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ENTOMOLEPIDIDAE (COPEPODA, SIPHONOSTOMATOIDA)
FROM THE ANTILLES

by

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ABSTRACT

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Entomolepididae were never recorded before from the Antilles. Two species have been discovered: *Parmulodes verrucosus* Wilson, 1944 and *Parmulella emarginata* n. gen., n. sp. Both are associates of the sponge, *Chondrilla nucula*, the former in Puerto Rico, Curaçao and Aruba, the latter in Curaçao.

Key words: Copepoda, Entomolepididae, *Parmulodes*, *Parmulella* n. gen., Antilles, sponge associates.

INTRODUCTION

The Entomolepididae form a small family, with only 5 genera and 8 species, with an essentially Tethyan distribution (Mediterranean, Florida, India, Sri Lanka, Australia, New Zealand). The host of most species is uncertain, but two previously described species, and a new species described below, are associates of sponges.

Hitherto, no Entomolepididae have been recorded from the Antilles. In the present paper two species from this region are described, one, *Parmulodes verrucosus* Wilson, 1944 was only known from Florida, the other is a new species belonging to a new genus, *Parmulella emarginata*.

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TAXONOMIC PART

Family ENTOMOLEPIDIDAE Brady, 1899

The family was formally diagnosed by EISELT (1959) and emended by MCKINNON (1988). The only difference with the family Asterocheridae (see STOCK 1987) appears to be the modified body shape (♂, ♀): the outline is shield-like, ovate, made up of a huge cephalosome and a crescent-shaped 4th pedigerous segment, between which 1 or 2 other pedigerous segments are wedged in as narrow transverse bands. The lateral margins of the body shield bear a narrow band of more or less radiate chitinous structures. The structure of the appendages on the other hand falls entirely within the range observed in the Asterocheridae. The validity of the family therefore depends on future discoveries, which may support or weaken the distinctions mentioned above. One such discovery is the new genus *Parmulella* described in the present paper, which – although falling within the diagnosis of the Entomolepididae – has the greater part of the urosome exposed, visible in dorsal view, whereas all previously recorded members of the family have the urosome, except for the tip of the caudal rami, hidden under the body shield. For this reason, *Parmulella* looks more ‘asterocherid’ than the other genera.

EISELT (1959), followed by MCKINNON (1988) divided the family Entomolepididae into two subfamilies, the Parmulodinae and the Entomolipidinae. The distinction between these two subfamilies is essentially based upon the body segmentation: the Entomolepidinae have pedigerous segments 2 and 3 free in dorsal view, in the Parmulodinae only pedigerous segment 2 is free. The remaining differences need reconsideration in the light of the morphology of the two Antillean species discussed in the present paper.

MCKINNON (1988: 997) diagnosed the Parmulodinae further by the mandible, which is “not greatly lengthened and retaining a recognizable blade”, whereas in the Entomolepidinae it is “stylet-like and greatly lengthened”. In the new genus *Parmulella* the body segmentation is as in the Entomolepidinae, whereas the mandible is as in the Parmulodinae. The fourth leg is characterized as ‘absent’ in the Parmulodinae, but both in *Parmulodes* and in *Parmulella*, rudimentary fourth legs have been discovered, overlooked in earlier descriptions. In the Parmulodinae the fifth leg is “absent or... considerably shorter” than in the Entomolepidinae. This may hold true for the female sex, but in the male, described in this paper for the first time, of *Parmulodes* this leg is

'stabförmig' (literally 'stick-like', i.e. very slender, parallel-sided), just as in *Entomopsyllus* and *Entomolepis*, both belonging to the Entomolepidinae.

For these reasons, I have refrained from using a subfamily classification for the Antillean forms recorded in the present paper.

The two species found in the Antilles (on Puerto Rico, Curaçao, and Aruba) are regular associates of the common lilac-brown or grayish-brown, slippery, encrusting sponge, *Chondrilla nucula* Schmidt. Sometimes a sponge harbours only one of the species, but in other instances both species were collected from the same sponge.

All specimens on which this paper is based have been deposited in the Zoölogisch Museum of the University of Amsterdam (ZMA).

Genus *Parmulodes* Wilson, 1944

WILSON, 1944: 544; EISELT, 1959: 659; MCKINNON, 1988: 997 (in key).

Remarks: Although all authors treated the generic name *Parmulodes* as of feminine gender (since it is based on *parmula*, feminine, Latin for 'little shield'), the addition of the suffix '-odes' makes it masculine (International Code of Zoological Nomenclature, 1985, art. 30b). I have changed therefore the endings of the species group name accordingly.

The monotypic genus is based on *P. verrucosus* Wilson, 1944, described from a single female collected on a 'coral tidal flat at Matecumbe, Fla., in July 1925' (WILSON 1944: 545). EISELT redescribed the species quite satisfactorily, using another female collected from almost the same locality: "a coral bank exposed at low tide east of the Matecumbe Islands, off the southern point of Florida, collected March 24, 1932" (EISELT 1959: 651, in translation).

The male and the host of this associate remained unknown. The present paper contributes some minor additions to the female morphology, fixes the host of the species as a sponge, *Chondrilla nucula*, extends the range of the copepod to Aruba, Curaçao, and Puerto Rico.

Parmulodes verrucosus Wilson, 1944

(Figs. 1-3)

P. verrucosa WILSON, 1944: 545-546, pl. 30 figs. 150-260; EISELT, 1959: 651-656, 659, figs. 3a-c, 4.

Material: All from the sponge *Chondrilla nucula* Schmidt.

PUERTO RICO: 24 specimens of both sexes, sample 63/72, Cayo Caracoles (La Parguera),

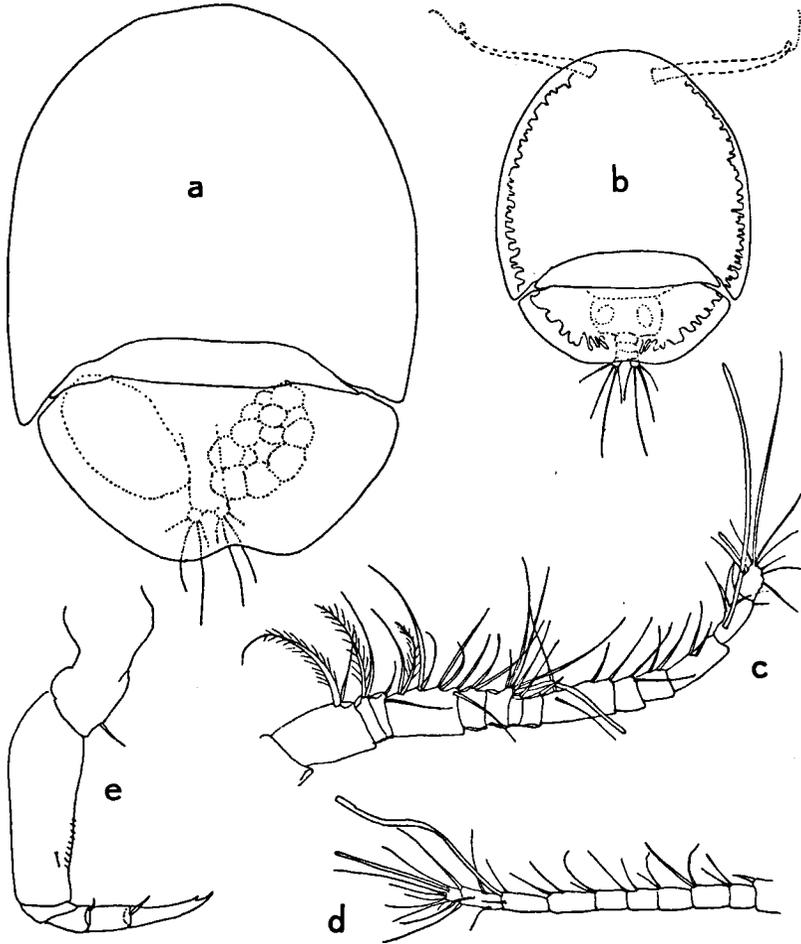


FIGURE 1. *Parmulodes verrucosus* Wilson, 1944 (from sample 63/72).
 a, ovigerous female (marginal ornamentation of body shield omitted) (scale 1); b, male, dorsal (1); c, antenna 1, ♂ (2); d, segments 8 (with spine) to 17 of antenna 1, ♀ (2); e, maxilliped, ♂ (2). Scales on Fig. 2.

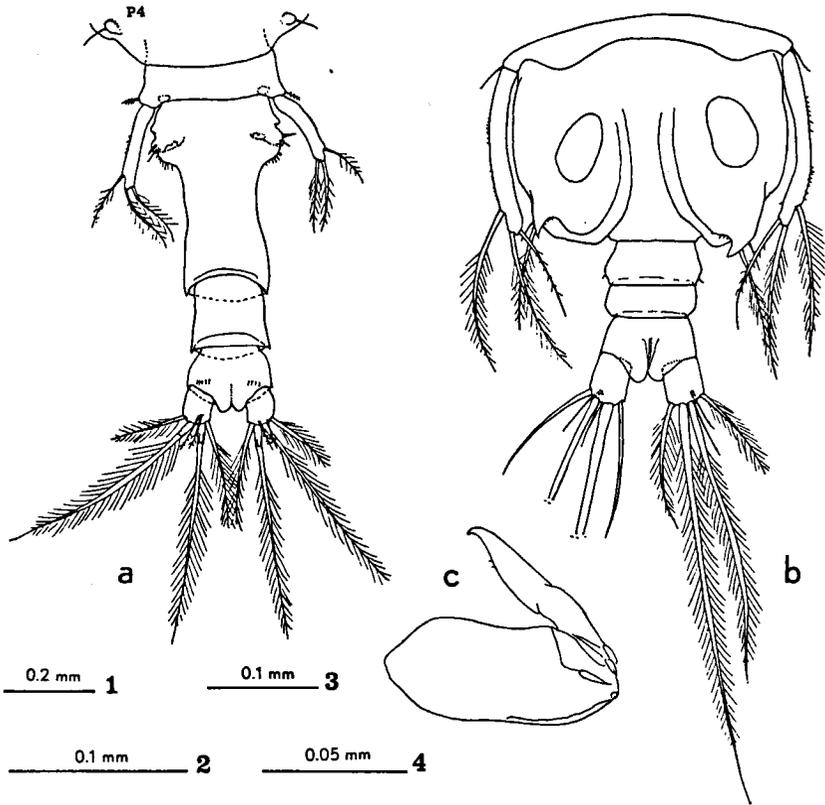


FIGURE 2. *Parmulodes verrucosus* Wilson, 1944 (from sample 63/72).
 a, posterior end of body, ♀, showing legs 4 to 6 (scale 3); b, urosome, ♂ (2); c, maxilla
 2, ♂ (2).

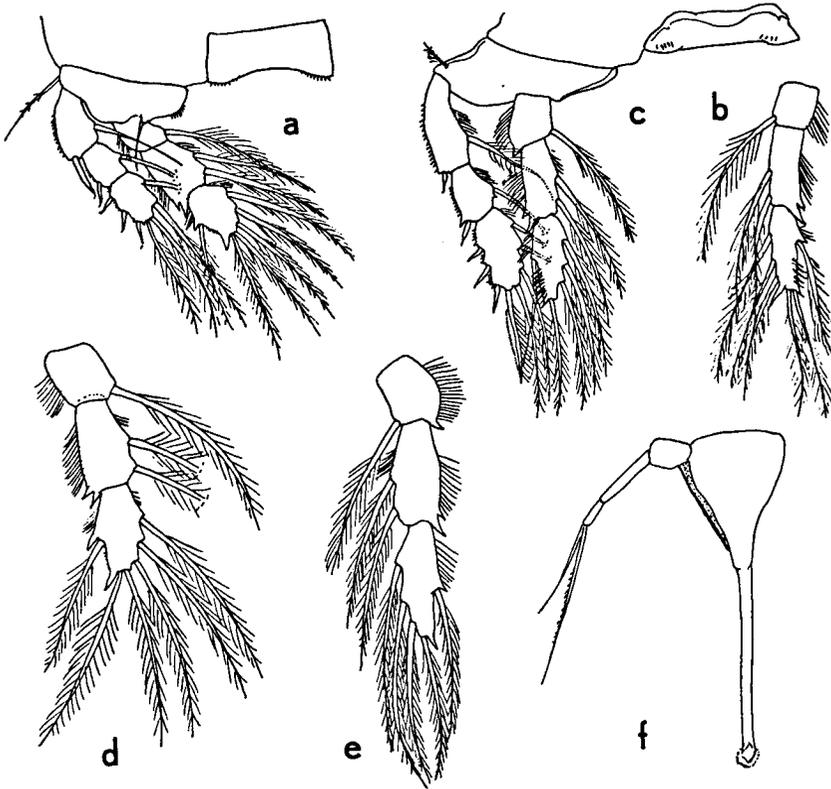


FIGURE 3. *Parmulodes verrucosus* Wilson, 1944 (from sample 63/72).
 a, leg 1, ♂ (scale 2); b, endopodite of leg 2, ♂ (2); c, leg 3, ♂ (2); d, endopodite of leg 1, ♀ (2); e, endopodite of leg 3, ♀ (2); f, siphon and mandible (mandible blade dotted), ♂ (3). Scales on Fig. 2.

under dead coral, depth 0.3 m, 14 Feb. 1963 (ZMA Co. 102.901). – 15 specimens, sample 63/75, San Christobál Reef, depth c. 0.5 m, 1 March 1963 (ZMA Co. 102.902). – 23 specimens, sample 63/123, edge of shelf off la Parguera, depth 20-35 m, 3 March 1963 (ZMA Co. 102.903).

CURAÇAO: 2 ♀♀, sample 58/51, Piscadera Bay in front of Caribbean Marine Biological Institute, depth 0.2 m, 21 Oct. 1958 (ZMA Co. 102.904). – 158 specimens of both sexes, sample 58/112, Fuik Bay, depth c. 3 m, 3 Dec. 1958 (ZMA Co. 102.905). – 6 specimens, sample 73-38, c. 500 m W of Piscadera Bay, reef, depth 32-40 m, 10 Dec. 1973 (ZMA Co. 102.906).

ARUBA: 14 specimens, sample 59/169A, Arasji, depth 0.3 m, 13 Jan. 1959 (ZMA Co. 102.907).

Descriptive notes: The female (Fig. 1a) has been ably redescribed by EISELT. Only a few remarks are necessary:

- The first antenna (Fig. 1d) usually is 17- or 18-segmented (segment may or may not be subdivided into two segments). EISELT is in doubt as to the number of segments: counts of 15 to 18 are presented in his paper. Three setae, one on each of the segments 1, 2, and 4, are plumose; the others are smooth.
- The genital segment is as illustrated (Fig. 2a).
- The furca (Fig. 2a) bears 6 setae (not 5).
- The ovisacs are ovate, contain a low number of eggs, and are positioned obliquely under the shield formed by the 4th pedigerous segment, close to the urosome (Fig. 1a).
- The fourth leg is present as a small unsegmented bud bearing a minute distal seta (P4 in Fig. 2a).

The male was hitherto unknown. It has very much the same body shape (Fig. 1b) as the female, but is considerably smaller: body length of 5 specimens 621-693 μm (mean 673 μm ; greatest width of cephalosome 467-543 μm (mean 500 μm). The females are 1200-1300 μm long and 940-1005 μm wide. The urosome (Fig. 2b) consists of a narrow 5th pedigerous segment; a wide, rounded-rectangular genital segment, and 3 post-genital segments.

The male first antenna counts 14 segments (Fig. 1c). Segment 1 ♂ is much less slender than in ♀ and segment 6 bears a strong aesthetasc, but otherwise segments 1 to 8 are similar in both sexes (segment 8 is characterized by bearing a spine). Segment 9 ♂ is homologous with segments 9 + 10 of ♀. Segment 12 ♂ is composed of fused segments 13 + 14 ♀, and segment 13 ♂ of segments 15 + 16 ♀. Segment 13 ♂ bears a strong, subproximally im-

planted aethetasc, and a strong distoanterior spiniform process. Distal (14th) segment ♂ bears small aesthete-like seta.

Mandible (Fig. 3f), siphon (Fig. 3f), maxillae 1 and 2 (Fig. 2c), and maxilliped (Fig. 1e) very similar to those of ♀.

Legs with same chaetotaxis formula as in ♀, but with small other differences. In leg 1 (Fig. 3a), the 2nd and 3rd endopodite segments are less slender than in ♀ (Fig. 3d). Third endopodite segment of leg 2 ♂ (Fig. 3b) bears 2 distal spiniform processes (in ♀ only one); the laterodistal margin of this segment bears a row of spinules, absent in ♀. Third endopodite segment of leg 3 ♂ (Fig. 3c) slightly less slender than in ♀ (Fig. 3e), bearing a row of spinules similar to P2 ♂ (absent in ♀). Leg 5 ♂ very narrow and slender, armed with 3 long, plumose setae (1 lateral, subdistal; 2 distal).

Genital segment as illustrated (Fig. 2b); leg 6 represented by 2 setae, much longer than in ♀.

Variability: The number of distal segments of antenna 1 ♀ is variable (vide supra). One male showed an aberrant chaetotaxis formula of endopodite segment 3 of leg 3, viz. II-I-3, instead of the normal III-I-4.

Live colour: The body is almost colourless (colour of weak tea), very transparent. Intestine and ovaries are transparent white, the marginal structures of the body shield are opaque white. Eye red. Ovisacs pale carmine-red to yellowish or light-brown (depending on ripening stage of the eggs).

Habitat: This copepod is a very regular associate of the sponge, *Chondrilla nucula*, in Puerto Rico, Curaçao and Aruba, and probably also in other islands of the Antilles. Copepodids, females and males occur, often in considerable numbers, on the external surface of almost every sponge examined. The shield-shaped body functions as a sucker which is used for the fixation of the copepod on the slippery surface of the sponge, even in the surf zone.

Parmulella n. gen.

Diagnosis: Copepoda Siphonostomatoida of family Entomolepididae. In dorsal view, body shield composed of cephalosome, and pedigerous segments 2 and 4 (segment 3 not free). Body shield *not* covering posterior part of genital

segment and none of the post-genital segments. Genital segment of ♀ wider than long. Two post-genital segments in both sexes.

Mandible blade greatly lengthened, almost setiform. Legs 1 to 3 biramous, leg 4 present as knob (♀) or monomerous rudiment (♂). Leg 5 leaf-shaped (♀) or clavate (♂). Caudal rami shorter than anal segment.

Remarks: Closely related to *Parmulodes*, but differing in smaller body shield (not covering greater part of urosome), shape of genital segment ♀ (in *Parmulodes* much longer than wide), number of post-genital segments in ♂ (in *Parmulodes* 3 instead of 2), shape of leg 5 ♀ (leaf-like versus stick-like), and of leg 5 ♂ (clavate versus stick-like).

Etymology: *Parmulella* is a diminutive of *parmula* (Latin = small shield). Gender feminine.

Type-species: *Parmulella emarginata* n. sp.

Parmulella emarginata n. sp.

(Figs. 3-6)

Material: All from the sponge *Chondrilla nucula* Schmidt in CURAÇAO: 1 ♀ (holotype), 1 ♂ (allotype), 16 ♀♀ and 6 ♂♂ (paratypes), sample 58/51, Piscadera Bay, in front of Caribbean Marine Biological Institute, depth c. 2 m, 21 Oct. 1958 (ZMA Co. 102.908). – 3 ♀♀, sample 73/31, c. 500 m W of Piscadera Bay, depth 32 m, 3 Dec. 1973 (ZMA Co. 102.909). – 1 ♀, sample 73/38, same locality as 73/31, but 32-40 m, 10 Dec. 1973 (ZMA Co. 910). – 49 specimens of both sexes, sample 74/109, Barbara Beach, depth c. 3 m, 17 Jan. 1974 (ZMA Co. 102.911).

In samples 58/51 and 73/38, *Parmulella emarginata* was found together with *Parmulodes verrucosus*.

Description: Female: Body length (excluding furcal setae) 777-893 µm (mean 845 µm, $n = 5$); greatest body width 644-707 µm (mean 681 µm). Ovisacs elliptical, containing very few eggs (Fig. 4a), 210-242 µm (mean 221 µm), and 159-187 µm wide (mean 170 µm).

Cephalosome with produced posterolateral corners, which envelop completely the narrower 2nd pedigerous segment. Fourth pedigerous segment slightly narrower than cephalosome; posterior margin concave over its entire length (Fig. 4a). Marginal ornamentation of cephalosome and fourth pedigerous somite well-developed, but without distinct radial striae. Urosome

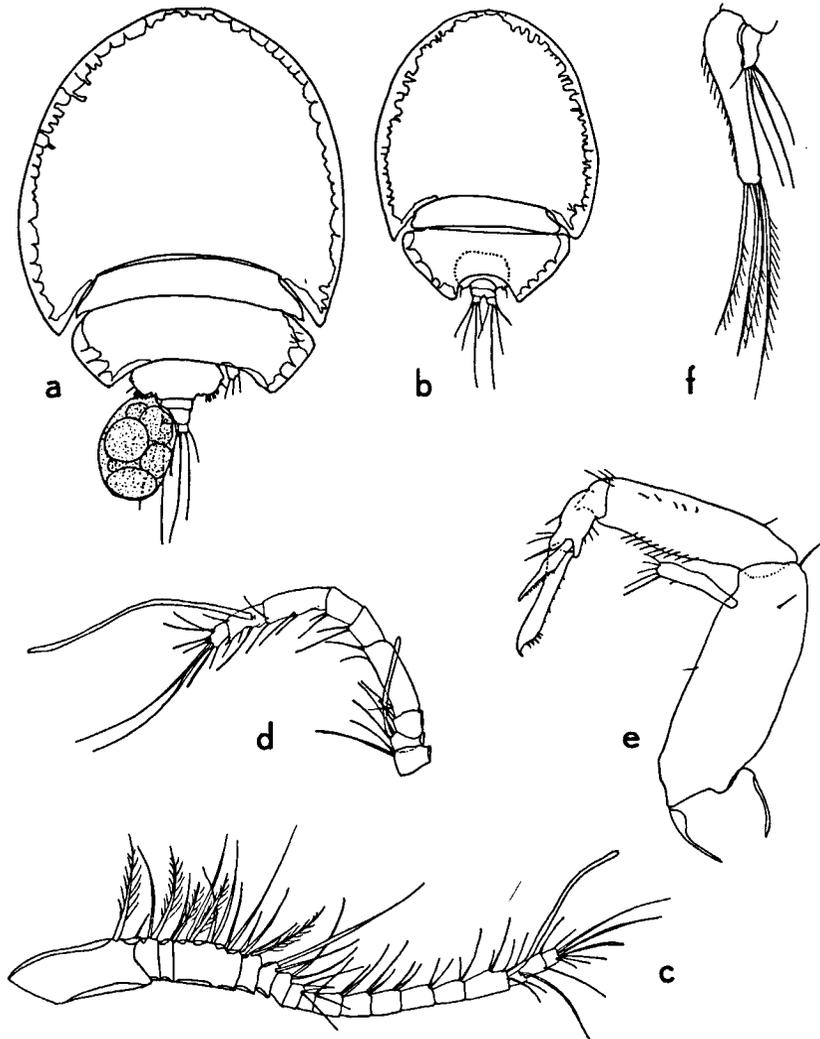


FIGURE 4. *Parmulella emarginata* n. gen., n. sp., paratypes.
 a, ovigerous female, dorsal (scale 1); b, male, dorsal (1); c, antenna 1, ♀ (2); d, segments
 6 to 14 of antenna 1, ♂ (2); e, antenna 2, ♀ (4); f, maxilla 1, ♀ (2). Scales on Fig. 2.

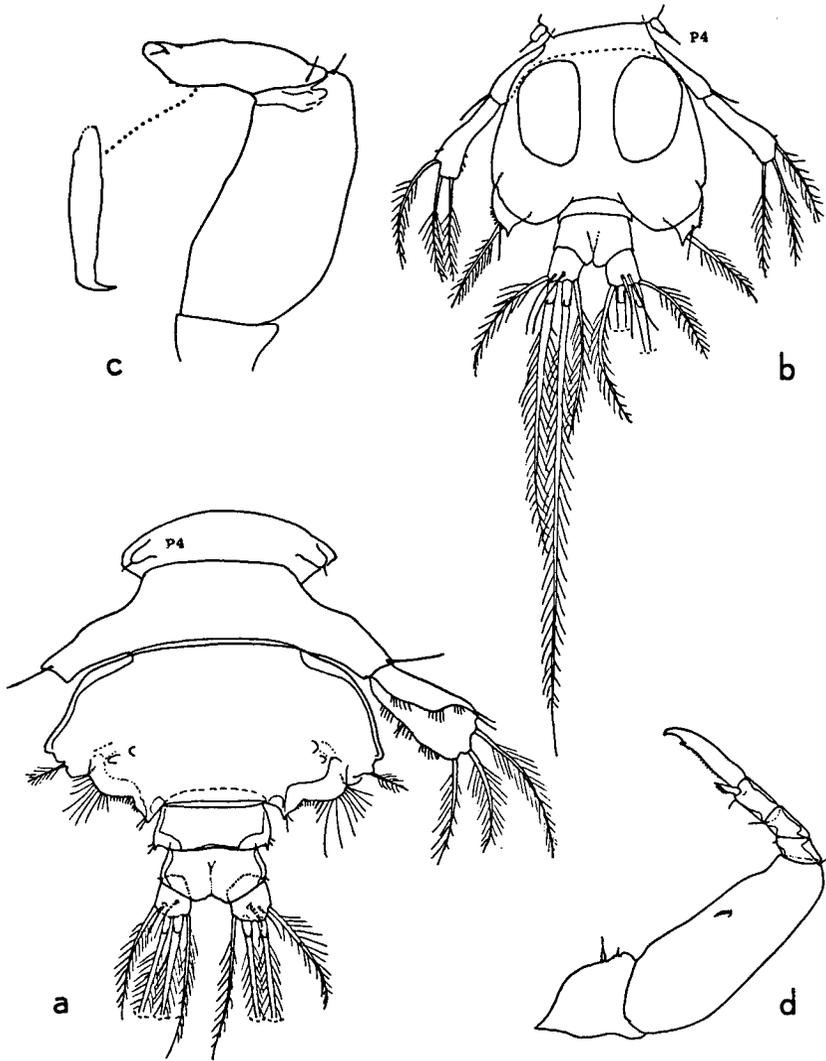


FIGURE 5. *Parmulella emarginata* n. gen., n. sp., paratypes.
 a, urosome, ♀ (scale 2); b, urosome, ♂ (2); c, maxilla 2, ♀ (with claw observed from different angle) (2); d, maxilliped, ♀ (2). Scales on Fig. 2.

(Fig. 5a) with well-demarcated 5th pedigerous segment, dorsally covered by body shield. Basal protuberance of fifth legs much more strongly developed than in *Parmulodes*. Genital segment much wider than long, of complex morphology, armed on each side with 1 plumose seta (= rudiment of sixth leg), a row of long setules, and a row of spinules. Two post-genital segments, both much wider than long. Caudal ramus slightly longer than wide, about as long as anal segment, with 4 long plumose setae and 2 short dorsal setae.

Antenna 1 (Fig. 4c) 18-segmented (but rather often segments 16 and 17 fused). A plumose seta on segments 1, 2, 3, 4, and 5; a strong spine on segment 8; a long, heavy aesthetasc on segment 15; a short aesthetasc-like seta on terminal segment.

Antenna 2 (Fig. 4e) with stick-like, monomeric exopodite, reaching to middle of first endopodite segment, armed with several thin setules. Second endopodite segment with strong, denticulate spine. Third segment straightish, with small, hook-like tip.

Oral siphon with long tubular distal part (as in *Parmulodes*), pointing obliquely downward, tip reaching level of insertion of first pair of legs. Distal tip of siphon slightly widened.

Mandible (Fig. 6a) with very long, almost setiform blade that overreaches the tip of the palp setae; a few minute denticles ornament distal part of stylet. Palp 2-segmented; segment 2 < 1, with 2 unequal distal setae.

Maxilla 1 (Fig. 4f) with short outer lobe, and long and slender inner lobe; both lobes with 4 setae.

Maxilla 2 (Fig. 5c) with massive basal segment and straightish claw which ends in a pointed tip, recurved at a right angle.

Maxilliped (Fig. 5d) with 2 'hand' segments and 4 'claw' segments; 3rd claw segment with denticulate spine; 4th claw segment with spiniform endal process and row of minute endal spinules.

Legs 1 to 3 (Figs. 6b, c, d) biramous, rami 3-segmented; with intercoxal plate; essentially built as in *Parmulodes*. Leg 4 without intercoxal plate, present as bud-like, non-articulated rudiment carrying a minute distal setule (Fig. 5a). Leg 5 (Fig. 5a) leaf-like, always folded along a longitudinal axis; distal margin with 2 spinules and 3 plumose setae; anterior and posterior margins with small spinules. Leg 6 represented by single short, plumose seta on lateral margin of genital segment.

Male: Body length 606-670 μm (mean 644 μm , $n=5$); greatest width of cephalosome 462-499 μm (mean 478 μm). Body shield (Fig. 4b) resembling

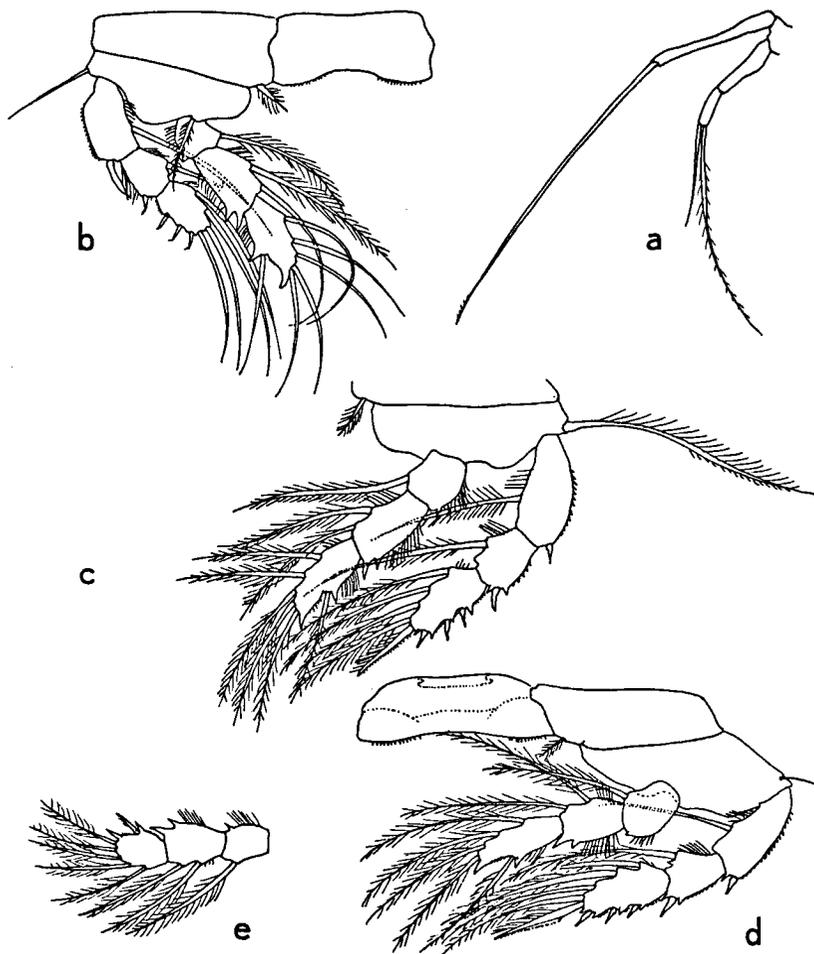


FIGURE 6. *Parmulella emarginata* n. gen., n. sp., paratypes.
 a, mandible, ♀ (scale 3); b, leg 1, ♀ (plumosity of some setae omitted for clarity) (2); c,
 leg 2, ♀ (2); d, leg 3, ♀ (2); e, endopodite of leg 1, ♂ (2). Scales on Fig. 2.

that of ♀, but posterior emargination of pedigerous segment 4 much narrower. Genital segment (Fig. 5b) slightly wider than long, imperfectly articulated with pedigerous segment 5. Two post-genital segments, the first very short, hidden in posterior excavation of genital segment. Caudal rami shorter than anal segment, resembling those of ♀.

Antenna 1 (Fig. 4d) having segments 1 to 8 as in ♀, but for the presence of an aesthetasc on segment 7. Spine on segment 8 present. Segment 9 ♂ corresponds with segments 9 + 10 ♀; segment 12 ♂ with segments 13 + 14 ♀; segment 13 ♂ with segments 15 + 16 ♀; and segment 14 ♂ with segments 17 + 18 ♀. A long, strong aesthetasc and a distoanterior pointed process on segment 13, and an aesthetasc-like seta on segment 14.

Leg 1 (Fig. 6e) shows a shorter endopodite segment 3 than in ♀; chaetotaxis of this segment is I-5 in ♂, 1-5 in ♀. Legs 2 and 3 resembling those of ♀. Leg 4 (Fig. 5b) without intercoxal plate, present as minute monomeric, articulated segment; distal set as long as, or slightly longer than the segment. Leg 5 (Fig. 5b) clavate (with subparallel margins, distally wider than proximally), with 3 long, plumose distal setae; less elongate and less narrow than in *Parmulodes verrucosus*. Leg 6 represented by pointed outgrowth on posterolateral corner of genital segment, armed with lateral row of denticles, a short, smooth seta, and a long plumose seta.

Remaining appendages as in ♀.

Etymology: The specific name, *emarginata*, alludes to the wide posterior concavity of pedigerous segment 4 in both sexes.

Remarks: It is noteworthy that the two copepod species recorded above occur on the same host, *Chondrilla nucula*, although they are apparently phenetically related. This poses, as in similar cases of double infection, the problem of 'sympatric' speciation, or of twofold infestation, separated by geological time, of the same host, for which I have, in this particular case, no solution to offer.

The four genera of the family Entomolepididae for which both sexes are known (*Entomolepis*, *Parmulodes*, *Parmulella*, and *Entomopsyllus*), the sexual dimorphism in legs 1 to 3 is expressed in different ways. In *Entomopsyllus nichollsi* there is no sexual dimorphism (McKINNON 1988). In *Entomolepis adriae*, the shape of endopodite segment 3 of leg 3 is sexually dimorphic (STOCK 1965). In *Parmulodes verrucosus* the endopodites of legs 1 to 3 show differences in shape

and fine ornamentation (*vide supra*). In *Parmulella emarginata*, finally, the chaetotaxis formula and the shape of endopodite segment 3 of leg 1 shows sexual dimorphism (*vide supra*).

Hosts of Entomolepididae: For three species of this family sponges have firmly been identified as hosts: for the two Antillean species recorded above the host is *Chondrilla nucula*; for the Mediterranean *Entomolepis adriae* EISELT, 1959, the hosts are two closely related species of *Verongia* (*V. aerophoba* and *V. cavernicola*, see STOCK 1965). *Entomolepis ovalis* BRADY, 1899, was once found on the tunicate *Botrylloides leachi* (see MCKINNON 1988), but this host may be accidental, while *Entomopsyllus nichollsi* MCKINNON, 1988 was taken in a plankton tow. *Paralepeopsyllus mannarensis* UMMERKUTY, 1960 was obtained from 'sponge washings' and 'crinoid beds'. The host indication in THOMPSON & SCOTT's (1903) descriptions of *Lepeopsyllus typicus* and *L. ovalis* are equally vague: 'in washings of the Muttuvaratu pearl oyster' and in 'general washings of invertebrates'. I would not be surprised if the real host of all these species are sponges.

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