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## *Paleaequor*, a New Genus of Polychaete Worm (Chrysopetalidae)

CHARLOTTE WATSON RUSSELL

Department of Annelids, Natural Sciences,  
Northern Territory Museum, GPO Box 4646,  
Darwin, NT 5794, Australia

**ABSTRACT.** A new genus, *Paleaequor*, of the polychaete family Chrysopetalidae is described. Three new species: *Paleaequor setula*, the type species from north-eastern Australia; *P. psamathe* from western Mexico; and *P. nicoyensis* from the Pacific coast of Costa Rica, are described. Two previously described species, *Paleanotus heteroseta* Hartman, 1945 and *Bhawania brevis* Gallardo, 1968, are referred to the new genus. A key to the species of *Paleaequor* is provided and comparison between the Western Pacific and American species made.

WATSON RUSSELL, CHARLOTTE, 1986. *Paleaequor*, a new genus of polychaete worm (Chrysopetalidae). Records of the Australian Museum 38(3): 153-174.

Ehlers (1864) established the family Chrysopetalidae (as Chrysopetalea) to contain the new genus *Chrysopetalum* Ehlers, 1864; *Paleanotus* Schmarda, 1861; and *Bhawania* Schmarda, 1861. Levinsen (1879) later included his genus, *Dysponetus*, within the family.

While there has been some revision of individual genera and description of new chrysopetalid species (e.g. Jorge, 1954; Mileikovsky, 1962; Orensanz, 1972; Perkins, 1985) there has been no comprehensive revision of the family. The morphology of chrysopetalid species is poorly known. These worms are mostly small to very small in size, the anterior segments are retractile and difficult to study; and differences in setal structure and ornamentation can be observed only under high magnification. These may be some of the reasons why chrysopetalids have been often misidentified to genus and why widespread species have been placed into cosmopolitan species complexes.

Ongoing studies of the Chrysopetalidae by the author have established important generic differences which include degree of retraction of anterior segments; number, size and shape of appendages of the prostomium, peristomium and the first setigerous segment; presence of a caruncle or nuchal fold; form of the pygidium; and the number, type and ornamentation of setae. Identification to species is based

primarily on number, type, position and ornamentation of notosetae and neurosetae.

During this study large numbers of specimens, including some misidentified as *Bhawania* and *Paleanotus*, were examined and found to represent an undescribed genus and species. These are described herein as new and a new generic name is proposed. Two previously described species, *Paleanotus heteroseta* Hartman and *Bhawania brevis* Gallardo, also are referred to the new genus.

### Materials and Methods

Material examined is deposited in the following institutions: Allan Hancock Foundation, University of Southern California, Los Angeles (AHF); Australian Museum, Sydney (AM); British Museum (Natural History), London (BMNH); California Academy of Sciences, San Francisco (CAS); Museum National d'Histoire Naturelle, Paris (MNHN); Northern Territory Museum, Darwin (NTM); Queensland Museum, Brisbane (QM); National Museum of Natural History, Smithsonian Institution, Washington D.C. (USNM).

Length is measured from the tip of the most extended appendages or setae of the anterior segments to the tip

of the paleae that extend past the pygidium. Width is measured mid-body, at the widest point, from tip to tip of the most extended setae, i.e. neurosetae or paleae. Chrysopetalids are fragile, and twists in the body due to preservation often make it difficult to flatten the animal for mounting on a slide and measuring. Where sufficient entire specimens were present, individuals were broken mid-body to measure length and width, and a number of segments were mounted between two cover slips in order to distinguish accurately setal numbers and types in both dorsal and ventral view.

Jorge's (1954) method was used in investigating the number and position of appendages on the prostomium, peristomium and first and second setigers: anterior ends were mounted between two cover slips and separate drawings made of the dorsal and ventral aspects. If the anterior segments are half to fully retracted, it is difficult to interpret the number and position of appendages. When the anterior segments are relaxed the paleae fans of the second and third setigers can be gently removed and the prostomium, peristomium and first and second setigers should be clearly visible.

To elucidate setal change throughout the body, a number of entire specimens from each species was dissected segment by segment and each setal type counted. The numbers of paleae and neurosetae together with the rib counts of the former are given as a range. Rib counts may vary within the fan from one palea to the next. They may also vary on paleae between the anterior and posterior ends and from small to large individuals. In order to make a standard comparison, all counts herein were based on mid-body setigers, except where otherwise indicated. Rib counts are of the longitudinal ribs and were made at the widest part of the distal end of the palea. Raised ribs, which in some

specimens only extend one half to two thirds the length of the palea, were counted at the mid-palea.

Use of a Scanning Electron Microscope (SEM) revealed in detail certain structures. SEM photographs helped to clarify paleae ornamentation which included the presence of shallow raised ribs serrated with a longitudinal series of indented cusps; a degree of fine serration of both palea margins and the presence of a type of reticulated scale that can obscure the granular pattern on the superior surface of the palea (Fig. 18).

Parapodia were excised and subjected to 10–30 seconds in an ultrasonic cleaner prior to preparation for SEM study. Parapodia were successively placed for 5 minutes in 70% EtOH, 5 minutes in 85% EtOH, 5 minutes in 95% EtOH and 5 minutes in 100% EtOH. No adverse effects followed the omission of amyl acetate in the final preparation. Specimens were put into the critical point dryer and after this procedure positioned with a spot of glue on a cover slip. Specimens were coated with a thin carbon underlay then sputter coated with gold palladium alloy.

At the USNM, a Cambridge S4-40 SEM was used. This SEM when set for a 20kv beam gave better resolution at high magnifications (e.g. x 5000) than 10kv. At Macquarie University a JOEL SEM unit was used.

#### Terminology of Setal Fascicles

Chrysopetalid setae consist of a notopodial fascicle of flattened setae referred to as 'paleae' and a neuropodial fascicle of falcigers and/or spinigers. The composition and distribution of notosetal and neurosetal types, particularly the structure of the paleae and the composition of the paleae fan have been

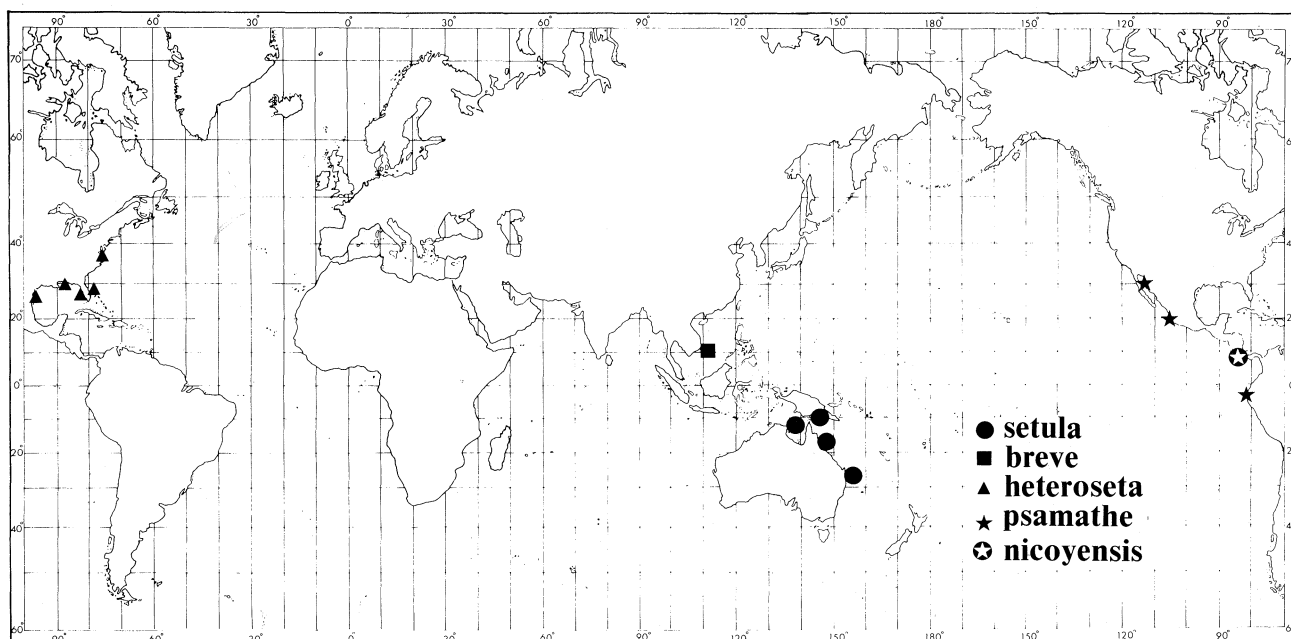


Fig. 1. Distribution map of *Paleaequor* species.

elucidated with the use of SEM in the present study.

An attempt has been made to divide the noto- and neurosetal fascicles into the units that can be counted and categorized according to shape. It should be noted, however, that most of these categories (especially neurosetal) are not entirely discrete as the setal fascicles are composed of a series of gradations of form with some setae inevitably possessing intermediary characters.

**NOTOSETAL CHARACTERS.** Chrysopetalids possess a notopodium with a dorsal horizontal ridge, in which a fascicle of paleae inserts both above and below the dorsal aciculum.

Previous authors have variously described the components of the paleae fan as 'smaller, narrower, larger, broader' (Schmarda, 1861; Ehlers, 1864; Hartman, 1945; Gallardo, 1968). The paleae fan consists of three parts, and a description of the three parts of the paleae fan in *Paleaequor* species in this paper is based on position within the fan—'lateral' (small group of narrow paleae that insert below the dorsal aciculum and adjacent to the dorsal cirrus), 'main' (large group that insert mid position above the aciculum) and 'median' (small group most proximally located) (Fig. 7). Two groups of intermediate paleae are regarded and counted as two separate subunits. The first subunit is located in between the lateral and main paleae groups and is present on all setigers. The second subunit is located between the main and median groups and is present only in posterior setigers.

**Lateral paleae.** Lateral paleae are thin, pointed and lack raised ribs and granules (Fig. 15). The first and second notopodia possess modified paleae. These have margin serration to the apex and are broader and shorter than subsequent lateral paleae.

**Main fan.** The main fan is comprised of large, symmetrical paleae with a number of longitudinal internal and raised ribs and, on the superior surface, a granular ornamentation. The large main fan can be sub-divided into distal, mid and proximal groups (Fig. 7). The number of ribs of each palea varies within a small range, distally to proximally, within the main fan. In general the most distal paleae have fewer ribs and the mid to proximal paleae have a greater number of ribs (Tables 1, 3). *Paleaequor* species possess distally hyaline, erosive main paleae. The apex of these paleae appear to have undergone some structural weakening. Towards the distal quarter of the palea the horizontal striae fade, then disappear, leaving the longitudinal ribs to continue weakly to the apex. The finely serrate margins also discontinue towards the distal quarter which is composed of a flimsy, glassy tip, triangular in shape when entire and rounded or frayed when eroded (Fig. 18a,b).

**Median paleae.** A small group of median paleae of each parapodium interdigitates smoothly and flatly at the mid-body line. They are similar in shape to, and appear to be a continuation of, the main paleae fan but are nonetheless a discrete unit and insert at a shallow

angle to the main fan (Figs 13, 14). In general, the distal median paleae are larger, with rounded tips, and the proximal median paleae shorter, with rounded to pointed tips and a smaller hyaline apex. In some species the distal median paleae are very broad, with a large number of ribs, and in other species are less broad and have fewer ribs. The median paleae can be distinguished from the main paleae by having a more finely serrate proximal margin (Figs 22, 26).

**Subunit 1.** Subunit 1 consists of 2–3 slender paleae located in between the lateral and main groups and inserted just above the dorsal aciculum. The most distal subunit 1 palea is shorter and has fewer number of ribs compared to the more proximal palea (Fig. 15).

**Subunit 2.** The presence of a single, slender palea between the main and median groups, helps to delimit the main and median units. This small palea possesses equally serrate margins that continue nearly to the apex (Figs 22, 25). It is found only in the posterior body segments; in three species it is present only on the posterior ten setigers, and in two species on the posterior half of the body.

**NEUROSETAL CHARACTERS.** The neurosetal fascicle which inserts below the ventral aciculum is composed of spinigers and falcigers which are divided into four units based on position: superior spinigers; mid-superior falcigers; mid-inferior falcigers; and inferior spinigers or falcigers (Fig. 7). Two subunits are recognised.

**Units 1 to 4.** The first unit is composed of a small number of superior spinigers. The uppermost spinigers in this group have long blades while those in the lower position have slightly shorter blades with a greater degree of dentition. The second unit of mid-superior falcigers is composed of long-bladed falcigers in the uppermost position, and falcigers with medium length blades and very pronounced basal dentition in the lower position. The third unit has a large number of mid-inferior falcigers. The uppermost falcigers in this group have medium length blades with less pronounced dentition while those in the lower position have shorter blades and similar dentition. The small fourth unit comprises an inferior group of spinigers or falcigers according to species group. The inferior spinigers have short, attenuated blades with long, fine teeth and the inferior falcigers have short, broad to narrow blades, with short, fine to no dentition.

**Subunits 1 and 2.** The first subunit is an additional (or replacement) short spiniger located between the first and second units and present on posterior setigers in all species. The second subunit is a particularly narrow falcigerous seta located within the fourth unit, and is present on posterior setigers in three species.

### Taxonomy

#### Family CHRYSOPETALIDAE Ehlers, 1864

##### *Paleaequor* n. gen.

**Type species.** *Paleaequor setula* n. sp.

**Description.** Body rectangular, narrow, slightly tapered at both ends. Juveniles elongate, ovoid shape. Maximum segment number 127. Body pale yellow to brown with reddish brown to brown pigmented patches on bases of dorsal and ventral cirri and pygidial lobe. Pale gold to golden brown paleae fans imbricate over dorsum, covering worm completely. Paleae in transverse row in notopodium with leading edges visible proximally; median paleae interlock in the midline forming gently convex to flattened dorsum. Anterior three segments in conjunction with prostomium largely retractable. Prostomium subrectangular, longer than wide, compressed between anterior segments. Two pairs of red-brown eyes arranged in rectangle on dorsal surface of prostomium, anterior pair larger. Single, subulate median antenna inserting anterior to anterior pair of eyes; two slightly longer lateral antennae inserting on anteroventral margin of prostomium. Two long, cylindrical palps inserting on ventral edge of prostomium. Horizontal, folded lip ventral and posterior to palps. Eversible proboscis with two fragile, transparent stylets. Semicircular glandular nuchal fold present posterior to prostomium. Peristomial or tentacular segment reduced, fused in part to prostomium; supporting a dorsal and ventral tentacular cirrus on each side, ventral pair originating adjacent to palps. First setigerous segment biramous, fused in part to peristomium. Notopodial fascicle with reduced numbers of paleae; neuropodium with fascicle of spinigerous neurosetae; dorsal cirrus present, ventral cirrus absent. Setigers two and three directed anterolaterally, all subsequent setigers laterally directed. All setigers except first with three types of paleae, dorsal and ventral cirri, and four types of spinigerous and falcigerous neurosetae. Interramal region ciliate. Notopodium with 3–8 slim, pointed lateral paleae with 3–8 ribs and very finely serrate margins, inserted posteriorly and overlying dorsal aciculum. Tiny, simple seta may also be present posterior to lateral group. 2–3 slender paleae (subunit 1) insert between the lateral and main groups, the most distal with 9–13 ribs, and shorter in length than proximal. The proximal with 12–15 ribs and 1 raised rib. Large group of symmetrical, broad main paleae with 15–24 ribs and 3–6 shallow, raised ribs. Proximal margin of main paleae more strongly serrate than distal margin. A single, slender palea (subunit 2),  $\frac{1}{2}$  to  $\frac{3}{4}$  length of main paleae inserting between main and median groups in the posterior half to posterior 10 setigers of body, and possessing 8–13 ribs, 1–2 raised ribs, and margins equally serrate. Median paleae, 2–4 in number, distinguished from main paleae by a weaker, more finely serrate proximal margin. Distal median paleae of same size, slightly or largely broader than main

paleae, with 16–26 ribs, 0–6 raised ribs. Next proximal median paleae shorter and more distally rounded with 13–21 ribs and most proximal paleae short, distally rounded to pointed with 8–20 ribs. Very fine to large, scattered to dense granular pattern present on superior surface of main and distal median paleae. Close-set horizontal striae in between longitudinal ribs fade towards distal tip of palea, leaving shallow, triangular, hyaline apex. Dorsal cirrostyle subulate, pseudoarticulated and retractile within cirrophore. Dorsal cirri longer on posterior setigers and extending past pygidium. Short to long, conical, pointed neuropodia not extending past notopodia and supporting a subacicular fascicle of heterogomph neurosetae. Superior group with 1–4 spinigers with long, slim shafts and long attenuated blades with fine basal dentition. One extra or replacement short spiniger (subunit 1) present within posterior setigers. Mid-superior group with 6–8 falcigers with long to medium length blades with coarse basal dentition. Mid-inferior group with 6–12 falcigers with medium to short length blades with less coarse basal dentition. Inferior group with 3–7 spinigers or falcigers with slim, short shafts and either narrow attenuated spinigerous blades with fine dentition or broad to narrow (subunit 2) falcigerous blades with fine to no dentition. All neurosetal shaft cores subdivided internally by longitudinal and horizontal striae. Ventral cirri slender, weakly pseudoarticulated and non retractile. Pygidium either quadrate with two anal cirri or rounded dorsally with two anal cirri and a small ventral cone. Anus ventral.

**Remarks.** *Paleaequor* differs from all other chrysopetalid genera in possessing two pygidial forms, finely ornamented paleae with erosive, hyaline tips, two inferior neurosetal forms and a wide range of neurosetal types including falcigers with prominent long toothed blades.

The formula of cirri on the anterior segments of *Paleaequor* is also found in two described and one undescribed chrysopetalid genera — *Bhawania* (unpub. data, author), *Paleanotus* (revision by author, in prep.) and n. gen. 1 (ms. in prep.). *Paleaequor* and *Paleanotus* are distinctly different genera with the former possessing greater body length and number of segments, greater degree of retractibility of the anterior segments and different numbers and types of notosetae and neurosetae. *Paleaequor* and *Bhawania* form a group within the Chrysopetalidae that possesses particularly retractile anterior segments, retractile dorsal cirri, and flattened golden brown paleae that cover the entire dorsum. *Paleaequor* most closely resembles *Bhawania* and has been previously confused with it. *Paleaequor* differs from *Bhawania* in possessing a narrower, shorter body with fewer number of segments. *Paleaequor* has a comparatively discrete, semicircular, glandular nuchal fold in comparison to the thick, fleshy, projecting nuchal ridge found in *Bhawania*. Both genera possess different pygidial forms and different numbers and types of notosetae and neurosetae.

Spinigerous inferior neurosetae have been reported for three species that have been incorrectly referred to *Bhawania* (*B. cryptocephala* Potts, 1910; *B. cryptocephala* var. *pottsiana* Horst, 1917; *B. pottsiana* Gibbs, 1971). These specimens exhibit characters that belong to both *Bhawania* and *Paleaequor* but until entire specimens can be examined the generic status of these chrysopetalids remains unclear.

Very little is known of the feeding biology of any chrysopetalid genera. The shape of the stylets is similar in all *Paleaequor* species and in comparison with other genera the only distinguishing feature in *Paleaequor* is the greater fragility and wider groove of the stylets. They also lack the serrated tips found in *Chrysopetalum* and *Paleanotus* (author, unpub. data). The function of the stylets interpreted from their structure would be one of piercing and sucking. *Paleaequor* has been recorded almost exclusively from sandy sediments, sometimes in association with large groups of tube-dwelling polychaetes (Wilson, 1979). It is possible that the *Paleaequor* species are omnivores feeding on small sand-dwelling invertebrates.

*Paleaequor* species are found in warm, tropical to subtropical waters between 37°N and 30°S (Fig. 1). They inhabit sediments that range from coarse sand and shell grit to fine sand and mud. Depth ranges from the intertidal to more than 80 m.

**Etymology.** The name *Paleaequor* is a combination of the Latin *palea*, meaning scale, and *aequor*, meaning an even, level surface, and refers to the flattened paleae that cover the entire dorsum. Gender neuter.

**Key to *Paleaequor* Species**

- 1. Pygidium quadrate without ventral cone (W. Pacific). . . . . 2
- Pygidium rounded with ventral cone (E. Pacific, W. Atlantic). . . . . 3
- 2. 4–8 lateral paleae; main paleae with 17–24 ribs; 4–5 inferior spinigers. . . . . *P. setula* n. sp.
- 3–4 lateral paleae; main paleae with 17–20 ribs; 5–7 inferior spinigers. . . . . *P. breve* (Gallardo)
- 3. Main paleae with 17–24 ribs; distal median paleae with 20–25 ribs. . . . . 4
- Main paleae with 17–19 ribs; distal median paleae with 16–20 ribs. . . . . *P. nicoyensis* n. sp.
- 4. Neurosetae with fine, short-bladed superior spinigers and 0–1 long-bladed mid-superior falcigers. . . . . *P. psamathe* n. sp.
- Neurosetae with robust, long-bladed superior spinigers and 2 long-bladed mid-superior falcigers. . . . . *P. heteroseta* (Hartman)

***Paleaequor setula* n. sp.**

Figs 2–12

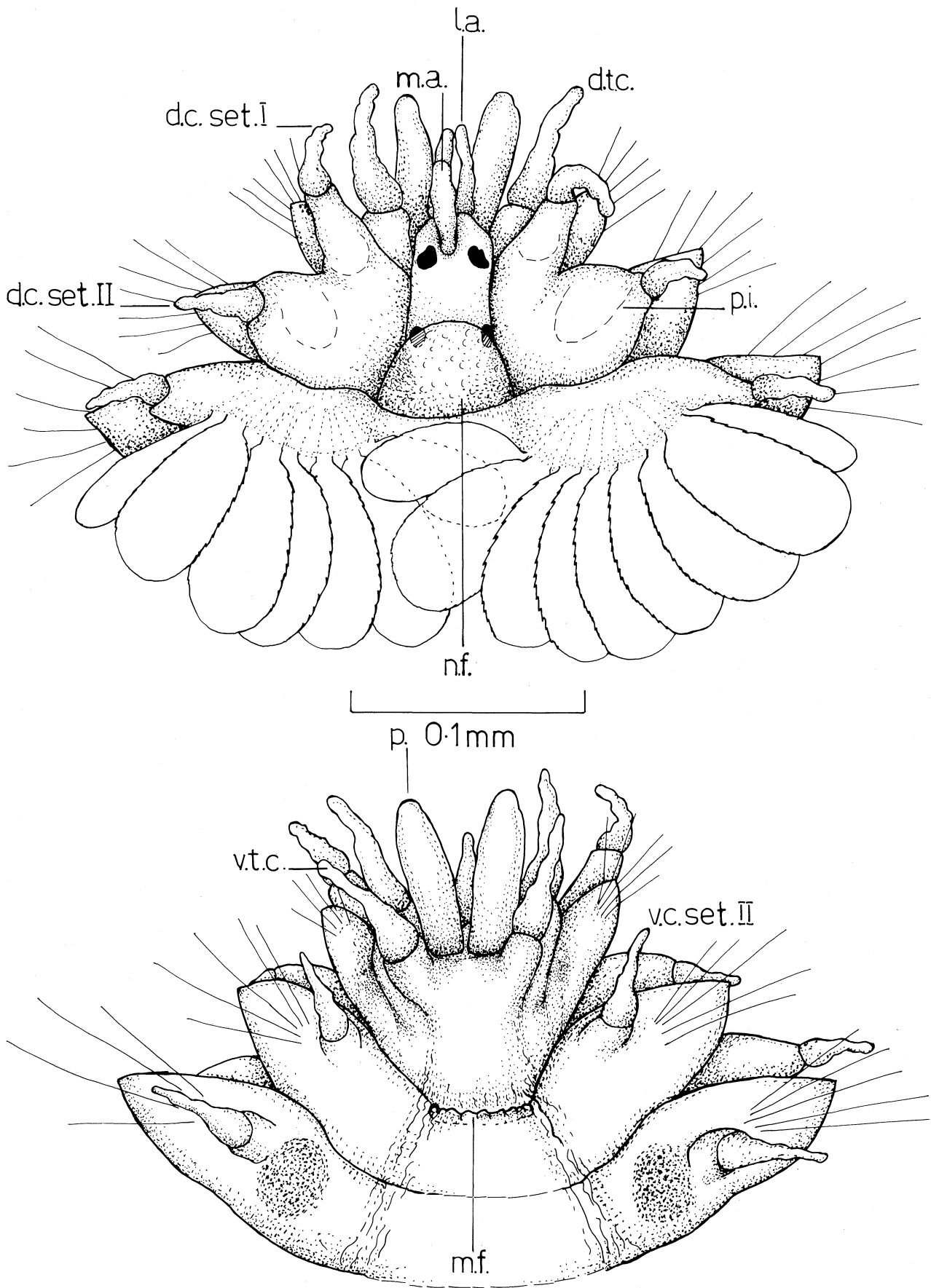
**Material examined.** HOLOTYPE: Australia, Queensland, Halifax Bay, Stn G (19°10'S, 146°44'E) slightly gravelly, muddy sand, 5 m, NTM W.1673, coll. J. Carey, January 1978; 68 setigers, 9.2 mm length, 1.2 mm width, specimen entire. PARATYPES: Queensland, Halifax Bay, Stn G, slightly gravelly, muddy sand, 5 m, 3, NTM W.1674, coll. J. Carey, January 1978; Halifax Bay, Stn E (19°09'S, 146°37'E), slightly gravelly, muddy sand, 5 m, 4, AM W. 198712, coll. J. Carey, January 1978; same locality, habitat, date and collector, 4, USNM 97486; 4, BMNH ZB1985.82-85; 4, AHF 1435.

Size range of paratype specimens 20 setigers, 1.2 mm length, 0.6 mm width to 71 setigers, 7.6 mm length, 0.9 mm width.

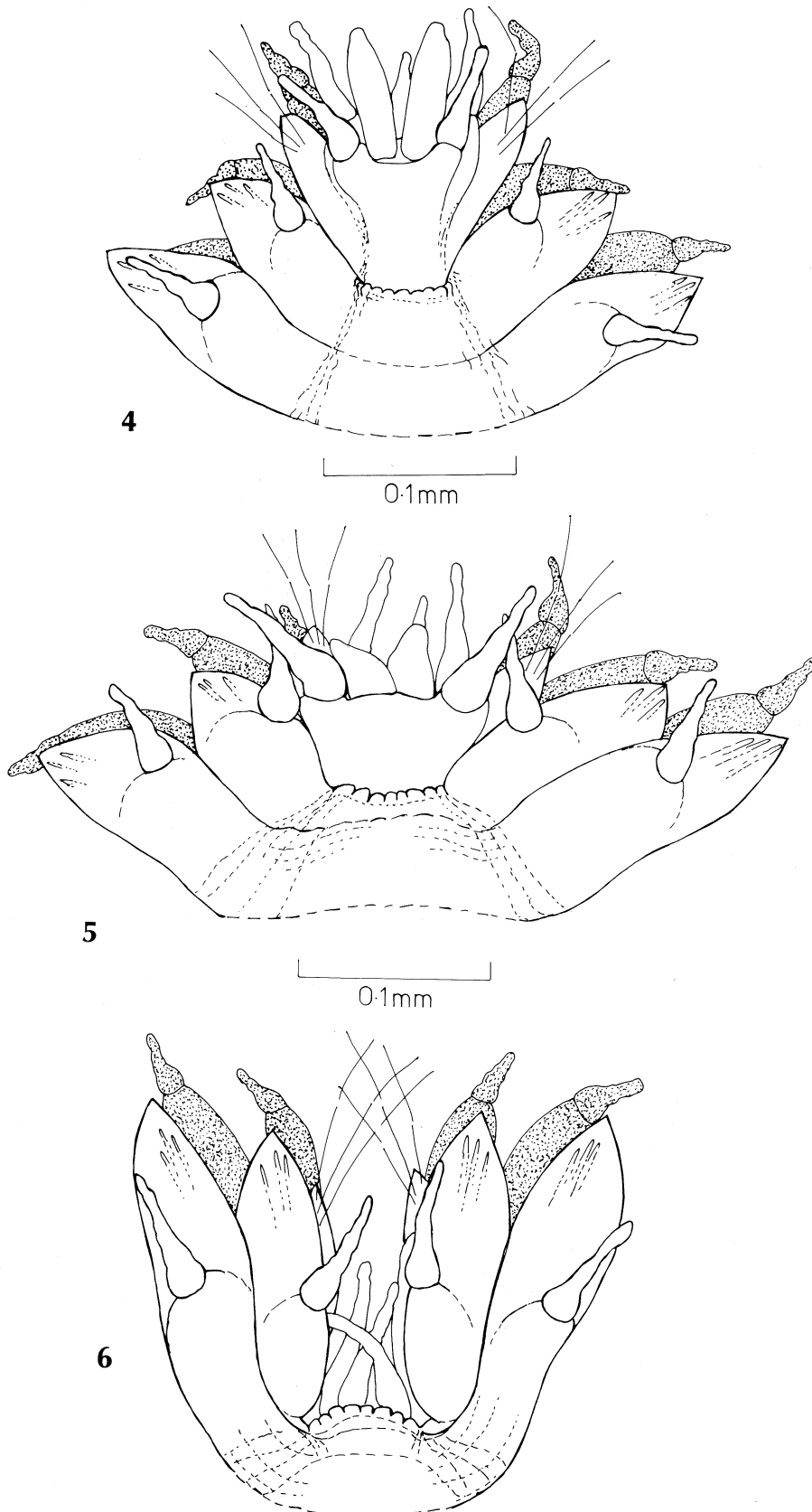
**Additional material.** Australia, Queensland, Halifax Bay, Stn F (19°10'S, 146°38'E), slightly gravelly, muddy sand, 5 m, 4, NTM W. 1681, coll. J. Carey, July 1977; Stn F, 5 m, 8, NTM W.1686, coll. J. Carey, February 1980; Stn C (19°10'S, 146°37'E), muddy sand, 2 m, 9, NTM W.2053, coll. J. Carey, January 1978; Stn A (19°07'S, 146°33'E), muddy sand, 2 m, 20, NTM W.1684, coll. J. Carey, February 1979; Stn A, 12, NTM W.1685, coll. J. Carey, January 1980; Brisbane River, Quarantine Station, Stn 2, 1, AM W.7466, coll. D.F. Boesch, 1972; Moreton Bay, Bramble Bay, 80–90% sand and mud, 5.4 m, 1, QM GH 10622, coll. S. Cook, 12 December 1972; Bramble Bay, Stn 3B, shell grit and mud, 1, QM GH613, coll. I.P., April 1975; Stn 3B, shell grit and mud, 1, QM GH614, coll. I.P., June 1975; Stn 3C, shell grit and mud, 5.4 m, 1, QM GH612, coll. I.P., April 1975; Northern Territory, Gove, Mangrove Creek, Stn 4B, mud and sand, intertidal, 1, NTM W.1676, coll. N.T. Fisheries, 22 June 1971; Stn 3, mud, intertidal 1, NTM W.1675, coll. N.T. Fisheries, 14 December 1970. Papua New Guinea, Port Moresby Harbour, Tatana Island, Stn 1, fine calcareous mud at base of reef, 20–25 m, 7, NTM W.1678, coll. J. Watson, June 1981; Stn 2, same locality and habitat, 8, NTM W.1679, coll. J. Watson, June 1981; Vahunabada Reef, Stn 3, same habitat, 2, NTM W.1677, coll. J. Watson, June 1981; Esade Reef, Stn 4, same habitat, 2, NTM W.1680, coll. J. Watson, June 1981.

**Description.** Holotype with anterior segments retracted (Fig. 6). Tips of prostomial and peristomial appendages visible above nuchal fold. Two pairs of red eyes faintly visible beneath nuchal fold. Notosetae comprising: 3–8 lateral paleae with 3–5 ribs (Fig. 8); 2–3 slender paleae with 9–15 ribs inserted between lateral and main groups; 15–17 main paleae with 17–22 (24 maximum) ribs and 3–6 raised and finely serrated ribs; 2–3 median paleae with 9–22 ribs and 0–3 raised ribs consisting of 2 distal median paleae with 13–22 ribs plus a smaller, slightly pointed proximal median with 9–12 ribs. One small, slender palea (½ length of main), with 8 ribs, and 0–2 raised ribs inserting between the main and median groups on posterior 10 setigers. Medium to small granules on superior surface of main and distal median paleae. Dorsal cirrostyle retractile within cirrophore (Fig. 7).

First and second neuropodia with neurosetae spinigers only. Subsequent neurosetae with superior group of 4 spinigers with long, slim shafts present from anterior setigers to mid-body setigers; 3 with long blades and fine basal dentition (Fig. 9a), and 1 with slightly shorter



**Figs 2-3.** *P. setula*, anterior end, dorsal view (above) and ventral view (below). **m.a.**, median antenna; **l.a.**, lateral antennae; **p.**, palp; **d.t.c.**, dorsal tentacular cirrus; **v.t.c.**, ventral tentacular cirrus; **d.c. set. I.**, dorsal cirrus setiger 1; **d.c. set. II.**, dorsal cirrus setiger 2; **v.c. set. II.**, ventral cirrus setiger 2; **n.f.**, nuchal fold; **m.f.**, mouth flap; **p.i.**, paleae insertion (Paratype NTM W.1674).



**Figs 4-6.** *P. setula*: 4, anterior end, ventral view, relaxed (Paratype NTM W.1674); 5, anterior end, ventral view, half retracted (NTM W.2053); 6, anterior end, ventral view, retracted (Holotype NTM W.1673).



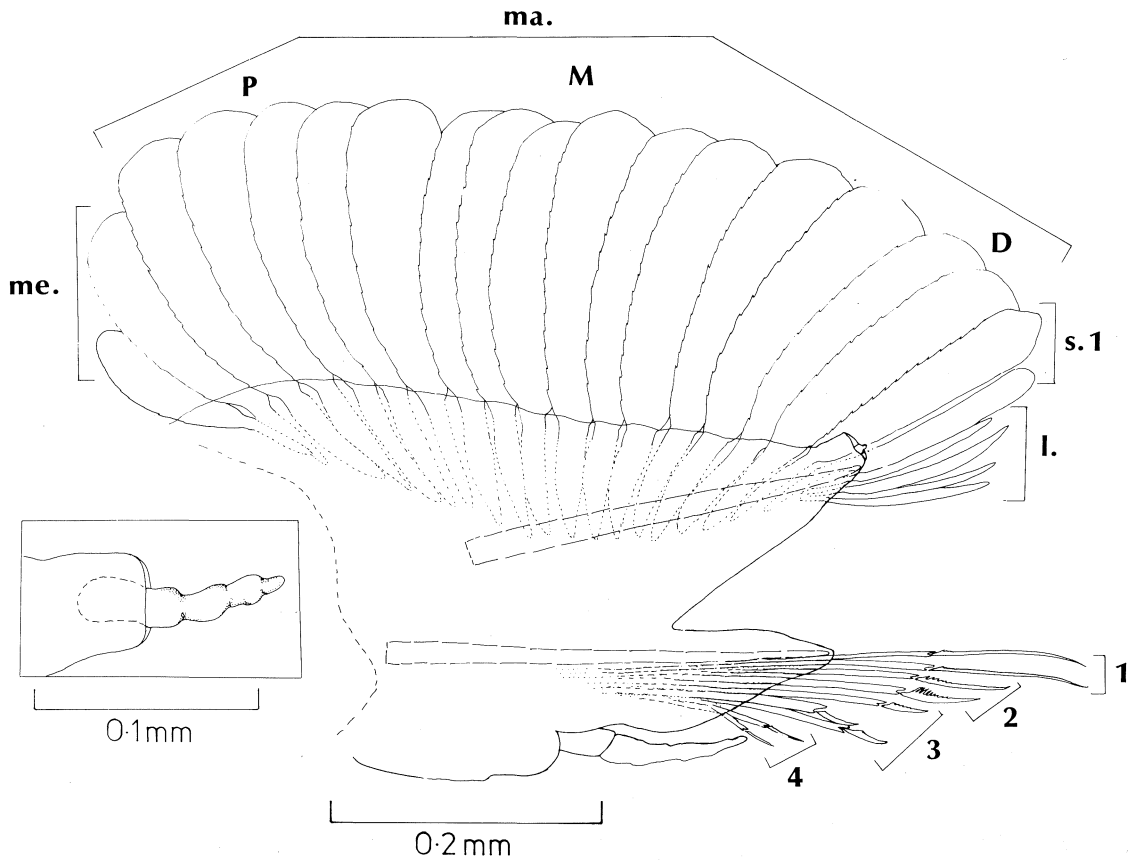
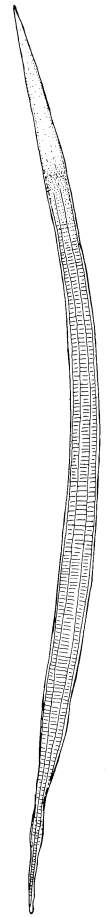


Fig. 7. *P. setula*, setiger 30, ventral view. Notosetal units: **L**, lateral; **s. 1**, subunit 1; **ma.**, main; **D**, distal; **M**, mid; **P**, proximal; **me.**, median. Neurosetal units: **1**, superior spinigers; **2**, mid-superior falcigers; **3**, mid-inferior falcigers; **4**, inferior spinigers; **inset**: dorsal cirrus, relaxed (Holotype NTM W.1673).



0.04 mm

Fig. 8. *P. setula*, lateral palea (Holotype NTM W.1673).

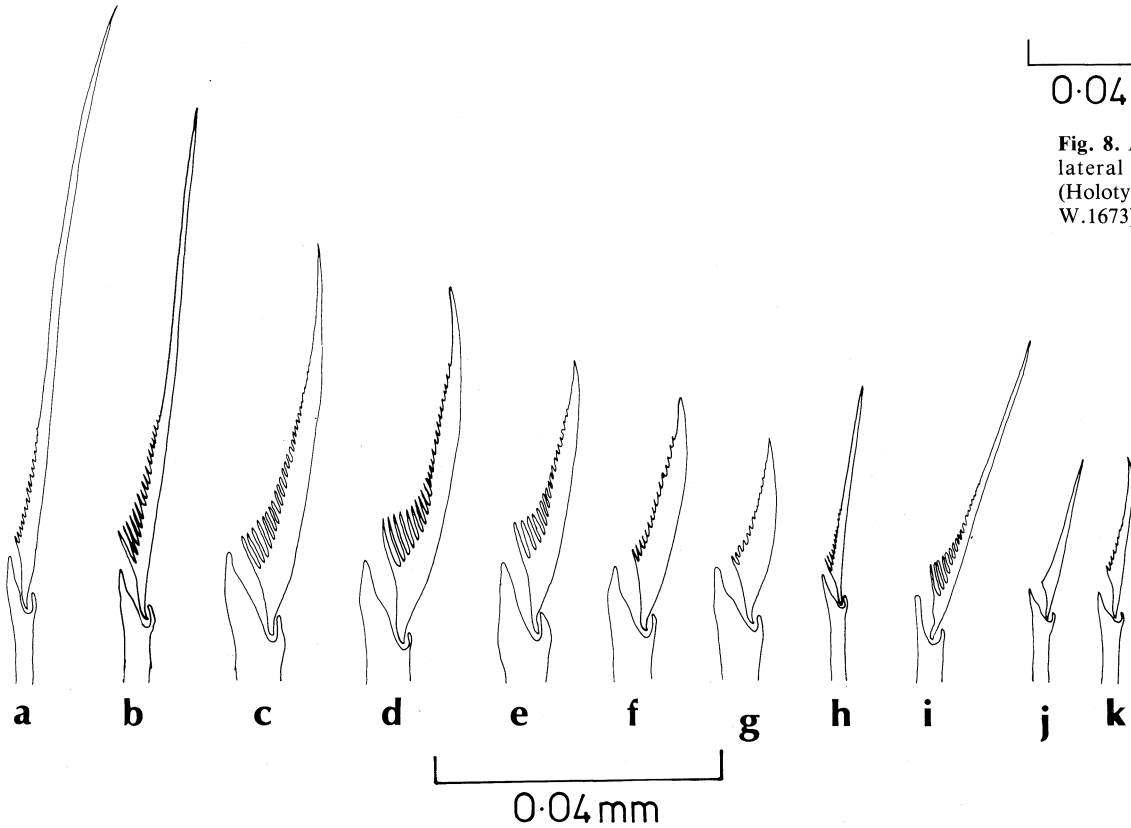


Fig. 9. *P. setula*, setiger 34, neurosetal units: **a-j**, Holotype NTM W.1673; **k**, NTM W.1686.

blade and more pronounced basal dentition (Fig. 9b). Up to 3 superior spinigers, including 1 with short, fine blade (Fig. 9i), present in posterior setigers. Mid-superior group with 6-8 falcigers with medium length blades each with coarse basal dentition (Fig. 9c, d). Mid-inferior group with 6-10 falcigers with short blades and finer basal dentition (Fig. 9e, f, g). Inferior group of 4-5 spinigers with slim, short shafts and narrow blades with very fine basal dentition (Fig. 9h). Pygidium quadrate with 2 anal cirri located on lateral posterior edge (Fig. 12).

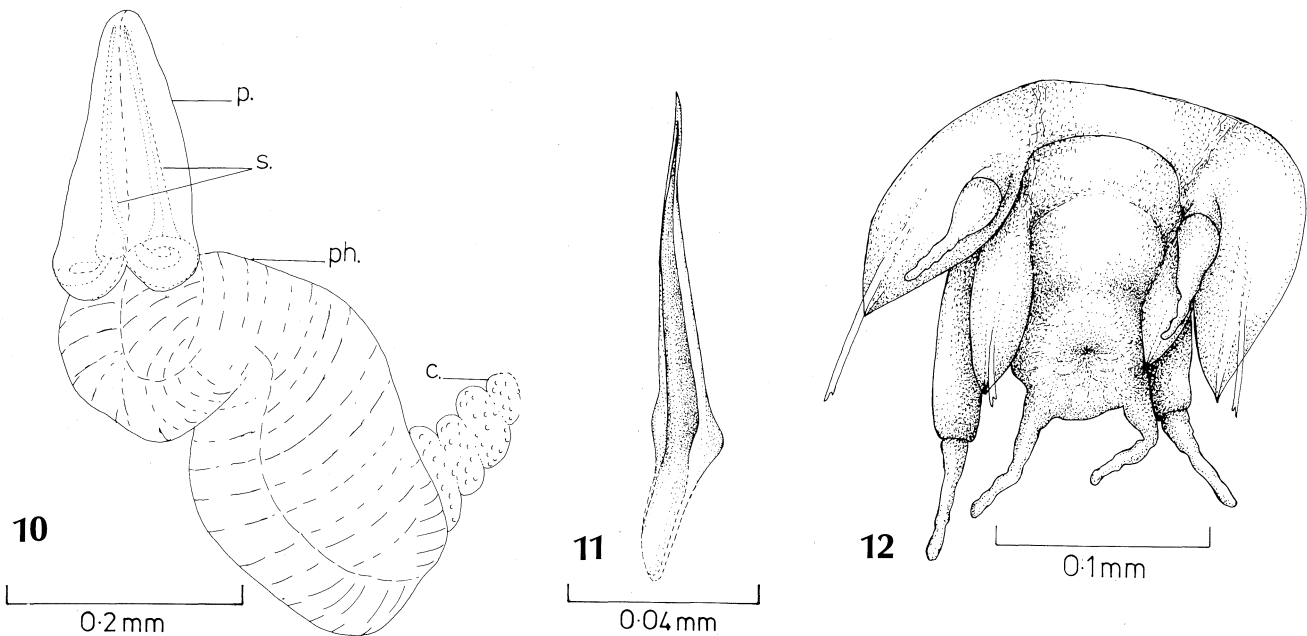
**ADDITIONAL MORPHOLOGICAL INFORMATION.** Based on paratypes and other material.

**Prostomium and three anterior segments.** The prostomium in *Paleaequor setula* is small and compressed in between the anterior three segments. When these segments are relaxed, the prostomium and its appendages are clearly visible with the posterior pairs of eyes just posteriorly covered by the nuchal fold. (Paratype NTM W.1674, Fig. 2). The anterior three segments (peristomium, setiger 1 and 2) in conjunction with the prostomium (with which they are fused) are capable of retracting. At the point of greatest retraction, the appendage tips are only visible dorsally above the nuchal fold and ventrally above the mouth fold (Fig. 6). Three stages, relaxed, semi-retracted and retracted, based on *P. setula* specimens but characteristic for all *Paleaequor* species, are figured in ventral view (Figs 4,5,6). The degree of fusion is complex within the three segments. In Fig. 2 the peristomial segment dorsally appears separated from setiger 1, and in Fig. 3, ventrally it appears fused to setiger 1. In dorsal aspect, setigers 1 and 2 appear fused but ventrally there is a clear segmental line between setiger 1 and 2. Further study is needed to elucidate the retraction mechanism.

**Stylets.** A mouth flap, which appears as a horizontal wrinkled ridge (Fig. 3), opens on the anterior margin of setiger 2 (or segment 3). Sometimes the proboscis may be partly extruded through the mouth opening with the two tips of the stylets visible. When the proboscis is relaxed the stylets may be seen through the ventral body wall at a level between the 3rd and 5th setigerous segments.

Upon dissection, the pharynx is revealed as an elongate, strongly muscular organ which is characteristically bent midway (Fig. 10). Small caeca are present posteriorly. Anteriorly, a constriction separates the proboscis, which contains two stylets, from the remainder of the pharynx. In situ, ventrally, the two transparent stylets are set close, each with the groove facing one another. They are extremely fragile and difficult to excise entire. A longitudinal groove runs the entire length of the stylet, narrowing distally. The proximal third of the stylet widens and flares out laterally; it appears to be attached to the proboscis wall at this point. Proximally, the base of the stylet is extremely fragile so this section has not been dissected out entire and observed in detail (Fig. 11).

**Variations in setal counts.** *Paleaequor setula* shows some variation in setal counts between setigers and between individuals of different size. Table 1 shows, for an entire specimen of 81 setigers (NTM W.2053), differences between setigers in the numbers of paleae within the notosetal fascicle, the number of ribs on the various paleae types and the numbers of different neurosetal types. There is a decrease in the number of lateral, main and median paleae within the anterior and posterior 10 setigers. The larger number of ribs on the main paleae is concentrated in the mid group and occurs on the mid-body setigers. Main paleae with a higher



**Figs 10-12.** *P. setula*: 10, pharynx and proboscis, ventral view (s., stylets in situ; p., proboscis; ph., pharynx; c., caeca); 11, stylet, ventral view (NTM W.2053); 12, pygidium, ventral view (Holotype NTM W.1673).

**Table 1.** Comparison of setal counts between setigers of an 81 setiger individual of *P. setula* NTM W.2053

Setiger number	1	2	4	5	11	13	28	42	51	74	77	79	81
<b>Notosetal characteristics</b>													
Lateral paleae (number)	1	2-3	4	4	4	5-6	4	4	4	3	3	2	1
Number of ribs	3-5	3-5	2	2	2-3	2-3	2-3	2	2-3	2	4	3	3
Lateral, sub-unit 1 (number)	0	0	2	2	3	3	3	3	2	2	2	2	2
Number of ribs	0	0	*	*	11,12,15	11,12,15	10,12,15	*	9,13	12,12	9,13	13,14	11,14
Main paleae (number)	2	4	8-9	11	14-15	14-15	14-15	16	16-17	12-13	10	6	3
Number of ribs (distal)	8	14	17	18	21	21	20	20	20	19	16	17	17
Number of ribs (mid)	0	15-16	18	20	21-23	21	21	23	21-24	20-21	20-21	18-22	18
Number of ribs (proximal)	0	14	17	18	*	*	20	21	22	19	19	21	20
Median paleae (number)	0	1	1	*	2	2	2	2	2	2	2	3	1
Number of ribs (distal)	0	12	18	*	*	*	20	21	20	19	20	20	20
Number of ribs (proximal)	0	0	0	*	*	*	17	18	*	15	*	12,18	0
Presence (+), absence (-) of single palea, sub-unit 2	-	-	-	-	-	-	-	-	-	+	+	+	+
<b>Neurosetal characteristics</b>													
Superior spinigers (number)	9	10	3-4	4	4	4	4	4	4	3	3	3	blades
Mid-superior falcigers (number)	0	0	6	6	6	7	7	7	6	6	5	4	all broken
Mid-inferior falcigers (number)	0	0	6	6	7	10	10	10	8	6	4	4	6 shafts
Inferior spinigers (number)	0	0	4-5	4-5	5	5	5	5	5	5	4	3	present
0 absent													
* damaged or obscured													

number of ribs (e.g. 23-24) are not consistently dispersed from setiger to setiger but appear only irregularly. The most proximal median paleae consistently possess a lower number of ribs compared to the most distal median paleae. The single palea (subunit 2) is only present in setigers 74 to 81. There is a slight decrease in numbers of neurosetal types in the anterior- and posterior-most setigers (with the exception of superior spinigers on 1st and 2nd neuropodia). The most noticeable change is the decrease of mid-inferior falcigers within the anterior and posterior 10 setigers.

Table 2 compares setal counts between six *P. setula* individuals of different size, ranging from 16 to 105 setigers. Setal counts also vary between individuals of different size. The numbers of main paleae and, to a lesser extent, lateral paleae increase with setiger size. The numbers of median paleae remain constant. Larger individuals also possess main paleae with a larger number of ribs. It should be noted, however, that these higher numbers of ribs of main paleae are not consistent from setiger to setiger within the individual (see example

Table 1). The higher numbers of lateral paleae of larger individuals also vary from setiger to setiger. For example, a specimen of 68 setigers, (NTM W.1673) with 4-6 lateral paleae on most setigers, has a single count of 8 on the 33rd notopodium; a specimen of 79 setigers (NTM W.1679), with 4-5 lateral paleae on most setigers, has 7 lateral paleae on 7 mid-body setigers.

Overall numbers of neurosetae (not included in Table 2) also increase with size. A specimen of 16 setigers (NTM W.1686) possesses a fascicle of 17; a specimen of 105 setigers (NTM W.1676) has 25-30 neurosetae per neuropodium on the mid-body setigers. There are small differences of neurosetal shape between individuals of different size, e.g. a specimen of 16 setigers (NTM W.1686) possesses smaller inferior spinigerous neurosetae (Fig. 9j) including some that could be described as falcigerous (Fig. 9k).

**Occurrence with other genera.** *Chrysopetalum* sp. (2) and a new chrysopetalid genus and species (8) (n. gen. 1, author ms. in prep.) were present with *P. setula* in samples from Stn A and G, Halifax Bay, Queensland.

**Table 2.** Comparison of setal counts with increasing number of setigers for 6 specimens of *P. setula*

Registration number	NTM W.1686	NTM W.1684	NTM W.1678	NTM W.1673	QM GH 10622	NTM W.1676
Locality	Halifax Bay, Queensland	Halifax Bay, Queensland	Port Moresby, Papua-New Guinea	Halifax Bay, Queensland	Moreton Bay, Queensland	Gove, Northern Territory
Setigers (number)	16	26	46	68	82	105
Length (mm)	1.2	2	3.7	9.2	14	12.6
Width (mm)	0.6	0.6	1.0	1.2	1.4	1.5
Lateral paleae (number)	2-3	3	3-4	4-6(8)	4-6(7)	4-6(7)
Main paleae (number)	7-9	12	12-14	15-17	18-20	18-20
Main paleae (number of ribs)	16-18	16-18	16-21	17-22(24)	17-22(24)	17-22(23)
Median paleae (number)	2-3	2-3	2-3	2-3	2	2

**Note:** all paleae counts based on mid-body setigers

**Habitat.** Type material was made available from samples from a nickel mining monitoring study carried out in Halifax Bay, Queensland (Carey, 1981). Inshore stations (B,C,D) are situated at tidal creek entrances with generally muddy sediments (grain size number in this habitat varies seasonally). Near-shore stations (A,E,F) have slightly gravelly, muddy sand as does the one offshore station (G). Stations A and G are situated near coral reefs (J. Carey, pers. comm.). Other material comes from sediments that range from shell grit and mud (Moreton Bay, Queensland: Stephenson, 1976) to calcareous muds at the bases of reefs (Port Moresby Harbour, Papua New Guinea: J. Watson, pers. comm.). Depth ranges from the intertidal to 25 m.

**Distribution.** Southern Queensland, Australia to Southern Papua New Guinea.

**Etymology.** The specific name, *setula*, is derived from the Latin diminutive meaning little bristle, in reference to the small inferior spinigerous neurosetae.

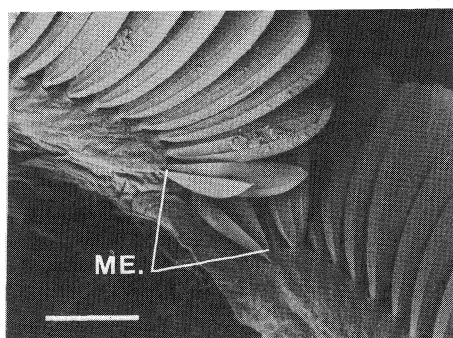
*Paleaequor brevis* (Gallardo) new combination  
Figs 13–17

*Bhawania brevis* Gallardo, 1968: 54–55, pl. IX, figs 1–9, (Nha Trang, Vietnam).—Shin, 1980: 162–163.

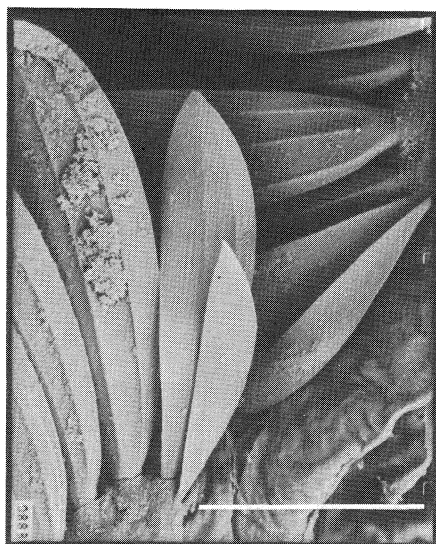
**Material examined.** HOLOTYPE: Vietnam, Bay of Nha Trang, Stn 270 (12°15' N, 109°10' E), sandy mud, 22 m, AHF N.11593, coll. Gallardo, 23 March 1960; 127 setigers, 18 mm length, 1.3 mm mid-body width, 0.8 mm width anterior end, 0.6 mm width posterior end, specimen entire.

**Additional material examined.** Bay of Nha Trang, Stn 130, mud, 16m, 1, AHF N.11597, coll. Gallardo, 11 February 1960; Stn 74, sandy mud, 10 m, 2, AHF N.11596, coll. Gallardo, 20 January 1960.

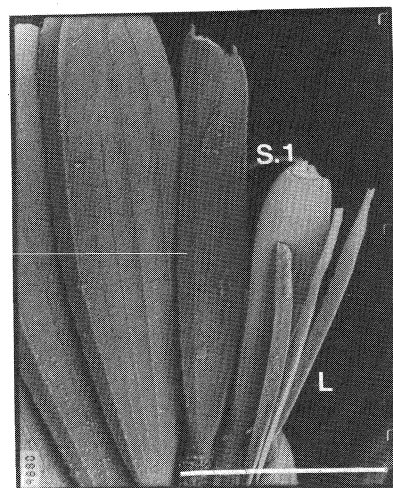
**Description.** Holotype with anterior segments retracted. Tips of prostomial and peristomial appendages visible above nuchal fold. Two pairs of eyes, faintly visible beneath nuchal fold. Notosetae comprising: 3–4 lateral paleae with 3–4 ribs (Fig. 15); 2 slender paleae with 10–13 ribs inserted between lateral and main groups (Fig. 15); up to 17 main paleae with 16–20 ribs and 3–5 raised and very finely serrated ribs; 2–3 median paleae with 8–20 ribs and 0–3 raised ribs



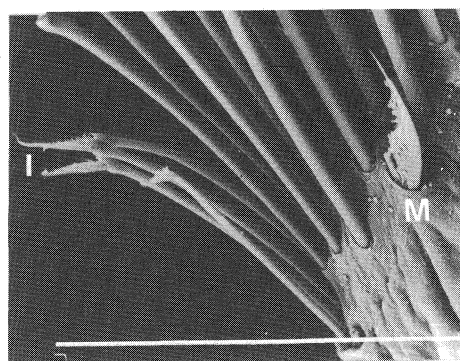
13



14



15



16

**Figs 13–16.** *P. brevis*, setiger 65: 13, main and median (ME.) paleae (Holotype AHF N.11593); 14, median palea, detail (Holotype AHF N.11593); 15, lateral (L) and subunit 1 (S.1) paleae (Holotype AHF N.11593); 16, lower part neuropodium (I, inferior spinigers; M, mid-superior falciger coming through neuropodium) (Holotype AHF N.11593). Scale lines = 100  $\mu$ m.

(Figs 13, 14), comprising 2 distal median paleae with 16-20 ribs, and a smaller, more pointed proximal median palea with 8-16 ribs. One small, slender palea ( $\frac{1}{2}$ - $\frac{2}{3}$  length of main) with 8 ribs inserting between main and median groups on the posterior 10 setigers. Patchy, very fine granules on superior surface of main and distal median paleae.

Neurosetae comprising a superior group of 4 spinigers (Fig. 17a) on the anterior to mid-body setigers. Up to 3 spinigers present on each of the posterior setigers including 1 with short, fine blade (Fig. 17h). Mid-superior group has 6-8 falcigers with long to medium length blades with a coarse basal serration (Fig. 17b,c). Mid-inferior group has up to 9 falcigers with short blades and fine basal serration (Fig. 17d,e). Inferior group with 4-7 spinigers with slim, short shafts and attenuated blades with fine, long basal serration (Figs 16, 17f,g). Pygidium quadrate with 2 anal cirri located on lateral posterior edge.

**Comments.** Gallardo's (1968) diagrammatic figures of the retracted prostomium and three anterior segments of *Bhawania brevis* agree well with the anterior end described in this paper for *Paleaequor*. He stated that the eyes were absent. On inspection of specimens, two

pairs of eyes in fact are present, although their pigmentation is very faint and they are covered entirely by the nuchal fold. Shin (1980) observed two pairs of red eyes in specimens of this species (as *B. brevis*) collected off Hong Kong Island.

Gallardo recognized 'thin, blunt-tipped setae' and 'long paleae', which correspond here to the categories of lateral and main paleae. His description did not include the raised and serrated ribs of the main paleae which, in this species, are particularly shallow and very finely sculptured. Gallardo described four types and positions of neurosetae—'superior most ... spinigers,' 'lower and next lower ... falcigers' and 'lower most ... spinigers'. These descriptions agree closely with the neurosetal terminology proposed here. However, Gallardo's division of the neurosetal fascicle into supra and sub-acicula is incorrect, as all neurosetae insert below the ventral aciculum.

**Habitat.** Mud and sand sediments in depths of 10-22 m. From Hong Kong, Shin (1980) records 2 specimens from Kap Shui Mun in sandy mud (22 m) and 2 specimens from off Lamma Island in soft mud (26 m). Specimens were not examined by the author.

**Distribution.** South Vietnam; Hong Kong.

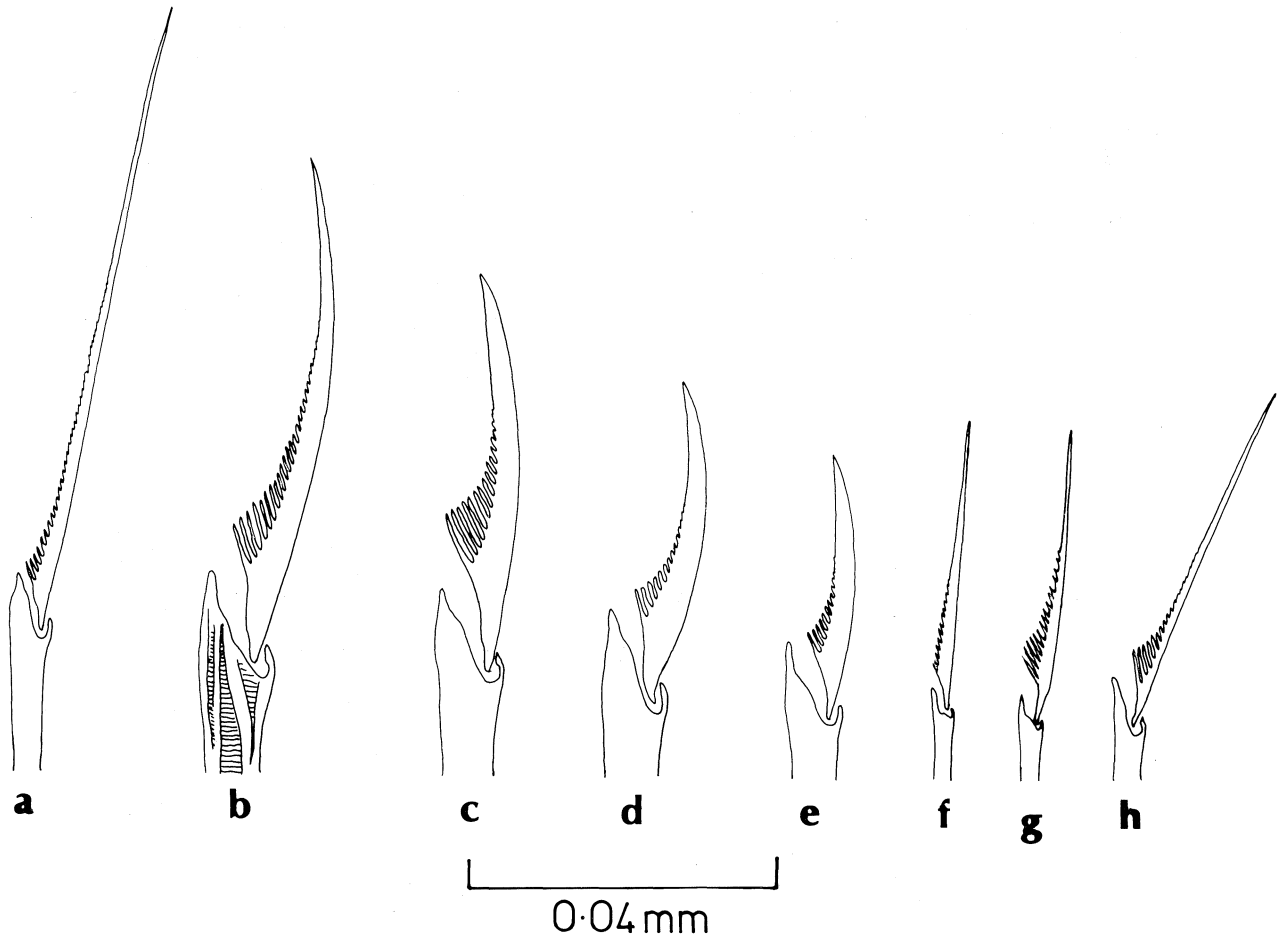


Fig. 17a-h. *P. brevis*, setiger 20, neurosetal units (Holotype AHF N.11593).

*Paleaequor heteroseta* (Hartman), new combination  
Figs 18–21

*Paleanotus heteroseta* Hartman, 1945: 12, pl. 1, figs 1–6, (North Carolina, U.S.A.).—Renaud, 1956: 9, fig. 5; Day, 1973: 14; Wilson, 1979: 627; Gardiner, 1982: 100, fig. 5f–i; Gathof, 1984: 26–29, fig. 8a–g.

**Material examined.** HOLOTYPE: United States, North Carolina, Beaufort, Bogue Sound, No. 0090 (originally No. 70), dredged shell fragments, 'shallow depths', 15 June 1940, AHF N.1545; 62 setigers, 7 mm length, 0.84 mm width, specimen entire.

**Additional material examined.** Virginia, York River, 1, USNM 56559, coll. G.R. Gaston, March 1976. North Carolina, off Beaufort, sand and broken shell, 10 m, 53, USNM 51005, coll. J.H. Day, 19 April 1965; Cape Lookout, among *Petaloproctus socialis* colonies, intertidal, 10, USNM 52859, coll. S. Gardiner, 17 August 1974; same locality and habitat, 30, USNM 52860, coll. H. Wilson, November 1974. Florida, Indian River, 1, MNHN A870, coll. J.L.T., 8 July 1963; St. Lucie Co., Hutchinson Island, (27°22'08"N, 80°13'46"W), 11.5 m, 1, USNM 54227, coll. Gallagher et al., 1 March 1972; same locality; 10.9 m, 1, USNM 54226, coll. Gallagher et al., 5 March 1973. Gulf of Mexico, Florida, Panama City, offshore, (30°03'06"N, 86°08'08"W), 24, USNM 97885, 8 April 1958; Panama City, 12 mi. offshore, 30 m, 20, USNM 97856, coll. M.L. Jones et al., 9 September 1959; Tampa Bay, 100, USNM 45522, coll. John L. Taylor, 29 October 1963; Gulf of Mexico, 29°20'04"N, 84°44'03"W, Stn 2423, 30 m, 39, USNM 55803, coll. R/V *Columbus Iselin*, July 1976. Texas, off Freeport, 18 m, 2, USNM 51471, coll.

D.E. Harper; Port Aransas, 6, USNM 97857, coll. M.L. Jones, dredge, June 1962; Lydia Ann Channel, associated with chaetopterid tube, 3, USNM 97860, coll. M.L. Jones, 2 July 1962; same locality and collector, off abandoned lighthouse, 1, USNM 97858, 19 June 1962; same locality and collector, between beacon 83 and buoy N84, 2, USNM 97859, 19 June 1962.

**Description.** Holotype with anterior segments retracted in part. Prostomial and peristomial appendages visible dorsally above nuchal fold. Two pairs of red-brown eyes visible; anterior pair above nuchal fold and posterior pair beneath nuchal fold.

Notosetae comprising 3–4 lateral paleae with 5–9 ribs (Fig. 19 left); 2 slender paleae with 10–15 ribs inserting between lateral and main groups; up to 14 main paleae with 17–22 (24 maximum) ribs and 3–6 raised and finely serrated ribs (Fig. 18a,b); 3–4 median paleae with 11–25 ribs and 0–5 raised ribs, comprising 2 broad, distal paleae with 20–25 ribs, the next proximal palea smaller with 17–21 ribs and the most proximal and smallest with 11–17 ribs. One small, slender palea ( $\frac{1}{2}$  to  $\frac{2}{3}$  the length of main palea) with 10–13 ribs and 2–3 raised ribs inserting between the main and median groups of paleae on the setigers of the posterior half of the body. Large to medium granules on superior surface of main and distal median paleae.

Neuropodium long and pointed. First and second neuropodia with neurosetae composed of spinigers only

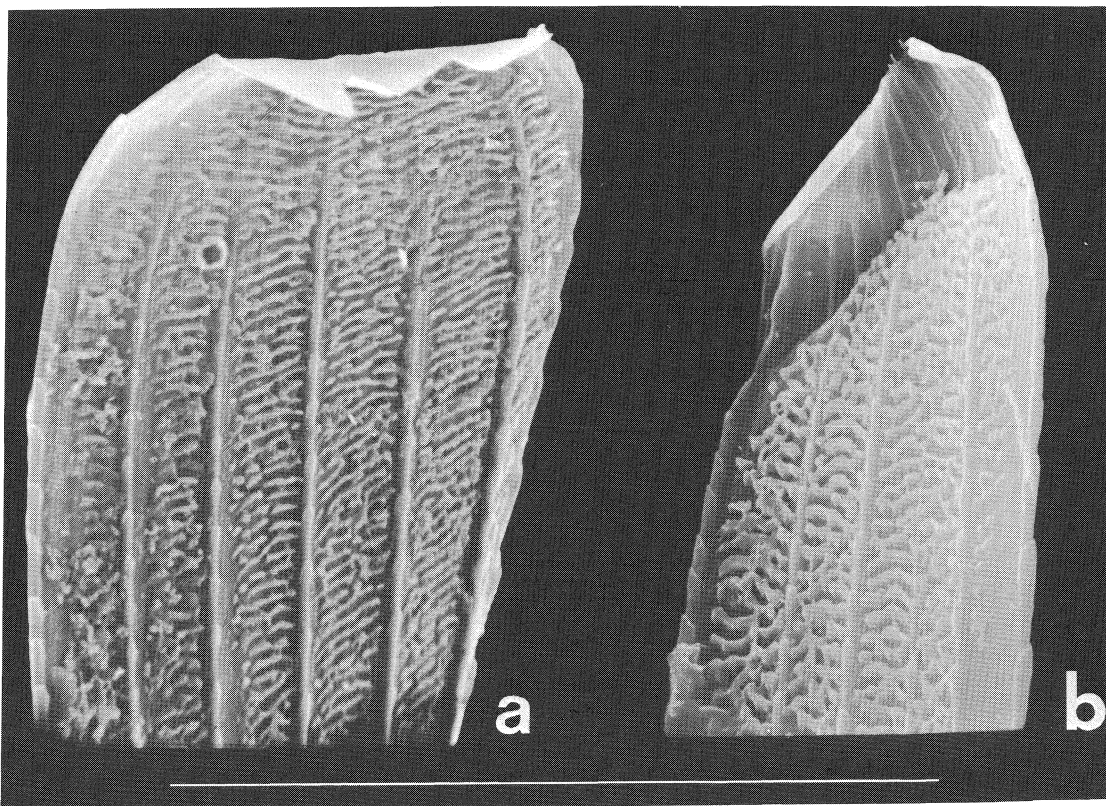


Fig 18. *P. heteroseta*, setiger 31, main paleae, distal third; scale line 100  $\mu$ m (a, mid main palea; b, distal main palea) (Holotype AHF N.1545).

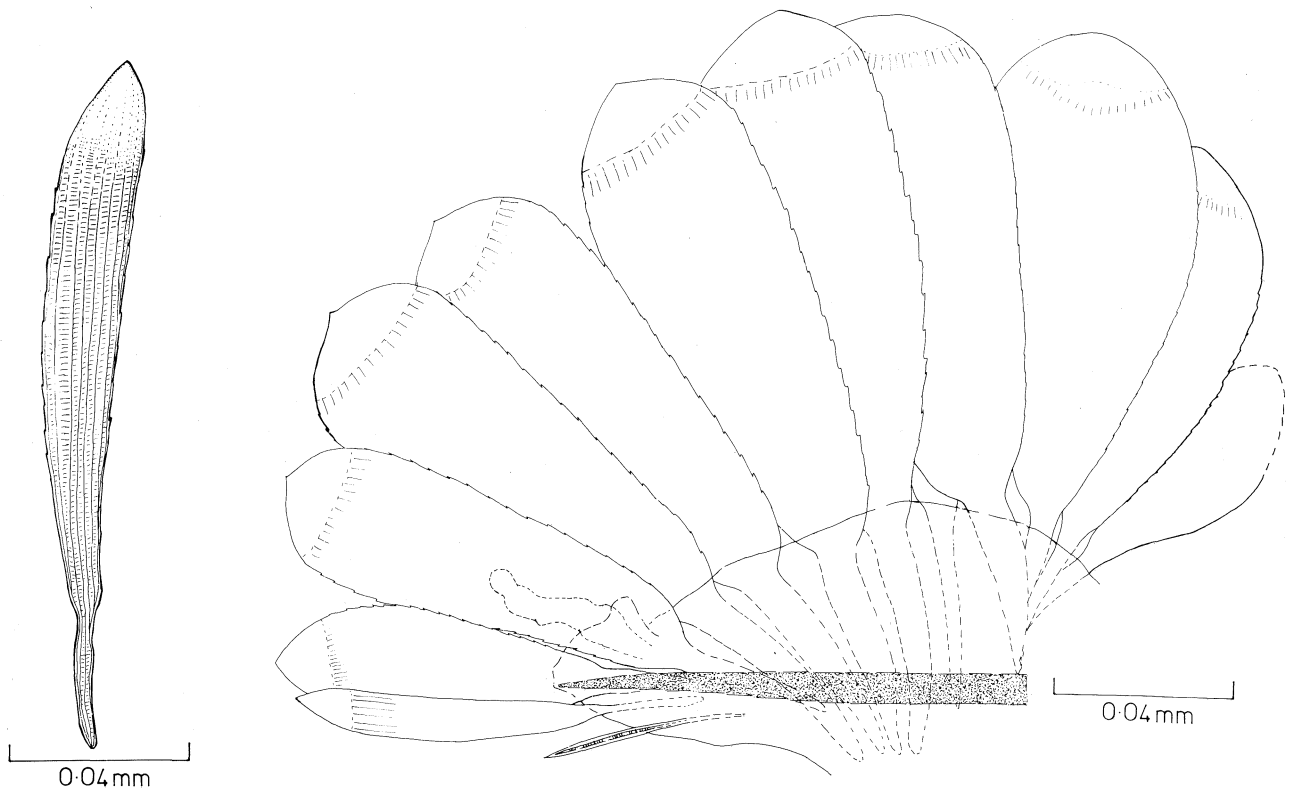


Fig. 19. *P. heteroseta*: left, setiger 30, lateral palea (Holotype AHF N.1545); right, setiger 5 of juvenile, dorsal view (USNM 97856).

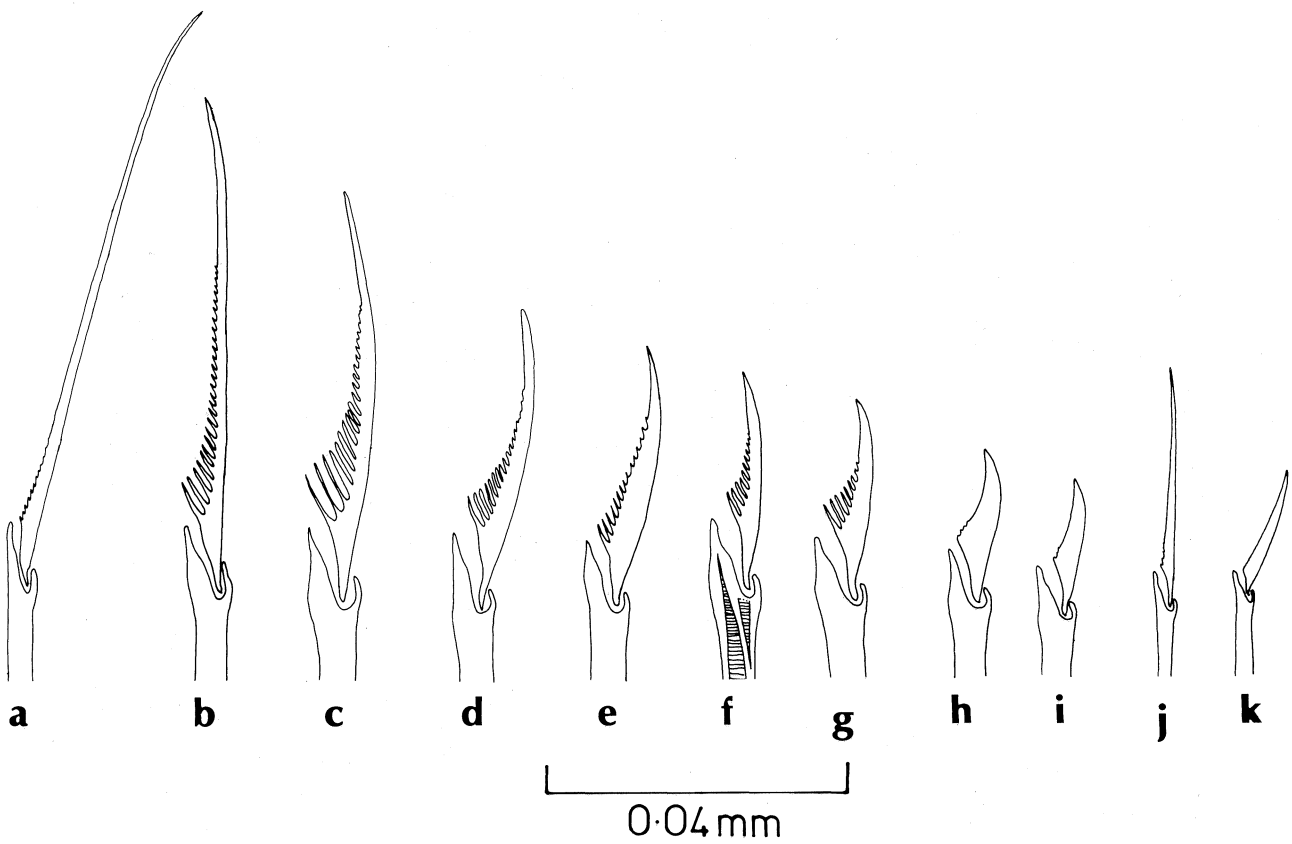


Fig. 20a-k. *P. heteroseta*, setiger 30, neurosetal units (Holotype AHF N.1545).

of which up to 4 may persist to setiger 10. Subsequent neurosetae with superior group of 2 spinigers with long, slender shafts and long blades (Fig. 20a) on each setiger from anterior to mid-body region. Posterior setigers with up to 3 spinigers, including 1 with a short, fine blade (Fig. 20j). Mid-superior group with up to 7 falcigers, including 1–2 with long blades (Fig. 20b) and others with medium length blades with coarse basal serration (Fig. 20c,d). Mid-inferior group with 8–12 falcigers with medium to short blades with coarse to fine basal serration (Fig. 20e,f,g). Inferior group with up to 6 falcigers with slender, short shafts and short blades with fine basal serration (Fig. 20h,i). A single falciger with a narrow blade is found within the inferior group of neurosetae in the posterior 10 setigers (Fig. 20k). Pygidium composed of rounded dorsal structure with 2 short anal cirri and a small ventral cone (Fig. 21).

#### ADDITIONAL MORPHOLOGICAL INFORMATION

**Variation in setal counts.** *Paleaequor heteroseta* shows some variation in setal counts between setigers and between individuals of different size. Table 3 shows, for an entire specimen of 61 setigers (USNM 51005), differences between setigers in the numbers of paleae within the notopodium; the numbers of ribs on the various paleae types; and the numbers of different neurosetal types. There is a decrease in the numbers of main paleae in the anterior and posterior 10 setigers. The larger number of ribs on the main paleae are concentrated in the mid group of the main paleae fan and occur on the mid-body setigers. Main paleae with a higher number of ribs (e.g. 23, 24) are not consistently dispersed from one setiger to the next and appear irregularly. The large distal median paleae possess a consistently high number of ribs from the 10 setiger onwards, compared to the smaller proximal median

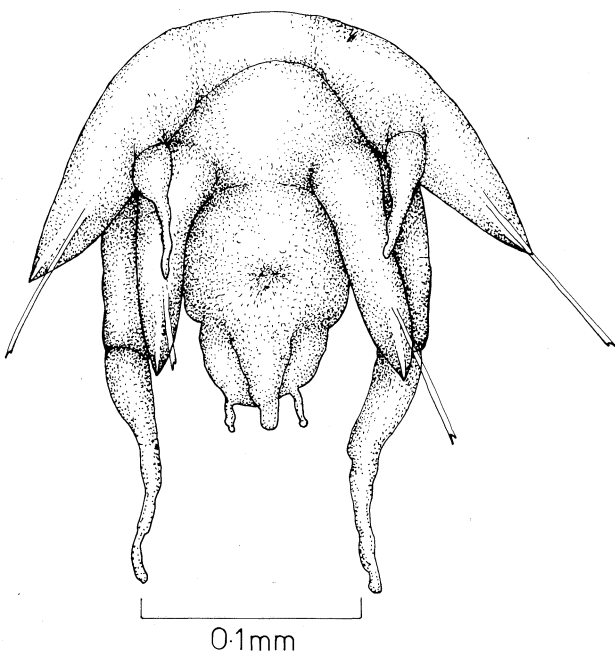


Fig. 21. *P. heteroseta*, pygidium, ventral view (USNM 52859).

paleae. The single paleae (subunit 2) is present in setigers 26 to 61. There is a slight decrease in numbers of neurosetal types in the anterior- and posterior-most setigers (with the exception of the superior spinigers in the anterior four setigers).

Setal counts also vary between individuals of different size. For example, a specimen of 9 setigers (USNM 97856) has a fan of 5 main paleae, whereas the type specimen of 62 setigers (AHF N.1545) has a fan of 14 main paleae. The numbers of ribs of the main and median paleae increase with setiger size. The numbers of mid-inferior falcigers increase with setiger size. Specimens of 72 setigers (USNM 45522) and 61 setigers (USNM 51005) possess 10–12, whereas a specimen of 32 setigers (USNM 45522) has 6–8 and a specimen of 9 setigers (USNM 97856) has 5–8.

**Notes on *P. heteroseta* juveniles.** Specimens of 9 and 13 setigers (USNM 97856) have an ovoid body shape and a more convex dorsum in comparison to the long, narrow body shape and the very slightly convex to flattened dorsum of the adult. The two juveniles also possess silvery, almost transparent paleae in contrast to the usual golden brown paleae of the adult.

The 9 setiger individual has 0–1 lateral palea with 4–6 ribs. All notopodia have a tiny simple seta located just posteriorly to, or overlying the dorsal aciculum. Two slender paleae (subunit 1) with 12 and 13 ribs insert in between the lateral and main groups. There are up to 5 main paleae on each setiger with 15–18 ribs and 0–5 raised ribs. The three median paleae have 14–21 ribs (Fig. 19 right). Neurosetae resemble the four categories found in the adult and neurosetae numbers are as follows: superior 2, mid-superior 4, mid-inferior 5–8, and inferior 3–4.

**Comments.** In her description of *Paleanotus* (= *Paleaequor*) *heteroseta*, Hartman (1945) recognised two types of neurosetae and their three positions within the fascicle which correspond to the superior, mid and inferior positions designated by the author. Approximate numbers of neurosetae within each category given by Hartman agree with the numbers cited here. The ‘narrower’ and ‘broader’ paleae designated by Hartman correspond to the author’s categories of lateral and main paleae. Her description did not include the raised and serrated ribs of the main paleae.

**Other chrysopetalids incorrectly referred to *P. heteroseta*.** Mileikovsky (1962) described some chrysopetalid larvae collected from the Gulf Stream (37°35’N, 70°48’E) as *Paleanotus heteroseta*. These specimens of 4 and 5 setigers possess symmetrical main paleae with longitudinal ribs, horizontal striae and strongly serrate margins that all extend to the apex of the palea. The 9 setiger specimen of *P. heteroseta*, described above, has main paleae with finely serrated margins and distinct hyaline tips that closely resemble those of the adult. As Mileikovsky’s specimens are lost (R. Levenstein, pers. comm.) it is difficult to determine to what chrysopetalid genus these larvae belong.

Specimens of *Paleanotus* (= *Paleaequor*) *heteroseta*



**Table 3.** Comparisons of setal counts between setigers of a 61 setiger individual of *P. heteroseta* USNM 51005

Setiger number	1	2	4	6	10	18	26	36	48	51	55	58	60
<b>Notosetal characteristics</b>													
Lateral paleae (number)	1	2	3	4	3-4	3-4	3	3	3	2	2	3	1
Number of ribs	5	5	4-7	4-8	4-8	6-8	6-7	6	4-7	4-6	6-7	6-7	6
Lateral, sub-unit 1 (number)	0	0	1	1	1	1	2	2	2	2	2	2	2
Number of ribs	0	0	15	*	15	15	13,13	13,14	15,15	13,14	13,14	12,15	13,13
Main paleae (number)	3	7	8	10	11	10	13	12	10	9	7-8	6	2
Number of ribs (distal)	10	16	18	*	17	19	17	18	18	19	19	18	17
Number of ribs (mid)	0	18	19	*	20	21-23	21-23	22-24	23	21-24	22	21	18
Number of ribs (proximal)	0	17	20	*	20	22	22	21	20	20-22	23	22	0
Median paleae (number)	0	2	2	3	3	4	3	4	4	4	4	4	3
Number of ribs (distal)	0	18	*	18,18	21,21	24,20	24,20	23,22	25,20	25,23	24,23	23,20	23
Number of ribs (proximal)	0	17	*	17	19	**	19	19,16	**	20,17	20,16	17,11	18,13
Presence (+), absence (-) of single palea, sub-unit 2	-	-	-	-	-	-	+	+	+	+	+	+	+
<b>Neurosetal characteristics</b>													
Superior spinigers (number)	10	5-7	4	2	2	2	2	2	2	3	3	2	2
Mid-superior falcigers (number)	0	4-5	6	7	5	6	6	5	5	5	4	3	1
Mid-inferior falcigers (number)	0	0	3	12	10	10	8	10	12	10	6	*	2
Inferior falcigers (number)	0	0	3	4	4	4	4	4	4-5	4-5	5	5	2

0 absent

\* damaged or obscured

were reported from the Cape Verde Islands by Rullier (1964). This material in the Paris Museum is misidentified. Rullier's specimens represent two species belonging to the genera *Paleanotus* and a new genus.

**Occurrence with other genera.** Collections from the Gulf of Mexico reveal *Chrysopetalum occidentale*, *Paleanotus chrysolepis* and a new chrysopetalid genus and species (n. gen. 1) occurring within the same samples of *P. heteroseta* (Gathof, 1984). *Paleaequor heteroseta* has been collected in larger numbers (e.g. 100 specimens, USNM 45522) compared to the mostly single specimens of other chrysopetalid genera. In one lot (USNM 97856) a sample was composed of approximately half *P. heteroseta* and new genus 1, the majority of which were juveniles in both cases. *Bhawania goodei* has been recorded from the same general localities as *P. heteroseta* along the eastern United States coast but they never occur in the same sample. The two genera are found in different habitats; *Bhawania* being recorded from under rocks and in association with corals in shallow depths (both records Day, 1973; Gardiner, 1982), and *Paleaequor* from sandy and muddy sediments.

**Habitat.** *Paleaequor heteroseta* has been recorded from localities along the eastern seaboard from Northern Carolina (Hartman, 1945) to Indian River, Florida (Renaud, 1956). Recent collections by G. Gaston from York River, South Virginia represent a northward extension of range. The sites of these localities are largely composed of sheltered bays and submarine banks near entrances to rivers. Depth ranges from the intertidal to 12 m, and sediments are recorded as coarse sand, and sand and broken shell (Hartman, 1945; Day, 1973; Gardiner, 1982; Wilson, 1979). Wilson (1979) records *P. heteroseta* occurring as one of the numerically

dominant species in a polychaete community associated with maldanid sedimentary reefs on a sand flat at Point Lookout, North Carolina.

Localities in the Gulf of Mexico range from Tampa Bay, Florida to Port Aransas, Texas in depths to 30 m. Gathof (1984) records scattered occurrences of *P. heteroseta* for the northwest and northeast end of the Gulf of Mexico in sediments which range from sandy clayey silt and fine to coarse sand, in depths of 14-82 m.

**Distribution.** Eastern coast of United States to Gulf of Mexico.

### *Paleaequor psamathe* n. sp.

Figs 22-24

**Material examined.** HOLOTYPE: Mexico, Gulf of California, Sonora, Pelican Point, (31°20'N, 113°38'W), USNM 97850, coll. B. Burch, 10 May 1969; 54 setigers, 3.6 mm length, 0.8 mm width, specimen entire. PARATYPES: Pelican Point, (31°20'N, 113°40'W), 13.6 m, 3, USNM 97851, coll. B. Burch, 30 September 1967.

**Additional material examined.** Gulf of California, Punta Cholla, intertidal, 7, AHF N.14112, coll. S.A. Glassell, 9 May 1941; off Cholla, 31°20'N, 113°41'W, rock and gorgonian bottom, 10.3 m, 6, CAS 17395, coll. T.A. Burch, 31 May 1968; Bahia Coastocomate, Jalisco, 60 km. NNW of Manzanillo, Colima and 3 mi. NW of Barra de Navidad, Stn RAD 1-68, under rocks and sand beneath rocks, 3-18 m, 1, USNM 97854, October 1968. Ecuador, Gulf of Guayaquil, Stn 773-D, (02°49'S, 80°31'W), 20 m, 2, USNM 97853, coll. Anton Bruun CR. 18B, 11 September 1966; Stn 773 (02°43'S, 80°33'W), 20 m, 8, USNM 97852, coll. Anton Bruun CR. 18B, 11 September 1966.

Range of specimens from Gulf of California and Western Mexico, 31 setigers, CAS 17395, 2 mm length, 0.45 mm width to 74 setigers USNM 97854, 8.7 mm length, 0.65 mm width.

Range of specimens from Gulf of Guayaquil, 13 setigers, 1.04 mm length, 0.5 mm width to 53 setigers, 4.4 mm length, 0.6 mm width; both USNM 97852.

**Description.** Holotype with prostomium and anterior segments retracted in part, two pairs of red-brown eyes visible dorsally. Notosetae comprising: 3–4 lateral paleae with 4–7 ribs; 2 slender paleae with 10–13 ribs inserted between lateral and main groups; up to 13 main paleae with a maximum of 21 ribs with 5–6 raised and finely serrated ribs; 4 median paleae with 13–25 ribs and 0–6 raised ribs, comprising 2 broad, distal paleae with 20–25 ribs, the next proximal palea smaller with 18–20 ribs, and the most proximal and smallest with 13–15 ribs. One slender palea ( $\frac{2}{3}$  length of main palea) with 10–13 ribs and 2 raised ribs inserting between the main and median groups on the posterior half of the body (Fig. 22). Large, scattered to dense granules on superior surface of main and distal median paleae.

Neuropodium short and conical (Fig. 23). First setigerous neuropodium with neurosetae spinigers only, of which up to 4 persist to setiger 5. Subsequent neurosetae with superior group of 2 spinigers, with slim shafts and fine attenuated blades (Fig. 24a), present on each setiger to mid-body region. Posterior setigers each with up to 3 spinigers, including 1 with a short, hair like blade (Fig. 24i). Mid-superior group with 4–6 falcigers with medium length blades and coarse basal serration (Fig. 24c,d). Within this group a long-bladed falciger present only on the anterior segments (Fig. 24b). Mid-inferior group with 8–10 falcigers with medium to short blades (Fig. 24e,f,g). Inferior group of 3–5 falcigers with short shafts and short, broad blades with fine basal serration, and terminating in a blunt, smooth tip (Fig. 24h). Single falciger with a narrow blade included within inferior group on posterior 10 setigers (Fig. 24j). Pygidium rounded, dorsal structure with 2 short anal cirri and a ventral cone.

**Comments.** The specimen from near Barra de Navidad, western Mexico (USNM 97854) is long and slim with a white body and near transparent paleae. Neurosetae and paleae types are similar to those specimens from the Gulf of California. The neurosetae of the posterior segments are sparse and mostly broken.

Ecuadorian specimens of *P. psamathe* differ slightly from those of the Gulf of California. Characters that distinguish the Guayaquil population include a higher number of ribs in the main (up to 22) and median paleae (16–26). There appear to be no long falcigers present in the upper mid-superior group, and the lower mid-superior falcigers are slightly shorter with characteristic long basal serration on the blades.

At present, *P. psamathe* appears to have a disjunct distribution with a northern population extending from 31° to 19°N and a southern population recorded from 2°S (Fig. 1).

**Occurrence with other genera.** One specimen of *Paleanotus* sp. was found in one sample with *P. psamathe* (USNM 97851). *Paleanotus* sp. and

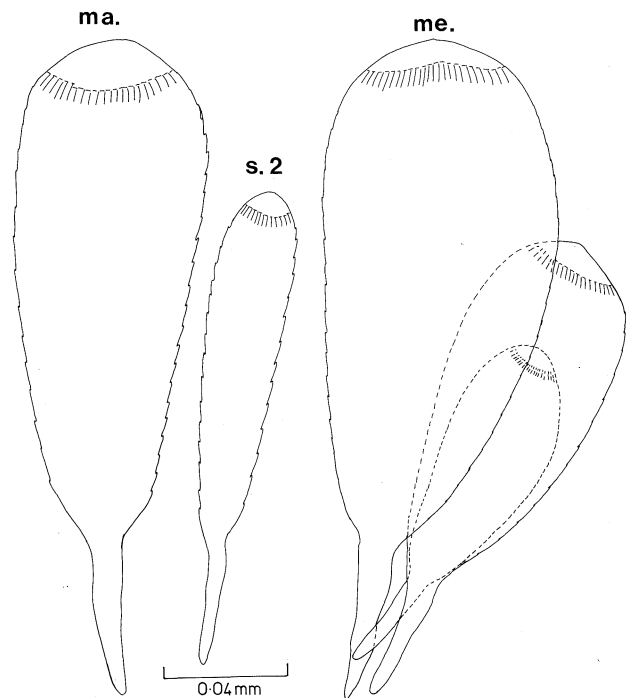


Fig. 22. *P. psamathe*, setiger 33; **ma.**, proximal main palea; **s.2**, subunit 2 palea; **me.**, median paleae (Holotype USNM 97850).

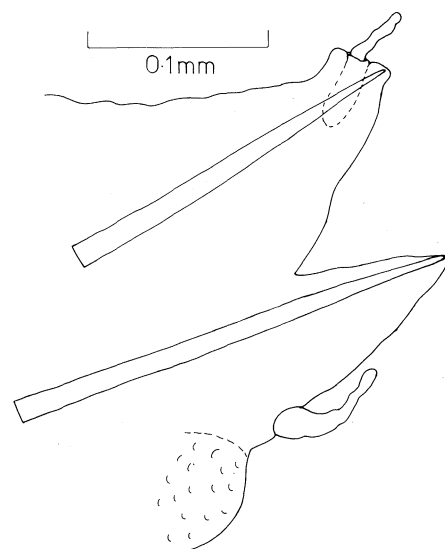


Fig. 23. *P. psamathe*, setiger 34, ventral view (Holotype USNM 97850).

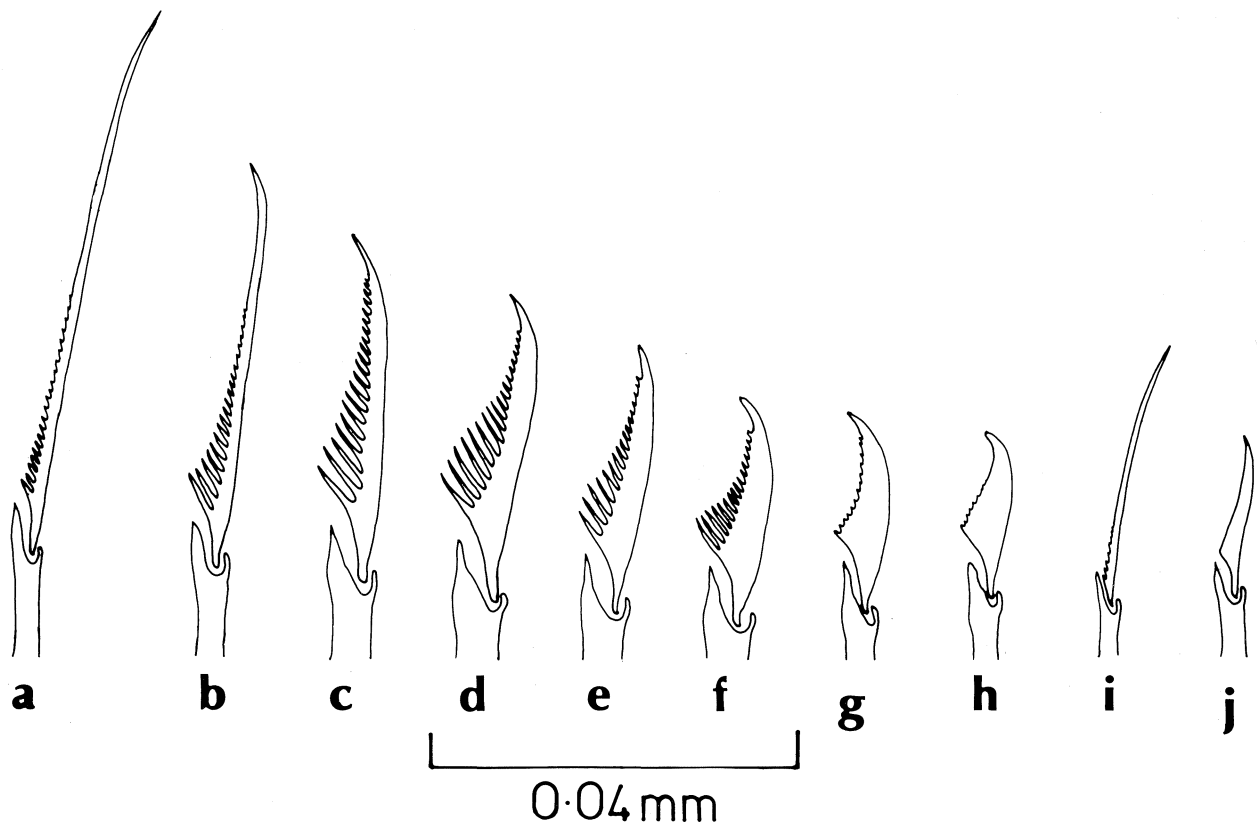


Fig. 24a-j. *P. psamathe*, setiger 32, neurosetal units (Holotype USNM 97850).

*Chrysopetalum* sp. were found with *P. psamathe* (USNM 97852).

**Habitat.** A collection of ten polychaete families from Punta Cholla included *P. psamathe* (AHF N 14112) and a number of terebellid and chaetopterid tube dwellers. Habitat data for polychaetes collected two days later from the same locality is recorded in the AHF register as 'sand and shell, encrusted tubes'. All Gulf of California collecting sites are around Cholla, Sonora which is located at the northeast end of the Gulf. A distribution map of sediments within the Gulf of California characterize the Cholla sites as silt and sand (Fauchald, 1979). Depth ranges from the intertidal to 18 m.

The more southwestern Mexico habitat is described as 'sand beneath rocks' at depths of 3–18 m. Gulf of Guayaquil material was located at a depth of 20 m.

**Distribution.** Gulf of California, Western Mexico and Ecuador.

**Etymology.** The species name, *psamathe*, is named after a nereid goddess of the sandy shore.

***Paleaequor nicoyensis* n. sp.**

Figs 25–28

**Material examined.** HOLOTYPE: Central America, Costa Rica, Gulf of Nicoya, Stn 12, silt-clay and sand, 44 m, USNM 97484, coll. H. Dean, 11 July 1980; 52 setigers, 6.2 mm length,

1.2 mm width, specimen entire with damaged pygidial segment.

PARATYPES: Gulf of Nicoya, 2, USNM 97485; 3, AHF 1434; 13, NTM W. 1906. Range of specimens from 22 setigers, 2.7 mm length, 1.0 mm width to 37 setigers, 3.8 mm length, 1.06 mm width; both NTM W.1906.

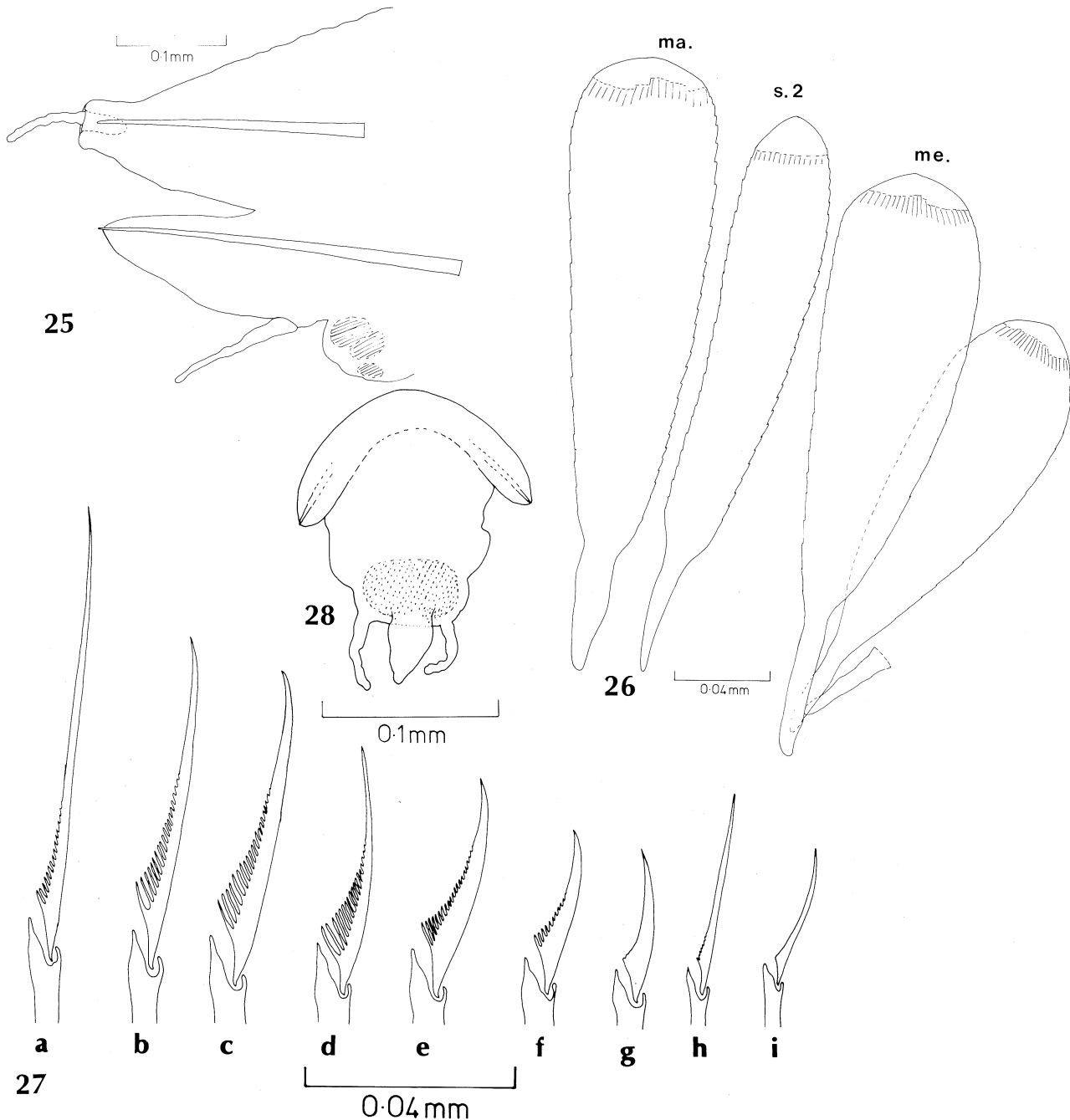
**Description.** Holotype with anterior segments relaxed. Prostomial and peristomial appendages visible. Two pairs of red-brown eyes visible anterior to nuchal fold. Notosetae comprising: 3–4 lateral paleae with 4–8 ribs; 1–2 slender paleae with 9–15 ribs inserted between lateral and main groups; up to 14 main paleae with 16–20 ribs and 3–5 raised and finely serrated ribs; 3–4 median paleae with 13–21 ribs and 0–4 raised ribs, 2 most distal median paleae with 17–21 ribs, 2 most proximal with 13–16 ribs. One small, slender palea (approximately  $\frac{3}{4}$  length of main paleae) with 11–13 ribs and 2–3 raised ribs inserting between the main and median groups on posterior 10 setigers (Fig. 26). Small, fine granules on superior surface of main and distal median paleae. Paleae with very close set horizontal striae.

Narrow, pointed neuropodium with long, subulate ventral cirrus (Fig. 25). First and second neuropodia with neurosetae spinigers only. Subsequent neurosetae with superior group of 2 spinigers with slim shafts and long blades (Fig. 27a) present on each setiger to mid-body region. Posterior setigers have up to 3 spinigers including 1 with a short, fine blade (Fig. 27h). Mid-superior group of up to 8 falcigers, comprising 2 with

long blades (Fig. 27b), the others medium length blades with coarse basal serration (Fig. 27c,d). Mid-inferior group of 8-10 falcigers with medium to short length blades and coarse to fine basal serration (Fig. 27e,f). Inferior group of 4-5 falcigers with slender, short shafts and narrow, distally curved blades with fine to very fine basal serration (Fig. 27g). A single falciger with a very slim blade (almost spinigerous) included within inferior group in posterior 10 setigers (Fig. 27i). Pygidium

damaged in holotype; pygidium of paratypes composed of a rounded dorsal structure with two anal cirri and a slim, ventral cone (Fig. 28).

**Habitat.** A number of chrysopetalids were made available from samples from a benthic survey carried out in the Gulf of Nicoya, Costa Rica (Maurer, 1984). Specimens of *P. nicoyensis* were present in a number of stations located off the mouths of the Rio Barranca



**Figs 25-28.** *P. nicoyensis*: 25, setiger 25, dorsal view (Holotype USNM 97484); 26, setiger 49, proximal main palea (ma.), subunit 2 palea (s.2), median paleae (me.) (Holotype USNM 97484); 27a-i, setiger 29, neurosetal units (Paratype USNM 97485); 28, pygidium, ventral view (Paratype NTM W.1906).

**Table 4.** Comparison of setal counts between five *Paleaequor* species

Species	<i>P. setula</i>	<i>P. breve</i>	<i>P. heteroseta</i>	<i>P. psamathe</i>	<i>P. nicoyensis</i>
<b>Pygidium</b>					
1. quadrate without anal cone	1	1	2	2	2
2. rounded with anal cone					
<b>Notosetal characteristics</b>					
Lateral paleae (number)	4-7(8)	3-4	4	3-4	4
Number of ribs	2-5	2-4	4-9	4-7	4-8
Main paleae (number of ribs)	17-22(24)	17-20	17-22(24)	17-21	17-19
Median paleae (number)	2-3	2-3	3-4	3-4	3-4
Number of ribs (distal)	13-22	16-20	20-25	20-24(26)	16-20
Numbers of ribs (proximal)	9-12	8-16	11-20	13-18	13-16
Posterior position of single palea (sub-unit 2) within:					
1. posterior 10 setigers	1	1	2	2	1
2. posterior half of body					
<b>Neurosetal characteristics</b>					
Superior spinigers (number mid-body)	4	4	2	2	2
Mid-superior falcigers (number of long falcigers only)	2	2	2	0-1	2
Mid-superior falcigers (number)	6	6	5	4-5	6
Mid-inferior falcigers (number)	6-10	6-9	8-12	8-10	8-10
Inferior neurosetal type:					
1. spinigers	1	1	2	2	2
2. falcigers					
Inferior neurosetae (number)	4-5	5-7	4-6	3-5	4-5
<b>Distribution</b> (Fig. 1)	Australia: Queensland, Northern Territory, Papua-New Guinea	Vietnam: South Vietnam	Eastern United States: Southern Virginia to Gulf of Mexico	Mexico: Gulf of California, Western Mexico. Ecuador	Central America (Pacific): Costa Rica

and Rio Grande de Tarcoles. These are situated in the lower eastern Gulf, characterized by a shallow sandy silt shelf. Sediments recorded from individual stations range from sand to silt-clay with a high organic content associated with the latter. Depth ranges from 13 to 46 m.

**Distribution.** Pacific coast of Costa Rica.

**Etymology.** The species name, *nicoyensis*, is derived from the type locality (Gulf of Nicoya).

### General Discussion

The five species of *Paleaequor* fall into two distinct morphological groups; group A (*P. setula*, *P. breve*) occurs in the western Pacific, and group B (*P. heteroseta*, *P. psamathe*, *P. nicoyensis*) occurs in the eastern Pacific and western Atlantic. Table 4 summarizes the character states for all species. The two species groups are separable on the basis of three characters, the states or values of which are constant within each group but differ between the two groups. Species in group A possess a quadrate pygidium, narrow lateral paleae with a low number of ribs, and inferior neurosetae composed of spinigers. Species in group B possess a pygidium composed of a dorsal rounded structure and a ventral cone, lateral paleae with a higher number of ribs, and inferior neurosetae composed of

falcigers. There are two additional characters that separate group A and B. The numbers of superior spinigers and median paleae are constant on mid-body setigers between group A and B but the numbers of superior spinigers and median paleae on the most anterior and posterior setigers are within a similar range for all *Paleaequor* species.

Within group A, *P. setula* differs from *P. breve* in having a higher number of lateral paleae. When comparing the structure of the paleae in the two species, *P. setula* has more ribs on the main paleae and there are also more ribs on the distal median paleae than in *P. breve*. There are fewer inferior spinigerous neurosetae in *P. setula* and the blades of these also are shorter (0.024-0.028 mm versus 0.031-0.036 mm). *Paleaequor setula* has higher numbers of lateral paleae than all other *Paleaequor* species.

Within group B (Americas), the relationship of the western Atlantic species (*P. heteroseta*) to the two American Pacific species (*P. psamathe* and *P. nicoyensis*) is equivocal. The composition and rib number of the three paleae types is similar in *P. heteroseta* and *P. psamathe* but the composition of the neurosetal fascicles in these species differs. *Paleaequor heteroseta* has larger, more robust neurosetae and higher numbers of mid-superior, long-bladed falcigers and inferior neurosetae. *P. heteroseta* shares similar

neurosetal characters with *P. nicoyensis* but the composition of the notosetal fascicles differ. *Paleaequor heteroseta* has broad proximal main and distal median paleae with a higher number of ribs and a single palea (subunit 2) located within the posterior half of the body.

In comparison with *P. heteroseta* and *P. nicoyensis* the northern and southern populations of *P. psamathe* possess short, conical neuropodia and relatively short-bladed spinigerous and falcigerous neurosetae. *Paleaequor psamathe* lacks, or has small numbers of long-bladed mid-superior falcigers and small numbers of inferior falcigers. *Paleaequor psamathe* differs greatly from *P. nicoyensis* in both notosetal and neurosetal characters; the fact that these two species are most dissimilar is of interest as *P. nicoyensis* is located in the middle of the range of distribution of *P. psamathe*.

*Paleaequor nicoyensis* is distinguished from *P. psamathe* and *P. heteroseta* by lower numbers of ribs in the main and median paleae; finer raised rib ornamentation and a finer granular sculpture on the main paleae; and the position of the single palea (subunit 2) within the posterior 10 setigers. It is further distinguished by having longer, narrower blades of the mid-inferior falcigers, and two types of inferior neurosetae (falcigerous and near spinigerous) within the posterior 10 setigers. In comparison with the other two American species, the rounded dorsal part of the pygidium in *P. nicoyensis* is retracted so that the two anal cirri extend laterally rather than posteriorly to the slim, ventral cone. While *P. nicoyensis* appears most closely related to its American congeners it also exhibits characters linking it to the western Pacific species. *Paleaequor nicoyensis* share with *P. setula* and *P. breve* a lower rib number on the distal median paleae; the position of the single palea within the posterior 10 setigers; and the presence of an inferior, almost spinigerous neuroseta within the posterior 10 setigers. It further shares with *P. breve* a similar number of ribs in the main and distal median paleae; fine raised rib ornamentation and a very fine granular sculptured superior surface on the main paleae.

Certain setal patterns, related to tapered body form, are persistent, i.e. present in all members of the genus, e.g. (1) certain setal types present in the mid-body increase, decrease or are absent at the anterior and posterior ends; (2) certain setal types are only present at the anterior or posterior end.

Certain setal characters in *Paleaequor* appear to be morphologically labile. This is evident by variation within and between individuals of a species in the type and number of setae throughout the body length. Similar variation also occurs between species, particularly variation in superior spiniger number, mid-superior upper falciger type and number, and type and number of inferior neurosetae. Setal variation between species is also seen in the number of median and lateral paleae, the number of ribs on the median and lateral paleae, and in the location of the single palea (subunit 2). Much of the variation in setal numbers and setal

morphology is difficult to interpret, particularly without outgroup comparisons, and it remains unclear whether the evolutionary changes in setal characters in *Paleaequor* involves principally loss or acquisition.

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