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NEW SPECIES OF *PHERETIMA*, *PITHEMERA*, AND *POLYPHERETIMA* (CLITELLATA: MEGASCOLECIDAE) FROM KALBARYO, LUZON ISLAND, PHILIPPINES

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ABSTRACT. **–** Eight new species of pheretimoid earthworms collected from Kalbaryo, Ilocos Norte Province, Luzon Island, the Philippines are described herein: four new species of *Pheretima*, three new species of *Pithemera*, and one new species of *Polypheretima*. All the *Pheretima* species lack genital markings. *Pheretima margaritata*, new species, *Pheretima kalbaryoensis*, new species, and *Pheretima thaii*, new species, have spermathecae in vi–ix, but *Pheretima globosa*, new species, has spermathecae in vii–ix. The distances between the male pores in *Pheretima margaritata*, new species, *Pheretima kalbaryoensis*, new species, *Pheretima thaii*, new species, and *Pheretima globosa*, new species, are 2.4 mm, 4.5 mm, 1.4 mm, and 1.7 mm, respectively. *Pithemera glandis*, new species, and *Pithemera fusiformis*, new species, have five pairs of spermathecae in v–ix. *Pithemera levii*, new species, has four pairs in v–viii. *Pithemera glandis*, new species, has no genital markings, but *Pithemera fusiformis*, new species, has paired genital markings in xix and xx. *Pithemera levii*, new species, has paired genital markings in xviii and xix. *Polypheretima pagudpudensis*, new species, has spermathecae in vi–vii, and genital markings paired in xvii, xix, and xx. Descriptions of the new species are provided, including illustrations of the ventral view, male pore region, and spermathecae.

KEY WORDS. **–** Taxonomy, *Pheretima, Pithemera, Polypheretima*, Megascolecidae, Clitellata, Philippines.

INTRODUCTION

This paper is one of a series of reports on the largely unknown earthworm fauna of the Philippines (James et al., 2004; James, 2004; Hong & James, 2004; Hong & James, 2008a, b). Beginning in early 2001, we surveyed numerous sites in the northern Philippines, one of which is covered here. The present site is Kalbaryo-Pagudpud, a somewhat isolated forested mountain on the very northwest corner of Luzon, 560 km from Manila, in the province of Ilocos Norte. Nearby towns are Bangui and Dumalneg. Kalbaryo is one of the last remaining forests at the northern end of the Central Cordillera Range of Luzon. At the time of our survey it was being considered for protected status by the Department of Environment and Natural Resources of the Government of the Philippines. Kalbaryo has a maximum elevation of about 400 m on the mountains. Lower slopes are mainly secondary forest, with primary forest at higher elevations. There is a pronounced dry season from March to April. Our visit was in early June, early in the rainy season.

The earthworms collected belong to the *Pheretima* complex (Sims & Easton, 1972) and fall into three genera, *Pheretima*, *Pithemera*, and *Polypheretima*.

The four new *Pheretima* species fall within two provisional species groups designated by Sims & Easton (1972): three species in the *darnleiensis* group and one species in the *dubia* group. The *darnleiensis* species group needs re-examination in light of collections made at Kalbaryo and elsewhere in the Philippines and Indonesia. Prior to our work it contained 15 species names all synonymized by Sims and Easton (1972) as *Pheretima darnleiensis* (Fletcher, 1886) and encompassed a large geographic area (Torres Straits to Philippines) with considerable, perhaps excessive, morphological variations (James, unpublished data). The species reported here extend both the range and the morphological variation of the species group.

Pithemera has fewer known species compared to most other genera in the *Pheretima*-complex, less than the small

genera *Ephemitra* Sims & Easton, 1972, and *Archipheretima* Michaelsen, 1928. *Pithemera* contains 12 species in the *bicincta*, *pacifica*, and *sedgwicki* species groups and one species transferred to *Amynthas*. In this paper the three new *Pithemera* species belong to the *bicincta* group in Sims & Easton (1972).

Holotypes and some paratypes are deposited in the National Museum of the Philippines Annelid collection (NMA). The remaining paratypes are deposited in the Kansas University Natural History Museum (KUNHM), USA, National Institute of Biological Resources, Korea (NIBR) and the Zoological Reference Collection (ZRC) of the Raffles Museum of Biodiversity Research, Singapore.

TAXONOMY

Pheretima margaritata, new species
(Figs. 1A–B)

Material examined. – Holotype: One clitellate (NMA 4385), Philippines, Ilocos Norte Province, Pagudpud, Kalbaryo (18°33.65'N 127°57.83'E), 239 m, litter layers in the forest, coll. Y. Hong, A. Castillo & M. Levi, 3 Jun.2001. Four paratypes: 1 clitellate (NMA 4393), 1 clitellate (KUNHM), 1 clitellate (NIBR), 1 clitellate (ZRC): same data as for holotype.

Other material: 10 clitellates, 4 aclitellates (KUNHM), Kalbaryo (18°30.94'N 120°54.52'E), 408 m, litter layer in the forest, 3 Jun.2001.

Diagnosis. – Four pairs of spermathecal pores in 5/6–8/9; 0.4 mm openings of copulatory bursae, spermathecal pores and male pores 0.25–0.28 and 0.26 circumference ventrally apart, respectively.

Etymology. – The name *margaritata* is Latin for pearl, here referring to the color of the spermathecal diverticulum.

Description. – Dark brown dorsal pigment, segmental equators unpigmented around setae. Dimensions 85–148 mm by 3.0–3.7 mm at segment x, 3.4–3.7 mm at xxx, 3.2–3.8 mm at clitellum, segments 83–96; body cylindrical in cross-section. Setae regularly distributed around segmental equators, numbering 24 at vii, 30 at xx; 4 between male pores, size, distance regular; setal formula AA:AB:YZ: ZZ = 4:2.5:4:7 at xiii. Clitellum annular in xiv–xvi; setae invisible externally.

First dorsal pore in 9/10, four pairs of spermathecal pores in 5/6–8/9, obvious bump inside segmental furrows, laterally placed, distance between spermathecal pores 2.8 mm (0.25–0.28 circumference ventrally apart). Female pore single in xiv on 0.5 mm oval, 0.4 mm openings of copulatory bursae paired in xviii, distance between openings 2.4 mm (0.26 circumference ventrally apart). Genital markings absent.

Septa 5/6–7/8 thin, 8/9, 9/10 absent, 10/11, 11/12 slightly muscular, 12/13, 13/14 thin. Gizzard in viii–x, intestine enlarged from xv, medium paired lymph glands from xxviii along dorsal vessel; intestinal caeca simple, originating in xxvii, and extending anteriorly about to xxv, each consisting of a finger-shaped sac; typhlosole almost none. Hearts x–xiii esophageal; ix lateral, right side much larger.

Ovaries and funnels in xiii, spermathecae in vi–ix with nephridia on spermathecal ducts; spermatheca with small broad oval ampulla, flattened by gizzard, duct shorter than ampulla, iridescent diverticulum, seminal chamber egg-shaped, with stalk longer than ampulla; several diverticula pass through septum to the anterior of the next segment. Male sexual system holandric, testes and funnels in ventrally paired sacs in x, xi. Seminal vesicles two pairs in xi, xii with dorsal lobes. Prostates in xvii–xviii, with short muscular duct entering central medial face of copulatory bursae without coelomic glands; copulatory bursa openings flanked anteriorly and posteriorly by circular pads; penis with long slit opening on one side.

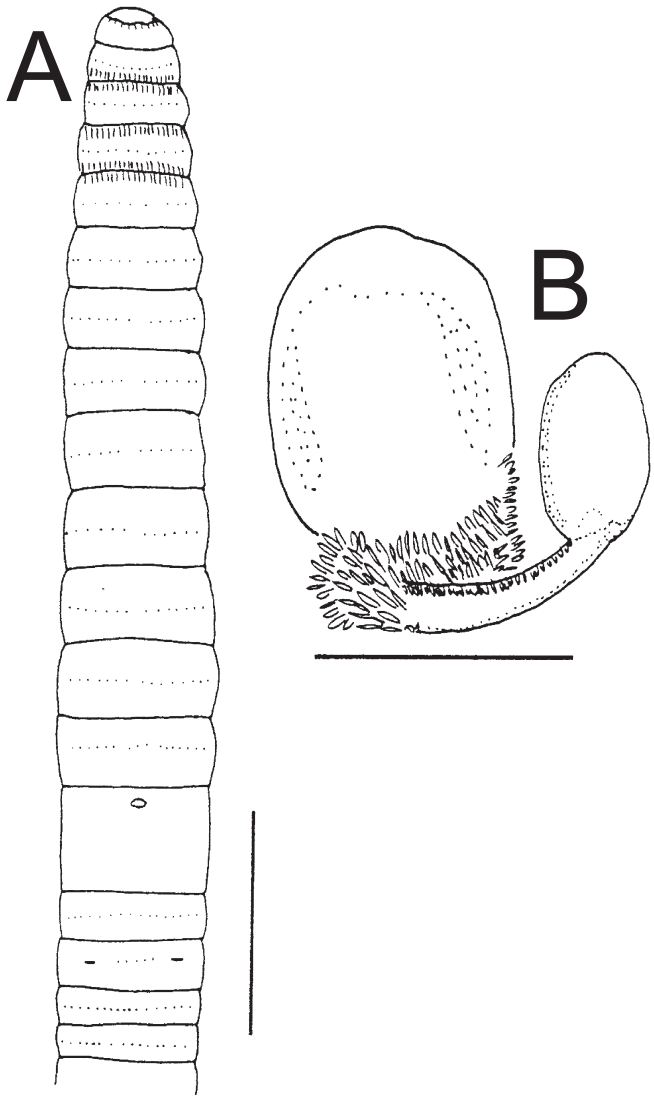

Fig. 1. *Pheretima margaritata*, new species: A, ventral view; B, spermathecae and diverticulum. Scale bars = 5 mm (A), 1 mm (B).

***Remarks.* –** *Pheretima margaritata*, new species, keys to the *darnleiensis* group in Sims & Easton (1972), composed of fifteen species, all of which were synonymized by Sims & Easton (1972). This species group is defined by having either four or five pairs of spermathecae, the last pair in segment ix, and the rare fifth in segment v. *Pheretima margaritata*, new species, differs from *P. darnleiensis* in having fewer setae per segment, fewer segments, generally shorter length (vs. restricted sense of *P. darnleiensis*, 155 mm), and consistently dark brown dorsal pigment, rather than sometimes unpigmented. The spermathecal diverticula are longer in *Pheretima margaritata*, new species, and the male and spermathecal pores are wider apart. Our examination of many of the species included in the synonymy of *P. darnleiensis* suggests that species-level differences have been ignored or discounted against the large number of spermathecae. The range possessed by *P. darnleiensis* sensu lato (Torres Strait to the Philippines; Borneo, Indonesia, Malaysia) could be either the result of an overly broad species concept or the consequence of human transport. We believe that this species was suspected of being a peregrine, at least within Southeast Asia, and for that reason the variations in size, coloration, and other characters were discounted. Certainly the original record on Darnley Island is outside the known natural range of *Pheretima*, so the suspicion was correct for that site. Even if there is a regional peregrine species embedded within *P. darnleiensis* we feel confident that 1) it does not include all the synonymized names and, 2) our material obtained from remote forested areas is native, not introduced. In any case, resolving the questions about the species divisions within *P. darnleiensis* will require a separate paper.

Pheretima kalbaryoensis, new species
(Figs. 2A–B)

***Material examined.* –** Holotype: One clitellate (NMA 4386), Philippines, Ilocos Norte Province, Pagudpud, Kalbaryo (18°33.65'N 127°57.83'E), 239 m, litter layers in the forest, coll. Y. Hong, A. Castillo & M. Levi, 14 Mar.2001, 3 Jun.2001.

Other material: 2 aclitellates, same data as for holotype (NMA).

***Diagnosis.* –** Four pairs of spermathecal pores in 5/6–8/9; spermathecal pores and male pores 0.23 and 0.17 circumference ventrally apart, respectively, typhlosole present, septa 8/9/10 present.

***Etymology.* –** The species is named after its type locality, Kalbaryo in Philippines.

***Description.* –** Dark brown dorsal pigment,1/3 segment length white stripes on setal rings, narrowing dorsally. Dimensions 210 mm (aclitellate 145 mm) by 6.2 mm at segment x, 7.0 mm at xxx, 6.7 mm at clitellum, segments 93; body cylindrical in cross-section. Setae numbering 38 at vii, 49 at xx; 7 between male pores; setae slightly more widely spaced dorsally, setal formula AA:AB:YZ:ZZ = 6:2:3:6 at xiii. Clitellum annular in xiv–xvi; setae invisible externally.

First dorsal pore in 11/12, four pairs of spermathecal pores in 5/6–8/9, conspicuous, distance between spermathecal pores 4.5 mm (0.23 circumference ventrally apart). Female pore single in xiv, on 0.6 mm oval, 1.0 mm openings of copulatory bursae paired in xviii, distance between male pores 3.6 mm (0.17 circumference ventrally apart). Genital markings absent.

Septa 5/6–7/8 thick, 8/9, 9/10 very thin, 10/11–12/13 thick with muscle, 13/14 thin. Gizzard in viii, intestine enlarged from xv, small paired lymph glands from xxviii along dorsal vessel; intestinal caeca simple, originating in xxvii, and extending anteriorly about to xxiv or xxiii, each consisting of a large finger-shaped sac; typhlosole low simple fold from xxvii, 32 longitudinal blood vessels in intestinal wall from xxviii. Hearts x–xiii esophageal; ix lateral, left side large.

Ovaries and funnels in xiii, spermathecae in vi–ix with nephridia on spermathecal ducts; spermathecae with small ampulla, diverticulum sausage-shaped, as long as ampulla or longer than ampulla. Male sexual system holandric, testes and funnels in ventrally paired sacs in x, xi. Seminal

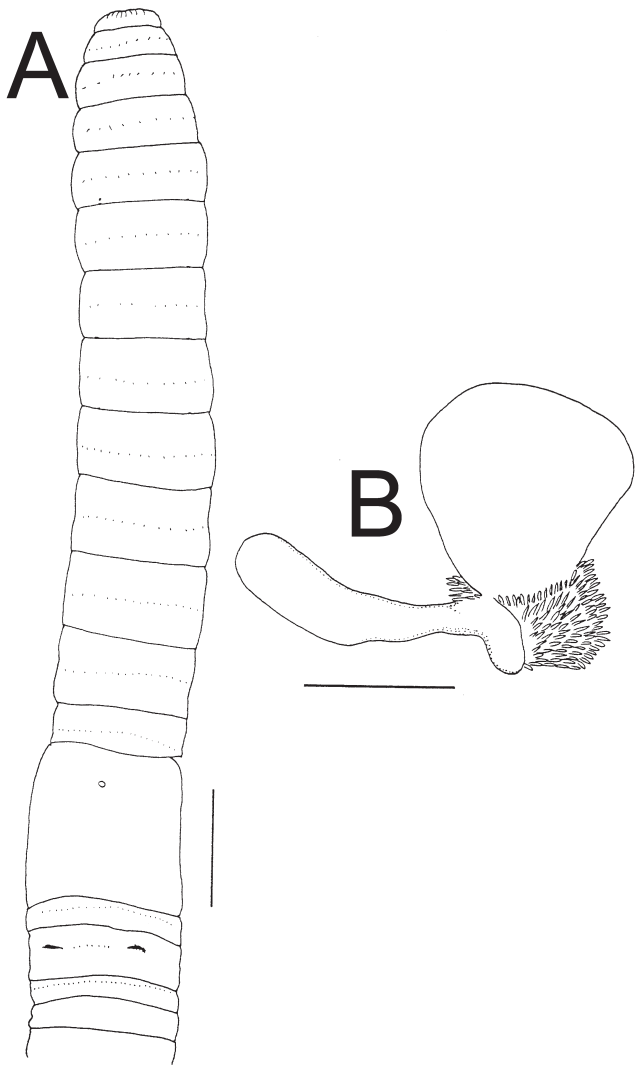

Fig. 2. *Pheretima kalbaryoensis*, new species: A, ventral view; B, spermathecae and diverticulum. Scale bars = 5 mm (A), 1 mm (B).

vesicles two pairs in xi, xii with dorsal lobes. Prostates in xvii– xviii, two lobes, smooth duct entering center of the copulatory bursae without coelomic glands, penis small, male pore just below tip; copulatory bursa openings flanked by anterior and posterior large flat circular pads.

***Remarks.* –** The species also keys to the *darnleiensis* group in Sims & Easton (1972). *P. darnleiensis* has fewer setae per segment, shorter body length, ampulla shorter than diverticulum and first dorsal pore in 9/10. The present species is larger than *Pheretima margaritata*, new species, and has more setae per segment, more closely placed male and spermathecal openings, septa 8/9/10 present, and a sausage-shaped diverticulum rather than a diverticulum with an egg-shaped seminal chamber.

Pheretima thaii, new species
(Figs. 3A–B)

***Material examined.* –** Holotype: One clitellate (NMA 4387), Philippines, Ilocos Norte Province, Pagudpud, Kalbaryo (18°30.94'N 120°54.52'E), 408 m, litter layers in the forest, coll. Y. Hong, A. Castillo & M. Levi, 3 Jun.2001.

***Diagnosis.* –** Four pairs of spermathecal pores in 5/6–8/9; spermathecal pores and male pores 0.5 and 0.2 circumference ventrally apart, respectively.

***Etymology.* –** The species is named for Dr. Thai Tran Bai, a Vietnamese biologist who made many good contributions to the taxonomy of earthworms.

***Description.* –** Dark brown dorsal and brown ventral pigment, intersegmental furrows and large circles around each seta unpigmented, these circles fuse where setae are closely spaced. Dimensions 60 mm by 2.1 mm at segment x, 2.3 mm at xxx, 2.5 mm at clitellum, segments 81; body cylindrical in cross-section. Setae more crowded ventrally in anterior segments, almost evenly distributed in posterior half, numbering 16 at vii, 24 at xx; 3 between male pores, size, distance irregular; setal formula AA:AB:YZ:ZZ = 1.5:1.5:4:7 at xiii. Clitellum annular in xiv–xvi; setae invisible externally.

First dorsal pore in 9/10, four pairs of spermathecal pores in 5/6–8/9, conspicuous, lateral (0.5 circumference). Female pore single in xiv, on 0.4 mm oval, 0.3 mm openings of copulatory bursae paired in xviii, 1.4 mm between male pores (0.2 circumference ventrally apart). Genital markings absent.

Septa 5/6–7/8 thin, 8/9, 9/10 absent, 10/11–13/14 thin. Gizzard in viii–x, intestine enlarged from xv, medium paired lymph glands from xxviii along dorsal vessel; intestinal caeca simple, originating in xxvi, and extending anteriorly about to xxiii, each consisting of a finger-shaped sac; typhlosole almost none. Hearts x–xiii esophageal; ix lateral.

Ovaries and funnels in xiii, spermathecae in vi–ix with nephridia on spermathecal ducts; spermatheca with small ovate ampulla, duct shorter than ampulla, diverticulum seminal chamber egg-shaped, iridescent, as long as ampulla, stalks long. Male sexual system holandric, testes and funnels in ventrally paired sacs in x, xi. Seminal vesicles two pairs in xi, xii with dorsal lobes, vas deferens slender, not muscular. Prostates in xvii–xix, with short muscular duct entering center of the copulatory bursae without coelomic glands; copulatory bursa openings flanked by anterior and posterior circular pads, penis long with vertical slit pore on medial face.

***Remarks.* –** *Pheretima thaii,* new species, has the same number of spermathecae as the previous two new species,

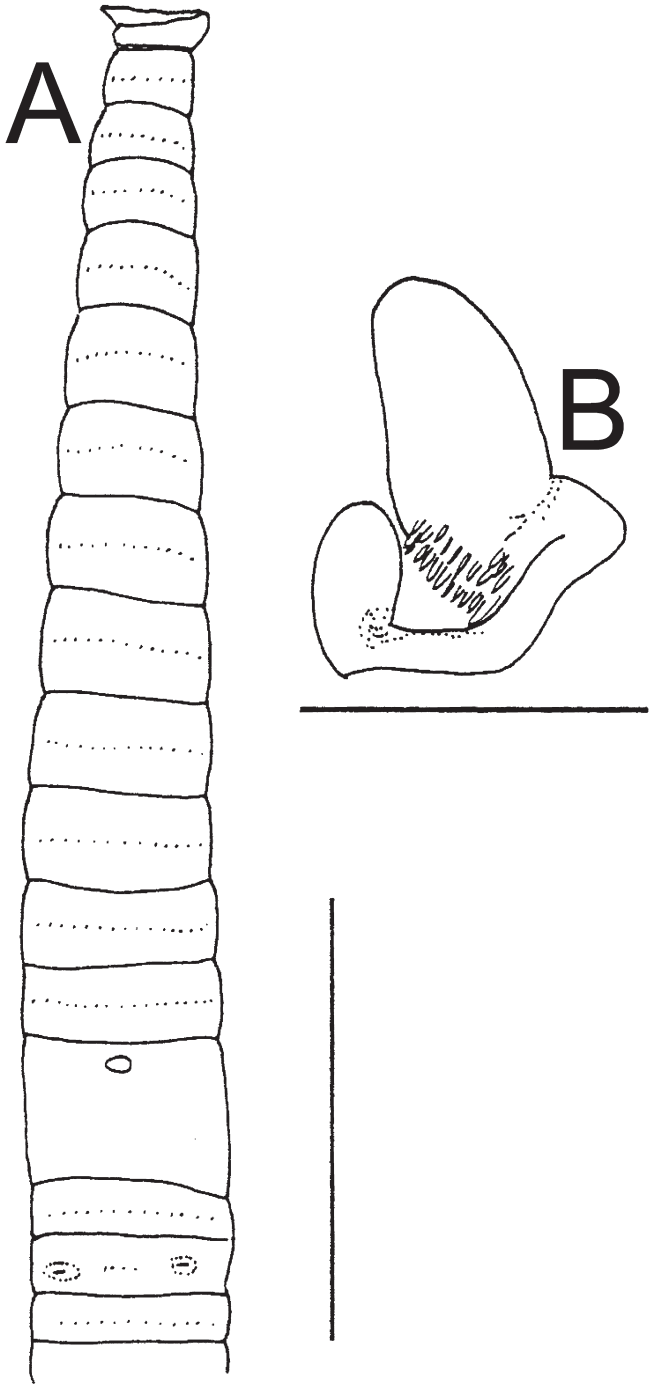

Fig. 3. *Pheretima thaii*, new species: A, ventral view; B, spermathecae and diverticulum. Scale bars = 5 mm (A), 1 mm (B).

but it differs from them and *P. darnleiensis* in the much more widely spaced spermathecal pores, much smaller body size and presence of ventral pigment. Its spermathecal ampulla is as long as the diverticulum, unlike *Pheretima kalbaryoensis,* new species. The diverticulum shape is similar to that of *Pheretima margaritata*, new species, but other characters are different.

Pheretima globosa, new species
(Figs. 4A–B)

Material examined. **–** Holotype: One clitellate (NMA 4388), Philippines, Ilocos Norte Province, Pagudpud, Kalbaryo (18°33.59'N 120°57.50'E), 175 m, litter layers in the forest, coll. Y. Hong, A. Castillo & M. Levi, 3 Jun.2001. Paratypes: 1 clitellate (NMA 4394), 1 clitellate (KUNHM), 1 clitellate (NIBR), 1 clitellate (ZRC): same data as for holotype.

Other material: 15 clitellates and 5 aclitellates, same data as for holotype (NMA).

Diagnosis. **–** Three pairs of spermathecal pores in 6/7–8/9; spermathecal pores and male pores 0.32 and 0.22 circumference ventrally apart, respectively.

Etymology. **–** The name *globosa* is Latin for spherical, here referring to the shape of the spermathecal diverticula seminal chamber.

Description. **–** Light brown dorsal pigment. Dimensions 35–42 mm by 2.3–2.5 mm at segment x, 2.5–2.7 mm at xxx, 2.5–2.6 mm at clitellum, segments 71–80; body cylindrical in cross-section. Setae regularly distributed around segmental equators, numbering 29 at vii, 52 at xx; 9 between male pores; size, distance irregular; setal formula AA:AB:YZ: ZZ = 1:1:1:2 at xiii. Clitellum annular in xiv–xvi; setae invisible externally.

First dorsal pore in 11/12, three pairs of spermathecal pores in 6/7–8/9, very small, distance between spermathecal pores 2.4 mm (0.32 circumference ventrally apart). Female pore single in xiv, on 0.3 mm oval, 0.3 mm openings of copulatory bursae paired in xviii, distance between male pores 1.7 mm (0.22 circumference ventrally apart). Genital markings absent.

Septa 5/6–7/8 thick, 8/9, 9/10 absent, 10/11–13/14 thin. Gizzard in viii–x, intestine enlarged from xv, paired lymph glands from xxviii along dorsal vessel; intestinal caeca simple, originating in xxvii, and extending anteriorly about to xxvi, each consisting of a short finger-shaped sac; typhlosole almost none. Hearts x–xiii esophageal; ix lateral, right side only.

Ovaries and funnels in xiii, spermatheca in vii–ix with nephridia on spermathecal ducts; spermatheca with spherical ampulla, duct shorter than ampulla, diverticulum seminal chamber egg-shaped. Male sexual system holandric, testes and funnels in ventrally paired sacs in x, xi. Seminal vesicles two pairs in xi, xii with dorsal lobes. Prostates in xvii–xviii, with short muscular duct entering center of the copulatory bursae without coelomic glands; copulatory bursa openings flanked by anterior and posterior circular pads, penis only small bump on copulatory bursa roof.

Remarks. **–** *Pheretima globosa*, new species, keys to the *dubia* group in Sims and Easton (1972), which is composed of five species, *P. philippina* (Rosa, 1891), *P. callosa* Gates, 1937, *P. dubia* (Horst, 1893), *P. korinchiana* Cognetti, 1922, and *P. poiana* Michaelsen, 1913. The present species is small, with body length 35–42 mm, and 71–80 segments, but *P. poiana* and *P. philippina* are large worms, greater than 180 mm in length with more than 110 segments. *Pheretima callosa* is large bodied (330 by 16 mm), has at least twice as many setae per segment as *Pheretima globosa,* new species, pseudovesicles in xiii and xiv, and thickly conical penes with deep cleft on the tips. *Pheretima callosa* is from the

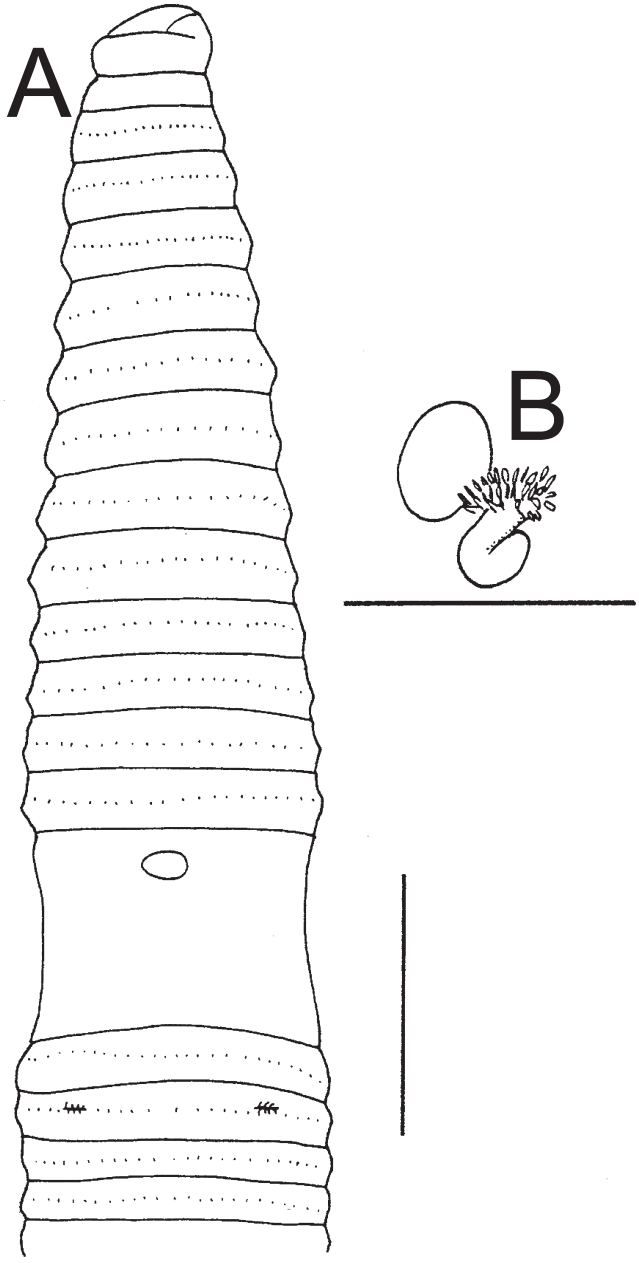

Fig. 4. *Pheretima globosa*, new species: A, ventral view; B, spermathecae and diverticulum. Scale bars = 3 mm (A), 1 mm (B).

Philippines, Luzon Island, Benguet Province at 2,130 m asl in oak forest, so is geographically the nearest neighbor among the *dubia* group. *Pheretima philippina* is from Mindoro, a more southerly island in the Philippines. *Pheretima dubia* is only twice the length of *Pheretima globosa*, new species, and has spirally twisted spermathecal diverticula. *Pheretima korinchiana* is also much larger (90–180mm), has violet-brown dorsal pigment, 12 setae between the male pores, laterally placed spermathecal pores, and a club-shaped diverticulum on an undulating or spiral stalk. Ignoring for the moment the numbers and locations of spermathecae that define the *dubia*-group, the present species is otherwise very close to the overall morphological pattern of the three species described here for the *darnleiensis*-group. It seems reasonable to hypothesize that *Pheretima globosa*, new species is derived from a *darnleiensis*-group ancestor, by loss of the anterior pair of spermathecae. James (2005) presents preliminary molecular evidence that similar reductions from the *darnleiensis*-group spermathecal battery have taken place in other Philippine *Pheretima* species.

Pithemera glandis, new species

(Figs. 5A–B)

Material examined. – Holotype: One clitellate (NMA 4389), Philippines, Ilocos Norte Province, Pagudpud, Kalbaryo (18°33.65'N 127°57.83'E), 239 m, litter layers in the forest, coll. Y. Hong, A. Castillo & M. Levi, 3 Jun.2001. Paratypes: 1 clitellate (NMA 4395), 1 clitellate (KUNHM), 1 clitellate (NIBR), 1 clitellate (ZRC): same data as for holotype.

Other material: 5 clitellates and 10 aclitellates, same data as for holotype (NMA).

Diagnosis. – Five pairs of very small spermathecal pores in 4/5–8/9; spermathecal pores and male pores 0.15 and 0.18 circumference ventrally apart, respectively. Genital markings absent.

Etymology. – The acorn shaped spermathecal ampulla is the source of the species name (*glandis* is Latin for acorn).

Description. – Brown dorsal pigment. Dimensions 62–108 mm (aclitellate 72 mm) by 4.1–4.5 mm at segment x, 4.2–4.6 mm at xxx, 4.3–4.6 mm at clitellum, segments 129–136; body cylindrical in cross-section. Setae regularly distributed around segmental equators, numbering 53 at vii, 61 at xx; 8–11 between male pores, size, distance regular; setal formula AA:AB:YZ:ZZ = 3.5:2:2:3.5 at xiii. Clitellum annular in xiv–1/2xvi; ventral setae of xvi visible externally.

First dorsal pore in 12/13, five pairs of minute spermathecal pores in 4/5–8/9, ventral, 2.0 mm between spermathecal pores (0.15 circumference ventrally apart). Female pores paired in xiv within 0.5 mm oval, male pores paired in xviii, 2.5 mm apart (0.18 circumference ventrally apart), slightly protuberant white spot on 0.3 mm porophores within 1.0 mm outer rings. Genital markings absent.

Septa 5/6–7/8 thick, 8/9 absent, 9/10–12/13 muscular. Gizzard in viii–ix, intestine enlarged from xv; intestinal caeca simple, originating in xxii, and extending anteriorly about to xx, each consisting of a small triangle-shaped sac; typhlosole medium depth simple fold from xxii. Hearts x–xii esophageal; ix lateral, viii absent.

Ovaries and funnels in xiii, spermathecae in v–ix; no nephridia on spermathecal ducts; spermatheca with an elongate acorn-shaped ampulla, ducts slender, as long as

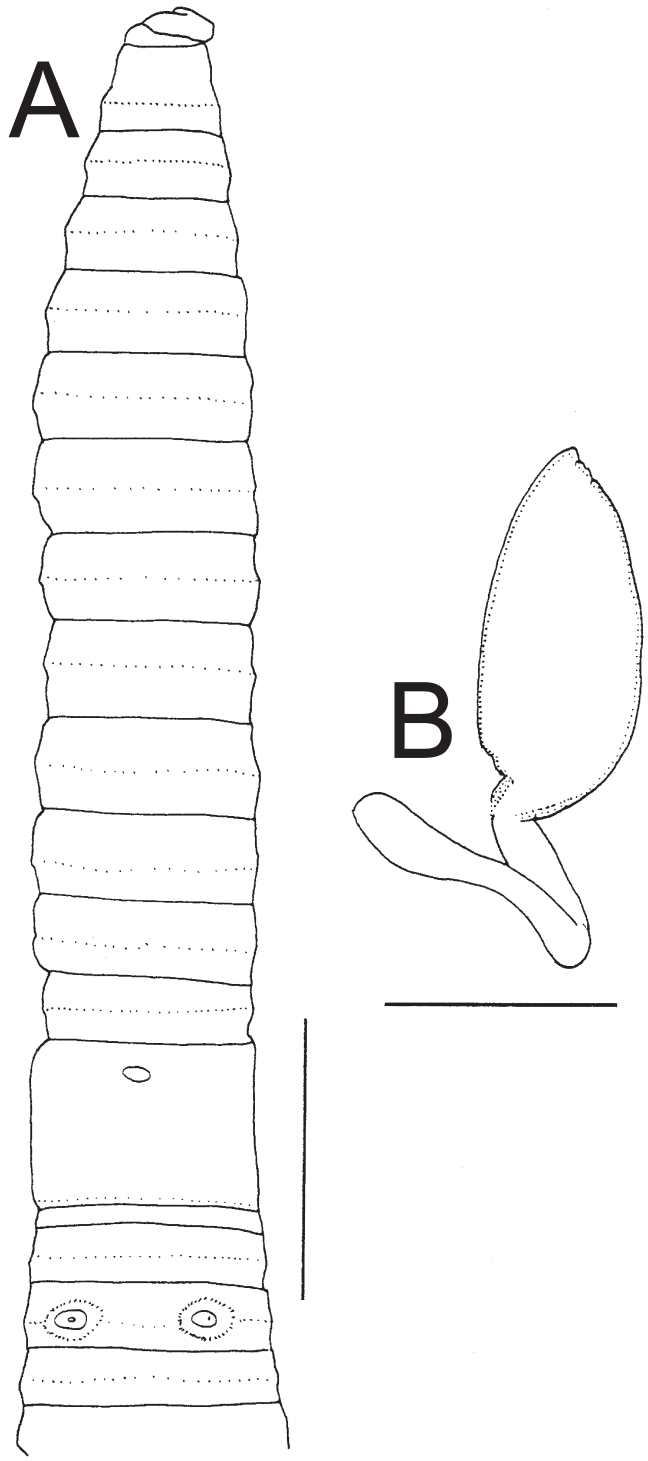

Fig. 5. *Pithemera glandis*, new species: A, ventral view; B, spermathecae and diverticulum. Scale bars = 5 mm (A), 1 mm (B).

ampulla, diverticulum shorter than ampulla with elongate oval chamber. Male sexual system holandric, testes and funnels in inverted U-shaped sacs in x, xi, testes sacs enclosing hearts x, xi, seminal vesicles xi. Seminal vesicles two pairs in xi, xii with fine bushy dorsal lobes, prostates in xvii–xix, four small main lobes, ducts long slender, widening slightly towards body wall, vas deferens very thin.

***Remarks.* –** *Pithemera glandis*, new species, keys to the *bicincta* group in Sims & Easton (1972), which is composed of two species, *Pi. bicincta* (Perrier, 1875) and *Pi. violacea* (Beddard, 1895). The species shares some characteristics of the spermathecal pores in 4/5–8/9, and ampulla longer than diverticulum, with *Pi. bicincta* and *Pi. violacea*. *Pithemera glandis*, new species, has no genital papillae, but *Pi. bicincta* has paired genital papillae in segments xviii and xix, and one pair of genital papillae just behind the male pores at 18/19. *Pithemera glandis*, new species, differs from *Pi. violacea* in having 8 or more setae between the male pores, and lacking the genital papillae on 18/19 found in *Pi. violacea*.

Pithemera fusiformis, new species
(Figs. 6A–B)

***Material examined.* –** Holotype: One clitellate (NMA 4390), Philippines, Ilocos Norte Province, Pagudpud, Kalbaryo (18°33.59'N 120°57.50'E), 175 m, litter layers in the forest, coll. Y. Hong, A. Castillo & M. Levi, 3 Jun.2001. Paratypes: 1 clitellate (NMA 4396), 1 clitellate (NIBR), 1 clitellate (ZRC): Same data as for holotype.

Other material: 10 aclitellates, same data as for holotype (NMA).

***Diagnosis.* –** Five pairs of spermathecae in v–ix; male pores invaginate white spots on 0.3 mm small round porophores, male pores 0.31 circumference ventrally apart. Genital markings paired in xix and xx.

***Etymology.* –** This species is named for the spindle-like appearance of the prostatic ducts.

***Description.* –** Brown dorsal pigment. Dimensions 20–22 mm by 1.7 mm at segment x, 1.8 mm at xxx, 1.6 mm at clitellum, segments 90; body cylindrical in cross-section. Setae regularly distributed around segmental equators, numbering 36 at vii, 47 at xx; 10 between male pores, size, distance regular; setal formula AA:AB:YZ:ZZ = 1.5:1:1:1.5 at xiii. Clitellum annular in xiv–1/2xvi; setae of xvi visible externally.

First dorsal pore in 12/13, five pairs of spermathecal pores in 4/5–8/9, unrecognizable externally. Female pore single in xiv, on 0.2 mm oval, male pores paired in xviii, invaginate white spots on 0.3 mm small round porophores, distance between male pores 1.8 mm (0.31 circumference ventrally apart), male pore region protuberant laterally. Genital markings paired in xix, xx. Septa 5/6–7/8 thin, 8/9 absent, 9/10–13/14 thin. Gizzard in viii–ix, intestine enlarged from xv; intestinal caeca simple, originating in xxii, and extending anteriorly about to xxi, each consisting of a small sac, laterally placed; typhlosole none. Hearts xi–xiii esophageal; ix lateral.

Ovaries and funnels in xiii, spermatheca in v–ix; no nephridia on spermathecal ducts; spermatheca with small ampulla, duct longer than ampulla, diverticulum sausage-shaped, shorter than ampulla. Male sexual system holandric, testes and funnels in paired lateral sacs in x, xi, not connected. Seminal vesicles two pairs in xi, xii with dorsal lobes. Prostates in xvii–xix, one or two lobes; prostatic duct with spindle-shaped muscular expansion in ectal half.

***Remarks.* –** The species also keys to the *bicincta* group in Sims & Easton (1972), but *Pi. bicincta* and *Pi. violacea* have the ampulla longer than the diverticulum and different locations of genital papillae. *Pithemera fusiformis*, new species is greatly smaller than *Pithemera glandis*, new species, (20–22 vs. 62–108 mm), has genital papillae and also lacks a typhlosole.

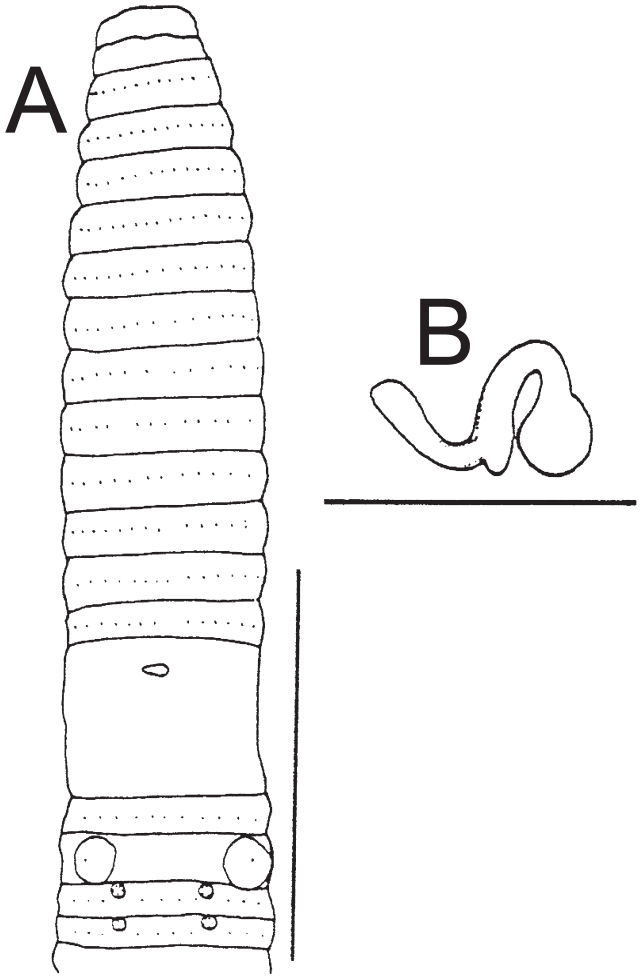

Fig. 6. *Pithemera fusiformis*, new species: A, ventral view; B, spermathecae and diverticulum. Scale bars = 3 mm (A), 1 mm (B).

***Pithemera levii,* new species**
(Figs. 7A–B)

***Material examined.* –** Holotype: One clitellate (NMA 4391), Philippines, Ilocos Norte Province, Pagudpud, Kalbaryo (18°30.94'N 120°54.52'E), 408 m, litter layers in the forest, coll. Y. Hong, A. Castillo & M. Levi, 3 Jun.2001. Paratypes: 1 clitellate (NMA 4397), 1 clitellate (KUNHM), 1 clitellate (NIBR), 1 clitellate (ZRC), same data as for holotype.

Other material: 7 clitellates and 13 aclitellates, same data as for holotype; 20 clitellates and 4 aclitellates, Kalbaryo (18°33.65'N 127°57.83'E), 239 m, colls. Y. Hong, A. Castillo & M. Levi, 3 Jun.2001.

***Diagnosis.* –** Four pairs of spermathecal pores in 4/5–7/8; spermathecal and male pores 0.11 and 0.13 circumference ventrally apart, respectively. Large circular genital papillae paired presetal in xviii and xix.

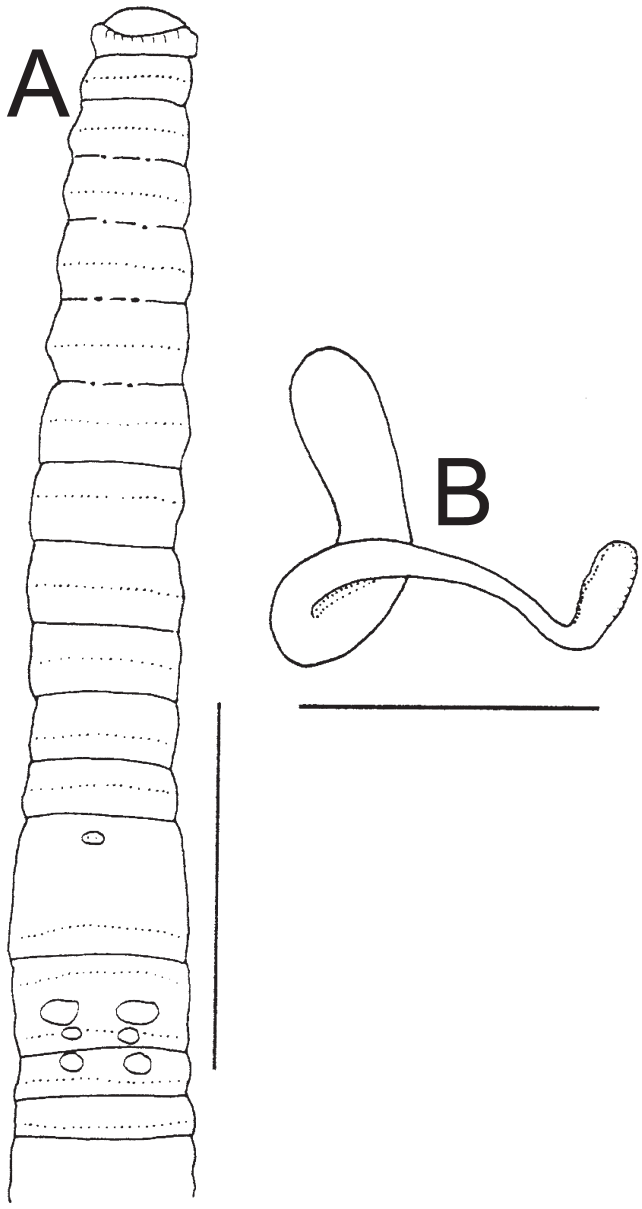

Fig. 7. *Pithemera levii*, new species: A, ventral view; B, spermathecae and diverticulum. Scale bars = 5 mm (A), 1 mm (B).

***Etymology.* –** The species is named for the collector of the type material, Mr. Matthew Levi.

***Description.* –** Brown dorsal pigment. Dimensions 50–65 mm by 2.3–2.6 mm at segment x, 2.5–2.7 mm at xxx, 2.5–2.8 mm at clitellum, segments 82–111; body cylindrical in cross-section. Setae regularly distributed around segmental equators, numbering 54 at vii, 63 at xx; 6–7 between male pores, size, distance regular; setal formula AA:AB:YZ:ZZ = 1:1:1:1.5 at xiii. Clitellum annular in xiv–1/2xvi; ventral setae of xvi visible externally.

First dorsal pore in 12/13, four pairs of spermathecal pores in 4/5–7/8 (one worm 4/5, 5/6 only), very close to medio-ventrum, 0.8 mm between spermathecal pores (0.11 circumference ventrally apart). Female pores paired in xiv, on 0.3 mm oval, male pores paired in xviii, on 0.3 mm dark oval, hardened porophores, 1.1 mm between male pores (0.13 circumference ventrally apart); large circular genital papillae paired, presetal in xviii, xix in line with male pores.

Septa 5/6–7/8 thick, 8/9 absent, 9/10–11/12 thick, 12/13, 13/14 thin. Gizzard usual in viii–ix, intestine enlarged from xv; intestinal caeca simple, originating in xxii, and extending anteriorly about to xxi, each consisting of a fingernail-shaped sac; typhlosole medium depth simple fold from xxii. Hearts x–xii esophageal; ix lateral, viii absent. Vessel branches from lateral heart ix to body wall, extends posteriorly to xiv.

Ovaries and funnels in xiii, spermatheca in v–viii (one worm v, vii only); no nephridia on spermathecal ducts; spermatheca with elongate cylindrical ampulla slightly expanded knob at ental end , duct short, diverticulum stalk slender, longer than ampulla; chamber small ovate. Male sexual system holandric, testes and funnels in paired sacs in x, xi, not joined dorsally. Seminal vesicles two pairs in xi, xii without dorsal lobes. Prostates in xvii–xix, 2–3 or more main lobes, prostatic duct with spindle-shaped muscular expansion in ectal half. Glandular tissue on body wall anterior to genital markings in xviii, xix.

***Remarks.* –** *Pithemera levii*, new species, has one pair of presetal genital papillae in each of xviii and xix, but *Pi. bicincta* has paired papillae in xviii extending from segments xviii to xix, and one pair of genital papillae just behind male pores at 18/19. *Pithemera levii*, new species, differs from *Pi. violacea* and *Pi. bicincta* in having only four pairs of spermathecae and no intersegmental genital papillae.

***Polypheretima pagudpudensis,* new species**
(Figs. 8A–C)

***Material examined.* –** Holotype: One clitellate (NMA 4392), Philippines, Ilocos Norte Province, Pagudpud, Kalbaryo (18°33.65'N 127° 57.83'E), 239 m, litter layers in the forest, coll. Y. Hong, A. Castillo & M. Levi, 14 Mar.2001, 3 Jun.2001.

Other material: 3 aclitellates, same data as for holotype (NMA).

***Diagnosis.* –** Two pairs of spermathecal pores in 5/6, 6/7; male pores xviii on extending to lateral margin of ventrum, distance between male pores 1.5 mm (0.23 circumference ventrally apart). Genital markings paired in xvii, xix and xx.

***Etymology.* –** The species is named for its type locality, Pagudpud in Philippines.

***Description.* –** Worm unpigmented. Dimensions 56–63 mm by 2.1 mm at segment x, 2.2 mm at xxx, 2.0 mm at clitellum, segments 126–136; body cylindrical in cross-section. Setae regularly distributed around segmental equators, numbering 63 at vii, 27 at xx; 8 between male pores, size, distance irregular; setal formula AA:AB:YZ:ZZ = 3:1.5:1:1 at xiii. Clitellum annular in xiv–xvi; setae invisible externally.

First dorsal pore in 12/13, two pairs of spermathecal pores in 5/6, 6/7. Female pore single in xiv on 0.3 mm oval, male pores xviii on protuberant white spot at center of round porophores, distance between male pores 1.5 mm (0.23 circumference ventrally apart). Genital markings paired in xvii, xix, xx; all slightly medial to male porophores; genital markings within white epidermal thickenings spanning greater width than male porophores; small paired pre- and post-setal epidermal thickenings medial to porophores in xviii.

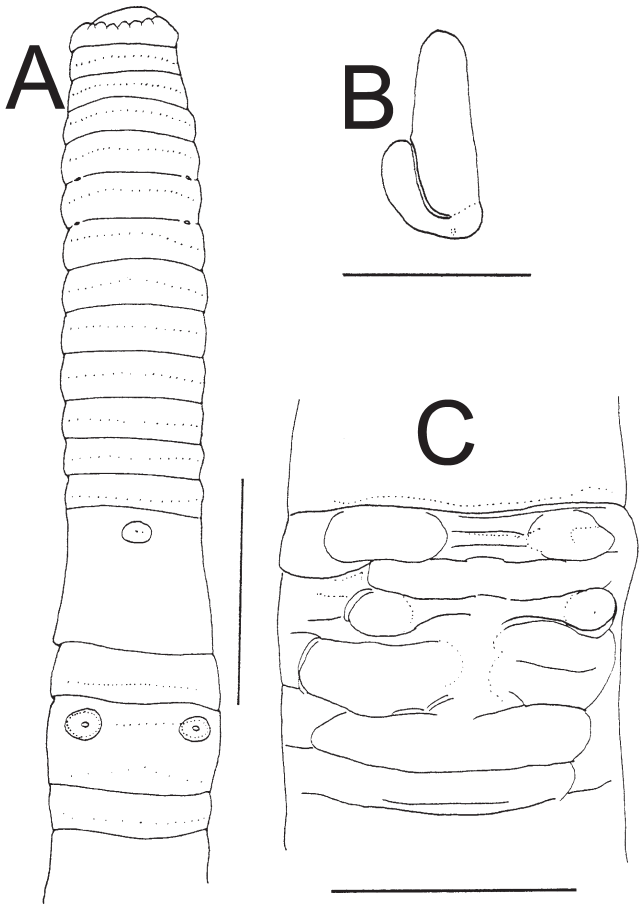

Fig. 8. *Polypheretima pagudpudensis*, new species: A, ventral view; B, spermathecae; C. malepore region in xviii. Scale bars = 3 mm (A), 2 mm (C), 1 mm (B).

Septa 5/6–7/8 thick, 8/9–13/14 thin. Gizzard in viii, intestine enlarged from xv, intestinal caeca absent; typhlosole large, 1/2 lumen diameter from xxii. Hearts x–xii esophageal; ix lateral.

Ovaries and funnels in xiii, spermatheca in vi, vii without nephridia on spermathecal ducts; spermatheca with elongate ampulla, diverticulum stalk shorter than ampulla, chamber small oval. Male sexual system holandric, testes and funnels in dorsally united sacs in x, xi. Sacs do not enclose hearts. Seminal vesicles two pairs in xi, xii, very small. Prostates broad but thin, in xvii–xxii, ducts slender.

***Remarks.* –** The species shares the spermathecal pores in 5/6, 6/7, and male pores on prominent porophores with *Polypheretima sempolensis* Easton, 1979. *Polypheretima sempolensis* has paired postsetal genital markings on xvii, and paired presetal on xix, but the present species has paired genital markings covering the ventrum of xvii, xix, and xx. Also, *Polypheretima pagudpudensis*, new species, has no genital markings in the spermathecal pore region, but *Po. sempolensis* has paired presetal genital markings on ix, xii and occasionally xiii, median to the line of spermathecal pores, and the genital markings are exceptionally large, invading the setal lines and the intersegmental furrows. *Polypheretima sempolensis* were recorded from East Java, at 1,400–1,500 m elevation.

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