas tokioensis* (Beddard, 1893)

* The only three species that Goto and Hatai (1899: 23) later claimed not to have seen.

(Michaelsen, 1900) and where many remain today or, at best, as *species inquirendae* in Michaelsen (1903: 85) (Table 2).

Prof. Goto made no further offerings and the next earthworm publication was 25 years later by Hatai (1924) now in Sendai. In a subsequent footnote, Hatai (1929: 271) remarked that he had collaborated (as assistant but designator of "new" species) with Prof. Goto more than 25 years previously, but that this work was discontinued (around 1900) owing to change of his residency to the USA as a student at Chicago and Professor in Philadelphia. Hatai (1929) said he returned permanently to Japan five years earlier (ca. 1923) and for three years preceding publication his collection locations were (at least): Yunoshima Island; Kominato, Aomori; Sendai, Miyagi; Uwajima, Ehime (Shikoku); Oshima Island (Tokyo); Kirishima yama and Sakurajima, Kagoshima. Hatai (1929: 274) used formalin to preserve specimens which, although common, is perhaps relevant to specimens examined herein that have this poisonous odour.

In a later paper, unapologetically justifying his initial mis-diagnosis of *Metaphire sieboldi* (Horst, 1883), Hatai (1931a) remarked that Goto and Hatai's collections were limited to the central part of Japan (and Taiwan, then part of a Japanese Empire) and to "gardens, refuge piles, pastures etc." rather than mountain passes. Hatai (1931a: 401) also hoped to "straighten up most of the confusions" he claimed were caused by European writers. Nevertheless, his later papers often described yet more junior synonyms and failed to accept nor correct his many earlier errors. Just one of several examples is *Perichaeta vesiculata* Goto and Hatai, 1899 (with its spermathecal pores likely miscounted, as with several other of his species) along with *Pheretima kikuchii* Hatai and Ohfuchi, 1936 both being ostensible synonyms of prior *Duplodicodrilus schmardae* (Horst, 1883). This perhaps relevant as Tube #4 specimen in the current collection labeled "*Ph. schmardae*" is a misidentification of *Metaphire californica* (Kinberg, 1867). Ironically, it seems Dr. Hatai retired to Kamakura where many of his "species" were from.

Mr. Shinryo Ohfuchi was Hatai's student and co-author, both working in the Zoological Department of the Saito Ho-on Kai Museum in Sendai, established from a charitable trust (The Saito Gratitude Foundation) which funded collection trips (*e.g.*, Hatai, 1930) some time before the Museum opened. Later Hatai became director of that Museum (possibly partly on the "strength" of his taxonomic work) as he continued to publish on earthworms in the Museum journal. Simultaneously, Hatai became a professor at the Biological Institute of Tohoku Imperial University in Sendai where it appears Ohfuchi also worked since both authors gave both addresses in joint papers.

Regarding collection localities, Ohfuchi (1937: 32, 110) said "The materials upon which the present article is based, were collected from the six prefectures of Northeast Honshu, Japan,

Table 2. Most critical errors and mistakes in Goto and Hatai's earthworms, all initially in defunct genus *Perichaeta* Schmarda, 1861 now in *Amynthas* Kinberg, 1867, *Metaphire* Sims and Easton, 1972 or in *Dupodicodrilus* Blakemore, 2008; with notes on discovery of some syntypes now in UMUTZ.

No.	Genus	Species	Date: page	Error statement	Syntypes**	Actual situation and synonymy
1	*Metaphire*	*sieboldii*	1898: 65	Spermathecae in 5/6/7/8	—	6/7/8/9, see *Metaphire communissima*
2	*Amynthas*	*fuscatus*	1898: 66	*Spermathecae in 6–9 or in 5–7	Possibly	*Amynthas fuscatus* (Goto and Hatai, 1898)
3	*Amynthas*	*campestris*	1898: 67	*Spermathecae in 8 and 9 or in 6–8; dorsal pores in 13/14 or 12/13	Not found	*Amynthas robustus* (Perrier, 1872)?
4	*Amynthas*	*kamakurensis*	1898: 68	One specimen described from "Kamakura, Tokyo"	Not found	*Amynthas gracilis* (Kinberg, 1867)?
5	*Amynthas*	*parvulus*	1898: 68		?	*Amynthas gracilis* (Kinberg, 1867)
6	*Amynthas*	*heteropodus*	1898: 69	*Prostates absent (page 69) or present in Table 18	?	*Amynthas corticis* (Kinberg, 1867)
7	*Amynthas*	*obscurus*	1898: 70	Spermathecal pores shown as markings	?	?
8	*Amynthas*	*scholasticus*	1898: 70		?	*Amynthas corticis* (Kinberg, 1867)
9	*Amynthas*	*decimpapillatus*	1898: 71		?	*Amynthas gracilis* (Kinberg, 1867)?
10	*Amynthas*	*flavescens*	1898: 72		?	*Amynthas gracilis* (Kinberg, 1867)?
11	*Amynthas*	*productus*	1898: 73	Male pore presence or absence confused	?	*Amynthas gracilis* (Kinberg, 1867)?
12	*Amynthas*	*micronarius*	1898: 74	Male pores shown with 10 setae between but said to be only 8	Topotypes (?syntypes)	*Amynthas micronarius* (Goto and Hatai, 1898)
13	*Amynthas*	*vittatus*	1898: 74	Genital markings confused with spermathecal pores	Not found	*Amynthas vittatus* (Goto and Hatai, 1898)
14	*Amynthas*	*grossus*	1898: 75		Not found	*Aminthas fuscatus* (Goto and Hatai, 1898)
15	*Amynthas*	*schizoporus*	1898: 76	Genital glands confused with spermathecal diverticula	Not found	*Amynthas tokioensis* (Beddard, 1892)?
16	*Amynthas*	*takatorii*	1898: 76	Glands as spermathecae	Maybe	*Amynthas aspergillum* (Perrier, 1872)
17	*Amynthas*	*candidus*	1898: 77		Maybe	*Amynthas candidus* (Goto and Hatai, 1898)
18	*Amynthas*	*irregularis*	1899: 13	Setae confused as either 61, or 51 on 17	?	*Amynthas tokioensis* (Beddard, 1892)?
19	*Amynthas*	*iizukai*	1899: 14	No caeca	Missing	Simple caeca present; *Amynthas fuscatus* (Goto and Hatai, 1898)
20	*Amynthas*	*shimaensis*	1899: 15	Simple caeca present	Not found	*Amynthas fuscatus* (Goto and Hatai, 1898)?
21	*Amynthas*	*carnosus*	1899: 15	Spermathecae in 5/6/7/8 (i.e., in 6–8) or in 7–9	Not found	Spermathecae in 5/6/7/8/9 (i.e., in 6–9); *A. carnosus* (Goto and Hatai, 1899)
22	*Metaphire*	*acincta*	1899: 16	Clitellum absent	Not found	Clitellum present; *D. acinctus* (Goto and Hatai, 1899)
23	*Amynthas*	*agrestis*	1899: 17	Goto and Hatai (1899: 23) missed *A. agrestis* manicate caeca	Not found	*Amynthas agrestis* (Goto and Hatai, 1899)
24	*Amynthas*	*parvicystis*	1899: 18	Spermathecal pores and markings confused; Goto and Hatai (1899: 23) ambiguous on caeca	?	*Amynthas tokioensis* (Beddard, 1892) if manicate caeca, otherwise cf. *A. masatakae* (Beddard, 1892)
25	*Metaphire*	*glandularis*	1899: 18	Markings mid-7 (miscounted) and glands near spermathecal pores and male pores	?	Mid-8 and doubtfully glands near those pores; *M. hilgendorfi*?
26	*Amynthas*	*levis*	1899: 20	Papillae around spermathecal pores confused	Yes	*Amynthas tokioensis* (Beddard, 1892)?
27	*Metaphire*	*vesiculata*	1899: 21	Spermathecal pores in 6/7/8 ? but maybe a mistake (as for *Perichaeta parvicystis*)?	Not found	Probably synonym of *Duplodicodrilus schmardae* (Horst, 1883)
28	*Metaphire*	*megascolidioides*	1899: 21	Multiple intestinal caeca misdescribed	Not found	*Metaphire megascolidioides* (Goto and Hatai, 1899)
29	*Metaphire*	*communissima*	1899: 23	See *M. sieboldi*	Yes	*Metaphire communissima* (Goto and Hatai, 1899)

* Errors indicated by Horst (1889: 242).

** Syntypes published in Blakemore and Ueshima (2011) with several other specimens/labels deteriorated (marked "?")

from 1934 to 1936. Besides those collected by Dr. Hatai in 1923 and myself from the said region, many specimens from Central and Western Japan were also studied."

Under Ohfuchi (1937: text fig. 30) details are: Ibuki, Ibuki district, Kagoshima Prefecture, March and October, 1928 (Kyushu); Hokonage, Mt. Kirishima, October 19, 1928 (collected by Hatai and Araya); Tomitaka, Miyazaki, Miyazaki Prefecture, October 21, 1928; Agricultural school, Izumi, Kumamoto Prefecture, October, 1928; Kochi, Kochi Prefecture, October 10, 1929 (Shikoku); Matuyama, Ehime Prefecture, October, 1929 (Shikoku); Izumitsu, Oshima, October, 1927; near Lake Hamana, Shizuoka Prefecture, August, 1930; Matuyama, Ehime Prefecture, October 20, 1930 (Shikoku again); Odawara, Kanagawa Prefecture, August 15, 1930; Komaba, Tokyo Prefecture, June 14, 1931 (significant as this may be a "Tokyo" site); Mito, Ibaraki Prefecture, August 5, 1930; Sendai, Miyagi Prefecture, 1922–1924 (collected by Hatai?). Ohfuchi (1937: 121) also noted "The eight hundred and eight specimens examined in this study were collected from the localities shown in Text-fig. 30, from 1922 until 1930 by Dr. S. Hatai and Mr. T. Araya." Ohfuchi (1938: 2) later mentioned that he was helped by Mr. Araya, also a curator of the Saito Ho-on Kai Museum.

Their contemporary was Shinjiro Kobayashi working from a high school in "Keijo, Korea (= Seoul)" when it was annexed to Japan who wrote several papers on earthworms (*e.g.*, Kobayashi, 1939, 1941) with some specimens supplied by Dr. Hatai as acknowledged in several of his papers published in the Tohoku University journal.

Search for types. Types are crucial for resolution of taxonomic confusion. Historical type specimens are essential for revision of Japanese earthworms, especially the controversial species of Goto and Hatai (1898, 1899) and Hatai (1930), but searches had been fruitless until recently (see Blakemore and Ueshima, 2011). The whereabouts of early Japanese earthworm material was unreported, apart from a brief mention by Easton (1979: 43) of a type of *Perichaeta iizukai* Goto and Hatai, 1899 at one time being in the collection of the University of Tokyo although no material remained there according to Dr. Minoru Imajima, and this confirmed by Drs. Takenori Sasaki and Rei Ueshima, curators of the University Museum of University of Tokyo (UMUTZ). Investigations for types in Tohoku University and Saito Ho-on Kai Museum, Sendai were also fruitless, as reported in Blakemore *et al.* (2010). This due, in part, to the transfer of the earthworm collection of the Saito Ho-on Kai Museum to the National Museum of Nature and Science (NSMT) in 2006 whence cataloguing of >1,200 earthworm specimens has been undertaken by senior curator, Dr. Toshiaki Kuramochi.

The eponymous "Box of Worms" in question was re-discovered on a shelf in the spirit collection of NSMT and passed to the author on the day a fellowship there started on 19th April, 2010. Apparently it had been taken to Tokyo 30 years earlier as the only label (see photo Fig. 1) stuck on a Ford motor parts box addressed to Dr. Imajima at the National Science Museum (Natural History Institute) 3–23–1 Hyakunin-cho, Shinjuku-ku, Tokyo 160, Japan, was written in Japanese and read (Fig. 1):

"1981 (Showa 61) [sic], October, 10th.
Transferred from Saito Ho-on Kai Museum.
Imajima and Ishizuka.
Oligochaeta *Pheretima* group (futo mimizu)."

Earlier inspection of many other specimens transferred in 2006 from the Saito Ho-on Kai Museum collection by the author in 2009 (prior to the discovery of this box) found most in too poor a condition to determine accurately, being mainly dried out and variably labeled. In particular, the search was for potential syntypes of Hatai's later *Drawida* spp., plus possibly of *Amynthas phaselus* (Hatai, 1930) (synonym ?*maculosus* Hatai, 1930), *Metaphire yamadai* (Hatai, 1930), *Amynthas*? *yunoshimensis* (Hatai, 1930), *Amynthas tappensis* (Ohfuchi, 1935), *Metaphire tosaensis* (Ohfuchi, 1938), *Amynthas*

Fig. 1. The box of samples from the Saito Ho-on Kai Museum.

gomejimensis (Ohfuchi, 1937), *Metaphire hataii* (Ohfuchi, 1937) and *Metaphire servina* (Hatai and Ohfuchi, 1937) that were all described around 1930s by these authors. Preliminary inspection findings (and omissions) are presented in Appendix 1.

After initial work on this NSMT material was completed and a first draft of the current paper submitted in September 2010, yet another "Box of Worms" was discovered in the corner of a storage room at Yokohama National University (YNU) that had also been loaned many years earlier to Mr. Kotaro Ishizuka and handed to Dr. Eijiro Nishi in 2002 without any catalogue but said to contain no types. In fact, this box contained crucial historical material, including syntypes of Goto and Hatai from UMUTZ that, because the samples and labels were rapidly deteriorating, required priority curation. Details of this second box are provided in Appendix 2. Some information was published in an earlier paper (Blakemore and Ueshima, 2011) which the work presented in this thoroughly revised contribution now complements.

It is entirely appropriate, in the Results below, to first deal with *Metaphire communissima* (Goto and Hatai, 1899: 23) that was their final species name after Goto and Hatai's (1898: 65) initial misidentification of it with "?*Perichaeta sieboldii* Horst" (= *Metaphire sieboldi*), an error that Goto and Hatai (1898: 66) called "preposterous to suppose" due to inability on the part of European contemporaries (*e.g.*, Horst, Rosa, Beddard and Michaelsen) to correctly identify Japanese nationalistic science and species.

Materials and Methods

The eponymous box contained 21 sample tubes with single or pairs of worms (Fig. 1). Each tube included a label reading "The Saito Ho-on Kai Museum, Zool. No." with some information written by hand (probably Hatai's or Ohfuchi's, or possibly Araya's) in black ink. Most had new silicone plugs but appeared otherwise unadulterated, only one, slightly larger tube had an original cork plug and it had this note "*Drawida hattamimizu* Kanazawa," as with all other samples, it was preserved in formalin. This undissected immature/subadult specimen it is not considered further as it is not a pheretimoid nor a likely syntype of *D. hattamimizu* Hatai, 1930, i.e., nothing indicates that it formed a part of Hatai's original description (see Blakemore *et al.,* 2010).

The remainder of 20 tubes, with the same Saito Ho-on Kai Museum labels, were numbered by me with prefix "#" and had specimens that were, for the most part, previously undissected. They were allocated registration numbers (NSMT-An) and many were sketched, dissected and described in the author's usual style (Blakemore, 2000, 2010b–d) in order to provide more accurate identification. These then are the subjects of the current paper, augmented with data on historical material now returned to UMUTZ.

Tissue samples from non-essential posterior segments of these historical specimens sent for DNA barcoding at the iBOL project at Guelph

University (courtesy Drs. Paul Hebert, Natalia Ivanova and Sean Prosser) failed to yield usable results unlike those by Blakemore *et al.* (2010) based on fresher, Ethanol-preserved material.

Discussion and justification for specimen status is mostly confined to Remarks following species and/or specimens descriptions that follow ICZN (1999) rules and recommendations especially for explicit designation of neotypes where appropriate. A "?" before a taxon name implies some uncertainty as to its description or position. Another "?" after genus means tentative generic position. Following abbreviations are used: rhs — right hand side, lhs — left hand side, GMs — genital markings.

Results

The box in question and sample specimens of concern are shown in Fig. 1 and Table 3.

Table 3. Samples in the Saito Ho-on Kai Museum specimen box.

Tube No.	Identification on original label	NSMT	Condition of specimen(s)	Current identification	Specimen status
#1	*Ph. communissima* Goto and Hatai Sendai City 1923–1924	An 428	Mature, partly dissected with its gut still in jar	*Metaphire communissima* (Goto and Hatai, 1899)	Non type specimen (note: many other specimens in NSMT)
#2	*Ph. glandularis* Sendai City 1923–1925	An 427	Mature	*Metaphire glandularis* (Goto and Hatai, 1899)	Non type specimen, synonym of *M. hildgendorfi*?
#3	*Ph. acincta* Goto and Hatai/VIII 1930	An 429	Mature, dissected and part of gut missing	*Duplodicodrilus acinctus* (Goto and Hatai, 1899)	Neotype
#4	*Ph. schmardae* Horst Nagasaki City	An 430	Mature	*Metaphire californica* (Kinberg, 1867)	Misidentified non type specimen
#5	*Ph. agrestis* Goto and Hatai Morioka (Iwate Pref., Tohoku)	An 431 and 432	Two matures	*Amynthas agrestis* (Goto and Hatai, 1899)	Neotype plus undissected non type specimen (also see #17 and Mishima specimens)
#6	*Ph. hilgendorfi* Michaelsen Sendai City 1923–1925	An 434	Mature	*Metaphire hilgendorfi* (Michaelsen, 1892)	Non type specimen
#7	*Ph. carnosa* (Goto and Hatai) Sendai City 1923–1925	An 435	Mature	*Amynthas carnosus* (Goto and Hatai, 1899)	Neotype. Published in Blakemore (2012)
#8	*Ph. sieboldi* Horst Kochi 17/X 1930	An 436	Aclitellate sub-adult	*Metaphire sieboldi* (Horst, 1883)	Non type specimen
#9	*Ph. yunoshimaensis* (sic) Hatai Yunoshima Aomori Pref. 1922	An 437	Mature, undissected	*Amynthas*? *yunoshimensis* (Hatai, 1930)	Topotipic neotype (possible synonym of *M. hilgendorfi*?)
#10	*Ph. irregularis* Goto and Hatai Oarai Ibaraki Pref.	An 438	Mature	*Amynthas irregularis* (Goto and Hatai, 1899)	Synonym of *A. tokioensis*? (cf. #11 and #16)
#11	*Ph. levis* Goto and Hatai Sendai Kunimi pass 5/X 1930	An 439	Mature	Nothing of note differs from *A. irregularis* #10	Non type specimen (cf. #10 and #16)
#12	*Ph. phaselus* Hatai Aomori Kominato Village 1922	An 441	Mature	Appears same as *Amynthas maculosus* #13	Syntype? (synonym of *A. maculosus*?). See #13
#13	*Ph. maculosus* (Hatai) Aomori Yunoshima 1927	An 442	Mature, undissected	*Amynthas maculosus* (Hatai, 1930)	Syntype (synonym of *A. phaselus*?). See #12
#14	*Ph. Marenzelli* Cognette (sic) 24/XI 1929 Aone Onsen Miyagi Pref.	An 423 and 443	2 matures	*Amynthas marenzelli* (Cognetti, 1906)	Non type specimens (synonym of *A. corticis*)
#15	*Ph. vittata* Goto and Hatai Kanagawa, Odawara-Station/VIII 1930	An 444	Mature	*Amynthas vittatus* (Goto and Hatai, 1898)	Neotype (not syntype as collected >1898)
#16	*Ph.* abnormal Ibaraki Pref. Kuji Cty Kuji Village	An 440	Mature	Nothing of note differs from *A. irregularis* #10	Non type specimen cf. #10 and #11
#17	*Ph. agrestis* Goto and Hatai	An 433	Mature	*Amynthas agrestis*	See #5 also
#18	*Ph.* sp. Sendai Naga Town Kamohara's home 16/VI 1931	An 445	Mature	*Amynthas micronarius* (Goto and Hatai, 1898)	Non type specimen (cf. #19)
#19	*Ph. micronaria* Goto and Hatai (no other information)	An 446 and 447	2 matures, both undissected	*Amynthas micronarius*	Neotype plus a non type specimen (cf. #18) with publication pending
#20	*Ph. yamadai* Hatai Tottori Pref. (collected from type locality)	An 448	Mature, undissected	*Amynthas yamadai* (Hatai, 1930)	Neotype (possibly syntype but undissected and undated)

Tube #1. ***Metaphire communissima*** (Goto and Hatai, 1899)

(Fig. 2)

?*Perichaeta sieboldi*: Beddard, 1892: 759.

Perichaeta sieboldii: Goto and Hatai, 1898: 65; Goto and Hatai, 1899: 23 (not of *Megascolex sieboldi* Horst, 1883).

Perichaeta communissima Goto and Hatai, 1899: 23 (Tokyo, Sendai, Tsugaru, Shizuoka, Ibaraki, Bitchū. Types unreported).

Perichaeta sieboldi lenzi Michaelsen, 1899: 9 (Central Japan, Nakahama in Province Setsu.Types missing).

Pheretima communissima: Michaelsen, 1900: 262 (synonym *sieboldi* var. *lenzi*); Oishi, 1930: 400; Ishizuka, 2001: 66, figs. 14.1–8; Minamiya *et al.,* 2007: 56.

Amynthas communissimus: Sims and Easton, 1972: 235; Easton, 1981: 51 (synonymy).

Pheretima florea Ishizuka, 1999b: 52 [From (Mt. Daibosatsu-toge in Yamanashi Prefecture)].

Pheretima commnissima (lapsus calami): Ishizuka, 1999b: 53.

Pheretima frolea (lapsus calami): Ishizuka, 2001: 66.

Metaphire communissima: Blakemore, 2003b: 7, 28 (new

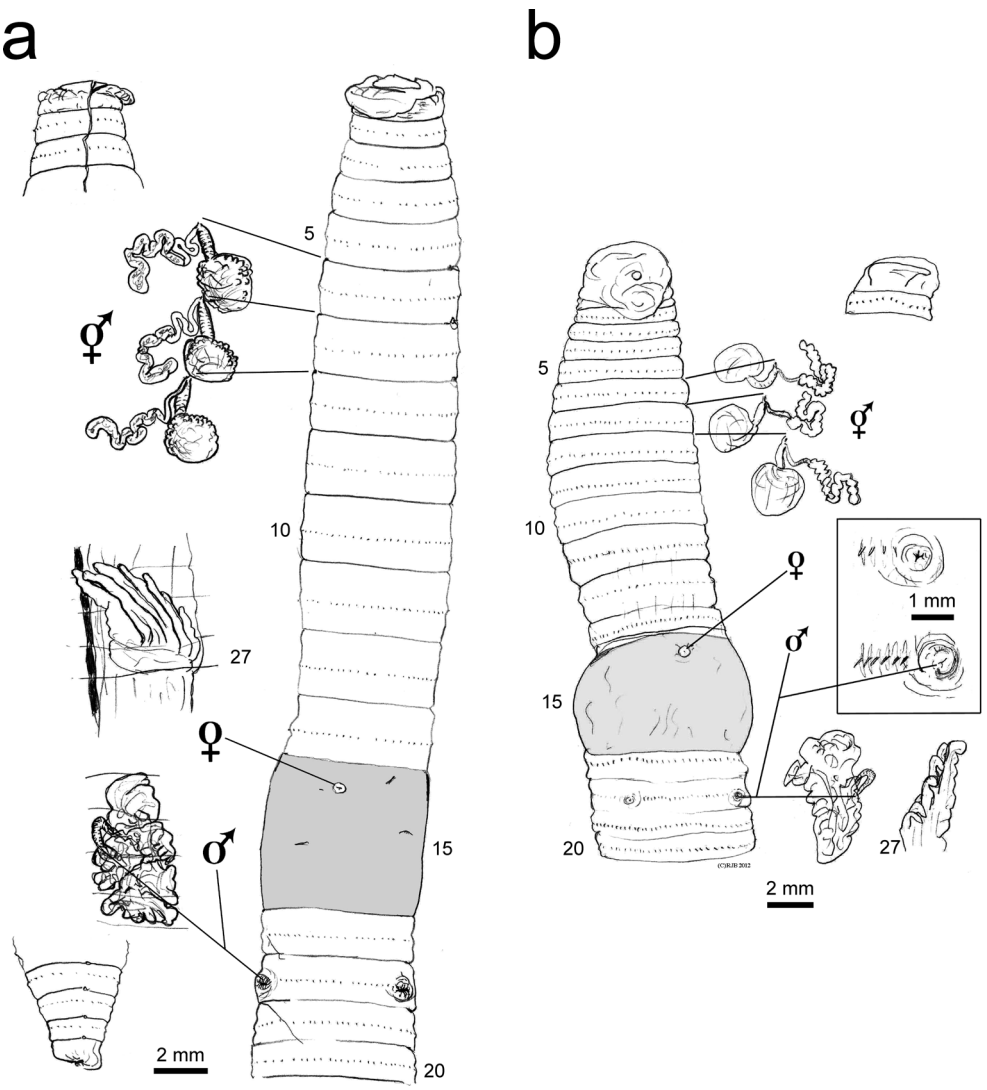

Fig. 2. *Metaphire communissima*. — a, NSMT-An 428 (Tube #1, previously dissected); b, lectotype UMUTZ-Ann-Og-26, ventral view with spermathecae, prostates and caeca *in situ*; dorsal view of undissected paralectotype's prostomium and [boxed] X2 enlargements of non-superficial male pores (18 rhs) of both specimens.

combination, synonyms *sieboldi lenzi, florea*); Blakemore and Ueshima, 2011: 64, figs. 2a–d.

Material examined. NSMT-An 428, previously dissected around caeca; mature labeled "*Ph. communissima* Goto and Hatai, Sendai-City 1923–1924," [same label as Tubes #2 (*M. glandularis*), #6 (*M. hilgendorfi*) and #7 (*A. carnosus*) specimens herein], but since this date is after 1899 publication it is not a syntype although from a stated type-locality. Many other *M. commmunissima* specimens from the Saito Ho-on Kai Museum are in the NSMT collection, in various states of preservation (see Appendix 1). Subsequently found syntypes now in UMUTZ-Ann-Og-26 were described in Blakemore and Ueshima (2011), see Fig. 2b and now I choose the previously dissected specimen (figured) as lectotype (under ICZN, 1999: Article 74 and ICZN Declaration 44) in order to enhance the stability of nomenclature; the remaining UMUTZ specimen in the same jar becomes the paralectotype.

Distribution. Japan. Ishizuka (2001) implies that geographical or topographic locations of his *P. florea* specimens coming from a Yamanashi mountain is unique, but he appears to ignore the distribution of *M. communissima* given in (Goto and Hatai, 1898: 66, 1899: 23) as from Bitchū (= Okayama Prefecture) to around Osaka, through Shizuoka, Tokyo, Ibaraki and Sendai to Aomori or, as Goto and Hatai state "that is to say all over the Main Island." Michaelsen (1899) gives us Tottori and Easton (1981: 51) quotes "Ohfuchi, 1938d" and others extending the range to southern Hokkaido; all this putting Yamanashi about central within its known range.

Diagnosis based on NSMT-An 428 specimen and UMUTZ-Ann-Og-26 syntypes. NSMT-An 428: 170 mm long with 116 segments. Lectotype, 125 mm with 103 segments (but lacking its posterior tip), undissected paralectotype 130 mm; Goto and Hatai (1899: 23) say up to 250 mm or more with 140 segments, but usually round 190 mm with about 100 segments. Pale grey with buff clitellum 14–16, or puce (NSMT-An 428). First dorsal pore in 12/13. Setae numerous (60) and crowded ventrally. Spermathecal pores in 5/6/7/8. Genital markings absent. Male pores in small copulatory pouches (sometimes invaginated into lateral slits), about 14–20 setae intervene. Septa 8/9 thin or absent and 9/10 aborted around gizzard, from 10/11 onwards thin. Spermathecae in 6–8 roundish ampullae often somewhat rugose with long, convoluted diverticula. Seminal vesicles large in 11 and 12. Ovaries in 13 with small pseudovesicles on 12/13 just above the ovaries; small ovisacs on 13/14 (in NSMT-An 428). Prostates in 17–20 with long, muscular duct to slight copulatory pouch. Last hearts in 13 (those in 10 not found in NSMT-An 428). Intestine from 15; caeca manicate with about 5–9 "fingers" from 27, a low lamellar ridge but no typhlosole found; gut contains mucous-enveloped soil with a few grits. NSMT-An 428 has gregarine cysts around its prostates and scattered elsewhere internally.

Remarks. In contrast to the current species, and contrary to Goto and Hatai (1898), *M. sieboldi* is one of the most striking and easily recognized of Japanese species due to its brilliant, iridescent blue colouration in the adult form (possibly to deter bird predation). Other differences from *M. sieboldi*—apart from spermathecal pores not in 6/7/8/9—are that here the male pores are perhaps slightly wider, almost lateral, and spermathecal ducts appear longer and more muscular.

Ishizuka (2001: 66) redescribes *communissima* on the same page as his *florea* (misspelt *frolea*) giving their respective lengths as 90–180 and 60–80 mm, but bigger worms almost always grow from smaller ones. The only other difference is spermathecal ampullae stated to be "shovel-shaped" in *florea* as opposed to "*globular*" in *communissima*, even though Michaelsen (1900: 262) had stated they were "*flattened*" and, rather obviously, it is irrelevant as ampullae by their nature can be either inflated or deflated due to use and "packing." Both his figured specimens (Ishizuka, 2001: figs. 14, 15) have non-superficial male pores within copulatory pouches, sup-

porting their inclusion in *Metaphire*, and are essentially indistinguishable, supporting their synonymy. Were parthenogenetic specimens of *M. communissima* to lack male pores, these would presumably be similar (synonymous?) to either *A. agrestis* (Goto and Hatai, 1899) or *M. hataii* (Ohfuchi, 1937: 13) specimens that also lack genital makings. Thus, the relationship of *M. communissima* to the prior *A. agrestis* and subsequent *M. hataii* may require resolution should their characteristics overlap.

The NSMT specimen conforms tolerably to the UMUTZ syntypes that both agree with Goto and Hatai's original précis and with later descriptions, although its name may sometimes be found misspelt as "*communisima*" or "*communisimma*."

Tube #2. ***?Metaphire glandularis***
(Goto and Hatai, 1899)

(as part of a *Metaphire hilgendorfi* species-group)

(Fig. 3)

Perichaeta glandularis Goto and Hatai, 1899: 18, figs. 9–11. [From "Takahashi (Prov. Bitchū)," now Okayama Pref., Type unknown].

Pheretima glandularis: Michaelsen, 1900: 315 (as a possible "variety" of his *P. hilgendorfi*); Kobayashi, 1941: 260; Gates, 1958: 11–13 (as possible synonym of *P. hilgendorfi*).

Metaphire glandularis: Sims and Easton, 1972: 238 (in a now defunct *Metaphire glandularis* species-group); Easton, 1981: 51 (include separately in his *Amynthas hilgendorfi* species-complex); Blakemore, 2003b: 29, 2005: 108, 2007: 115, 2010a: 12 (as a junior synonym of *Metaphire hilgendorfi*).

Material examined. NSMT-An 427, a mature specimen labeled "*Ph. glandularis* Sendai 1923–1925," previously undissected, here dissected and figured. So far (see Blakemore and Ueshima, 2011) a *glandularis* syntype has been elusive.

Distribution. The label locality, if actually from Sendai, is far removed from the original Takahashi collection site; however, as a junior synonym of *M. hilgendorfi* (Michaelsen, 1892), its distribution includes Hokkaido, all of central Japan, as well as Korea and USA.

It should be noted here and for the description by Blakemore (2012) of *A. carnosus* (Goto and Hatai, 1899), that this same label location and date of "Sendai 1923–1925" for Tubes #1 (*M. communissima*), #2 (*M.* cf. *glandularis*), #6 (*M. hilgendorfi*) and #7 (*A. carnosus*) specimens, possibly mean simply that the specimens were in the collection in Sendai at that time (see Introduction), and not necessarily from there.

Remarks. Perichaeta glandularis was described by Goto and Hatai (1899: 18) as dorsally banded, with spermathecal pores in 6/7/8, markings in 7 (mistake for 8?) and 17/18 and figured with male pores in copulatory pouches (i.e., *Metaphire*), but in other regards complying with Michaelsen's prior *α* morph of *M. hilgendorfi*. Their original description is problematical as the authors (Goto and Hatai, 1899: 19–20) state "Sometimes the posterior borders of the spermatheal pores are surrounded by similar papillae . . . and a fourth group of 8–9 glands close to each male pore" and they figure (Goto and Hatai, 1899: figs. 10, 11) these secondary capsulogenous glands opening near the spermathecal and male pores, whereas such glands are more usually associated with *Amynthas tokioensis* (Beddard, 1892) that typically lacks the central genital markings and has superficial male pores, or with *A. vittatus* (as redescribed herein). Possibly they relate to parasitic artefacts or, more likely, the figures by Goto and Hatai are composite images of several species/specimens. On current knowledge, no one has seen such an arrangement of features in any subsequent worm in the last 112 years and neither does this specimen conform, thus it's identification as "*Ph. glandularis*" may be questioned.

Specimen NSMT-An 427 is uniformly coloured, 150 mm long with 114 segments, has spermathecae in 7/8/9 and a unilateral non-superficial male pore on 18 lhs; its marking are midventral in 8 (rather than 7) and anteriorly in 18 and it thus complies with prior *M. hilgendorfi*, as redescribed by Blakemore (2003a, 2003b, 2005, 2010a, in prep.), to synonym *Perichaeta rokugo* Beddard, 1892, and also to *Amynthas*? *yunoshimensis* (Hatai, 1930) as mentioned below. Proba-

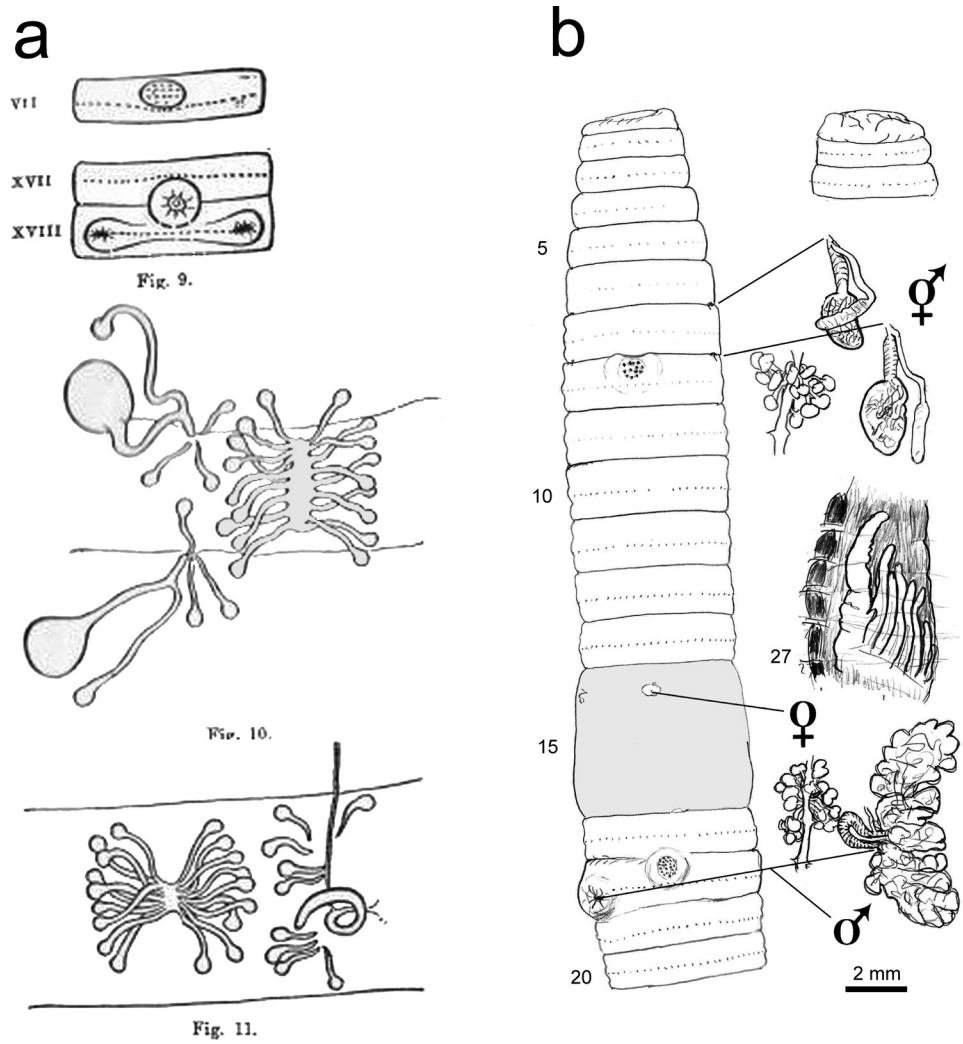

Fig. 3. *Metaphire glandularis* (a) and *Metaphire* cf. *glandularis* (= *M. hilgendorfi*) (b). — a, Goto and Hatai (1899: figs. 9–11); b, NSMT-An 427 showing spermathecae, 18 rhs prostate from non-superficial male pore and intestinal caeca in *situ*, and genital markings glands overlain by ventral nerve cord.

bly *M. glandularis* should be considered a misdescribed synonym of prior *M. hilgendorfi*, or, at best, a *species incertae sedis*.

As noted in Discussion, also by Gates (1982: 52), this specimen's single, non-superficial male pore exemplifies correct placement in genus *Metaphire* Sims and Easton, 1972. Conversely, under some authors' schemes, one half of this specimen would belong to one species and genus and the other half to another, this being clearly ridiculous.

Tube #3. ***Duplodicodrilus acinctus*** (Goto and Hatai, 1899) comb. nov.

(Fig. 4)

Perichaeta acincta Goto and Hatai, 1899: 16, fig. 6 (Tokyo. Types unknown).

Pheretima acincta: Michaelsen, 1900: 252; Hatai, 1931b: 182, fig. 32; Ohfuchi, 1957b: 1360, fig. 3849; Yamaguchi, 1962: 10 (synonym *yezoensis*); Kamihira, 1973: 57; Minamiya *et al.*, 2007: 56.

Amyntas acinctus: Beddard, 1900: 650.

Amynthas acinctus: Sims and Easton, 1972: 235 [*hawaya-*

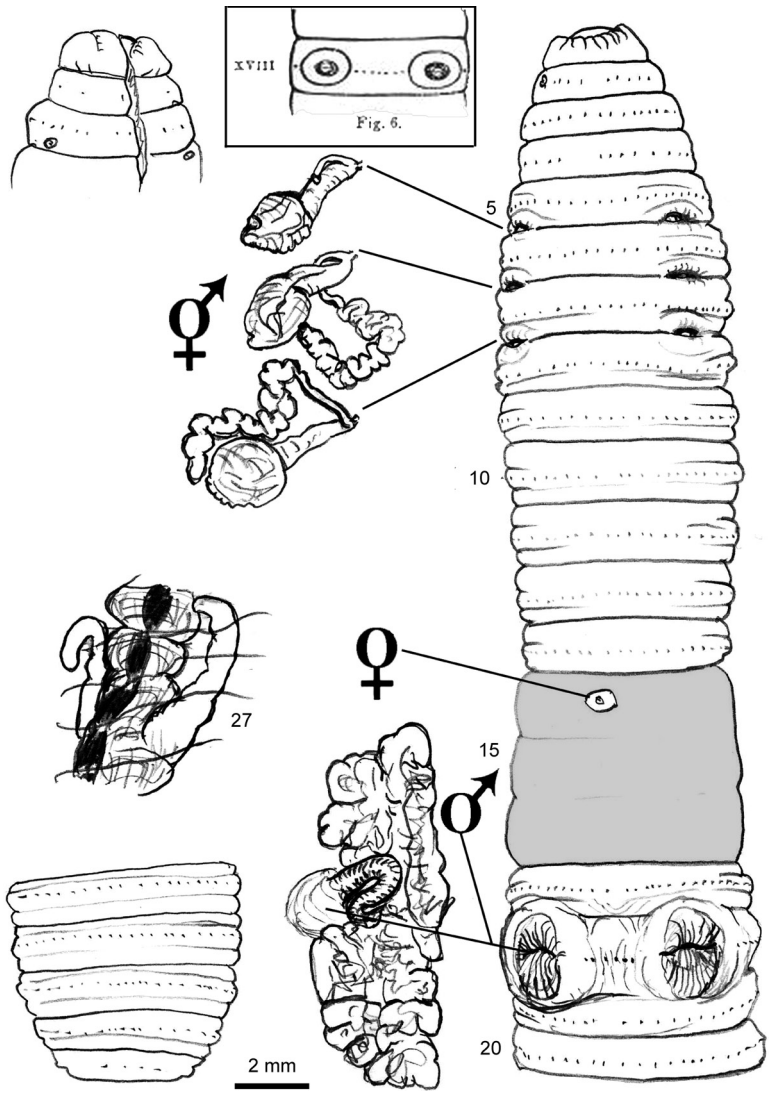

Fig. 4. *Duplodicodrilus acinctus*. — NSMT-An 429 (neotype, previously partially dissected with 6 rhs spermatheca missing its diverticulum). Boxed is Goto and Hatai's (1899: fig. 6) of a probable immature.

nus (= *gracilis*) group]; Easton, 1981: 48 (synonyms ?*phaselus* Hatai, 1930; ?*maculosus* Hatai, 1930; ?*kamitai* Kobayashi, 1934; ?*phaselus tamurai* Kobayashi, 1938); Blakemore, 2003a: 242 (same synonyms, but compare to *A. phaselus* herein).

Pheretima yezoensis Kobayashi, 1938a: 412, figs. 4a–c (One clitellate specimen 190 mm long from a "cultivated field" in Hakodate. Type not known).

Metaphire yezoensis: Easton, 1981: 60; Blakemore, 2003a: 243.

Metaphire acincta: Blakemore, 2007: 18, 76, 84, 2008b: 18, 89 (synonym *yezoensis*); Blakemore *et al.*, 2010: 16.

*Material examined***.** Newly designated neotype, NSMT-An 429, labeled "*Ph. acincta* Goto and Hatai /VIII 1930." Posterior amputee, previously dissected and pinned with guts around mid-riff removed after segment 12 and these missing from jar. Here redescribed and sketched. Neotype locality unstated, however "VIII/1930" is collection date of Tube #15 and, moreover, Ohfuchi (1937: 113) described *Ph. nipponica* specimens from Odawara, collected on "VIII/1930."

Distribution. Japan from Tokyo (or Odawara) to Hokkaido but possibly no longer Korea [the Korean listing probably for when *phaselus* was considered an *acinctus* synonym or from a report from Geo-je Island by Song and Paik (1970) that requires re-evaluation]. Blakemore *et al.* (2010: 16) noted (unconfirmed) material in the Saito Ho-on Kai Museum collection from Hatta, Ishikawa Pref.

Diagnosis. Length 82–190 mm (neotype 125 + mm). Segments ca. 108–122 (neotype 94 +). Setae ca. 36–63. Dorsal pores from 12/13. Spermathecal pores gaping in 5/6/7/8. Male pores in lateral slits within large wrinkled copulatory pouches that extend just into 17 and 19 with 7 or fewer setae between secondary male pores. Genital markings absent. Seminal vesicles in 11 and 12. Spermathecae with long, bent and bubbled diverticula [described as "with appendicular diverticulum twice as long as the main portion" by Goto and Hatai (1899: 17)]. Intestinal caeca simple [or sometimes "each with a few ventral indentations" as per Kobayshi (1938: 413) and see Song and Paik (1970: fig. 9) where caeca are more clearly serrated in a possibly different species].

Remarks. Originally erected for two aclitellate specimens (probably subadults), hence its name, matures are naturally clitellate and may have larger male pores than those figured by Goto and Hatai. The patently smaller male pores of Song and Paik's (1970: fig. 2) specimens (plus serrated caeca) may now exclude them. Sims and Easton (1972) had *Metaphire yezoensis* in a *Metaphire merabahensis* species-group, whereas Easton (1981: 48, 60), while incorrectly placing *acinctus* in *Amynthas* and tentatively including *A. phaselus* subspp. in synonymy, but also maintained *Metaphire yezoensis* separately. Here the erstwhile synonym *Amynthas phaselus* (Hatai, 1930) is restored, debatably keeping some of its synonyms (*e.g.*, *Pheretima maculosa* Hatai, 1930 and *P. mutica* Chen, 1938 that are both treated below), while the synonym *P. yezoensis* is reaffirmed.

Male pores of *Duplodicodrilus acinctus*, and its synonym *yezoensis*, are on intromittent organs eversible from copulatory pouches that appear as large as in the type *Duplodicodrilus schmardae* (Horst, 1883), thus it is here reassigned to *Duplodicodrilus* Blakemore, 2008. The generic definition is now augmented to include species with intestinal caeca that are simple, sometime indented, as was well as complex/manicate as in the type; such variable caecal conditions also pertain to genera *Amynthas* and *Metaphire*.

Tube #4. ***Metaphire californica*** (Kinberg, 1867)

(Fig. 5)

Material examined. NSMT-An 430.

Remarks. NSMT-An 430 mislabeled as "*Ph. Schmardae* Horst" from Nagasaki (no collector, no date). Such misidentifications of *Metaphire californica* with *Duplodicodrilus schmardae* were in the past quite commonplace, and still are despite the full descriptions and supposed distributions of these common Japanese and/or Cosmopolitan taxa by Easton (1981) and more recently Blakemore (2003a, 2003b, 2008a, 2010b).

Tube #5. ***Amynthas agrestis*** (Goto and Hatai, 1899)

Material examined. NSMT-An 431 and 432 two undissected matures labeled "*Ph. agrestis* Goto and Hatai Morioka (in kanji)."

Remarks. Taxon subject to separate treatment (Blakemore, in prep.); see Tube #17.

Tube #6. ***Metaphire hilgendorfi*** (Michaelsen, 1892)

(Fig. 6)

Material examined. NSMT-An 434.

Remarks. A species-complex subject to separate treatment (Blakemore, in prep.; see Tubes #2 and #9).

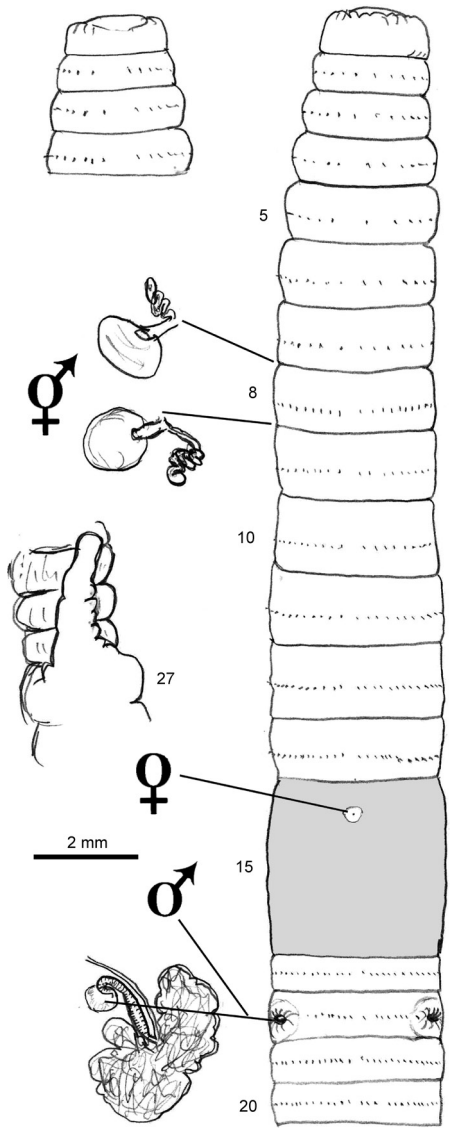

Fig. 5. *Metaphire californica*. — NSMT-An 430 mislabeled as "*Ph. Schmardae* Horst."

Tube #7. ***Amynthas carnosus*** (Goto and Hatai, 1899)

(Fig. 7)

Material examined. NSMT-An 435.

Remarks. This taxon was the subject of treatment in a separate publication (Blakemore, 2012) including variations allowed for by Kobayashi (1936b) that encompassed Korean synonyms *kyamikia* Kobayashi, 1934, *monstrifera* Kobayashi, 1936, *sangyeoli*, *youngtai, kimhaeiensis*, *sinsiensis* and *baemsagolensis*—all names by Hong and James, 2001, and Taiwanese *monsoonus* James *et al.*, 2005. A further revised synonymy to those presented in Blakemore (2003a, 2003b, 2012) separating this taxon from *A. corticis* (Kinberg, 1867) proper, should now include Japanese synonyms: *Pheretima subalpina* Ishizuka, 2000, *P. umbrosa* Ishizuka, 2000, *P. mutabilis* Ishizuka, 2000, *P. nigella* Ishizuka *et al.*, 2000, *P. nubicola* Ishizuka, 2000, *Amynthas noninvisa* Blakemore, 2010 (nom. nov. pro *P. invisa* Ishizuka, 2000 *non* Cognetti, 1913), and probably *Amynthas nonmonticolus* Blakemore, 2010 (nom. nov. pro *P. monticola* Ishizuka, 2000: 191 non Beddard, 1912 and its synonym *A. conformis* Ishizuka, 2000: 182) plus *A. nonsetosus* Blakemore, 2010 (nom. nov. pro *P. setosa* Ishizuka *et al.*, 2000 non Cognetti, 1908) too, all as new synonyms.

The label location and date "Sendai, 1923–1925" (same as *M. communissima*, *M. glandularis* and *M. hilgendorfi*), possibly means that the specimens were in the Sendai collection at that time and not necessarily from there, leaving the type locality ambiguous, this rather irrelevant for a distribution extending from China to Japan/Korea.

Tube #8. ***Metaphire sieboldi*** (Horst, 1883)

(Fig. 8)

Material examined. NSMT-An 436.

Remarks. NSMT-An 436, a large sub-adult 185 mm long with 150 segments and a dark blue iridescent sheen, previously undissected, labeled "*Ph. sieboldi* Horst Kochi, Muroto-misaki (in kanji) 17/X 1930." Compare to UMUTZ-Ann-Og-2, a previously ventrally dissected mature also bisected into halves (see Fig. 8b). The first species formally described from Japan, due to the distinctive colour of mature specimens it is easily recognized (see Hatai, 1931a; Easton, 1981; Blakemore, 2003a, b). The current specimen compares to Michaelsen's (1892: 235) immature from the Museum für Naturkunde Humboldt-

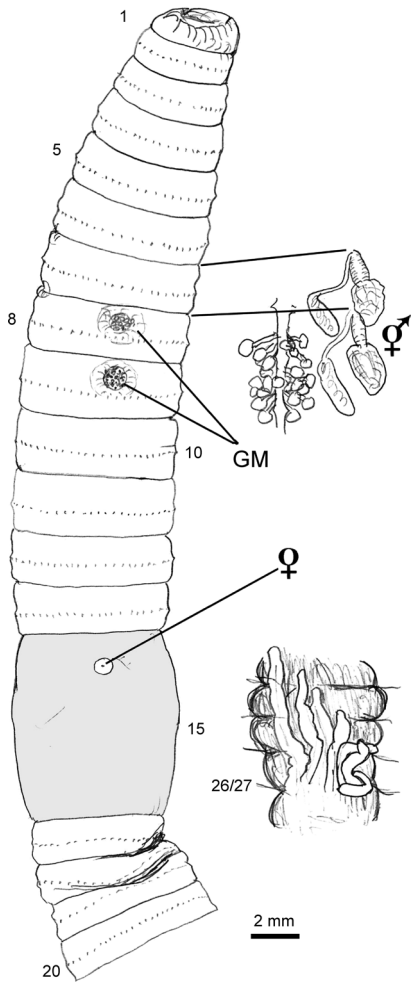

Fig. 6. *Metaphire hilgendorfi*. — NSMT-An 434 from "Sendai, 1923–1925."

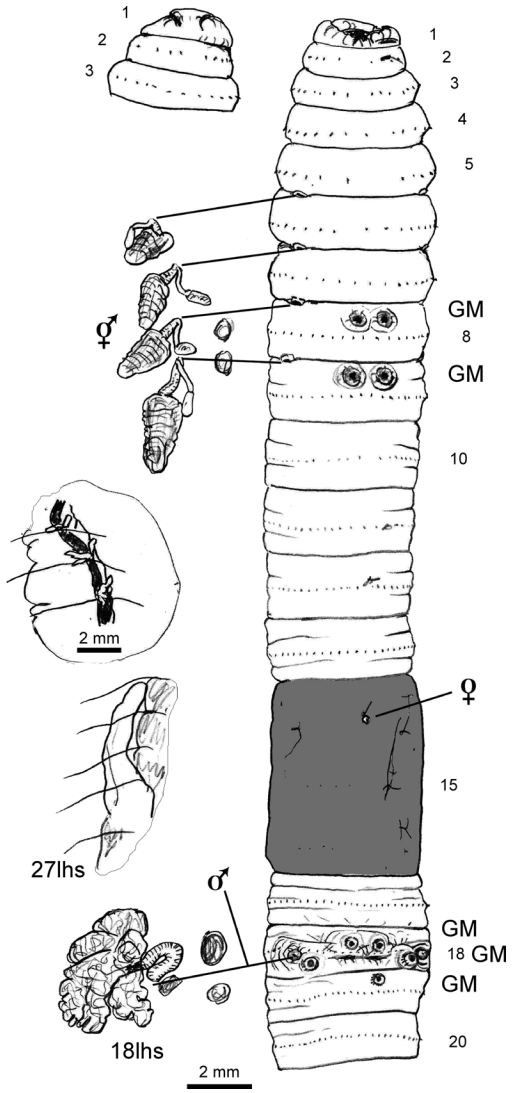

Fig. 7. *Amynthas carnosus*. — NSMT-An 435 (neotype) from Blakemore (2012: fig. 1).

Universitat Berlin No. 2113.

Tube #9. ***Amynthas? yunoshimensis*** (Hatai, 1930)

(Fig. 9)

Pheretima yunoshimensis Hatai, 1930: 655, figs. 4, 5 (Sapporo in Hokkaido and Aomori in northern Honshu. Types unknown); Gates, 1958: 13 (?synonym of *P. hilgendorfi*); Minamiya *et al.*, 2007: 56.

Amynthas yunoshimensis: Sims and Easton, 1972: 237; Easton, 1981: 52; Blakemore, 2003b: 7; Ito *et al.*, 2007: 83.

Pheretima yunoshimaensis (lapsus calami): Ishizuka, 1999a: 67.

Pheretima yunoshimaensis (lapsus calami): Ishizuka, 2001: 105.

Amynthas? *yunoshimensis*: Blakemore, 2007: 19, 2008b: 8; 2010a: 18, 2010b: 196.

Material examined. Newly designated topotypic neotype NSMT-An 437 label states "*Ph. yunoshimaensis* (lapsus calami) Hatai Aomori, Yunoshima (in kanji) 1922" (same date as Tube #12). Possibly it is part of the syntype series but, as it was previously undissected, is it not definite

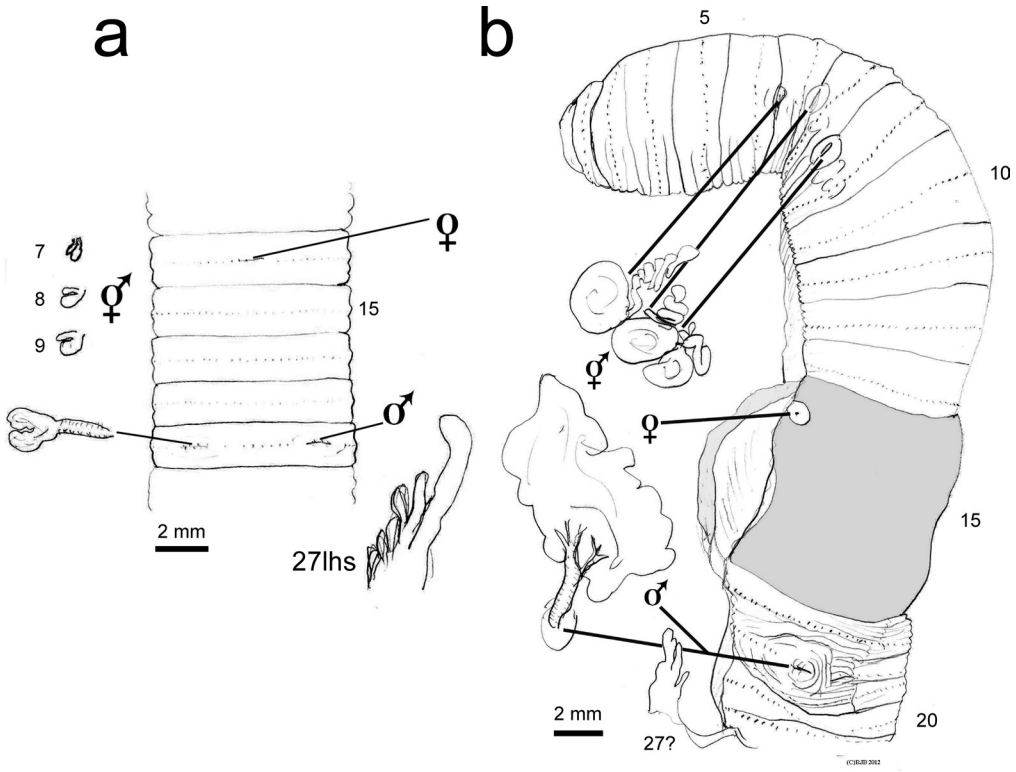

Fig. 8. *Metaphire sieboldi*. — a, NSMT-An 436 specimen; b, UMUTZ-Ann-Og-2, unlabeled specimen but (ventrally) dissected probably by Hatai, shown for comparison.

that it formed part of the original description.

Distribution. Hokkaido and Tohoku region of Japan.

Diagnosis. Neotype is 88 mm long with 60 segments but appears a posterior-amputee missing its posterior tip. Genital markings are as composite papillae in 8 and 18 with sessile glands internally. Spermathecae were said by Hatai to often be defective in some of 5/6/7/8 or entirely absent as here. Male pores and prostates often absent as in neotype. Intestinal caeca manicate.

Remarks. Despite its lack of spermathecae, the neotype complies exactly with Hatai's original description that allowed spermathecae absent or remnants in some of (5/)6/7/8. Thus, Sims and Easton (1972: 237) had this taxon partly in an *Amynthas tokioensis* species-group with spermathecal pores in 6/7/8, and partly (lapsus?) in an "*Amynthas sieboldi* species-group" with spermathecal pores in 6/7/8/9. Spermathecae for the most part appear defective or vestigial and were missing entirely in most degraded parthenogenetic forms. *P. yunoshimensis* was erected on 64 specimens for which 63 were anarenosomphic (lacking male pores and prostate glands) according to Gates (1958). Male pores were present in specimens from Sapporo and in one from Yunoshima (Hatai, 1930: 656) but their form was not described and thus this taxon is provisionally (i.e., with a "?") ascribed to *Amynthas* Kinberg, 1867—the default genus for pheretimoids—as cogently explained in Blakemore (2003a, 2003b: 13).

Probably it is a synonym of prior *Metaphire hilgendorfi* (Michaelsen, 1892) since both share patches of central genital markings in 8 and 18; *Amynthas*? *yunoshimensis* was dubiously separated on its marking glands being slightly more stalked (Hatai, 1930). In fact, Gates (1958: 13)

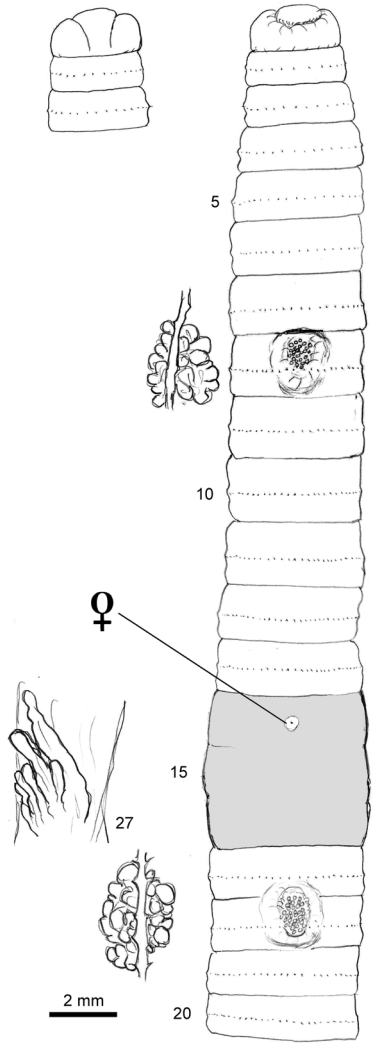

Fig. 9. *Amynthas*? *yunoshimensis*. — Topotypic neotype NSMT-An 437.

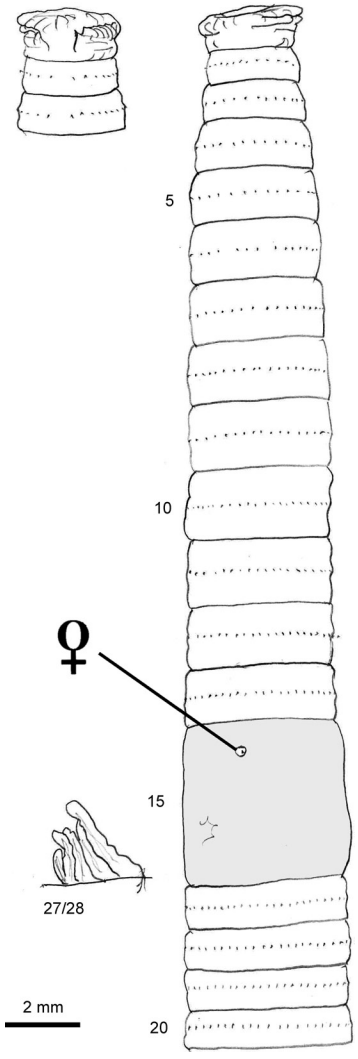

Fig. 10. "*Amynthas*? *irregularis*." — NSMT-An 438 specimen possibly of this taxon.

had earlier said *P. yunoshimensis* was indistinguishable (accepting an extra spermatheca or two in 5/6 as mere variations) and thought it a synonym of parthenogenetic *P. hilgendorfi*. A dubious claim by Hatai (1930: 656) of "no question" that his taxon is separate from *M. hilgendorfi* will shortly be investigated further (Blakemore, in prep.).

Tube #10. ***Amynthas*? *irregularis***
(Goto and Hatai, 1899)

(as probable synonym of *A. tokioensis*)

(Fig. 10)

Perichaeta irregularis Goto and Hatai, 1899: 13 [non Spencer, 1895 = *Perionychella irregularis*. From Uwajima (Shikoku) and Takahashi (Okayama). Types unknown].

Pheretima irregularis : Ohfuchi, 1938a: 2, 1939: 81 (synonym *P. levis* Goto and Hatai, 1899: 20); Minamiya *et al.,* 2007: 56.

Material examined. NSMT-An 438. Mature specimen previously undissected, labeled "*Ph irregularis* Goto and Hatai Ibaraki Oarai."

Distribution. Japan, or (as part of *A. tokioensis*) cosmopolitan: Japan, Korea, China, USA, etc.

Diagnosis. The specimen is 115 + mm long with 74 + segments (missing tip of posterior) (Goto and Hatai have 125 mm and 95 segments). First dorsal pore 12/13. It has 39, 43 and 48 setae on segments 7, 8 and 17, respectively (Goto and Hatai have 47, 47 and 61 respectively although their table on p. 24 shows "51" for the last count). Spermathecae, markings and male pores are missing. Septa 8/9/10 are aborted. Hearts are 10 rhs, 11lhs and paired in 12 and 13. Seminal vesicles large in 11 and 12; pseudovesicles in 13 and vestigial ovisacs in 14. Intestinal caeca manicate, a low lamellar typhlosole develops from 27.

Remarks. Beddard (1900: 633) had "*Pheretima hilgendorfi*" group synonyms: *rokugo, irregularis* and *schizopora* which were accepted by Easton (1981: 51) and Blakemore (2003a, b). Later however, Blakemore (2010a: 13) had these under *A. tokioensis* along with probable synonym, the subsequent *Perichaeta levis* Goto and Hatai, 1899: 20.

As with their prior *Perichaeta schizopora* Goto and Hatai, 1898, *P. irregularis* is such a degraded parthenogenetic morph, that it could actually be attributed to several taxa with manicate intestinal caeca. If not synonyms of *A. tokioensis* (Beddard, 1892), both names plus *A. levis* should be classed as *incertae sedis*. See also Tubes #11 and #16.

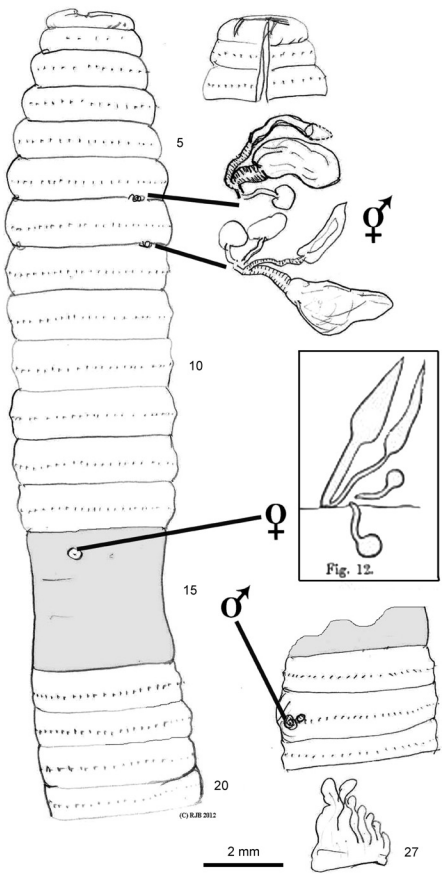

Fig. 11. *Amynthas levis*. — UMUTZ-Ann-Oc-34 (syntypes), one lacking male pores, one with analogue superficial male pore on 18 rhs; showing spermathecae *in situ* (7 lhs spermatheca missing the tip of its diverticulum) and manicate intestinal caeca. Boxed is Goto and Hatai's (1899: fig. 12) of a spermatheca and its glands.

Tube #11. ***Amynthas levis*** (Goto and Hatai, 1899)

(as possible synonym of A. *tokioensis*)

(Fig. 11)

Perichaeta levis Goto and Hatai, 1899: 20, fig. 12 [From Takahashi Okayama (as for their *P. irregularis*) and Kumamoto (Kyushu). Types not known previously].

Pheretima levis: Kobayashi, 1938a: 129, fig. 7; Gates, 1958: 21, 1982: 54.

Metaphire levis: Sims and Easton, 1972: 238 (*Metaphire glandularis* species-group).

? *levis*: Easton, 1981: 51 (Easton did not state the genus within his "*Amynthas hilgendorfi* species-complex" he just put a "?" as quoted here).

Metaphire? *levis*: Blakemore, 2003a, b: 30, 2007: 117, 2010a: 13, 2010b: 408 (due to Sims and Easton's listing in *Metaphire* but compared to *A. tokioensis*, see synonymy below).

Amynthas levis: Blakemore and Ueshima, 2011: 66, fig. 2a–d (in new combination after discovery of 4 syntypes re-described here).

Material examined. Previously designated syntypes, UMUTZ-Ann-Og-34 labeled "*P. levis*

Goto and Hatai. Meiji 29/8/? (= 1896). Location: Kikkuchi, Kumamoto. Collector: Takayama (in kanji)"; four specimens, one previously dissected and described as per Blakemore and Ueshima (2011), herein figured and further detailed.

Tube #11, NSMT-An 439 labeled: "*Ph levis* Goto and Hatai Sendai, Kunimi Mountain Pass (in kanji) 5/X1930," a previously undissected mature, is compared but not figured as, apart from a few more setae, it is superficially and internally similar to Tube #10 specimen.

Distribution. Japan and reported as introduced into North America to New Jersey (with *P. agrestis*) by Easton (1981: 53) and Gates (1954: 234, 1958: 21, 1982: 55) including from the Bronx Zoo N.Y. where they were raised as food for platypuses, and from compost heap in Union College, Schenectady; also claimed as "*Metaphire levis* (Horst, 1893)" — see http://www.inhs.uiuc.edu/~mjwetzel/AOGSMNP.PkChklst.html — but this possibly a misidentification of a species that does have copulatory pouches.

Description. UMUTZ syntypes 90–102 mm long with 84 segments in one of the four specimens (figured) with about 50 setae per segment; NSMT-An 439 is 125 mm with 100 segments and setal counts vary from 57–55 on segments 8 and 18, respectively. Syntypes have spermathecal and male pores variously in 6/7/8 with no male pores in figured syntype; both sets of pores absent from another; present but on 7/8/9 rhs only with superficial male pore on 18 lhs only (as figured) in a third syntype; or with spermathecae in 6/7 rhs only and no male pores in a fourth syntype. Accessory glands may accompany the spermathecae when present and there may be small genital markings near the superficial male pores as figured. NSMT-An 439 lacks both spermathecal and male pores as well as any markings. First dorsal pores are from 12/13. Septa 10/11 is present in dissected syntype (figured specimen) and seminal vesicles in 11 and 12 with pseudovesicle in 13. Last hearts are in 13 [Gates (1982) says hearts in 10 are lacking]. Intestine expands from segment 15, typhlosole is lacking (to about 30) or sometimes present (Gates, 1982), intestinal caeca manicate and the gut contains organic soil.

Remarks. Goto and Hatai's (1899: 20) account of *Perichaeta levis* was inadequate and is ostensibly the same as their earlier *P. schizopora* Goto and Hatai, 1898: 75 and possibly *P. parvicystis* Goto and Hatai, 1899: 18 (if this latter has manicate caeca). The only difference of note is that the single specimen of *schizopora* had one pair of spermathecae in 7/8 whereas *parvicystis* and *levis* supposedly had two pairs or fewer in 6/7/8 (possibly miscounts). For all three, Goto and Hatai sketch a spermatheca and these are identical, despite these authors' mis-characterization of genital glands as extra diverticula. None were noted to have prostate glands and all were thus parthenogenetic morphs; however, one syntype here has a superficial male pore (= *Amynthas*) and in this it this agrees with Gates' (1982) account, albeit he places the taxon in *Pheretima*.

Gates (1982: 54) attempted a redescription of *P. levis* as did Ohfuchi (1938b, 1939). Blakemore (2007, 2010a: 13, fig. 2, 2010b: 408, fig. 2.2) presents an argument that *schizopora*, *irregularis*, *parvicystis* and *levis* are junior synonyms of *Amynthas tokioensis* (Beddard, 1892) based on published account of my inspection of its London type (NHM 1904.10.5.166).

These synonyms of *A. tokioensis* in Blakemore (2010a: 13) were: ?*Perichaeta schizopora* Goto and Hatai, 1898: 76; ?*Perichaeta irregularis* Goto and Hatai, 1899: 13; *Perichaeta levis* Goto and Hatai, 1899: 20 (synonyms: ?*Pheretimaparvicystis* Goto and Hatai, 1899; ? *P. verticosa* Ishizuka, 1999; ?*Amynthas yongshilensis* Hong and James, 2001: 80), *A. eastoni* Hong and James, 2001: 83; *A. boletiformis* Hong and James, 2001: 84 — these synonyms as per Blakemore (2003b: 43, addenda, 2005); plus ?*A. jiriensis* Song and Paik, 1971 and ?*Amynthas paiki* Hong in Hong, Lee and Kim, 2001: 266 from Blakemore (2007); plus newly ?*Pheretima gucheonensis* Song and Paik, 1970 and ?*Pheretima surcata* Ishizuka, 1999 from Blakemore (2010a: 13). Further work is required to resolve all these.

Why the current athecate specimen, #11

NSMT-An 439, should be labeled as "*Ph. levis*" is a mystery unless it is Hatai's hint that he accepts his earlier descriptions are faulty. One translation of the Latin for *levis* is "unreliable." See also specimens from Tubes #10 and #16.

Tube #12. ***Amynthas*** sp. labeled "Ph. phaselus Hatai"

Material examined. NSMT-An 441, a previously undissected mature specimen labeled: "*Ph. phaselus* Hatai Aomori, Kominato Village (in kanji) 1922." A candidate topotypic syntype of *Amynthas phaselus* (Hatai, 1930) although not dissected. The specimen is not given any special status as syntpe (nor neotype) as it lacks supposedly characteristic "kidney bean shaped" outline of the male pores with longitudinal slits in centres that possibly function as seminal grooves (or deeper "L" shaped grooves as in its supposed *tamurai* synonym — see Tube #13 below).

Distribution. Japan (and Korea).

Remarks. Tube #12 specimen is exactly similar to Tube #13 specimen, thus it is probably misnamed and both should be placed in *A. maculosus* (other batches in NSMT cf. Appendix 1).

Tube #13. ***Amynthas maculosus*** (Hatai, 1930) comb. nov.

(Fig. 12)

Pheretima maculosus [sic] Hatai, 1930b: 661, fig. 7; Minamiya *et al.* 2007: 56. [Non *Pheretima maculosa* Gates, 1933 [= *Amynthas malacus* (Gates, 1936) nom. nov. pro *Pheretima maculosa* Gates, 1933 as confirmed by Sims and Easton (1972: 237), cf. Nakamura (1999: 2) who proposed the unnecessary replacement name "*Pheretima medimaculosa*"), from Sendai, Kominato, Yokohama village (in Hokkaido, not in Kanagawa), Moura, Sapporo and Yunoshima Island, Aomori Prefecture. Types previously unknown].

Metaphire maculosa: Sims and Easton, 1972: 239.

Material examined. Syntype, newly recognized NSMT-An 442, a previously undissected mature specimen, labeled: "*Ph maculosus* (Hatai) Aomori Yunoshima 1927."

Distribution. Japan (and Korea).

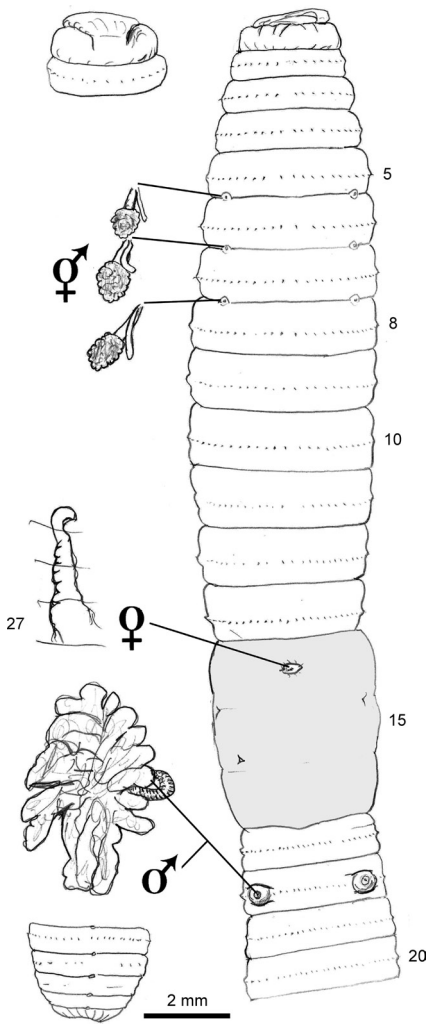

Fig. 12. *Amynthas maculosus*. — NSMT-An 442 (syntype) agreeing almost exactly with Hatai's (1930: fig. 7).

Diagnosis and summary. Syntype 140 mm long with 111 segments. Spermathecal pores in 5/6/7/8. Genital markings absent. Spermathecae with clavate diverticula. Male pores superficial as figured. Intestinal caeca simple with incised margins.

Remarks. Originally described as with "spotted appearance" — as with *P. phaselus* — that I think was due to gregarine parasitism; its Latin name "*maculosus*" meaning "spotted" should have followed declention in genus gender as "*maculosa*," this now irrelevent after its transfer

to (masculine genus) *Amynthas*. The current specimen, dissected for the first time, complies almost exactly with the original description and is provisionally restored from synonymy. Easton (1981: 48) tentatively put *Amynthas phaselus* (Hatai, 1930), *Metaphire maculosa* (Hatai, 1930) [genus designation from Sims and Easton (1972: 239) probably wrong and should be in *Amynthas*], *Amynthas kamitai* (Kobayashi, 1934) and *Amynthas phaselus tamurai* (Kobayashi, 1938) in synonymy of "*Amynthas acinctus*" that is described separately above as *Duplodicodrilus acinctus*.

Sorting the true synonymy of *A. phaselus* as briefed under Tubes #12 and #13 based on representative specimens of *A. phaselus* (some are in YNU collection, others newly found in Korea) requires morphological and, preferably, genetical comparisons including all Korean synonyms and is now in progress (Blakemore, in prep.).

Tube #14. ?*Amynthas marenzelleri* (Cognetti, 1906)

(as a part of an *A. corticis* species-complex)

(Fig. 13)

Pheretima marenzelleri Cognetti, 1906: 780, figs. 5–6 [from Yokohama (Kanagawa, not the Hokkaido village?) collected Dr. Haberer on 1.IV.1904. Type still in Vienna?]; Ohfuchi, 1936: 230 (misidentification); Kobayashi, 1938a: 407, figs. 1a–b; Minamiya *et al.,* 2007: 56.

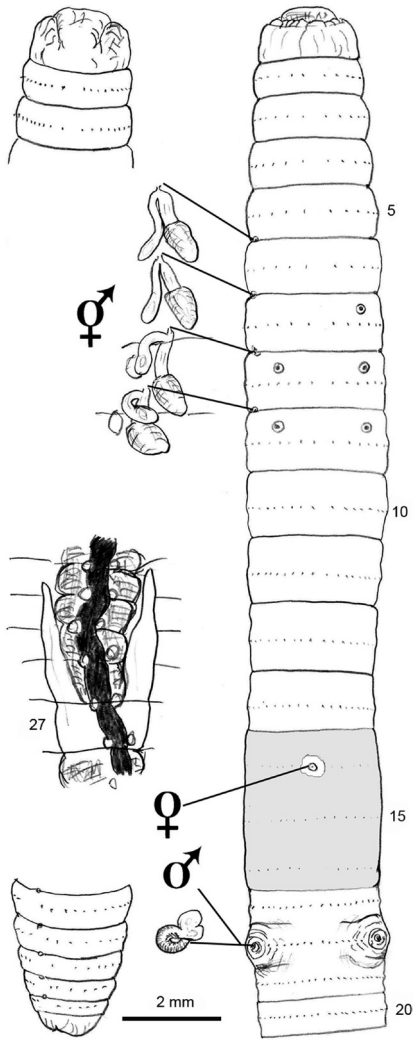

Fig. 13. "*Amynthas marenzelleri.*" — NSMT-An 443 specimen possibly of this taxon.

Material examined. NSMT-An 423, 443, two previously undissected matures, labeled: "*Ph. marenzelli* Cognette [sic] 24/XI 1929 Aone Onsen, Miyagi (in kanji)" one (443) here dissected and figured.

Distribution. Yokohama; Hokkaido (Kobayashi) or cosmopolitan as part of *A. corticis* species-complex.

Diagnosis and summary. Specimens 100–110 mm long with ca. 100 segments (Cognetti has 190 mm with 138 segments; Kobayashi, 160 with 130 segments). Dorsal pores small in 10/11 (12/13 from Cognetti). Spermathecal pores in 5/6/7/8/9. Genital markings in 7 rhs (in 443 only), paired in 8 and 9 (Cognetti has intersegmental markings in 7/8 and 8/9; they are absent in Kobayashi's specimens). Male pores superficial with about 14 setae between (Cognetti has 10 setae). Spermathecae with clavate diverticula (Cognetti and Kobayashi have them adiverticulate). Prostate glands reduced (as in Cognetti's and Kobayashi's accounts). Intestinal caeca simple with smooth margins.

Remarks. Types not known but the description was based on a single specimen in Vienna with the species named after a museum curator there.

Kobayashi (1938a: 407) claimed it from Hokkaido and in a footnote (page 408) said that Ohfuchi's (1936) description was for a different species. *Pheretima marenzelleri* is usually held in synonymy of *A. corticis*, along with dozens of other names, but there may be quantitative differences. The current specimen seems rather to belong in *A. corticis* too. For some reason Japanese workers tend to class similar looking specimens as "*Pheretima heteropoda* (Goto and Hatai, 1898)" even though there are several prior contending names. A full description and distribution of all of all current synonyms maybe found in Blakemore (2010b) and revision of the *A. corticis* species-complex based on types is now in progress (Blakemore, in prep.).

Tube #15. ***Amynthas vittatus*** (Goto and Hatai, 1898)

(Fig. 14)

Perichaeta vittata Goto and Hatai, 1898: 74, text fig. (Tokyo, Kamakura. No types).

Amyntas vitattus: Beddard, 1900: 635.

Pheretima vittata: Michaelsen, 1900: 312; Cognetti, 1906: 783, figs. 8–11 (Yokohama. Type in Vienna museum); Hatai, 1929: 271, figs. 1–2; Kobayashi, 1936a: 52, 1938: 112; Ishizuka, 2001: 64; Minamiya *et al.,* 2007: 56.

Amynthas vittatus: Sims and Easton, 1972: 236; Easton, 1981: 51; Blakemore, 2003b: 27, 2005: 8, 2007: 108, 2008b: 19, 108, 2010a: 15.

Material examined. Newly designated neotype, NSMT-An 444, a previously undissected mature specimen, labeled: "*Ph vittata* Goto and Hatai Kanagawa Odawara Station /VIII 1930." [Note: Ohfuchi (1937: 113) described *Ph. nipponica* specimens from Odawara, collected on "VIII/1930," see also Tube #3].

Distribution. Japan from Hokkaido to Kyushu (Kobayashi, 1936, 1938) and Korea; Hatai (1929) described it from Aomori, through Miyagi to Shikoku, also from Oshima and Kagoshima. Type localities are all within the Kanto Plain. An unverified reported is from Ashford, northeastern Connecticut as noted in Blakemore (2010b).

Diagnosis and summary of neotype. Distinctly lateral striped appearance due to darker dorsal intersegments with pale setal lines (said to be less marked in Korean worms), mid-dorsal line dark, ventrum pale. Size range ca. 100–160 mm with 68–110 segments (neotype 160 mm long with 110 segments). Setae 50–60. Dorsal pores 12/13 (neotype) or 13/14 (Goto and Hatai, 1898). Spermathecae, at most, paired in 6/7/8 or one or more (or all) aborted; genital markings absent or in paired sets of one to six papillae linearly in 7 and often in 8 too just in front of setal line (rarely in 5 or 6 also); similar markings sometimes near male pore(s), when present, on 18. Stalked glands correspond to genital markings and occur near spermathecae; occasionally these glands have smaller stalked branches. Septa 8/9/10 aborted. Holandric with seminal vesicles in 11 and 12. Ovisacs absent. Intestine from ½ 15 (neotype) or 16. Intestinal caeca manicate.

Remarks. Goto and Hatai (1898) confused the pre-setal genital marking glands in 7 and 8 with spermathecae and thus falsely claimed 6 pairs in these two segments (parroted by Cognetti, 1906). Hatai (1929: 279) did correct his earlier flawed account and indicated that spermathecae may be present in some of 6/7/8 of this "handsome earthworm." It is possible that Goto and Hatai's subsequent *P. irregularis* is merely a more degraded morph of *A. vittatus* or, because it lacks banding, of some other taxon. Characteristics merge between Goto and Hatai's *schizoporus* and *levis*; in all cases male pores were absent or superfical, i.e., not proven to qualify for *Metaphire*. Thus all three taxa (*irregularis*, *schizoporus* and *levis*) are potentially synonymous with *A. vittatus*. But since banding is distinctive (less marked in Korean worms according to Kobayashi, 1938) only for *A. vittatus* (and *A. levis*?), these other names are more likely associated with *A. tokioensis*. Blakemore (2003a, b) noted that several of Ishizuka's proposed taxa (viz. *conjugata*, *bimaculata*, *purpurata*, *silvatica* and *surcata*) may also be synonymous with each other and with either of these prior taxa (see Blakemore, 2010a).

Several variable specimens newly collected from Tokyo and/or Hokkaido and studied by the

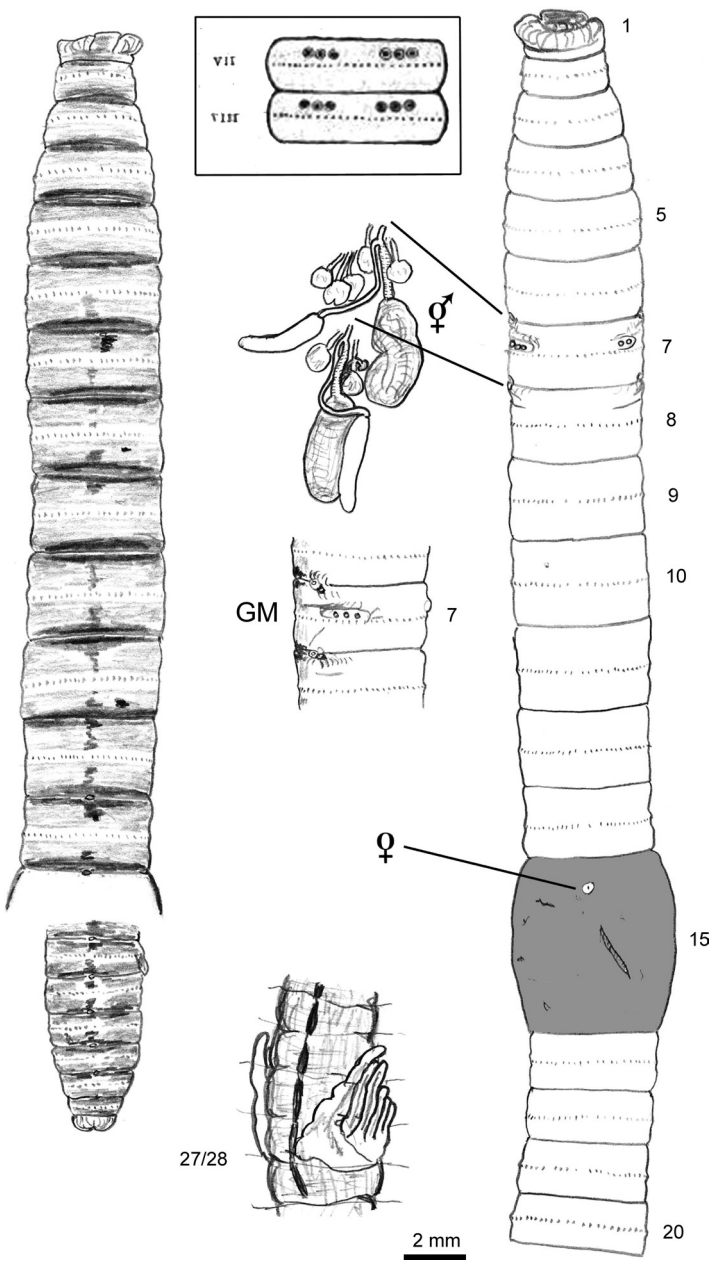

Fig. 14. *Amynthas vittatus*. — Neotype NSMT-An 444 showing ventral and dorsal views, with a lateral view of spermathecal pores in 6/7/8; spermathecae, genital glands and caeca shown *in situ*. Boxed is original sketch from Goto and Hatai (1898).

current author in Yokohama and Shiga Prefecture (*e.g.*, LBM FY2009-10-944) agree with *A. vittatus* and tend to have a similar banded colouration pattern dorsally. The markings (if present) on segment 7 and/or 8 are just anterior of the setal arc in lateral series of one to six on each side. This may well be the most distinct characteristic, although when they are single, double, or missing [*e.g.*, see Hatai's (1929: 280, fig. 2) twenty-eight kinds of variations of GMs] then this worm

will presumable be somewhat similar to several other taxa, especially to prior *A. tokioensis* that, however, lacks characteristic banding as discussed under that taxon in Blakemore (2003a, 2003b, 2007, 2010a).

Tube #16. **Specimen labeled "*Ph. abnormal*"**

Material examined. NSMT-An 440, a previously undissected mature, labeled "*Ph.* abnormal Ibaraki, Kuji Cty, Kuji Village (in kanji)" without collector or date information. Here described briefly, as exactly similar to both Tube #10 and #11 specimens.

Diagnosis. Length 100 mm. Segments 82. Dark anterior dorsum and buff clitellum. Dorsal pores from 11/12 but more open from 12/13. Setae ca. 50–60. Spermathecal and male pores missing. Genital markings absent. Internal anatomy conforms to Tube #10 and #11 specimens with septa 8/9/10 aborted, last hearts in 13, intestine from 15 and manicate caeca from 27.

Remarks. The labeling of this specimen is as "*Ph abnormal*" is again confusing and inconsistent since identifications had been attempted, albeit without dissections, of both Tube #10 and Tube #11 that nevertheless appear superficially and (by current dissections) to be morphologically identical; all may comply within variations permitted for *Amynthas tokioensis*.

Tube #17. ***Amynthas agrestis*** (Goto and Hatai, 1899)

Material examined. NSMT-An 433 undissected mature specimen labeled "*Ph agrestis* Goto and Hatai."

Remarks. See note with Tube #5 specimen.

Tubes #18 and #19. ***Amynthas micronarius*** (Goto and Hatai, 1898)

Material examined. Tube #18, NSMT-An 445, an undissected mature specimen labeled: "*Ph.* sp. Sendai Naga Town Kamohara's home (in kanji) 16/VI 1931"; Tube #19 NSMT-An 446 + An 447, two previously undissected matures labeled: "*Ph micronaria* Goto and Hatai."

Remarks. An 446 is a candidate neotype to be dealt with in a separate paper.

Tube #20. ***Metaphire yamadai*** (Hatai, 1930)

(Fig. 15)

Pheretima yamadai Hatai, 1930: 664, fig. 8 [From Tottori, Okayama, Wakayama, Kobe and Hatta (Ishikawa). Types unknown]; Chen, 1933: 255, figs. 20–21 (part?); Gates, 1935: 13–14 [synonym ?*pectinifera*; non *yamadai* Chen, 1933 A-form (? = *Ph. tschiliensis*) nec *yamadai* Chen, 1933 B-form (? = *Ph. pectinifera*)]; Kobayashi, 1939: 135 [synonyms *pectinifera*; *yamadai* B-form Chen, 1933, non *yamadai* A-form Chen, 1933 (= some species distinct from both *yamadai* and *tschiliensis*)].

?*Pheretima pectinifera* Michaelsen, 1931: 15 (From

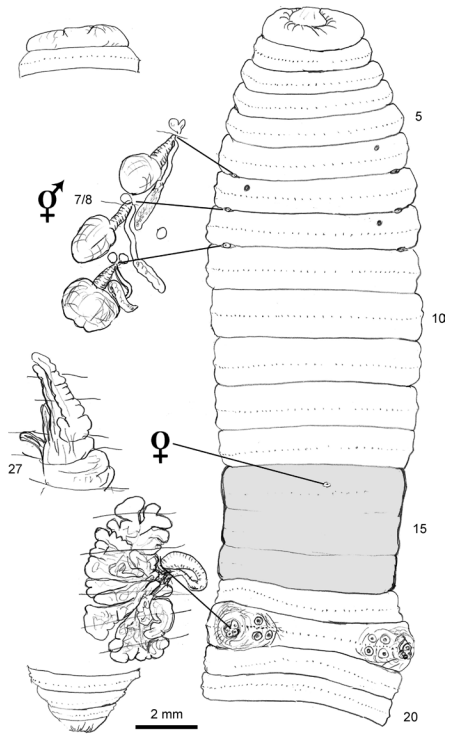

Fig. 15. *Metaphire yamadai*. — NSMT-An 448 (neotype) showing ventral and dorsal views, with spermathecae and genital glands, prostates, and caeca *in situ*. Body has some irregular dark dots, possibly parasitic artefacts (with cysts internally).

Soochow. Types missing); Gates, 1935: 14 ("*pectenifera*" lapsus, stating that at least four of the Hamburg specimens labeled as *Ph. pingi* are obviously *Ph. pectinifera*); Chen, 1936: 272 ("*pectinefera*" lapsus); Gates, 1939: 460 (a very confusing partial synonymy involving parts of *pingi* and *yamadai*).

Amynthas yamadai: Sims and Easton, 1972: 237 (*Amynthas sieboldi* species-group).

Metaphire yamardai [sic] (lapsus pro *yamadai*): Easton, 1981: 60 (as a junior synonym of *M. soulensis* — but this is not accepted here).

Metaphire yamadai: Blakemore, 2003b: 43, 2005: 9, 2006: 9, 2008b: 123 [suggesting synonymy of Korean *Metaphire quelparta* (Kobayashi, 1937), *M. sanseiana* (Ohfuchi, 1951: 56), and the probable new synonym of the latter species, *M. indigo* (Ohfuchi, 1951: 58)]; Blakemore, 2010a: 16 (as part of *M. hilgendorfi* /*A. tokioensis* species-complex — this inclusion now less justified).

Material examined. Newly designated neotype, NSMT-An 448; previously undissected mature labeled: "*Ph yamadai* collected from Tottori." Unfortunately no date is given thus, despite being from type-locality, and a likely syntype, it is not unequivocally proven as such. Other unregistered specimens in NSMT from Saito Ho-on Kai Museum Collection are comparable, viz. #174, 816, 867–874, especially the former batch (see Appendix 1).

Types unknown although description originally based on "a very large number of these from both Tottori and Okayama through the courtesy of Prof. Gentaro Yamada of the Tottori Government Agricultural College" and Kobayashi (1939) inspected "Three cotype-specimens with clitellar glandularity not yet complete, Tottori, Japan, May, 1930".

Distribution. Japan, China [Soochow, Nanking, Chusan, Shuan-shan and Ning-po — from Kobayashi (1939) who has *yamadai* in both Japan and China], Korea? (Easton, 1981: 60 states "Japan, China, Korea," but Korea is probably just for his *M. soulensis* synonym).

Diagnosis. Length average 127 mm (cf. 210 mm *pectinifera*); neotype 130 mm with 106 segments and ca. 80 setae on 12. Spermathecal pores in 6/7/8/9 (ca. 0.43 U apart — Easton, 1981). Dorsal pores 12/13 (neotype). Male pores at extreme margins on distended segment 18 within small copulatory chambers that are mostly everted by preservation (normally retracted and thus "non-superficial") porophore occuping 17/18–18/19 and with up to 32 setae between, escalating in density closer to male pores. Genital markings small, and variably median to spermathecal pores on 7 and 8 according to Easton and Kobayashi but overlooked by Hatai; found in current studies to be irregular in segments 6–8 (those shown as dark "rogue" dots on 6 rhs, 7 lhs and 8 rhs in Fig. 15 are possibly parasitic artefacts each with a small round 'gland' or cyst internally). More regular GMs median to male pores and within copulatory pouches (*pectinifera* has additional markings in several longitudinal ranks median to level of spermathecal pores in 7–9). Septa 8/9/10 aborted. Spermathecae in 7–9 are as figured with small glands associated. Holandric with seminal vesicles in 11 and 12. Last hearts in 13. Small ovisacs on 13/14. The muscular duct of the large prostatic gland of the neotype disappears into a small cavity on the body wall and no genital marking glands appear in this site although glands correspond with the more median cruciate markings. Intestine from 15 with caeca manicate [or the exact quote: "in XXVIII the finger shaped coeca (sic) with five projections are found in pairs"]; [Chen (1933: 255–261, fig. 21) has "caeca lobulated in 27–24 or 23(22), with parallel lobes or vertically tooth-shaped diverticula" and figures manicate caeca (but this was a misdescription according to Gates, 1948: 13)]. The neotype's manicate caeca have a longer lobe much incised on its outboard edge.

Remarks. Some accounts (erroneously?) have spermathecal pores in "5/6/7/8" despite them being described in 6/7/8/9 as here. Regarding male pores, Kobayashi (1939: 138) says "The general appearance of the male segment of this species resembles those of *Ph. asiatica*, *Ph. tibetana*, *Ph. tschiliensis*, *Ph. aggera*, *Ph. grahami*, *Ph. praepinguis*, *Ph. vulgaris* and *Ph. quelparta*; in each of these species there are found in the ventrolateral position of the copulatory chambers provided with crescent-shaped secondary male

pores, and each of these chambers contains internally a male disc and a primary male porophore. On the male disc, some setae are always planted and some genital papillae are usually found."

Thus, although the male pores appear everted in preserved specimens, they are classifiable as in copulatory pouches and thus qualify this species for *Metaphire*. Newly included in the *M. hilgendorfi* species-complex by Blakemore (2007, 2010a) but now, on the basis of the current redescription, *M. yamadai* merits separate status and is removed.

Synonymy of *M. yamardai* was by Chen (1933: 255, figs. 20–21) (in part, with junior synonym *pectinifera*); Gates (1935: 13–14) with synonym possibly of *pectinifera* but excluding Chen's 1933 *yamadai* A-form (= *Ph. tschiliensis*); and Kobayashi (1939: 135) with synonyms *pectinifera* and Chen's, 1933 *yamadai* B-form (non Chen's, 1933 *yamadai* A-form = some other species distinct from both *yamadai* and *tschiliensis*). Gates (1939: 460) has a very confusing partial synonymy of *pectinifera* involving parts of *pingi* and *yamadai*. Easton (1981: 60) has it with junior synonym *M. soulensis* — but this is not accepted here; while Blakemore (2003b: 43, 2005, 2006, 2008b: 123) suggests synonymy of Korean *Metaphire quelparta* (Kobayashi, 1937) and *M. sanseiana* (Ohfuchi, 1951: 56) (plus *indigo* Ohfuchi, 1951: 58), but provisionally excludes *M. pectinifea* (Michaelsen, 1931) with differences as noted in redescription of *M. yamadai* above.

Metaphire yamadai (Hatai, 1930) now appears almost exactly similar superficially to *M. aggera* (Kobayashi, 1934) that differs in its simple but incised intestinal caeca (or these misdiagnosed in *M. aggera*?), and Kobayashi (1938a: 155, 157) says that his *P. aggera* is close to, and may be synonymous with: *P. tschiliensis* Michaelsen, 1928 now *Metaphire*? *tschiliensis*, its synonym *Metaphire kiangsuensis* (Chen, 1930) from Chen (1933: 250), and with his own *Metaphire quelparta* (Kobayashi, 1937). Korean *M. quelparta* is almost exactly the same in each described character except for its large saccuar bodies associated with spermathecal pores, but it may belong in synonymy nevertheless, along with *M. sanseiana* (Hatai, 1951: 56) and the probable new synonym of the latter species, *M. indigo* (Hatai, 1951: 58). Research in Korea to confirm this possibility is pending (Blakemore, in prep.).

For *M. yamadai* in China, Chen (1933: 259, figs. 20, 21) shows variations with the caeca either deeply incised or manicate, but this was either a misdescription by usually reliable Chen of a composite of both Michaelsen's *P. pectenifera* and *P. tschiliensis* or else it attests to the unreliability of intestinal caeca as defining characteristics. Sims and Easton (1972: 264) for lobate/serrate caeca, noted they "cannot be regarded as taxonomic characters as they are more fully formed in the larger specimens and their development would appear to be correlated with growth." Nevertheless, the latter taxon may indeed have incised caeca and I currently maintain it separately classified as *Metaphire*? *tschiliensis* (Michaelsen, 1928).

Easton's (1981) inclusion of *Metaphire soulensis* (Kobayashi, 1938) in synonymy of *M. yamadai* (Hatai, 1930) is not here supported, as there are notable differences in morphology, especially of the markings around the male pores (when present in *soulensis*). Thus, parthenogenetic *M. soulensis* from Korea and Japan is maintained separately and has *Metaphire shinkeiensis* (Kobayashi, 1938) plus "*Pheretima*" *aokii* Ishizuka, 1999 — the latter from Tokyo with stated distribution, mysteriously, in "Japan (Shikoku, Honshu: Tokyo), Korea" by Ishizuka *et al.* (2000b: 181) — both included as junior synonyms for which, since it was clearly stated and demonstrated by Blakemore (2003b: 43, 2010a), there should be no need to repeat this here (but see Discussion).

Discussion

Are any of Goto and Hatai's taxa extinct? Possibly. But why such worms have not been recorded since relates partly to erratic interest in

eco-taxonomic survey of earthworms, yet is most likely due to inadequate initial description of the species.

As stated in the Introduction, almost all of Goto and Hatai's (1898, 1899) taxa have been in nomenclatural "limbo", mostly due to initial misdescription and with rampant parthenogenesis causing a complex zoological problem for more than 112 years, starting with Michaelsen (1900) who, acting as First Reviewer, attempted initial resolution. Hatai's later contributions did little to settle the many issues. No name-bearing type specimens had been known to remain in any institution, despite extensive searches by the current author, and presumably by previous workers, before some were recently re-discovered (see Blakemore and Ueshima, 2011). Under these circumstances it is permitted under ICZN (1999: Article 75) to designate neotypes in order to define the remaining nominal taxa objectively with the express purpose of clarifying their taxonomic status. In some cases the new type-localities differ slightly from the original localities claimed by Goto and Hatai, as is noted for each particular taxon; however, earlier taxa such as *A. masatakae* (Beddard, 1892) often have vague localities like "Japan." The main consideration is that the original author of these taxa (Dr. Hatai) seems to have had a hand in naming the current specimens, thus we have some support for these being close to his original concept, albeit there is often ca. 20–30 years difference in date of collection from original description and that most of the current specimens were undissected. Neotypes are justified on their merits in each situation as briefly discussed. It would have been preferable if Hatai attempted to resolve these outstanding issues 80 years earlier, or Ishizuka had 30 years ago.

Just like the genus *Perichaeta* Schmarda, 1861 being defunct for 112 years following Michaelsen (1900), the genus *Pheretima* Kinberg, 1867 *sensu stricto* has not been confirmed from Japan for 40 years since Sims and Easton (1972), Easton (1981) and Blakemore (2003a, b) (see Table 1). Yet attempts by Minamiya *et al.* (2007, 2009) and Ito *et al.* (2011) to resurrect something variously called either *Pheretima aokii* Ishizuka, 1999" or "*P. aokii* (Ishizuka, 1999)" lack apparent consideration neither of parthenogenetic degradation and natural variability of *Metaphire* Sims and Easton, 1972 or *Amynthas* Kinberg, 1867 species, nor of related taxa from Korea. Extension of the arguments proposed by such contemporary authors for retention of obsolete names would mean that specimens of parthenogenetic species — such as *Metaphire* cf. *glandularis* (= *M. hilgendorfi*) shown in Fig. 3 and *Amynthas levis* (questionably = *A. tokioensis*) shown in Fig. 11 in the current account — having only a single male pore (whether inverted or not) would presumably belong to one genus and species on one side of its body and another genus and species on its other side. Clearly a ridiculous concept!

Thus, to again repeat respective states: a specimen complicit with prior *M. soulensis* (Kobayashi, 1938) is in genus *Metaphire*, irrespective of whether or not it has male pores; and the parthenogenetically degraded entity named "*P. aokii*" was properly in default genus *Amynthas* rather than *Pheretima* before is was shown by Blakemore (2003a, b) to be synonymous to *Metaphire soulensis* and thus for the last decade has been regarded as its junior synonym, regardless if found in Japan or in Korea or elsewhere.

In addition to morphological examination, small tissue samples were taken to attempt mtDNA extraction and PCR amplification of COI barcode genes. Although unsuccessful, it is possible that technological development will allow future genetic barcoding of older, formalin types with data presented on the likes of GenBank or iBOLD information systems. In the meantime, neotypes, syntypes and specimens described here will hopefully provide exemplars for morphological comparison with fresher specimens that may yield usable DNA.

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Appendix 1. Summary of the Saito Ho-on Museum Collection (Hatai and Ohfuchi's earthworm samples) in the National Museum of Nature and Science, Tokyo briefly inspected 28 December 2009 by R. J. Blakemore. Spec, specimen; spex, specimens; db, incomplete NSMT earthworm database from 2009 based on this material.

Moniligastridae (*Drawida* spp.)

Drawida batches #72, 1159 and 1196 were inspected, all were dried and small except the latter which included some larger worms collected in 1937 (so not syntypes of *D. hattamimizu*). Batch #599 had small *Drawida* (*D. japonica*?) collected 1914.

Summary: no *Drawida hattamimizu* Hattai, 1930 samples were found.

Megascolecidae (pheretimoids)

Summary of possible pheretimoid types:

Pheretima gomejimensis Ohfuchi, 1937: #935 is dozen dried up spex possibly types as label says collected 4.ix.1936 from Gomejima, Aomori — the type locality. Medium sized pheretimoids but cannot tell whether any are mature or have been dissected. db says "gomejiminsis?" and notes label was outside jar.

Pheretima oyamai Ohfuchi, 1937 listed on db #340 from "Nakasatogun," possible type.

Pheretima servinus (sic) Hatai and Ohfuchi, 1937: dried batch #602 has some mention on the db and thus possibly type. Now included in the genus *Metaphire* as *M. servina*.

Pheretima tappensis Ohfuchi, 1935: batch #193 is possibly wet type but is from Hokkaido; batch #1199 is 2 or 3 dry specimens, possibly mature, at least one dissected, plus a vial with part of a body (gut?) inside. Batch #1214 also dry. The labels are poor and incomplete but one type locality is "Tappi" in Honshu cf. Batch #193 is two or more large specimens from Hokkaido.

Pheretima yamadai Hatai, 1930: batch #174 consists of about 6 specimens, one mature is dissected. Others have prominent (everted?) male pores. Possibly syntypes if the location "Tottori" is same as type location but no collection date (after or before 1930?). Notes: db mention of "*P. Nagasakiana* nov.sp." Batch #341 is a manuscript name with no ICZN status. Many unlabelled specimens (in both NSMT and UMUTZ) may yet be lost syntypes, but this indeterminable without further research.

Appendix 2. Yet another "Box of Worms" inspected by author in October, 2010

On Monday, 4th October, 2010 Dr. Rei Ueshima emailed R. J. Blakemore to say that he just recalled a box of original earthworm samples that had been taken from the Zoology Department of the University of Tokyo Museum (UMUTZ) several years earlier. Dr. Ueshima said the box was now held by Dr. Eijiro Nishi, Faculty of Education and Human Sciences, Yokohama National University (YNU) but that "These specimens (ca. 40 lots) were examined by Ishizuka and may contain no type specimen." Through the kindness of Dr. Nishi, this discarded box of worm samples at YNU was made available.

The box in question had the following label in Japanese on the outside:

"[To] Dr Eijiro Nishi, Original earthworm samples,

Heisei 13, 7th month [July, 2001].

[From] Kotaro Ishizuka"

Most of the glass jars were original, some were cracked, and the labels and contents were in various states of deterioration and leakage which is a great shame as these samples must have survived, due to the diligence of curators who recognized their value, both the 1923 Great Kanto Earthquake and the 1940s carpet bombing of Tokyo.

At least three sets of syntypes were thought present by the current author, and there was an urgent need to re-register these specimens, to stabilize samples, to decipher the labels, and to ensure this vitally important material is preserved and made available for morphological and DNA analysis into the future. These vitally important historical samples are now again safely stored in perpetuity at UMUTZ under curatorial care (see Table 2 footnote).