

REVISION OF THE TROPICAL MARINE LITTORAL
GENUS *PSEUDANURIDA* SCHÖTT
(Collembola : Pseudachorutinae)

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Abstract : Seven species have been described in *Pseudanurida* but examination of types or of material from near the type localities shows that only *P. billitonensis*, *P. bogoyawlensky*, *P. glauerti* and *P. sawayana* are valid. A further new species, *P. yini*, is described from Malaya. Descriptions are given with special attention to chaetotaxy, together with full synonymy, a key and comparative plates.

Pseudanurida is a genus of black, poduromorph Collembola very characteristic of the inter-tidal zone throughout the tropics. Two keys to the genus have recently been published by Schuster (1965) and Massoud (1967) but both relied heavily on the literature and the taxonomy remains confused by old descriptions of doubtful synonymy. As I have either seen types or collected fresh material from or near the type localities of the doubtful species, a further revision is found necessary. Although seven names have been proposed in the genus and a further species is described here, only 5 valid species are recognized. A key to these is provided in the text and in addition, 3 of the figures are so arranged as to provide independent comparisons from which complete or fragmentary material may be identified.

The genus was established by Schött (1901) for *P. billitonensis* from a sand bank off the Indonesian island of Billiton. Becker (1905) proposed *Pseudachorutides* for *P. bogoyawlensky* from foraminiferous sands off Bahrain island in the Persian Gulf. Most workers have since treated *Pseudachorutides* as a synonym of *Pseudanurida* although Yosii (1955) considered that they could both be justifiably maintained. They are treated here as one since in its broad sense, *Pseudanurida* is easily recognized by the combination of long furcula and styliform mouthparts found in no other Collembola.

Two further species have been described from the Near East, *P. clysmæ* Jackson 1927 and *P. dollfusi* Denis 1938, but because of the incomplete description of *P. bogoyawlensky* they have remained problematical. *Neachorutes glauerti* was described by Womersley (1933) from Western Australia but was later synonymized by him with *P. billitonensis* and this attribution has not been questioned. Re-examination of Womersley's types now shows that it is an independent species of which *P. australica* Salmon 1955 appears to be a synonym. Murphy (1965) attributed to *P. bogoyawlensky* a species from Gambia (West Africa) having also collected it in Southeast Asia and assuming it to be pan-tropical. Schuster (1965) described the same species from Brazil as a new species, *P. sawayana*.

I have since had the opportunity to collect extensively in Bahrain, the type locality of *P. bogoyawlensky*. As expected, *P. sawayana* proved to occur there but only in fresh-

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water habitats, while on the coral sands, reefs and other coastal situations a different species, presumably the original *P. bogoyawlensky* was abundant. No other species was found and on this interpretation, examination of the type of *P. clysmæ* and the excellent description of *P. dollfusi* show both to be synonyms of *P. bogoyawlensky*.

Of the described species therefore, only 4 remain valid, namely *P. billitonensis* Schött 1901, *P. bogoyawlensky* (Becker 1905), *P. glauerti* (Womersley 1933) and *P. sawayana* Schuster 1965. A further species, *P. yini* n. sp. from Malaya, is described in this paper.

Genus *Pseudanurida* Schött 1901

Pseudanurida Schött 1901: 320.

Type-species. *Pseudanurida billitonensis* Schött 1901 by monotypy.

REJECTED SYNONYMS:

Pseudachorutides Becker 1905: 72, type-species *Pseudachorutides Bogoyawlensky* Becker (1905) by monotypy.

Neachorutes Womersley 1933: 61, type-species *Neachorutes glauerti* Womersley (1933) by monotypy.

Pseudachorutoides Denis 1938: 239 (*lapsus calami*).

DISCUSSION OF SYNONYMY

Neachorutes is widely accepted as a synonym of *Pseudanurida* because Womersley (1939) reduced *N. glauerti* to synonymy under *P. billitonensis*. This is an invalid reason as the 2 species are distinct. Yosii (1955) proposes that *Pseudachorutides* be treated as a separate genus from *Pseudanurida* and although he is not followed here, the key below demonstrates that *P. billitonensis* is sufficiently isolated to be validly treated in this way. If a subsequent revisor should adopt this policy, *Neachorutes* will fall as a synonym of *Pseudachorutides*, not of *Pseudanurida*.

DESCRIPTION OF GENUS

Medium to large pseudachorutine Collembola with intense blue-black pigment. Body segments all separate and setose and with distinct non-setose inter-tergites but without prominent paratergites. Integument coarsely granulate especially on the dens. Abdomen 6 not bilobed and without anal spines. Some species with tegumental bleeding sites on head, abd. 1 and abd. 4 (note 1). *Antennae* with segments III and IV fused externally but not on the inner side, the compound segment being distinctively flexed inwards to the mid-line. Ant. IV without apical papilla (note 2). Sense organ of 3rd antennal segment (S. O. Ant. III) composed of 3 or 4 freely exposed simple sensillae whose position varies according to the species (note 3). *Post-antennal organ* absent. Ocelli 8 + 8 equal. *Buccal cone* long with elongate, hyaline epipharynx and pointed labium bearing 10 + 10 setae, none differentiated into microsetae. Mandibles with dentate apex but no molar plaque. Maxillae needle-like, with little or no trace of lamellae and no differentiated capitulum. Hypopharynx well developed, clearly divided into paired appendages here called superlinguae, united medially by a thin membrane (note 4). Labial syringe present (note 5). *Tibiotarsus* without tenent hairs. Claw strong, usually with inner but no lateral teeth. Empodial appendage absent. Ventral tube low, without setae on corpus and with none or one on valves. Tenaculum with 3 + 3 teeth on rami and prominent, separate anterior and posterior lobes on the corpus which are strongly tuberculate but bear no setae. Furcula long, extending forward beyond the ventral tube due to extreme elongation of the dens. Dens cylindrical and covered on all sides by very pronounced, conical tubercles, strongly bowed

outwards and with well developed basal, articular complex. Mucro unique, with conical, strongly tuberculate corpus bearing 4 longitudinal lamellae of which the anterior and posterior are continuous around the apex.

SEXUAL DIMORPHISM

In most species there is no marked external dimorphism except in the usual structures of the gonopore common to all poduromorph Collembola. The ♂ has no modified setae on the gonopore and there are no lateral fascicles of sensillae (cf. *Oudemansia*). One species however, *P. glauerti*, has the dorsal valve of Abd. 6 extended into a long, clavate appendage in the ♂.

The ♂ genital tract has a prominent internal sclerotized atrium of turbinate form. The ♀ genital tract has no detectable spermathecae.

NOTES ON MORPHOLOGY

Note 1. Tegumental reflex bleeding sites are areas of thin cuticle which at their simplest are surrounded only by a circle of enlarged cutaneous granules. They superficially resemble muscle insertions but receive no muscle fibers. In *P. billitonensis* and some species of *Oudemansia* the area of thin cuticle is raised on a prominent tubercle, more or less bilobed to form a pair of valves. When attacked, the animal is able to rupture the cuticle at this point and exude haemolymph, presumably as a repellent. Fixed bleeding sites occur to my knowledge only in certain species of *Pseudanurida* and *Oudemansia* where they are always dorsolaterally on the posterior part of the head, abdomen 1 and abdomen 4. "Autohaemorrhagy" or reflex bleeding has however been reported in some terrestrial pseudachorutines, notably *Arlesiella monodi* by Delamare (1951) where it is so dramatic that he was led to call it "reflex suicide." Whether these structures occur in other genera needs study and their resemblance to the pseudocelli of Onychiuridae may be of phyletic interest.

Note 2. A non-retractile, trilobed apical papilla has been reported on Ant. IV by Murphy (1965) and Massoud (1967). From certain lateral aspects the appearance of such a papilla is usual in all species, but close examination of many individuals has shown it not to be a true papilla. Certain of the tegumentary granules are fused apically into a ramifying ridge.

Note 3. In all species except *P. billitonensis* the sense organ of Ant. III consists of 3 freely exposed simple sensillae situated far proximal to their normal position in other Collembola, at or proximal to the middle of the segment. They are thus in an unusually exposed position on the ventral side. These species all occur much higher up the shore than *P. billitonensis*, often on barely damp rock surfaces exposed to the full heat of the sun. Sensitivity to subtle differences in microstratification of humidity could be a critically important survival factor. *P. billitonensis* has the sense organ composed of 4 sensillae positioned much as in other genera of poduromorphs, close to the apex of Ant. III. Comparison of fig. 1b with that of the superficially similar, elongate antenna of *P. glauerti* (fig. 2f) will strikingly demonstrate this difference.

Note 4. The systematic importance of the superlinguae has been uniformly neglected in Collembola taxonomy except for a few workers dealing specifically with these marine forms (Schött 1901 and Denis 1938 who both correctly recognized these toothed structures

for what they are). In describing terrestrial genera, no workers have commented on them and we cannot certainly say that toothed superlinguae are unique to *Pseudanurida* and *Oudemansia* though it seems possible. I have not seen them in a wide range of genera examined by me. However, in *P. sawayana* they are reduced to the condition of other genera and cannot be used as a fully diagnostic character. It may be an adaptation to the carnivorous feeding habits which are rare elsewhere in the Collembola.

Note 5. A prominent, median unpaired ovoid chitin-lined vesicle is visible in the lower part of the head. Its duct opens to the base of the labium at the origin of the ventral groove, and near to the vesicle receives a duct presumably from the labial nephridium (tubular gland). The vesicle is heavily sclerotized and is infolded ventrally at which point are inserted powerful muscles from the ventral surface of the head. I interpret this as an ectodermal reservoir possibly serving as either a secretory syringe or a suctorial apparatus. Its taxonomic interest is that I have seen no such structure among any other genera of Pseudachorutinae except *Oudemansia*.

BIOLOGY

All species are halophile and with the exception of *P. sawayana* are exclusively intertidal. *P. sawayana* is more characteristic of brackish conditions, being found in mangroves and estuaries and occasionally even on fresh water near the coast. All species are sapro-carnivores, feeding on stranded, dead or dying soft-bodied animals. When submerged at high tide they may be collected by disturbing the substrate under a water-filled vessel or funnel. They rise to the surface with trapped air of which a surprising amount occurs between tides and which supports a distinctive fauna of aerophile microarthropods.

AFFINITIES

Pseudanurida is close to a number of other tropical and mainly marine forms loosely grouped in the genus *Oudemansia* Schött. Both have the postantennal organ absent, Ant. III and IV fused and with exposed sense organ of Ant. III, development of superlinguae as toothed appendages, the presence of a labial syringe, and in some species, of differentiated reflex bleeding sites. *Oudemansia* differs in the short furcula, not reaching the ventral tube, in usually possessing anal spines and in the more typically pseudachorutid mucro.

Podura L. has a superficially similar furcula in that it is bowed and with basal articular complex but this is presumably convergent since it is in an entirely different family.

KEY TO SPECIES OF PSEUDANURIDA

1. Dens with 12 setae; dorsal lobe of abd. 6 with many ventral setae; all tergites with dense setae in several rows; abd. 5 with many ventral setae before the genital field; S. O. Ant. III distal; claw with strong basal tooth; epipharynx square-ended; mandible with numerous, even teeth; maxilla with 2 rudimentary lamellae; superlinguae with about 20 strong inner teeth *billitonensis* Schött
- Dens with 6 setae; dorsal lobe of abd. 6 without ventral setae; tergal chaetotaxy reduced and forming a single row on prothorax (3+3) and abd. 5 (dorsal and ventral); S. O. Ant. III proximal; claw with appressed tooth more distal in position or without;

- epipharynx apically cleft; mandible with 2 large lamelliform proximal teeth and a number of smaller distal teeth; maxilla without lamellae; superlinguae with fewer teeth..... 2
2. Head with strongly differentiated macrochaetae; abd. 6 with many setae on dorsal valve, including median unpaired setae in the anterior and posterior rows; ventral tube without setae on the valves..... **bogoyawlensky** (Becker)
(Tegumental bleeding sites not differentiated; antennae with segments III + IV short and compact).
Head without strongly differentiated macrochaetae; abd. 6 with 3 + 3 dorsal setae, median unpaired setae absent. Ventral tube with 1 + 1 setae placed far anteriorly on the valves 3
3. Abdomen 6 tapered cylindrical, without differentiation into dorsal and lateral anal valves although the corresponding seta tracts are clearly distinguishable; tegumental bleeding sites present on head, abd. 1 and abd. 4; tenaculum with both anterior and posterior lobes of corpus elevated beyond rami, mucro with posterior lamella supported by a toothlike strut **yini** n. sp.
(Antennae with segments III + IV short and compact; no marked sexual dimorphism).
Abdomen 6 with dorsal and ventral anal valves clearly separated by indentations (fig. 2d); tegumental bleeding sites not differentiated; tenaculum with only the anterior lobe elevated; mucro without supporting strut on posterior lamella..... 4
4. Antennae with segments III + IV short and compact (as in fig. 4j, but *P. sawayana* is itself figured by Murphy 1965); general body setae short except for p² on Abd. 5 and p³ on abd. 1-3, which are more than 2 × length of other setae; males with abd. 6 as in female..... **sawayana** Schuster
Antennae with segments III + IV elongate in adult; no outstanding differentiation of p² or p³ and general body setae strong; males with abdomen 6 greatly elongate (fig. 2c)
..... **glauerti** (Womersley)

***Pseudanurida billitonensis* Schött 1901**

Pseudanurida billitonensis Schött 1901 : 320-21 and plate XVII, fig. 11-20.—Yosii 1955 : 222-24, fig. 1A-M.

Type material. Naturhistoriska Riksmuseet, Stockholm 50, Sweden. (Presumed syntypes. Holotype not designated). Locality: Billiton (Indonesia, 2 1/2° S between Sumatra and Borneo) "about 20 individuals on a sandbank at low tide."

Based upon a brief examination of types, extensive material from Singapore and material from Okinawa (R. Yosii det.).

Adult ♀ up to 5 mm but mature from 2.2 mm and with complete chaetotaxy from 1.5 mm. Integument with prominent granulation. Reflex bleeding sites on head, abd. 1 and abd. 4 lying on prominent tubercles. Head with dorsal chaetotaxy as in fig. 1c, with prominent macrochaetae 1 + 1 on frons and 3 + 3 posterior but none in the eye-group. Tergal chaetotaxy (fig. 1a) complex, with micro-setae strong but shorter than claw III; prothorax with about 20 setae in 2-3 rows; abd. 1 without ventral setae, abd. 2 with 2, abd. 3 with 2-5 and abd. 4 with 2 ventrally on each side. Abd. 4-6 dorsally as fig. 2g. Abd. 5 dorsally and ventrally with numerous setae in several rows. Abd. 6 with dorsal valve pointed, strongly projecting beyond the ventral valves and bearing numerous ventral setae. *Antennae* equal to or longer than the head with segments I, II and III + IV as 10:16:23. Ant. III+IV of elongate type (fig. 1b) with S. O. Ant. III consisting of 2 sensillae close to the intersegmental groove and flanked by 2 others. Claw (fig. 3f) with a very strong basal tooth that may possibly represent a fused empodial appendage.

Ventral tube without valve setae. Dens with 12 setae (fig. 1c), mucro with the usual 4 longitudinal lamellae smooth, with weak support ribbing and no posterior strut. *Mouthparts*: Epipharynx square-ended (fig. 3c); mandibles with a very even row of heavily sclerotized teeth (fig. 5 m) which in front view are seen to be supported by a parallel row of smaller teeth behind them (fig. 5l); maxillae (fig. 5k) are essentially stylet-like and without capitulum, but vestiges of lamellae persist and overhang the tip; superlinguae (fig. 5j) heavily sclerotized and more rigidly fused in the mid-line than in other species, forming a bifurcate, strongly toothed

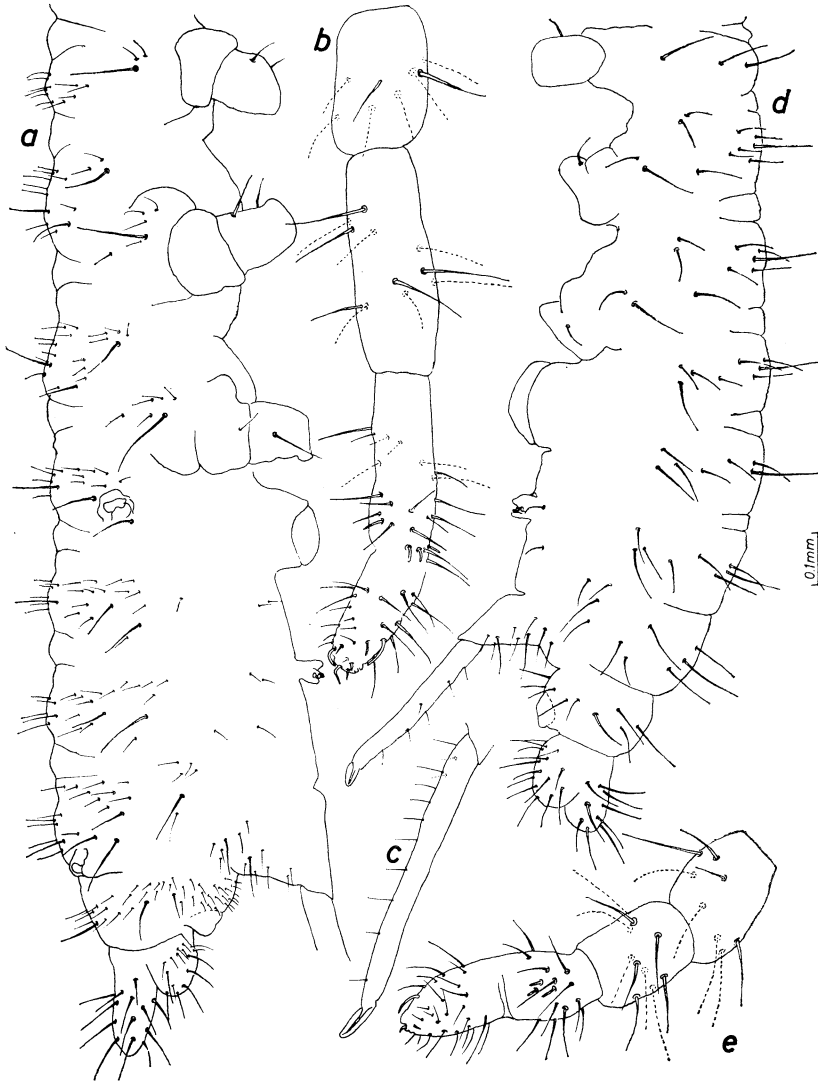


Fig. 1. a-c, *P. billitonensis*: a, body chaetotaxy $\times 1$ (Note: drawn from a mature ♀ of 2.5 mm, the chaetotaxy is fully developed); b, antenna $\times 2.2$; c, dens and mucro $\times 1$. d-e, *P. bogoyawlensky*: d, body chaetotaxy $\times 1$; e, antenna $\times 2.2$. Magnifications are relative to scale in figure.

process. Sexual dimorphism none apart from the gonopore.

DISTRIBUTION: Widespread in southeast Asia and extending north to Okinawa.

DISCUSSION: The description by Yosii (1955) of material from Takara-zima in the Tokara Islands is undoubtedly very close to, if not identical with, *P. billitonensis*. Schuster (1965b) suggests a different species may be involved since the mandibles are described with 25–30 teeth and the dens with only 5 setae. The double row of mandibular teeth in *P. billitonensis* may account for the difference, but the possibility of another species in this region should not be ignored. However, through the courtesy of Dr Yosii I have examined specimens from Okinawa that agree in all respects with *P. billitonensis*. Takara-zima (Treasure Island) appears from the Standard atlas of Japan, Tokyo, Teikokushoin (1957) to be a small island at the extreme southern end of the Tokara archipelago, approximately 320 km (200 mi) from Okinawa. I therefore accept Dr Yosii's identification as correct.

***Pseudanurida bogoyawlensky* (Becker 1905)**

Pseudachorutides bogoyawlensky Becker, 1905 : 72–73 (1906).

REJECTED SYNONYMS :

Pseudachorutides clysmæ Jackson 1927 : 289–90.

Pseudachorutoides dollfusi Denis 1938 : 239–43, fig. 1–12.

Pseudanurida dollfusi Schuster 1964; 1965a : 336–38; 1965b : 202. — Massoud 1967 : 173.

Type material. Not designated and not located (but possibly in University of Moscow or in the Zoological Institute, Leningrad which contains some Becker material). Type locality: "... coast of the Bahrain islands upon foraminiferous sand...."

Based upon extensive new material from Bahrain Island (Persian Gulf), 11.V.1964, D. H. Murphy coll., at the following sites: (1) Rocks covered with filamentous algae in highly polluted backwater in Bahrain town, at and above HW level, 1100 hr. (2) Under loose coral blocks on coral sand at MW level. Reef W of causeway near Bahrain town, 1130 hr. (3) As above, running freely on coral sand at MW level, 1200 hr. (4) As above, under coral blocks at LW level, 1400 hr. (5) Running freely on coral sand at MW level, reef on N shore of Muhaddeq island, 1500 hr. (6) Under rocks on coral sand at MW level, W coast 2 miles N of Bahrain town, 1600 hr.

Adult ♀ up to 2.2 mm. An adequate description is given by Schuster (1965a) under the name *P. dollfusi*. The following supplementary details apply mainly to chaetotaxy.

Integument with prominent granulation, no clearly defined reflex bleeding sites. Head with dorsal chaetotaxy as in fig. 3a. Body chaetotaxy as in fig. 1d, the dorsal setae unusually strong for the genus, even the dorsal "microchaetae" which are poorly differentiated from macrochaetae, being markedly longer than claw III. Prothorax with 3 + 3 dorsal setae including that of subcoxa 1. Abd. 1 and 2 without ventral setae. Abd. 3 with 1 + 1 ventral setae on either side of the tenaculum. Abd. 4 with 1 + 1 ventral setae. Abd. 5 with a single irregular row of strong setae both dorsally and ventrally (apart from those of the genital field) in both sexes. Abd. 6 with dorsal valve rounded, not markedly projecting beyond the ventral valves, bearing no ventral setae but with 12 strong dorsal setae arranged as in fig. 4a and including 2 median unpaired setae. *Antennae* 0.8 head diagonal with segments I to III+IV in the proportions

10: 10: 18. Ant. III + IV of compact type (fig. 1e) with S. O. Ant. III consisting of 3 sensillae half-way between base of segment and inner fold. Claw (fig. 3h) with closely appressed inner tooth at 0.4 from base, no lateral teeth but a thickening of the lateral lamellae may appear like one in lateral view. Ventral tube without valve setae. Tenaculum with separate, strongly tuberculate, equal, anterior and posterior lobes higher than the rami. Dens with 6 setae; mucro with the usual 4 smooth, longitudinal lamellae all with distinct support ribbing but the posterior lamella not (as in *P. yini*) deformed by any unusual development of one of these. *Mouthparts*: Epipharynx cleft, mandibles (fig. 5b) with 4-6 small teeth behind apex followed by 2 large lamellate teeth; maxilla needle-like without trace of lamellae or differentiated capitulum; superlingua (fig. 5a) with 6-7 sharp teeth in a single row. Sexual dimorphism none apart from gonopore.

DISTRIBUTION: Persian Gulf, Red Sea.

DISCUSSION: The species here recognized as *P. bogoyawlensky* was widespread at all levels of the beach in Bahrain and no other species was found under marine littoral conditions. *P. sawayana* was the only other species collected and was found exclusively in fresh water. It is thus unlikely to have been the species collected by the Russian Persian Gulf Expedition from a specifically marine habitat. Becker illustrates a smooth, postantennal depression, and this is clearly defined in the marine form but not in *P. sawayana* which has a less pronounced cutaneous tuberculation. He describes the body setae thus "Behaarung spärlich aber ziemlich lang", very appropriate for *P. bogoyawlensky* mihi but not for *P. sawayana* which has unusually short and weak chaetotaxy for the genus.

It is clear from Denis (1938) that he was describing the species here called *P. bogoyawlensky* in his description of *P. dollfusi*. His illustration of mouthparts is identical and he illustrated a macrochaeta involved in the eye-group. Of the species described in this paper, only *P. bogoyawlensky* has a macrochaeta in this position. The only discrepancy lies in his record of a prominent lateral tooth on the claw. I have examined numerous specimens of *P. bogoyawlensky* and no intact specimens possess a true tooth in this position. However, all possess a flexure of the lateral lamella at this point, proximal to which the lamella is more heavily sclerotized and in compressed mounts it commonly ruptures. To maintain the species on this character alone when the Bahrain material is otherwise identical is considered unjustifiable and *P. dollfusi* is therefore treated as a junior synonym of *P. bogoyawlensky*.

P. clysmæ (Jackson 1927) was described on the basis of a single specimen taken in a plankton net in the Suez canal. It was distinguished by the presence of minute anal spines. The unique holotype is preserved in the British Museum (Nat. Hist.), London, England, and has been re-examined. It is now mounted in Salmon's lactophenol PVA mountant and no anal spines or sockets in which they could have inserted exist. They must therefore have been artifacts due to attached debris, presumably lost when the specimen was remounted. Apart from the anal spines, Jackson's figure and re-examination of the specimen show it to have the identical chaetotaxy of Abd. 6 described here for *P. bogoyawlensky* and found in no other species.

Pseudanurida glauerti (Womersley, 1933)

Neachorutes glauerti Womersley 1933: 61, fig. 6 a-i.

REJECTED SYNONYMS :

Pseudanurida billitonensis Womersley 1939 : 105-07, fig. 44 G-L, (nec Schött 1901).

Pseudanurida australica Salmon 1955 : 131-32, fig. 1-11.

Type material. Holotype not designated or located but probably originally in a collection originally deposited at the University of Perth, Western Australia and now lost. Paratypes in South Australian Museum, North Terrace, Adelaide, South Australia.

Type-locality. Rottneest Island, Western Australia.

Material examined : Paratypes, material from Longreach, 1931 (Womersley), Marino Rocks, South Australia (Womersley) and extensive fresh material from Marino Rocks, South Australia, 15.III.1964, running on wet rocks at MW level, D. H. M. coll.

Adult ♀ up to 2.2 mm. Integument with prominent granulation leaving a well-defined postantennal pit. No reflex bleeding sites on head or body. Head with dorsal chaetotaxy as in fig. 3, without differentiated macrochaetae. Body chaetotaxy as in fig. 2a, of reduced ("*Pseudachorutides*") type with 3 + 3 dorsal on prothorax, ventrally none on abd. 1 or 2 and 1 + 1 on abd. 3 and 4, abd. 5 with a single row dorsally and ventrally apart from genital field. Abd. 6 with dorsal valve rounded, slightly overhanging ventral valves, with 3 + 3 dorsal setae and none ventrally. *Antennae* subequal to, or slightly longer than head with segments I:II:III + IV as 10 : 13 : 35. Ant. III + IV of elongate type (fig. 2f), III and IV relatively well separated, equal, with S. O. Ant. III composed of 3 simple exposed sensillae in a longitudinal line far proximal in position. It appears that elongation has occurred in the distal part of Ant. III in contrast to *P. billitonensis*. Claw typically without trace of inner tooth (fig. 2b). However, among material from Marino Rocks, a few specimens showed a very weak tooth in a far more distal position than so far seen in any other species (fig. 2c). Ventral tube with 1 + 1 valve setae. Tenaculum with strongly tuberculate anterior lobe higher than the rami, posterior lobe not elevated. Dens with 6 setae. Mucro with weak ribbing and no strut. *Mouthparts* : Epipharynx cleft; mandibles (fig. 5h) with 6-8 distal teeth (anterior to the usual 2 large lamellate teeth); maxillae styliform without lamellae or differentiated capitulum; superlinguae with a longitudinal row of 6-8 recurved teeth, followed by a transverse row of 4 stronger teeth (fig. 5f). Sexual dimorphism pronounced. This is the only species in which the ♂ reaches larger size than the ♀ (up to 2.5 mm). Abd. 6 with dorsal valve produced into a long clavate appendage with a whorl of 4 apical setae and 2 lateral basal (fig. 4c).

DISTRIBUTION. Southern and western coasts of Australia.

DISCUSSION. It is clear from the description of *P. australica* by Salmon (1955) that this species was founded upon females of *P. glauerti*. Dr Salmon was very understandably misled by Womersley's categorical suppression of *P. glauerti* as a synonym of *P. billitonensis* and was unfortunate in that his material included no males.

***Pseudanurida sawayana* Schuster 1965**

Pseudanurida sawayana Schuster 1965 : 199-202, fig. 3 a-f, 4 a-f.

REJECTED SYNONYM :

Pseudanurida cf. *bogoyawlensky* Murphy 1965 : 400-02, fig. 61-72.

Type material. Holotype (SMF A 1675) and paratype (SMF A 1676) in Senckenberg-Museum, Frankfurt-am-Main, West Germany.



Fig. 2. a-f, *P. glauerti*: a, body chaetotaxy $\times 1$; b, claw III (normal) $\times 3$; c, claw III with inner tooth $\times 3$; d, mucro in lateral view $\times 6$; e, mucro in posterior view $\times 6$; f, Ant. III + IV $\times 3$. g-k, *P. yini*: g, body chaetotaxy $\times 1.4$; h, mucro in posterior view $\times 10$; i, mucro in lateral view $\times 10$; j, Ant. III + IV $\times 6$; k, tibiotarsus and claw III $\times 6$. Magnifications are relative to scale in figure.

Locality: Brazil, Recife, Barra das Jangadas (creek connecting the Rio Pirapama and the Rio Jaboatão, a few km S of Piedade Marine Biol. Station), in mangroves.

MATERIAL EXAMINED: (1) Gambia, West Africa 1956-1959, localities listed by Murphy (1965) mangroves and rocky shore. (2) Brazil, Recife, 6.IV.1962 Boa Viagem beach under wood, D. H. M. coll. (2 spec.). (3) Sabah (North Borneo), Labuan, 9. IV.1963 on weed-covered rocks, small inlet inside Labuan town at low tide (1 spec.) D. H. M. coll. (4) Singapore, Pasir Ris, 2.V.1963, sparse mangroves by small stream, common, D. H. M. coll. (5) Bahrain, Persian Gulf, 11.V.1964, edge of inland, fresh-water stream (? of artesian origin) with *Sminthurides* - 6 spec. D. H. M. coll. (6) Ceylon, Mendel lake (a brackish lagoon on the W coast) 13.V.1964, 1 spec. D. H. M. coll. (7) Ceylon, Mannar, Giant's tank (a large, inland, artificial fresh-water lake), 1 spec. with *Sminthurides* and *Pseudobourletiella* 14.V.1964, D. H. M. coll.

Adult ♀ up to 1.5 mm. Integument strongly granulate but less so than in other species and not so clearly defining the post-antennal pit. No reflex bleeding sites on head or body. Head with dorsal chaetotaxy as in fig. 3d, short and with no differentiated macrochaetae. Body chaetotaxy (illustrated by Murphy 1965) short except for the macrochaetae at p³ on th. II and th. III, p⁴ on abd. 1 to 3, p³ on abd. 4 and p² on abd. 5. Prothorax with 3 + 3 setae. Ventrally, none on abd. 1 and 2, 1 + 1 on abd. 3 and 4. Abd. 5 with a single row dorsally and ventrally. Abd. 6. with dorsal valve rounded, not extending beyond ventral valves, with 3 + 3 dorsal and no ventral setae (fig. 4d). *Antennae* 0.8 head diagonal with segs. I:II:III + IV as 10:10:20. Ant. III + IV of compact type, III and IV equal with S. O. Ant. III of 3 simple exposed sensillae arranged in a triangle in proximal half of the segment. Claw with a closely appressed inner tooth. Ventral tube with 1 + 1 valve setae. Dens with 6 setae. Mucro lamellae with weak ribbing and no strut. The African material has the lateral lamellae with weak serration in most but not all individuals. A proportion of individuals from other localities show some serration apically but the character is variable and unreliable. *Mouthparts*: Clypeus vertical and convex and labrum very short so that the buccal cone is more posterior than in other species. Epipharynx cleft, mandibles (fig. 5e) with 4-6 distal teeth beyond the 2 basal lamellate teeth. Maxillae styliform. Superlinguae (fig. 5d) very simple, with a single recurrent tooth, approaching the condition found in other pseudachorutine genera. Sexual dimorphism none apart from gonopore.

DISCUSSION: This species is of extremely wide distribution. It appears to be the sole species present in the Atlantic area and has there been recorded both from mangroves and from exposed shore conditions. Even so, in Gambia it occurs in mangroves more than 80 km (50 mi) from the coast where for much of the year the water is virtually fresh. In southeast Asia, both localities were estuarine with direct, running fresh-water influence. In Bahrain it was found only by running fresh water and one of the Ceylon records was from exclusively fresh water, 64 km (40 mi) from the coast. We may note that its distribution links together that of the other, much more local species, and that where another species occupies the coast, *P. sawayana* is restricted to areas of immediate fresh-water influence. One might speculate that this is an ancestral form from which the others derive, driving it out of the marine habitat where both are present. Perhaps it is no coincidence that in chaetotaxy and structure of hypopharynx, *P. sawayana* is closest of all *Pseudanurida* to a typical *Pseudachorutes*.

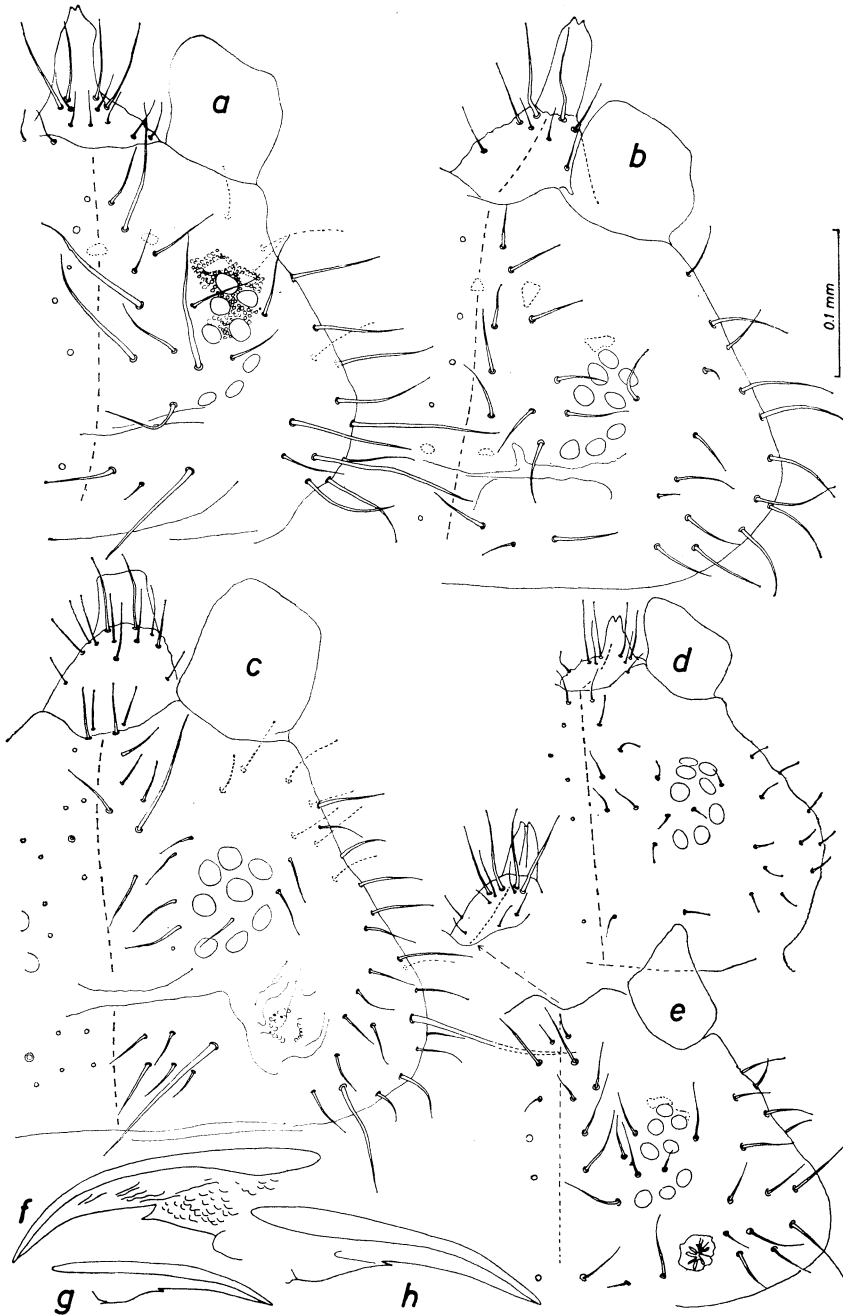


Fig. 3. a-e, dorsal head chaetotaxy of *Pseudanurida* spp.: a, *P. bogoyawlensky* $\times 1$; b, *P. glauerti* $\times 1$; c, *P. billitonensis* $\times 1/2$; d, *P. sawayana* $\times 1$; e, *P. yini* $\times 1$. f-h, claw of leg 3. f, *P. billitonensis* $\times 1\frac{1}{2}$; g, *P. sawayana* $\times 2$; h, *P. bogoyawlensky* $\times 2$.

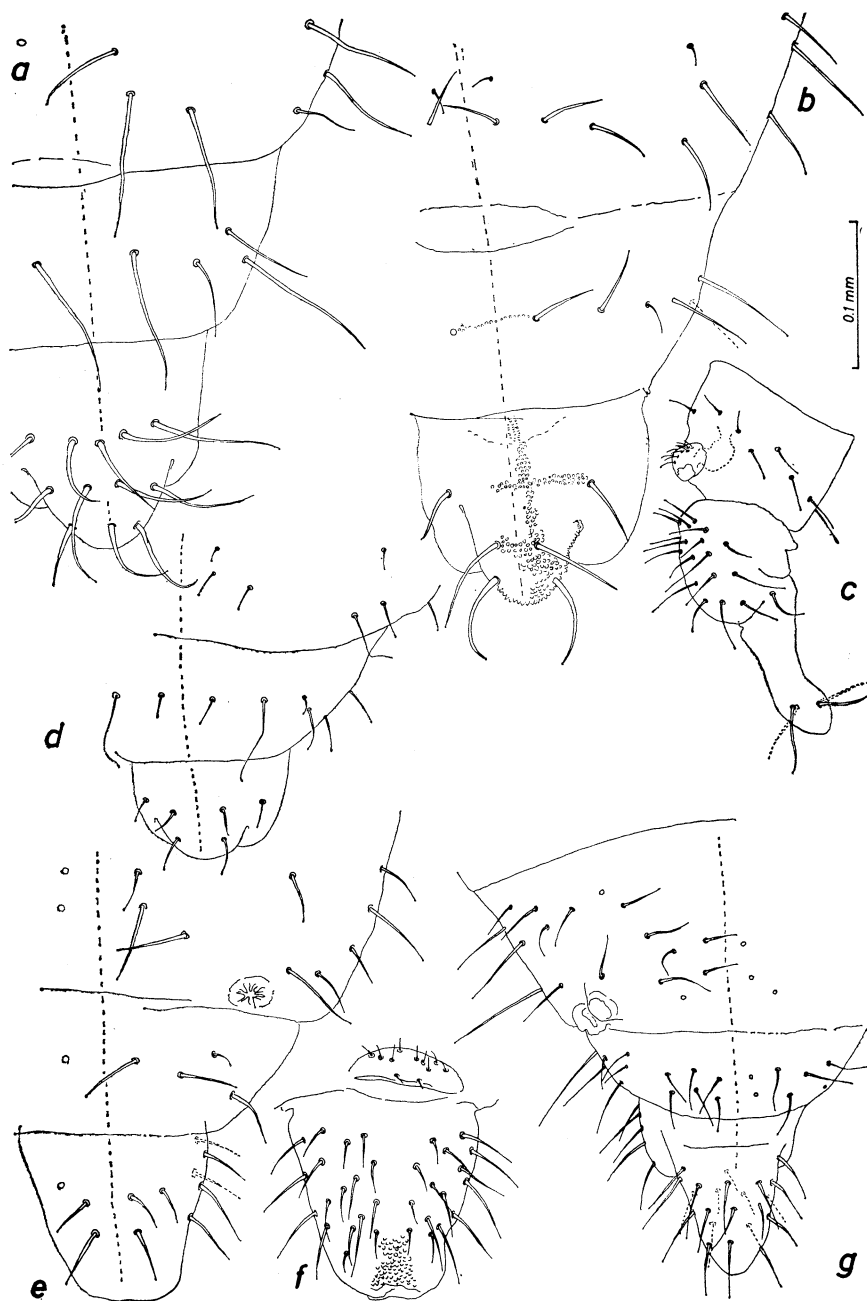


Fig. 4. a-g, dorsal chaetotaxy of abdominal segments 4 to 6: a, *P. bogoyawlensky* ♀ ×1; b, *P. glauerti* ♀ ×1; c, *P. glauerti* ♂ ×1/2; d, *P. sawayana* ♀ ×1; e, *P. yini* ♀ ×1; f, *P. yini* ♀ (ventral) ×1; g, *P. billitonensis* ♀ ×1/2.

***Pseudanurida yini* Murphy, new species**

Holotype ♀ and paratypes in British Museum (Nat. Hist.), London S. W. 7. Other paratypes and extensive topotype material in author's collection.

Type locality. Malaya, Perak, Lumut (4°12'N on the W coast of Malaya), crawling on rocks at HWNT level, rocky beach, 1/2 mile W of Lumut town, just within the estuary of the Dindings River. 4.VIII.1964, M. Yin-Murphy Coll.

The species is dedicated to my wife, Dr M. Yin-Murphy who collected the material.

Adult ♀ up to 1.5 mm. Integument with strong granulation leaving a well defined post-antennal pit. Reflex bleeding sites of simple type but prominent on head, abd. 1 and abd. 4. Head with dorsal chaetotaxy as in fig. 3e, without differentiated macrochaetae. Body chaetotaxy as in fig. 2g, with 3 + 3 dorsal setae on prothorax, ventrally none on abd. 1 and 2, 1 + 1 on abd. 3 and 4, abd. 5 with a single row dorsally and ventrally apart from the genital field.

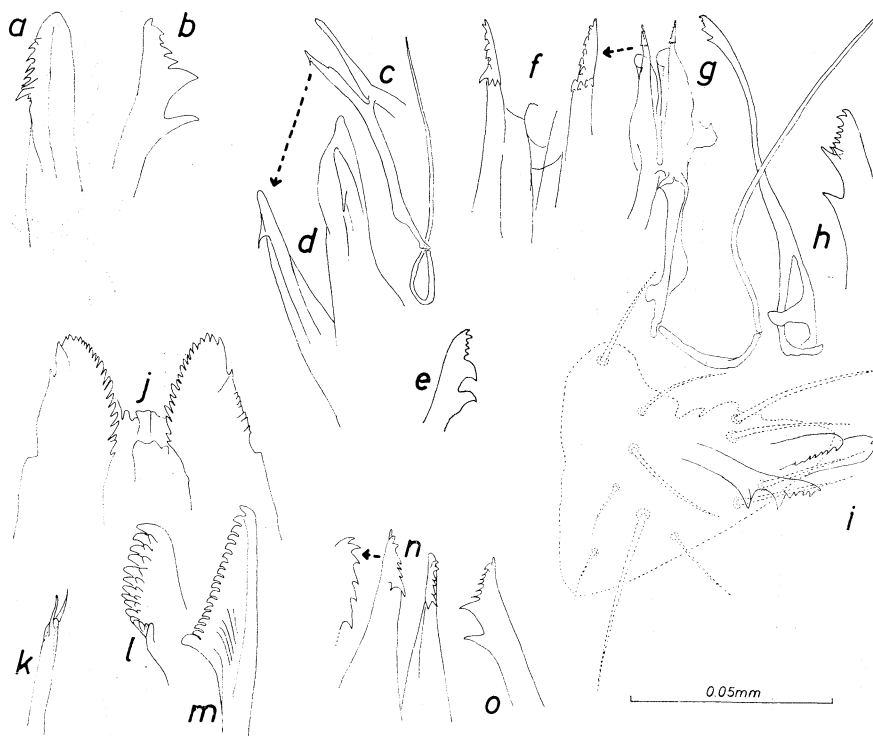


Fig. 5. Mouthparts of *Pseudanurida* spp.: a-b, *P. bogoyawlensky*: a, superlingua $\times 1$; b, mandible $\times 1$. c-e, *P. sawayana*: c, hypopharynx and mandible $\times 1/4$; d, superlingua $\times 1$; e, mandible $\times 1$. f-i, *P. glauerti*: f, hypopharynx in dorsal view $\times 1$; g, mouthparts in dorsal view $\times 1/4$; h, mandible $\times 1$; i, transparency view of labium, mandible, superlingua in lateral view and epipharynx $\times 3/4$. j-m, *P. billitonensis*: j, dorsal view of superlinguae $\times 1/2$; k, apex of maxilla $\times 1/2$; l, edge view of mandible to show double nature of tooth-row $\times 1/2$; m, lateral view of mandible $\times 1/2$. n-o, *P. yini*: n, superlinguae $\times 1$; o, mandible $\times 1$.

The median "microchaetae" of abd. 5 (p^1) subequal to p^2 (usually a macrochaeta). Abd. 6 unique, tapering conical with no incisions separating it into dorsal and ventral valves although the seta tracts remain distinct (fig. 4 e and f). Anus terminal. 3 + 3 dorsal setae. *Antenna* 0.6 head diagonal with segs. I:II:III + IV as 10:10:22. Ant. III + IV (fig. 2j) of compact type with S. O. Ant. III of 3 simple, exposed sensillae arranged in a triangle in proximal part of Ant. III. Claw with a well-defined inner tooth at slightly less than half-way along the blade (fig. 2k). Ventral tube with 1 + 1 anterior valve setae. Tenaculum with separate anterior and posterior lobes of corpus both very high, extending beyond the tridentate rami, posterior lobe higher than anterior. Dens with 6 setae. Mucro with the usual 4 longitudinal lamellae but distinctive in having the posterior lamella supported distally by a strong strut and so distorted by it as to appear tooth-like (fig. 2i). All lamellae smooth. *Mouthparts*: Buccal cone prominent. Epipharynx cleft. Mandibles with 2 strong recurved apical teeth, 5-6 intermediate teeth and 2 strong, lamelliform proximal teeth (fig. 5o). Maxillae styliform without trace of lamellae or differentiated capitulum. Superlinguae each with a longitudinal row of 5-6 sharp recurved teeth, the proximal one doubled (fig. 5n). Sexual dimorphism none apart from the gonopore.

Acknowledgement is gratefully given for the facilities of the British Museum (Nat. Hist.), London, the Swedish Museum of Natural History, Stockholm and the South Australia Museum, Adelaide. I would like to thank P. N. Lawrence, Dr Per Inge Persson and Gordon Gross of the above institutes and Prof. R. Yosii of Kyoto University, Japan, for their personal help.

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