

A new species of *Phyllochaetopterus* Grube, 1863 (Polychaeta: Chaetopteridae) from Hainan Island, South China Sea*

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Abstract *Phyllochaetopterus* species are widely distributed on the coast of China. Here, *Phyllochaetopterus hainanensis* n. sp., a new species collected from Hainan Island (China), is reported. It is characterized by having a V-shaped peristomium, two eyespots covered by a pair of large curved peristomial notopodia (cirri located beneath the palps), 13–14 chaetigers in the anterior body region, with three enlarged modified chaetae on the fourth notopodium, and more than five chaetigers in the middle body region. The modified chaeta has a slightly inflated head with an obliquely truncate end. The new species resembles *Phyllochaetopterus socialis* Claparède, 1869, but differs in the shape of peristomial notopodia and peristomium. Twelve species of *Phyllochaetopterus* have been described from the Pacific Ocean, including the new species described here. An identification key to the known Pacific species is provided together with a brief discussion of the taxonomic value of the eyespots for the genus.

Keyword: Chaetopteridae; *Phyllochaetopterus*; new species; identification key; Hainan Island; South China Sea

1 INTRODUCTION

The family Chaetopteridae is widely distributed from subtidal to deep waters, including hydrothermal vents and whale falls (Nishi and Rouse, 2014). Most chaetopterids are tube-dwelling worms. However, *Chaetopterus pugaporcinus* Osborn, Rouse, Goffredi & Robison, 2007 was described as a holopelagic species inhabiting deep mesopelagic waters off Monterey Bay, California (Osborn et al., 2007). Chaetopterids have three well-defined body regions, anterior (A), middle (B) and posterior (C); and one or more specialized enlarged chaetae in the fourth chaetiger of region A. The latter are a robust taxonomic character (e.g., in Bhaud (1998, 2003) for *Spiochaetopterus*), as well as a useful tool to identify species in planktonic stages (Bhaud, 1983).

Phyllochaetopterus Grube, 1863 differs remarkably from the other genera of the family in having species with a pair of so-called ‘tentacular cirri’ lying on each side of the prostomium. Their ‘tentacular cirri’ are probably nonhomologous to the tentacles of other

polychaetes (Fauchald and Rouse, 1997). As they are supported by thin capillary chaetae (Potts, 1914), we here consider them to be reduced and modified peristomial notopodia.

When we studied the polychaete collections at the Marine Biological Museum of the Chinese Academy of Sciences, we discovered some fragments of an unidentified species of *Phyllochaetopterus*. These are fully described and illustrated here as a new species. The World Register of Marine Species (WoRMS) lists 20 species of *Phyllochaetopterus* (Read and Fauchald, 2015) and, of these, 12 species are described as inhabiting the Pacific Ocean, including the new species (Nishi and Rouse, 2007, 2014). We provide an identification key to distinguish among species from the Pacific Ocean.

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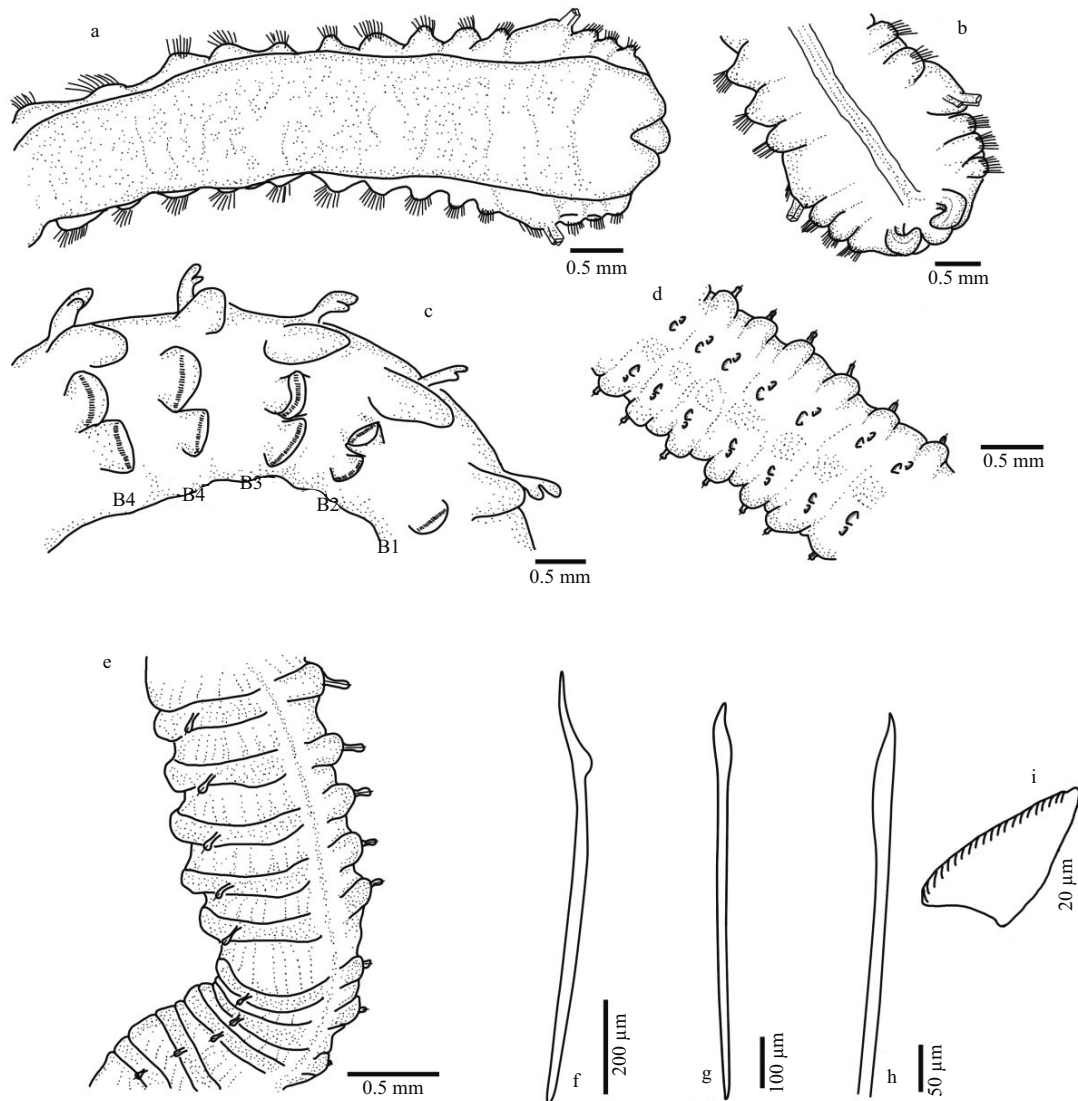


Fig.1 *Phyllochaetopterus hainanensis* n. sp. paratype MBM 190829

a–b. ventral and dorsal view of region A, respectively; c. lateral view of region B; d–e. ventral and dorsal view of posterior part of region C, respectively; f–h. notochaetae of region A; i. uncini from B1 neuropodia. Scale bars: a–e: 0.5 mm; f: 200 µm; g: 100 µm; h: 50 µm; i: 20 µm.

2 MATERIAL AND METHOD

Specimens and tubes were collected on 7 April 1958 in Lingao Harbor, north-west Hainan Island, and preserved in 72% alcohol. The specimens are deposited in the Marine Biological Museum at the Institute of Oceanology, Chinese Academy of Sciences (IOCAS), Qingdao, China. The samples were examined with a Zeiss Stemi 2000-C stereo microscope, and photographed and measured using an AxioCamMRc 5 camera. Detailed structures of the modified chaetae on the fourth chaetiger and notopodia of region C were observed with a scanning electron microscope.

3 RESULT AND DISCUSSION

3.1 Systematics

Family Chaetopteridae Audouin & Milne Edwards, 1833

Genus *Phyllochaetopterus* Grube, 1863

Phyllochaetopterus hainanensis n. sp. (Figs.1–4)

Material examined: Holotype, MBM283026, incomplete, palps and pygidium missing, 14 chaetigers in region A, 12 chaetigers in region B, six chaetigers in region C, with a section of tube, sandy beach, Lingao Harbor, Hainan Island, South China

Sea, coll. Wu Baoling, 7 April 1958.

Paratypes, collected in the same manner as holotypes on the same day. MBM 190829, incomplete, middle part missing; MBM 283028, incomplete, one anterior part; MBM 283027, three anterior parts and four middle region parts; MBM 283029, one anterior part; MBM 283031, incomplete, one anterior part; MBM 283032, incomplete, anterior part missing.

Diagnosis: Middle peristomium recurved.

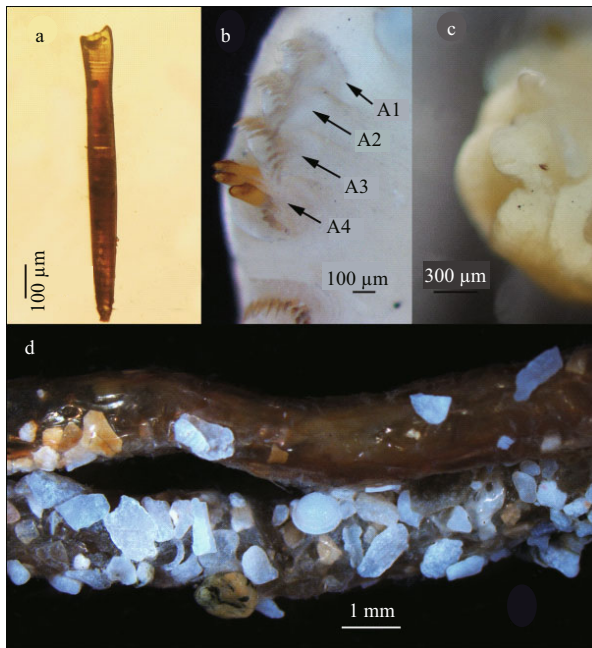


Fig.2 *Phyllochaetopterus hainanensis* n. sp.

a. modified chaeta from paratype MBM 283027; b. dorsal view of first four chaetigers (A1–A4) of paratype MBM 283027, showing notopodia (arrows); c. eyespots of paratype MBM 283027; d. tubes from paratype MBM 190829.

Prostomium spherical, with one pair of conspicuous lateral eyespots. Peristomial notopodia beneath palps, stout, semicircular. Up to 13–14 chaetigers in region A, first four chaetigers slightly stouter than posterior ones. Usually three pairs of large modified chaetae on fourth parapodia. Ventral part of region A entirely covered by glandular shields (ventral shields), whitish in alcohol-preserved specimens. Twelve chaetigers in region B; neuropodia of B1 unilobed, others bilobed. About 52 chaetigers in region C; notopodia unilobed and neuropodia bilobed.

Description: Region A 4.3–9.0 mm long, ca 2.0 mm wide at widest point of fourth chaetiger excluding parapodia. In holotype, region A 4.3 mm long excluding palps, and region B 10.5 mm long. Body 1.0–2.0 mm wide at fourth chaetiger excluding parapodia. Region C of paratype MBM 283032 about 20 mm long.

Region A convex ventrally and flattened dorsally. Two grooved palps arising from lateral side of prostomium (Fig.4b, c). Two cirri-like, conspicuous, stout peristomial notopodia on the posterolateral side of palps, semicircular or crescent (Fig.1b), with inner chaetae. Prostomium spherical, extended forward. Two dark-brown eyespots, visible after removing cirri (Fig.2c). Peristomium distinct with an obvious V-shaped incision ventrally (Fig.1a). Region A with uniramous parapodia, usually with 14 chaetigers (13 in one of eight specimens examined). Holotype with 15 notopodia on the left side and 14 on the right side. First four chaetigers slightly wider than posterior ones (Figs.1a–b, 2b). Chaetigers A1–A3 very short (Figs.1a, 4a–c). Parapodia on A4 large, broadly

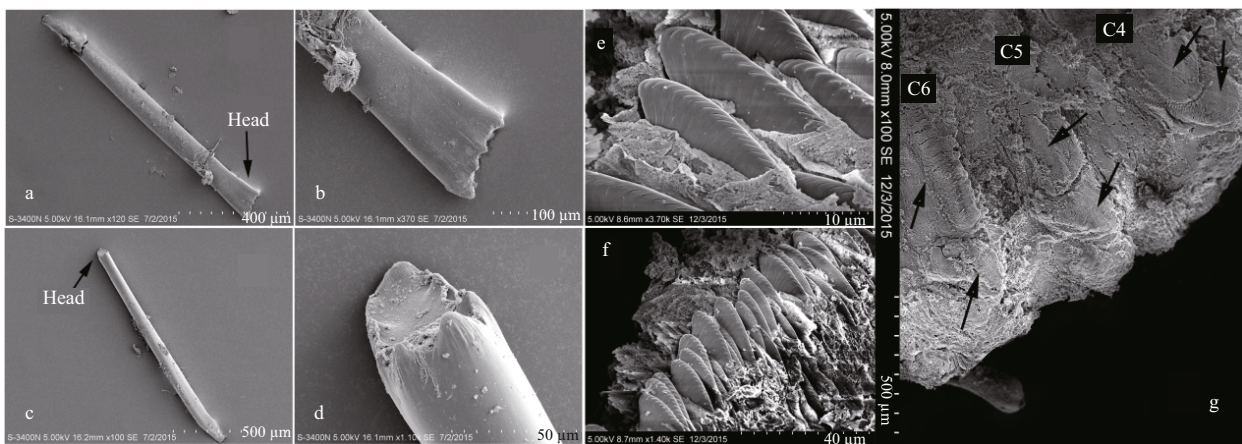


Fig.3 Scanning electron micrographs of A4 modified chaetae and uncini from region C of *Phyllochaetopterus hainanensis* n. sp. from paratypes MBM 283029 and 283031

a. lateral view of A4 modified chaeta; b. lateral view of the head of A4 modified chaeta showing small teeth on lateral edge; c. ventral view of A4 modified chaeta; d. ventral view of the head of A4 modified chaeta; e. uncini from region C; f. row of uncini; g. ventral view of C4–C6, showing bilobed neuropodia of region C.

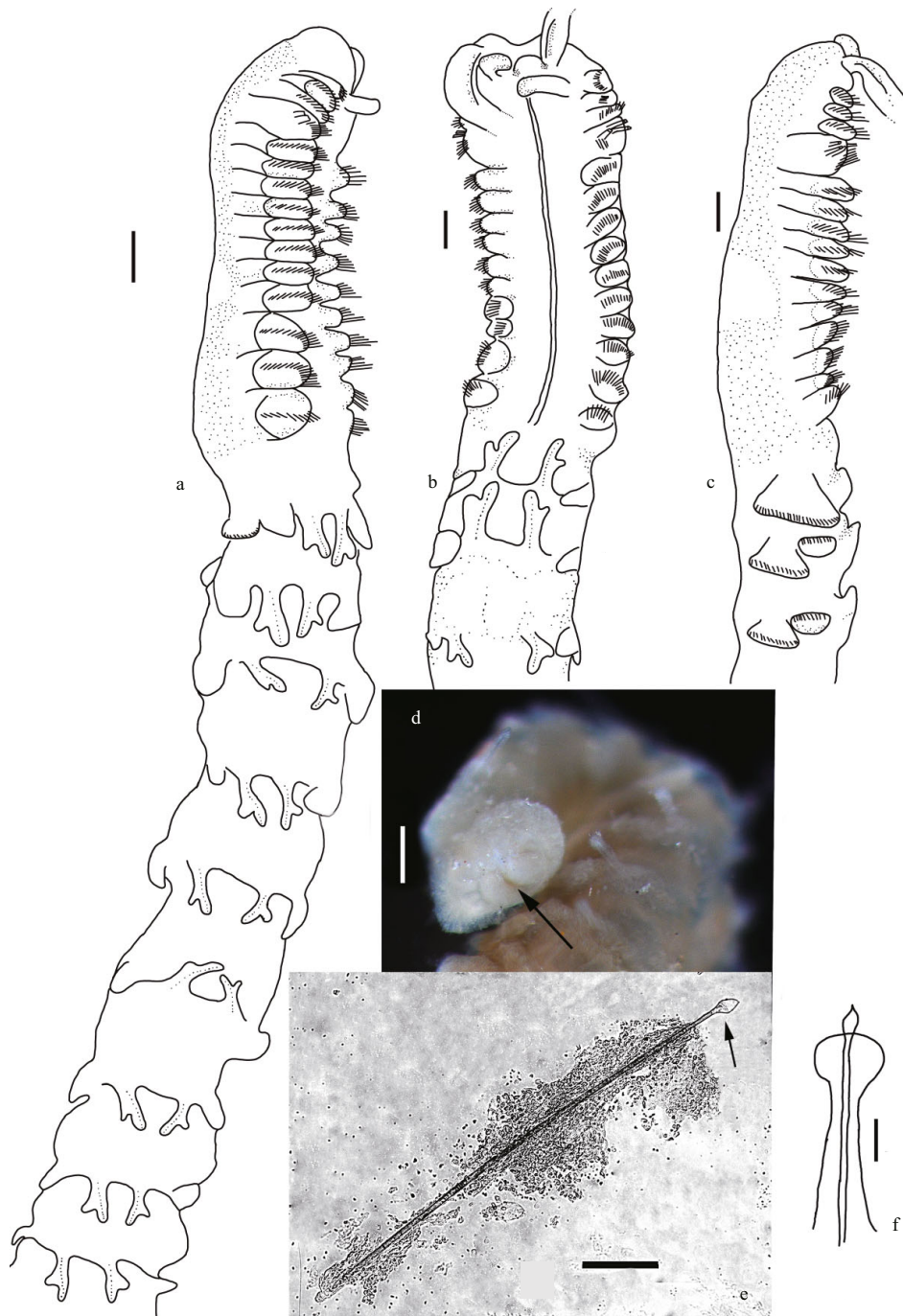


Fig.4 *Phyllochaetopterus hainanensis* n. sp.

a. holotype. Lateral view of regions A and B. Paratype MBM 283031; b. dorsal view; c. lateral view. Paratype MBM 283032; d. pygidium, arrow shows anus; e. notochaetae; f. notopodium. Scale bars: a–c: 0.5 mm; d: 200 μ m; e: 100 μ m; f: 50 μ m.

rounded, with 2–3 golden-yellow modified chaetae and lanceolate companion chaetae. Plate-like cutting chaeta with obliquely truncated head, slightly inflated in lateral view (Fig.3a, c), with 2–3 small teeth on both lateral edges (Figs.2a, 3b, d). Remaining parapodia with lanceolate and paddle-shaped chaetae (Fig.1f–h). Ventral shields (ventral glandular shields)

from A3 to the posterior end of region A. A semicircular creamy white patch from A9 to A11 or from A10 to A12.

Region B slender, with 12 chaetigers similar in length. Notopodia bilobed, with Y-shaped inner lobe and triangular lateral branchial lobe (Figs.1c, 4a–c); bases of paired inner lobes connected. Neuropodia of

B1 unilobed, large, triangular; remaining ones bilobed. Neuropodial uncini triangular, with concave occipital face. Uncini from region B with 17–20 fine teeth (Fig.1i).

Region C slender, fragile, with up to 52 chaetigers. Notopodia unilobed, digitate, with inflated head, with one slender lanceolate or paddle-like inner chaeta (Figs.4e, f). Neuropodia bilobed (Figs.1d, 3g), with small lateral lobe and larger ventral lobe (Fig.3g), bearing rows of uncini (Fig.3e, f). Uncini similar to those of region B, with ca 18 teeth. Pygidium simple (Fig. 4d), without any appendages.

Tube dark brown, with a thick wrinkled wall having attached sand, stones and shell fragments (Fig.2d).

Color: Body pale yellow in alcohol-preserved specimens. Region B sometimes dark green.

Etymology: The specific name derives from Hainan Island (China), the type locality.

3.2 Remarks

Phyllochaetopterus hainanensis n. sp. differs from all other species of the genus in having curved, inflated peristomial notopodia (slender, clavate in all other species). It resembles *Phyllochaetopterus verrilli* Treadwell, 1943 in having a V-shaped peristomium, but differs in having 14 (sometimes 13) chaetigers in region A (8–10 in *P. verrilli*) and 12 in region B (two in *P. verrilli*) (Treadwell and Verrill, 1943; Bhaud, 1983), as well as distinct eyespots (lacking in *P. verrilli*). The new species also resembles *Phyllochaetopterus socialis* Claparède, 1869 and *P. sibogae* Caullery, 1944 in numbers of chaetigers of region A and region B. *Phyllochaetopterus socialis* has 10–18 and 7–24 chaetigers in regions A and B, respectively (Day, 1967; Nishi and Rouse, 2007). *Phyllochaetopterus sibogae* has 13–14 and seven chaetigers in regions A and B, respectively (Caullery, 1944). In turn, neuropodia are all bilobed in *P. socialis* (neuropodia of B1 are unilobed in *P. hainanensis* n. sp.) and *P. sibogae* has a truncate peristomium, small peristomial notopodia and transparent tube (Caullery, 1944) (brown, thick, twisted in *P. hainanensis* n. sp.).

3.3 Discussion

Chaetopterid worms are easily broken into fragments owing to careless collection and stripping them from their chitinous tubes (Gitay, 1969; Yang and Sun, 1988). *Phyllochaetopterus* can be distinguished from the other genera of chaetopteridae

in having a pair of small ‘tentacular cirri’ on each side of the prostomium (Gitay, 1969; Fauchald, 1977; Nishi and Arai, 1996). We dissected one ‘tentacular cirrus’ of *P. hainanensis* n. sp. and observed the presence of an inner chaeta, in agreement with Potts (1914), who regarded the ‘tentacular cirri’ as reduced, modified notopodia of the peristomial segment. Despite the anatomical origin of these ‘cirri’ remaining unclear, it seems evident that they are not homologous to those of the other polychaetes (Fauchald and Rouse, 1997), so we are here referring to them as peristomial notopodia.

There are few discussions on the taxonomic and evolutionary significance of eyespots in Chaetopteridae and their presence is often unclear in some original descriptions. However, they are considered a robust taxonomic character. For instance, Nishi (1999) summarized the presence of eyespots in *Mesochaetopterus* and used it to differentiate *M. capensis* (McIntosh, 1885) and *M. selangolus* (Rullier, 1976); while Nishi et al. (2000, 2004) suggested they could be a diagnostic character in *Chaetopterus*, and analyzed them in eight species of *Spiochaetopterus* from the Indo-Pacific. Since Crossland (1903), who first described the eyespots of *P. elioti* Crossland, 1903 in detail, no other studies have been made. All the specimens we examined have brown eyespots despite being preserved in alcohol for decades, so we consider them a stable character of *P. hainanensis* n. sp. Among the 12 known species of *Phyllochaetopterus* from the Pacific Ocean, the deep-sea *P. lauensis* Nishi and Rouse, 2007 and *P. gigas* Nishi and Rouse, 2014 lack eyespots. Therefore, we tentatively suggest that the eyespots in deep-sea species of *Phyllochaetopterus* may have a tendency to reduce (or disappear).

Accordingly, the presence of eyespots may be a useful character to distinguish among the Pacific species of *Phyllochaetopterus* as stated in the following dichotomous key.

Key to species of *Phyllochaetopterus* from the Pacific Ocean

- 1a. 1–6 A4 modified chaetae, ventral shields sometimes with four sections 2
- 1b. >6 A4 modified chaetae, ventral shield forming a large glandular cushion
..... *P. herdmani* (Hornell in Willey, 1905)
- 2a(1). Region B with two chaetigers 3
- 2b(1). Region B with three or more chaetigers 7
- 3a(2). Region C notopodia with 2–4 chaetae 4
- 3b(2). Region C notopodia with only one chaetae ..
..... 5

- 4a(3). Tube cylindrical, translucent, unbranched, non-annulated *P. limicolus* Hartman, 1960
- 4b(3). Tube cylindrical, semitransparent, forked, annulated *P. claparedii* McIntosh, 1885
- 5a(3). Ventral shield with four sections with different colors, head of modified chaetae pear-shaped in frontal view 6
- 5b(3). Ventral shield unknown, head of modified chaetae oval in frontal view
..... *P. verrilli* Treadwell, 1943
- 6a(5). 1–2 A4 modified chaetae
..... *P. lauensis* Nishi and Rouse, 2007
- 6b(5). 4–6 A4 modified chaetae
..... *P. gigas* Nishi and Rouse, 2014
- 7a(2). Peristomium V-shaped; peristomial notopodia large, curved *P. hainanensis* n. sp.
- 7b(2). Peristomium nearly truncated; peristomial notopodia club-like 8
- 8a(7). White crescent ventral shield on region A ...
..... 9
- 8b(7). White crescent ventral shield on region A absent 10
- 9a(8). Head of A4 modified chaetae clearly inflated; neck more slender than shaft
..... *P. socialis* Claparède, 1869
- 9b(8). Head of A4 modified chaetae slightly inflated; neck as wide as shaft
..... *P. prolifica* Potts, 1914
- 10a(8). Head of modified chaetae obliquely truncated, slightly inflated 11
- 10b(8). Head of modified chaetae truncated and not inflated *P. sibogae* Caullery, 1944
- 11a(10). Eyespots absent; ventral shield with a light brown anterior portion and a white posterior portion *P. awasensis* Nishi and Hsieh, 2009
- 11b(10). With one pair of eyespots; ventral shield milk-white *P. elioti* Crossland, 1903

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