

STUDIES ON THE FAUNA OF CURAÇAO AND OTHER
CARIBBEAN ISLANDS, No.: 168

**MICROPARASELLIDAE (ISOPODA, ASELLOTA)
FROM BONAIRE**

with notes on the origin of the family

by

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Three members of the family Microparasellidae were found in Bonaire (Netherlands Antilles): *Microcharon herrevai* n. sp. from a number of oligo- and mesohaline wells in the central-eastern part of the island, *Microcharon* sp. (a single specimen only) from an oligohaline well in the central-western part, and *Angeliiera dubitans* n. sp. from a marine interstitial habitat. — Members of this family have been recorded from the greater part of the former Tethys Sea area, but only two species (both from Cuba) were known from the West Indies. — The possible origin of the brackish and limnic Microparasellidae is discussed. Like for several other crustaceans, an origin from marine mesopsammal ancestors is very plausible; these got adapted to limnic conditions when they "stranded" during marine regressions in the Miocene.

During a study still in progress on the fauna of phreatic waters of various West Indian islands, a number of isopods of the family Microparasellidae were obtained. Although material from some 20 Caribbean islands was examined, only the island of Bonaire yielded microparasellid isopods so far. These animals are described in the present paper. Up to now, the only other West Indian records for the family are those of COINEAU & BOTOSANEANU, 1973, from Cuba.

The methods employed are the same as in my previous study (Strock, 1976a) on the Antillean Thermosbaenacea. All chlorinities have been determined with the aid of an E.E.L. electric chlorinimeter.

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Microcharon herrerae n. sp.

Material. — 1♂ (holotype), 1♀ (allotype), 100+ paratypes. BONAIRE Sta. 76-14: Estate Bacuna, "Pos di Molina" (12°07'29" N 68°12'38" W). Cemented well on a kind of natural crevice in the limestone rock. Water level on 5½ m; water depth 0.20 m; temperature 27.7 °C; chlorinity 1250 mg/l; June 13, 1976. Accompanying species: *Ingolfiella putealis* Stock, 1976 (Amphipoda). Zoöl. Mus. Amsterdam (ZMA Is. 105.068).

Other samples, all from BONAIRE:

— 19 specimens, Sta. 75-15: Estate Bacuna, "Pos di Wayaka" (12°07'57" N 68°12'27" W), a shallow well accessible to cattle (a so-called "Pos'i pia"). Steps lead to abt. 5 m under the surface of the limestone plateau (Fig. 15); square artificial pool of abt. 2½ × 2½ m; water depth 0.10-0.20 m; temperature 30.1 °C; chlorinity abt. 800 mg/l; November 17, 1975. Accompanying fauna: *Ingolfiella putealis* Stock, 1976 (Amphipoda); a small snail, *Pyrgophorus parvulus* (Guilding, 1820); some mosquito larvae; numerous Ostracoda; terrestrial hermit-crabs, *Coenobita clypeata* (Herbst) (ZMA Is. 105.072).

— 1 specimen, same locality; September 21, 1975; coll. H. A. ten Hove (ZMA Is. 105.071).

— 8 specimens, Sta. 76-11: same locality; June 13, 1976; chlorinity 4600 mg/l; temperature 29.1 °C (ZMA Is. 105.073).

— 100+ specimens Sta. 76-13: Estate Bacuna, "Pos di Cerca" (12°07'35" N 68°12'31" W); cemented well surrounded by drinking troughs for cattle; two openings leading to a natural cavern (Fig. 16); water level on 6 m; water depth 0.20 m; temperature 29.5 °C; chlorinity 2350 mg/l; June 13, 1976. Accompanying fauna: some Copepoda Cyclopoida, many *Ingolfiella putealis* Stock, 1976 (ZMA Is. 105.069).

— 100+ specimens Sta. 76-34: east coast, lowest terrace of coastal plain, E. of plantation Mal Hasi (12°09'38" N 68°12'13" W); recently cemented well on a natural crevice in the limestone; depth abt. 4 m; water depth abt. 0.25 m; loamy; temperature not recorded; chlorinity 3450 mg/l; June 15, 1976. Accompanying fauna: *Ingolfiella* sp. (ZMA Is. 105.070).

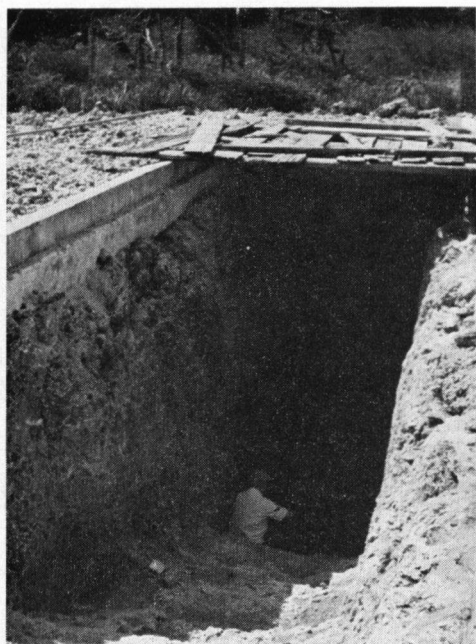


Fig. 15. Pos di Wayaka (Estate Bacuna), one of the wells on BONAIRE from where *Microcharon herrerae* n. sp. has been collected. This well is also the type-locality of *Ingolfiella putealis* Stock, 1976b.

Description. – Body length (without antennae and uropods) 1.53–1.93 mm (mean, based on 5 specimens 1.70 mm); width on the level of the 7th pereopods 215–246 μm (mean 227 μm). No marked size difference between the sexes. The cephalosome is longer than wide; the 1st and 5th pedigerous somites are much wider than long; the 2nd and 6th pedigerous somites are about as long as wide; the 3rd, 4th, and 7th pedigerous somites are slightly wider than long (Fig. 17a). The pleotelson (Fig. 19g) is much longer than wide (288–313 μm long, 213–250 μm wide), with regularly rounded lateral margins (Fig. 17a).

The first antenna (Fig. 17b) is 5-segmented. Segment 2 bears distally, implanted on a protuberance, an aesthete. A short, aesthete-like element is found also on segments 2 and 4. Segment 5 bears a very heavy aesthete. None of the setae is plumose.



Fig. 16. Pos di Cerca (Estate Bacuna), another well on BONAIRE in which *Microcharon herrerae* n. sp. has been found. On this and the preceding photograph the plantation owner, Mr. Julio Herrera, is visible.

The second antenna (Fig. 17c) has a pointed, 1-segmented exopodite, armed with 2 setae. The flagellum consists of 9 segments.

The left mandible (Fig. 18a) possesses a lacinia mobilis, in the form of a widening plate with 4 distal triangular teeth. Pars incisiva with 4 teeth. The pars molaris consists of a conical swelling with 2 plumose setae. Between the lacinia mobilis and the pars molaris, one finds a row of elements consisting of 2 denticulated, heavy spines, some cilia and 2 plumose setae. The mandible palp is built as usual in the genus (Fig. 18a).

The right mandible (Fig. 18b) differs chiefly in lacking a lacinia mobilis and in having 3 instead of 2 heavy, denticulated spines.

Lower lip (Fig. 19a) deeply cleft, ciliated.

First maxilla (Fig. 18c) consisting of 2 endites: the wider outer one bears a distal row of 10 finely pectinated spines; the inner endite may show up narrow (as in Fig. 18c) or, from under a different angle, wider and tapering (Fig. 18d); it bears cilia on both margins and a subterminal spinule.

The second maxilla (Fig. 19b) bears 3 arthrites of about the same

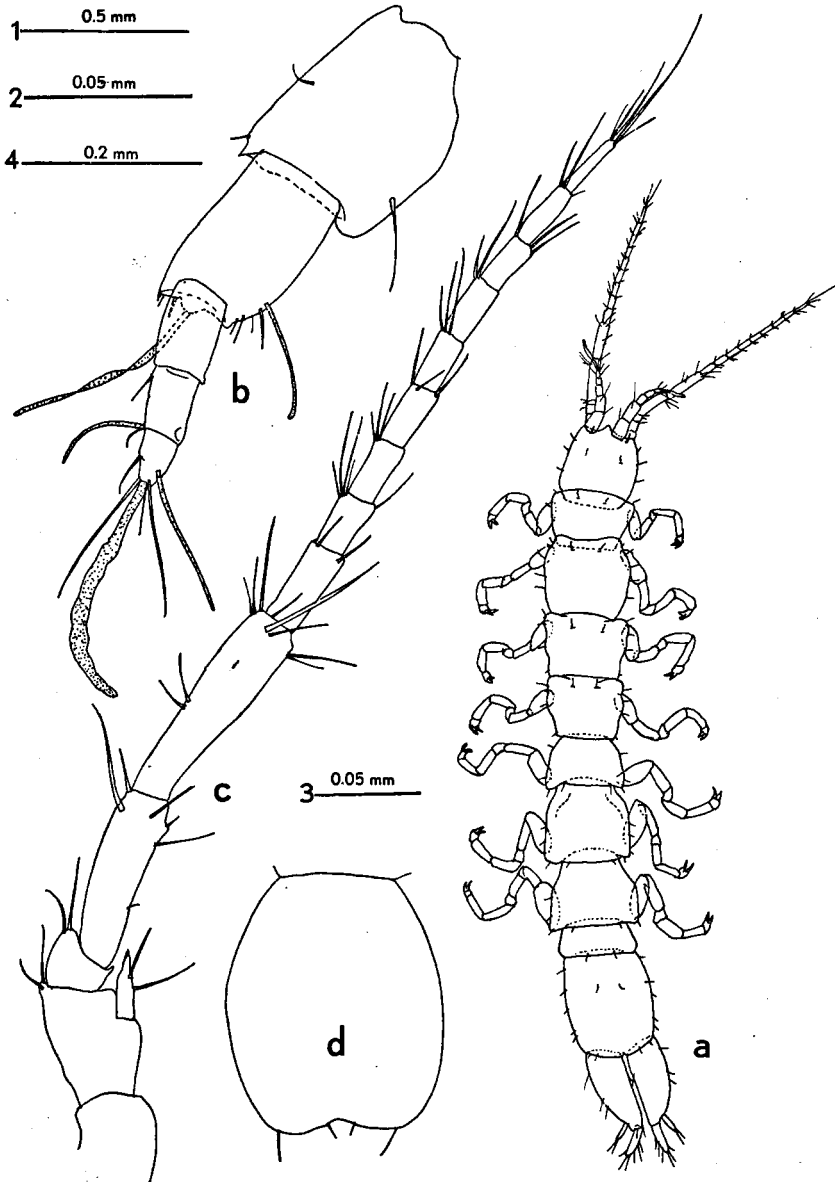


Fig. 17. *Microcharon herverai* n. sp., ♀ (paratype). a, entire animal, dorsal (scale 1); b, first antenna (2); c, second antenna (3); d, second pleopod (4).

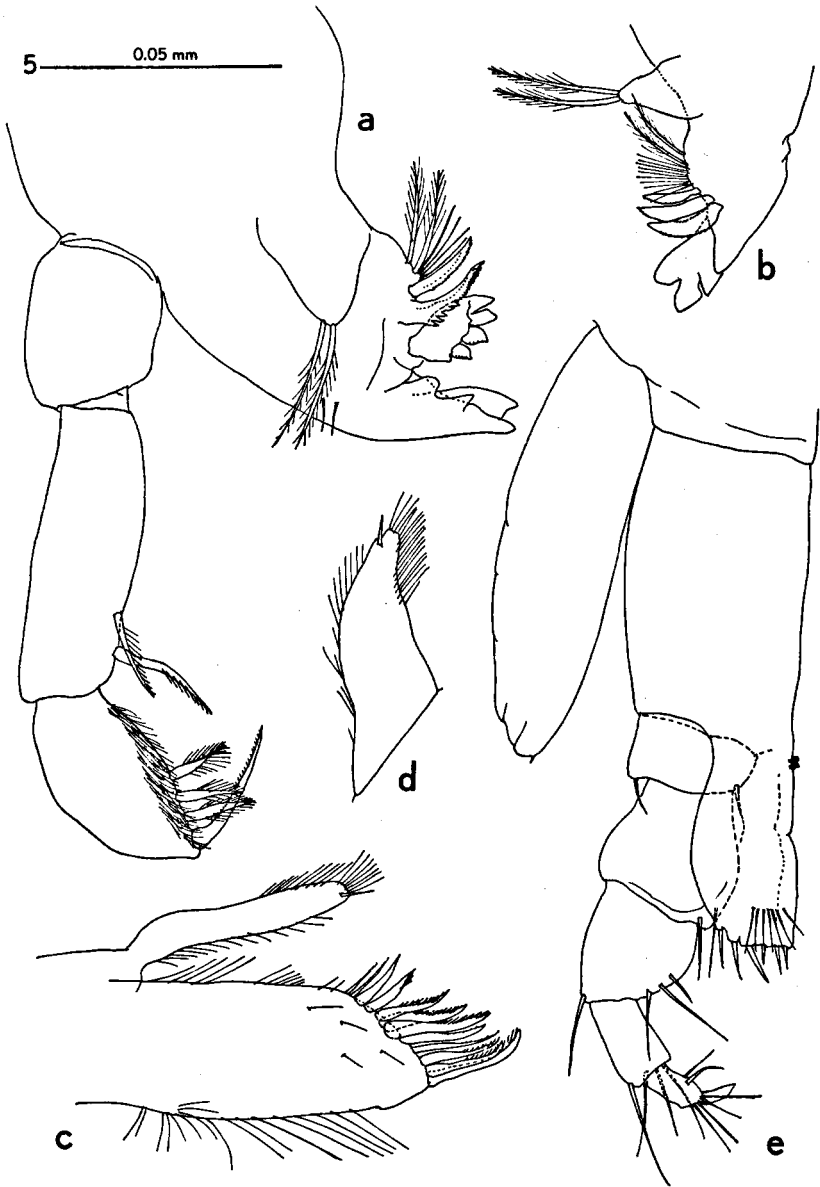


Fig. 18. *Microcharon herrerae* n. sp., paratypes. a, left mandible, ♂ (scale 5); b, masticatory part of right mandible, ♂ (5); c, first maxilla, ♀ (5); d, inner endite of first maxilla, ♀, seen under a different angle (5), e, maxilliped, ♂ (2).

length. The outer arthrite and the central arthrite each bear 3 finely pectinated claws and 1 seta. The medial arthrite bears 3 claws, 2 setae and one curved claw the median margin of which bears a row of long, needle-like teeth.

Maxilliped (Fig. 18e) with a slender, naked epipodite. The basipodal endite is distally armed with 3 larger and 3 smaller spines and a row of cilia; it is mediobasally provided with 2 "coupling hooks", shaped not unlike little trees. The palp consists of 5 segments, of which articles 2 and 3 are wide and somewhat swollen, whereas articles 4 and 5 are narrower and rectangular.

The pereopods (P1–P7) are rather similar in shape, but show small differences in armature.

P1 (Fig. 20a) has 1 long (naked) and 2 shorter setae on the anterior margin of the basis; the carpus bears 1 long seta on its posterior margin; the posterior margin of the propodus is armed with 1 subbasal setule, a row of stiff cilia, 1 subterminal setule and a distal, bifid spine; the anterior margin of the propodus bears 1 distal seta; the dactylus bears 1 posterior setule, 4 distal setae and 2 unguis.

P2 (Fig. 20b) has 2 longer and 1 shorter setae on the anterior margin of the basis; the long seta found on the posterior margin of the carpus in P1 is replaced in P2 by a bifid spine; the propodus is devoid of a subbasal setule, but has 2 anterodistal setae; distally, the propodus shows a distinct triangular projection.

P3 (Fig. 20c) and P4 (Fig. 20d) are similar, except for the presence of a plumose seta on the basis of P4 which is lacking in P3.

P5 (Fig. 20e) and P6 are similar; the basis bears a plumose seta and 2 naked setae. P7 is similar to P5, except for a reduction of the number of elements on the basis to one naked seta only.

The first pleopods (δ) consist of two coalescent halves (Fig. 19c). Distally, there is a narrow cleft; the ornamentation consists of 4 distal and 2 subdistal setules in each half. Pleopod 1 is rather elongated, wider at the base; the distal part is parallel-margined. Pleopod 1 is lacking in female.

Pleopod 2 (δ) has a copulation function (Fig. 19d). The basipodite (called, "sympod" or "sympodite" by some authors) has a roundedly rectangular mediobasal corner, and a broadly rounded laterobasal

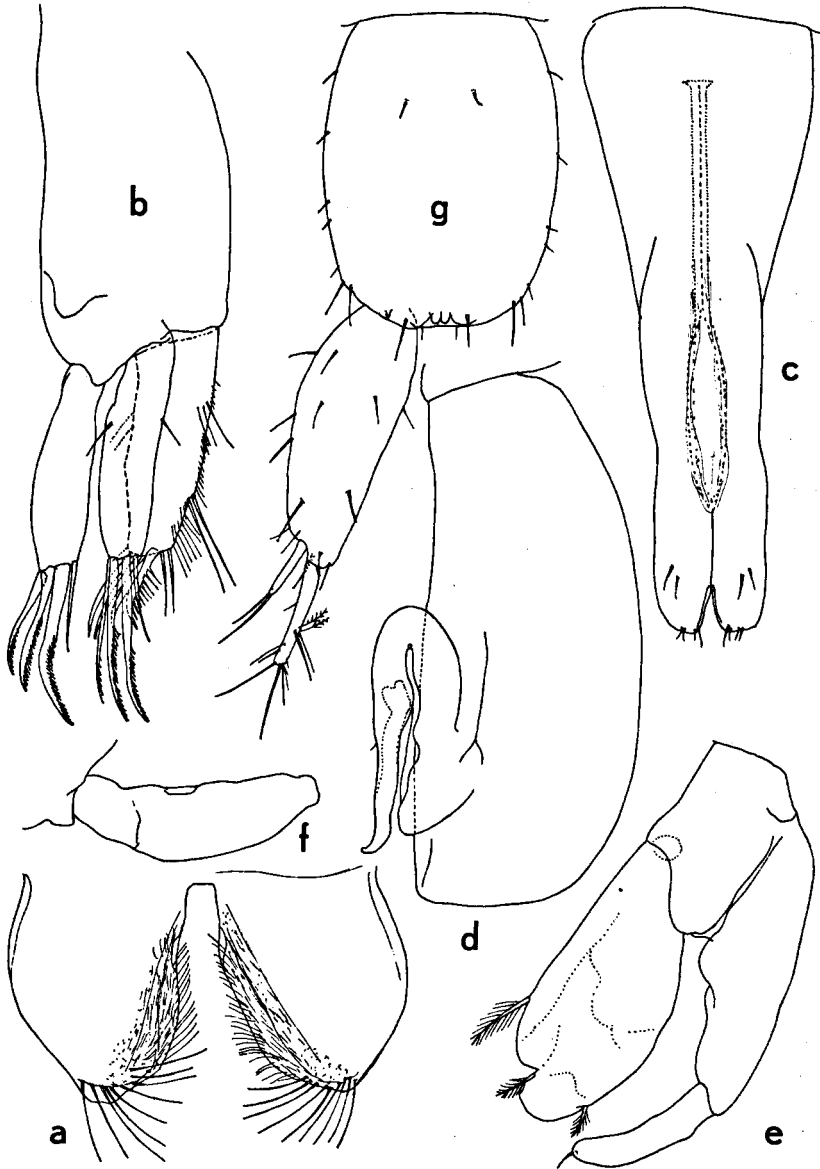


Fig. 19. *Microcharon herverai* n. sp., paratypes. a, lower lip, ♂ (scale 5); b, second maxilla, ♂ (5); c, first pleopod, ♂ (3); d, second pleopod, ♂ (3); e, third pleopod, ♂ (3); f, fourth pleopod, ♂ (3); g, pleotelson and uropod, ♀ (4).

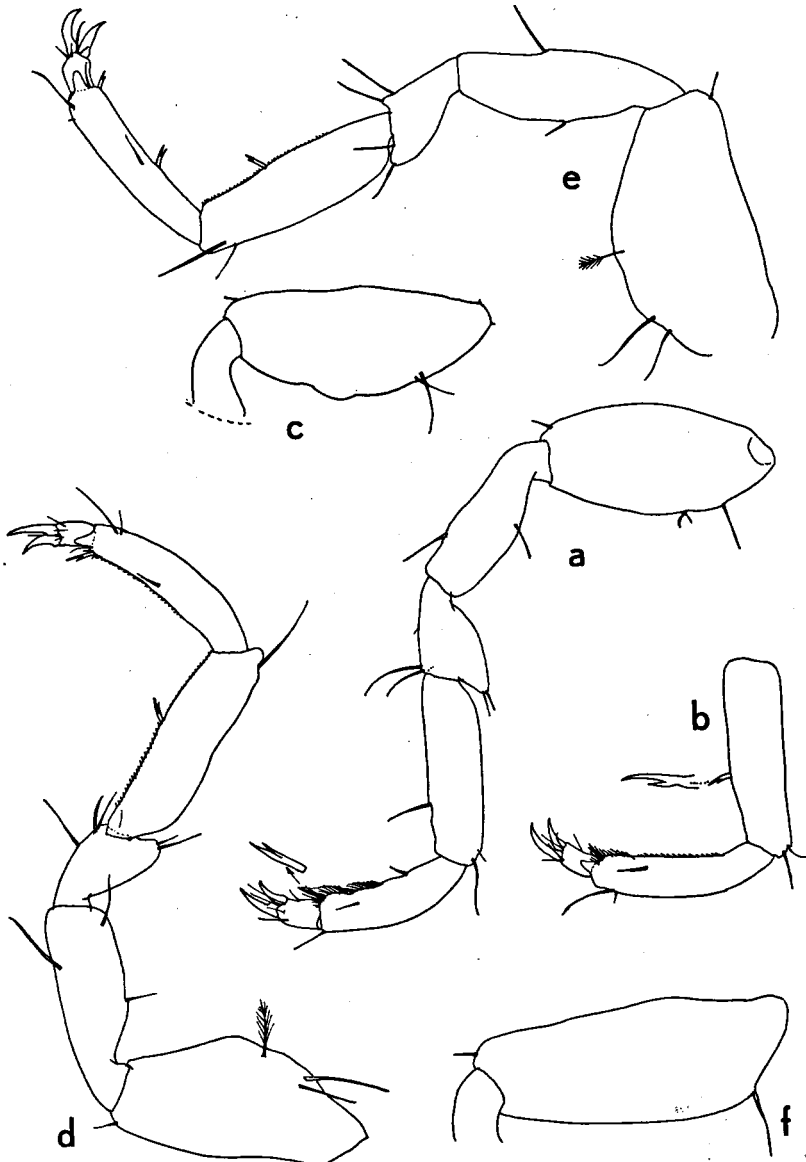


Fig. 20. *Microcharon herrerai* n. sp., ♀ (paratype). a, first pereopod; b, distal segments of second pereopod; c, basis of third pereopod; d, fourth pereopod; e, fifth pereopod; f, basis of seventh pereopod (all to scale 3).

one. The endopodite is completely recurved; the distal part is not filiform, but claw-like and is pointing mediad; it overreaches the exopodite tip. The exopodite is reduced to a rounded lobe.

The female 2nd pleopod assumes the shape of an operculum (Fig. 17d); it is longer than wide, with a distinct median notch; distal margin with 4 setules.

The 3rd pleopod is not sexually dimorph (Fig. 19e); the exopodite is curved inward; the narrow, sausage-shaped distal segment bears a terminal setule. The endopodite is distally bilobate and bears 3 plumose setae.

The 4th pleopod (Fig. 19f) is also similar in both sexes and consists of a 1-segmented, naked rudiment.

The uropod (Fig. 19g) has a wide and robust peduncle (313 μm long, 125 μm wide), about as long as the pleotelson. The exopodite is short, thin, narrow and armed with 2 terminal setae. The endopodite is also narrow, less than half as long as the peduncle, and armed with 3 longer terminal setae, 3 shorter terminal setae, 3 lateral setae and 4 median setae (2 of which are plumose). The uropods get easily detached, and many specimens lost them on one or both sides.

Remarks. — COINEAU, 1968: 172–173 has provided a very useful survey of the species and subspecies described in the genus *Microcharon*. The list contains 27 species and 5 subspecies (although COINEAU starts the list saying that the genus comprises 17 species and 6 subspecies). Including *M. profundalis* ssp. *kosovensis* Karaman, 1940, which is not listed, the number of subspecies is six indeed, and “17” may be a typographical error for “27”. The 4 fully marine species (*teissieri* (Levi, 1950), *heimi* Coineau, 1968, *salvati* Coineau, 1968, and *harrisi* Spooner, 1959) deviate both morphologically and ecologically from the fresh- and brackish water representatives in the genus. Since a generic name for the marine representatives is available (*Duslenia* Levi, 1950), it would seem tempting to subdivide *Microcharon*. However, a closer analysis shows that at least one freshwater species (*M. kirghisicus* Jankouskaya, 1964) has a 5-segmented first antenna (like the marine species). Of the species described after 1968, *M. monnioti* Bocquet, 1970 is marine but has

the (limnic) number of 6 segments in the first antenna, whereas *M. phreaticus* Coineau & Botosaneanu, 1973 from inland waters presents the (marine) number of 5 segments. The present species, from brackish inland wells on the island of Bonaire shows also 5 (the marine number) of antennal segments.

The marine forms are usually (but as we have seen not always) characterized by 5-segmented first antennae (versus 6 in the taxa from continental waters), by the presence of 3 plumose setae on the endopodite of pleopod 3 (versus unarmed), by short dactyli on the pereopods (versus very long, in particular the main claw), by the presence of a strongly pectinated element on the inner arthrite of maxilla 2 (versus pectinations absent). The new species from Bonaire shows all these characters.

Microcharon herrerae differs from the other species with a 5-segmented first antenna as follows:

— From *M. phreaticus* (the only other species known from the Antilles or the rest of the New World) in having setae on the endopodite of pleopod 3, in having short claws on the pereopods, and in having a strongly pectinated element on maxilla 2.

— From *M. kirghisicus* it differs in the same way as from *M. phreaticus*.

— From *M. teissieri* in having 4 (instead of 2) setae on the 2nd pleopod (♀), in having the peduncle in the uropod (♂ ♀) equal to and not longer than the pleotelson, in having more numerous elements on the second maxilla, etc.

— From *M. harrisi* in having a medially notched first pleopod (♀) and in having the peduncle of the uropod (♂ ♀) equal to and not longer than the pleotelson,

— From *M. heimi* it differs in the quite different shape of the first pleopod (♂) (with a subapical swelling in *heimi*), in the presence of 4 (instead of 2) setae on pleopod 2(♀), in the absence of plumosities on the carpal setae of the pereopods (♂ ♀), and in a differently ornamented first maxilla (♂ ♀).

— *M. salvati*, from New Caledonia, seems to be morphologically the closest to our species. The following differences are clear: inner lobe of maxilliped (♂ ♀) with 6 spines in *herrerae* (versus 2); pleopod 2

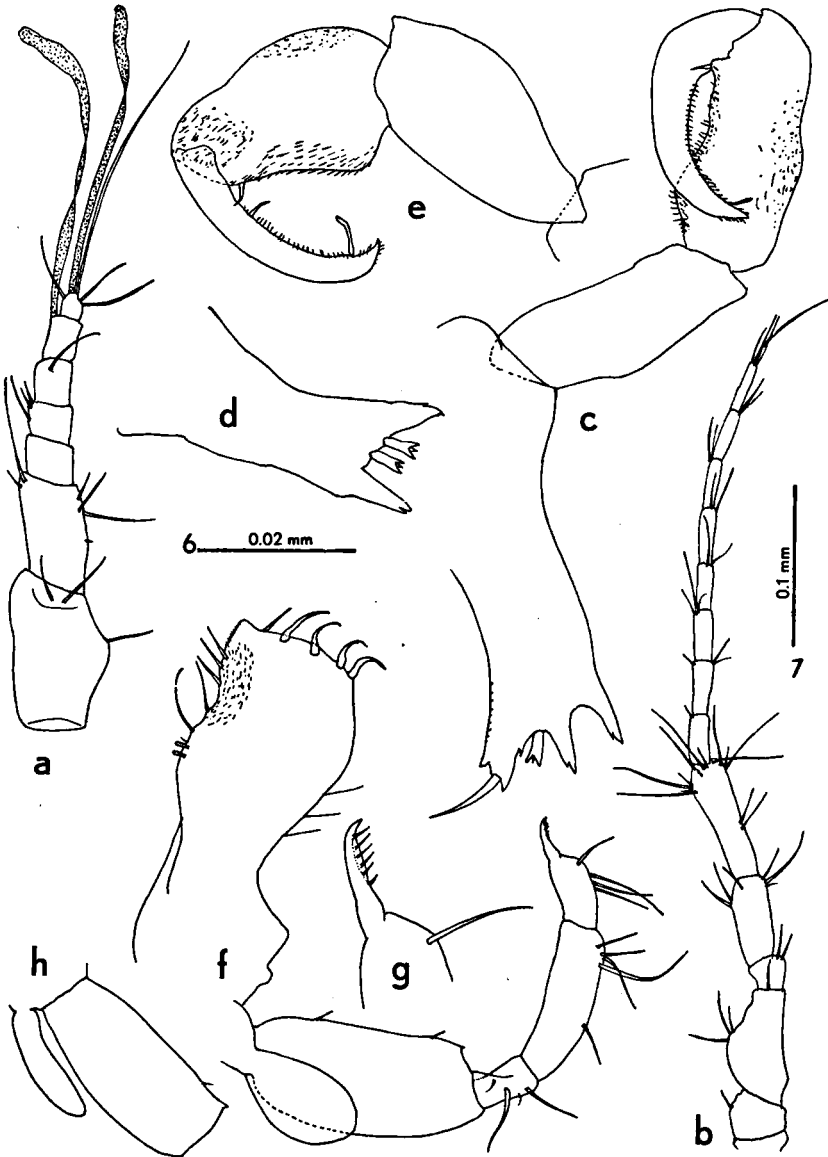


Fig. 21. *Angeliera dubitans* n. sp., paratypes. a, first antenna, ♂ (scale 2); b, second antenna, ♀ (7); c, left mandible, ♂ (6); d, right mandible (masticatory part only) (6); e, palp of mandible of another male (6); f, maxilliped, ♂, under cover glass pressure (2); g, claw of palp, more strongly enlarged; h, epipodite of male maxilliped, in situ (2).

(♀) relatively wider in *herrerai*; the propodus of the pereopods (♂ ♀) more slender in *herrerai*.

From all these species, *M. herrerai* n. sp. differs also markedly by the shape of the endopodite of the 2nd male pleopod: in all others, this endopodite is distally produced in a more or less narrow point, often thread-like (*teissieri*, *kirghisicus*, *harrisi*, *heimi*, *phreaticus*) or pencil-like (*salvati*). The produced part in these species always points straightly backwards or curves outwards. In the new species this endopodite is claw-like and curved inwards.

Microcharon sp.

Material. — 1♀. BONAIRE Sta. 76-15: N.E. of Kralendijk, well between Hato and Noor'i Salina (12°10'57" N 68°17'02" W). Water level at abt. 4½ m; water depth 0.20 m; temperature 27.8 °C; chlorinity 1500 mg/l; June 14, 1976. Accompanying fauna: phreatic Atyidae, Cyclopoida, Ostracoda (ZMA Is. 105.074).

Remarks. — The single specimen available is unfortunately a female, so it is hard to tell whether or not it belongs to *M. herrerai*. It has been collected in a part of Bonaire where the phreatic fauna is different from that found in the Bacuna – Rooi Lamunchi area (where all known localities of *M. herrerai* are localized). The main faunistic difference is the absence of Ingolfiellidea, and the presence of Atyidae, in the Kralendijk area.

Angeliara dubitans n. sp.

Material. — 1♀ (holotype) and 100+ paratypes. BONAIRE, Sta. 76-21: inland side of inlet salt-ponds (N.E. of the Willemstoren, southern Bonaire, 12°02'39" N 68°13'36" W); interstitial fauna of coral-sand, about 1 m from the waterline; water milky; chlorinity 23000 mg/l; June 14, 1976. Accompanying fauna: *Microcerberus* spec. (ZMA Is. 100.619 a-c).

Description. — In most features, the present material resembles strongly *A. racovitzai* Coineau & Botosaneanu, 1973, from Cuba, with which it will be compared in the following description.

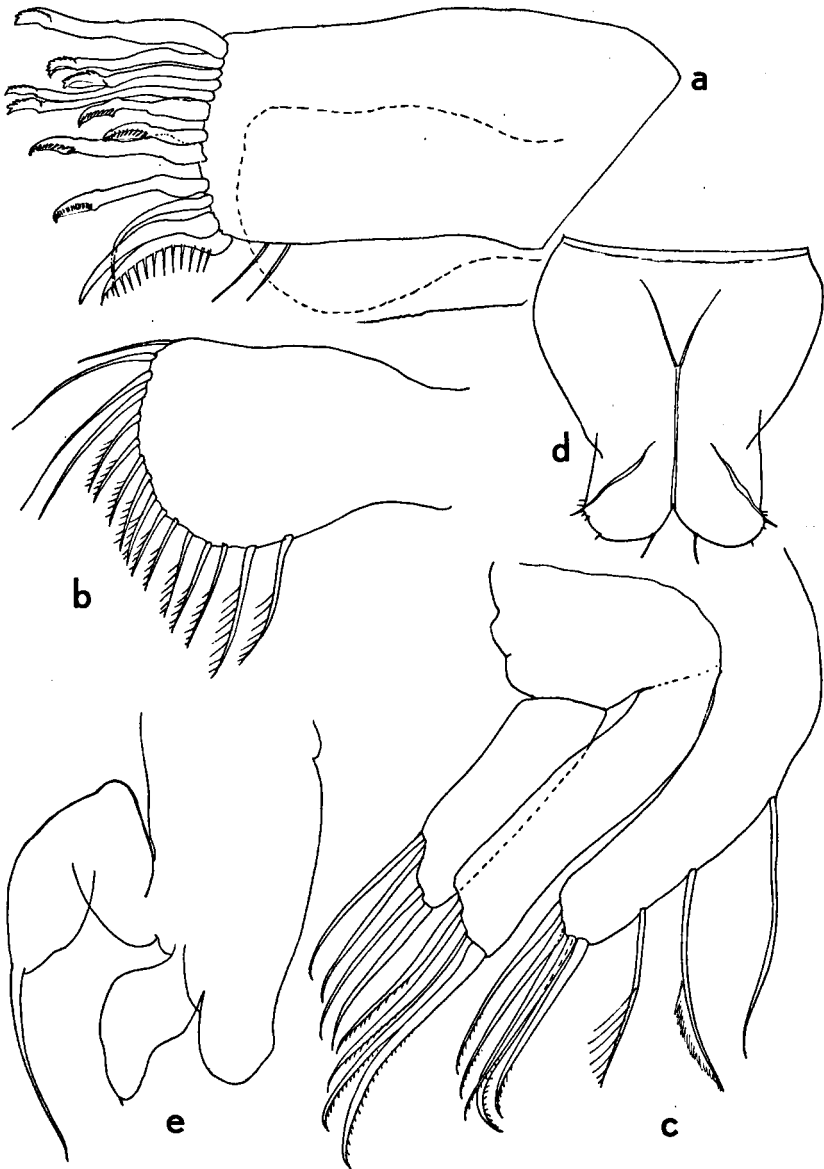


Fig. 22. *Angeliera dubitans* n. sp., ♂ (paratype). a, first maxilla, exopodite (endopodite dashed) (scale 6); b, first maxilla, endopodite (6); c, second maxilla (6); d, first pleopod (2); e, second pleopod (5).

Body length (♂♀) 0.95–1.04 mm (antennae and uropods not included), against 0.87–0.93 mm in *A. racovitzai*.

The first antenna (Fig. 21a) is 7-segmented; it differs from the corresponding appendage of *A. racovitzai* in having 3 setae on article 1, 5 on article 2, 0 on article 3, and 3 on article 4 (in *A. racovitzai*: 2, 3, 1 and 1, respectively). The distal two articles each bear an aesthete, in female these are shorter than the longest seta, in male they are more robust and longer than the longest seta.

The second antenna of *A. racovitzai* is unknown. In the present species, it consists of a pedunculus of 6 articles, and a flagellum of 8 articles. The armature of the segments is visible from Fig. 21b.

The mandible consists of a masticatory part and a palp. The palp shows up differently in different mountings (Figs. 21c, 21e). At any rate, there appears to be no ground for the supposition, that the left and right palp are not symmetrical. The palp consists of 2 basal segments and a curved claw; the 2nd segment bears several patches of pubescence, and a distal spine; the claw bears 2 spine-like elements and a row of spinules. The masticatory part is asymmetrical: on the right side (Fig. 21d) there are two mobile and two immobile teeth, on the left side (Fig. 21c) there are one mobile and three immobile teeth. The mobile teeth are larger than in *A. racovitzai*.

The first maxilla consists of a large exopodite and a smaller endopodite. The exopodite (Fig. 22a) distally bears 9 strong spines, distally curved and denticulated in a curious way; 2 smooth, curved spines (only one in *A. racovitzai*); and 1 unilaterally toothed curved element; medially, the exopodite bears 2 setae. The endopodite (Fig. 22b) bears a row of 15 to 16 setae (4 glabrous and 11 to 12 ciliated) along the distal and mediobasal margins (in *A. racovitzai* about 12 setae are found).

The second maxilla (Fig. 22c) has 3 arthrites: the lateral and central ones each bear 4 terminal elements; the medial one bears 5 terminal elements (4 in *A. racovitzai*) and 3 medial elements, 2 of which are ornamented (1 ornamented in *A. racovitzai*).

The maxilliped (Fig. 21f) has an elliptical epipodite, which shows up in dissections as a broad oval, but *in situ* it looks more finger-shaped (Fig. 21h) (in *A. racovitzai* the epipodite remained unknown).

The maxillipedal palp (Fig. 21f) has a wide basal segment, medio-

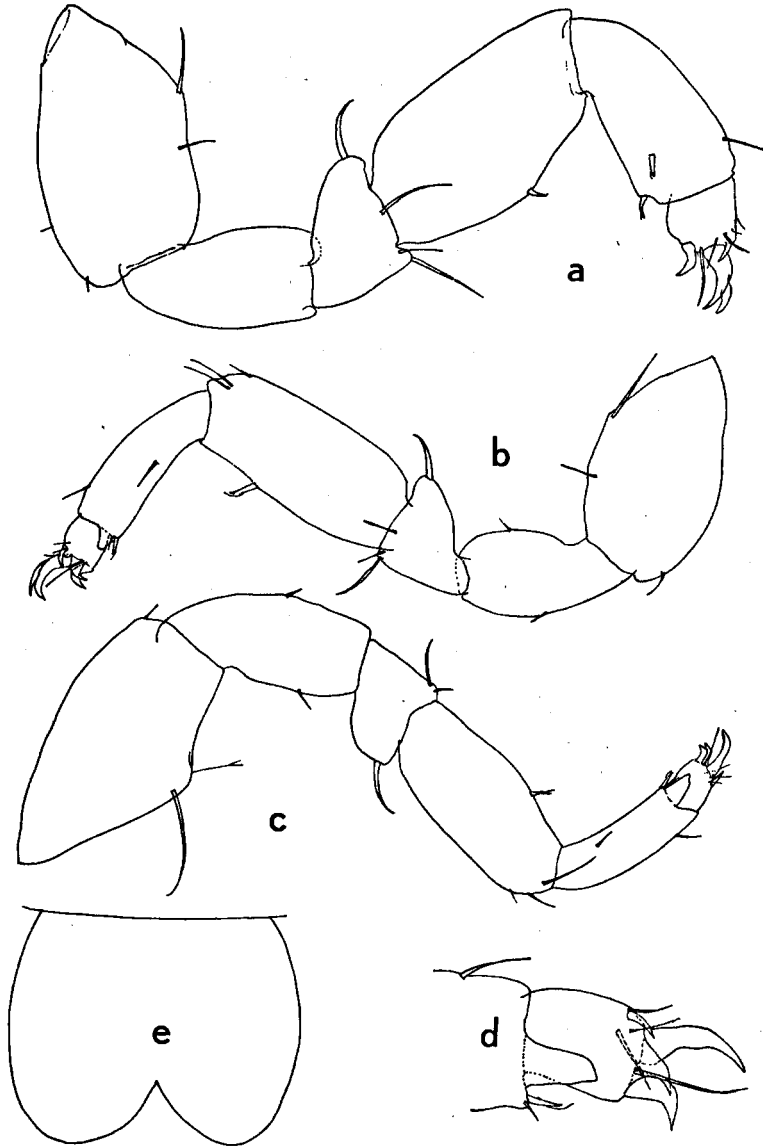


Fig. 23. *Angeliera dubitans* n. sp., paratypes. a, first pereopod, ♂ (scale 5); b, second pereopod, ♂ (2); c, fourth pereopod, ♂ (2); d, dactylar complex of fourth pereopod, ♂ (6); e, second pleopod, ♀ (2).

distally provided with a small pointed projection; the second segment is implanted eccentrically. The distal segment is almost rectangular, with 4 lateral setae and a distal, narrowly produced, claw-like projection (Fig. 21g). (In *A. racovitzai*, this distal palp segment is narrower, curved, and merges more gradually into the claw-like projection.) The basipodal endite is laterally armed with 3 setules, distally with 4 or 5 curved spines and 1 straight spine, medially with 5 setae and 2 "coupling hooks".

The first and second pereopods are unknown for *A. racovitzai*. In the present species, pereopod 1 (Fig. 23a) is smaller than the others; its basis bears 2 dorsal setae; the ischium is devoid of sizeable elements; the merus bears 1 strong, curved dorsal element and 3 normal setae; the carpus bears a ventral spine only; the propodus bears 1 dorsal setule and 2 ventral spines. The claw portion is complexly built: it consists of a squarish basal portion bearing 3 longer setae, 2 short setules, a ventral, smaller claw, a larger bifid claw and a dorsal claw-like spine.

The second pereopod (Fig. 23b) is longer than the first (notice that figures of P1 and P2-7 have been drawn to different scales), has a more slender carpus and a much more slender propodus than in P1. The ischium bears 1 dorsal and 1 ventral setule, the carpus bears, in addition to the ventral spine also found in P1, 3 dorso-distal setae; the propodus is distally produced into a triangular projection, lacking in P1; one of two spines on the propodus is replaced by a setule. The main claw is bifid, like in P1; it is accompanied by 2 smaller ventral, and 1 smaller dorsal claw and 4 setae.

The third and fourth pereopods (Fig. 23c) are mutually similar. The merus bears only 2 ventral setae (instead of 3 as in P1 and P2). The largest distal claw is simple (Fig. 23d); the remaining armature is homologous to that found in P2.

The fifth pereopod is sexually dimorph. In male (Fig. 24a) the carpus and propodus are more swollen than in female (Fig. 24b). The armature of the segments is almost identical to that in P3 and P4.

The sixth (Fig. 24c) and seventh pereopods are mutually similar. The dorsal margin of the basis shows an increased number of setules;

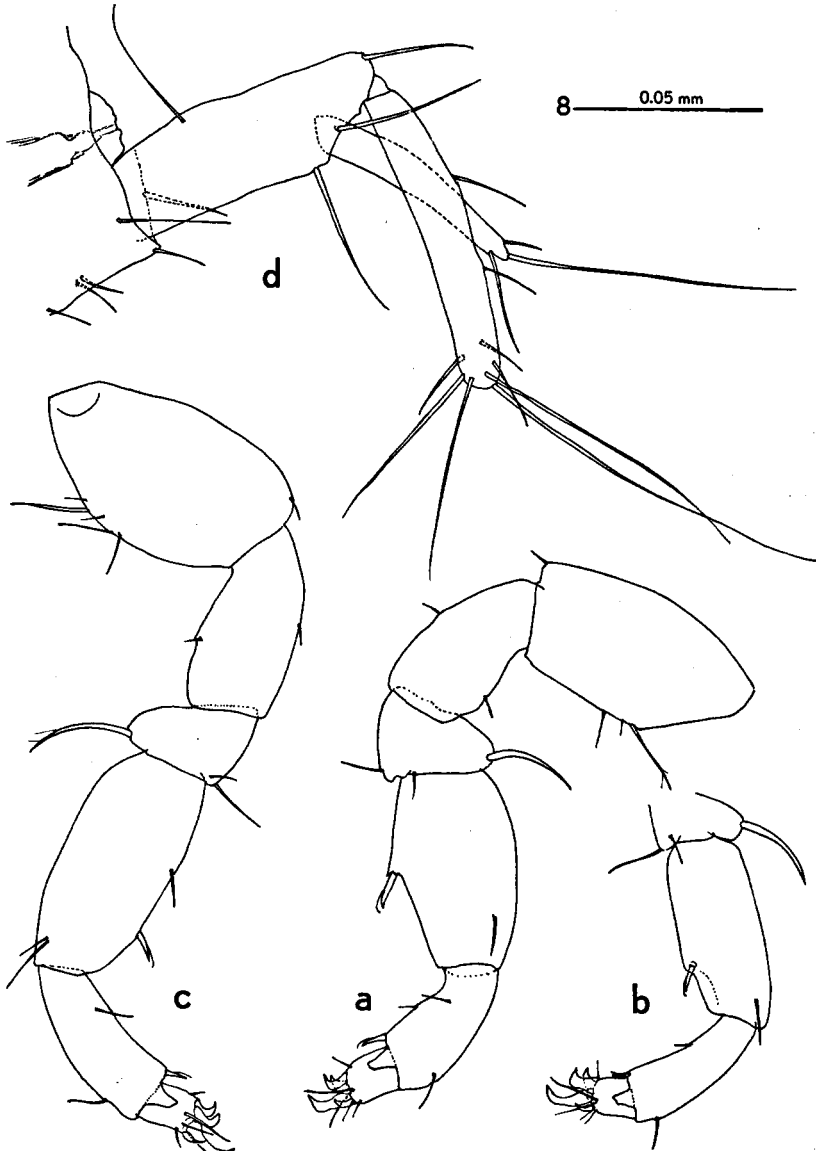


Fig. 24. *Angeliera dubitans* n. sp., paratypes. a, fifth pereopod, ♂ (scale 2); b, distal part of fifth pereopod, ♀ (2); c, sixth pereopod, ♂ (2); d, uropod, ♀ (8).

the ventral margin of the ischium bears, in addition to the usual spine, a subbasal setule.

In comparison with *A. racovitzai*, the pereopods in the Bonaire material differ in several respects: P3 and P4 have 1 more seta on the merus; P3 to P7 have a subbasal seta on the propodus (absent in *A. racovitzai*); there is a small but distinct auxiliary claw, dorsally of the main claw (absent in *A. racovitzai*); the dactylar complex bears 4 setae (not, or only in part, present in *A. racovitzai*).

The pleotelson is similar in shape and armature to that of *A. racovitzai*, as are the first male pleopod (Fig. 22d) and the second male and female pleopods (Figs. 22e, 23e).

The uropod (Fig. 24d) has a long peduncle, armed with 1 medial and 3 distal setae. The exopodite is slightly over $\frac{3}{4}$ of the length of the endopodite; it bears 1 very long terminal and 2 shorter subterminal setae. The endopodite bears 2 medial setae and 7 subterminal and terminal setae.

Remarks. — There are five species and one subspecies of *Angeliiera* known at present: *A. phreaticola* Chappuis & Delamare, 1952, *A. ph. ischiensis* Schulz, 1954, *A. xarifae* Siewing, 1959, *A. cosettae* Coineau & Rao, 1972, and *A. racovitzai* Coineau & Botosaneanu, 1973, whereas the animals described by GNANAMUTHU, 1954, as *Brevipleonida gracilis*, belong likewise without any doubt, as shown by DELAMARE DEBOUTTEVILLE, 1960, to the genus *Angeliiera*. I do not agree with his opinion, however, that *gracilis* is synonymous with *phreaticola*, since the ♀ operculum (= pleopod 2) is quite differently shaped in both species. As a matter of fact, *gracilis* may prove to be a senior synonym of *cosettae*, a synonymy supported by the same general geographic origin of the material (*gracilis*: Madras; *cosettae*: northern Andaman Islands).

As COINEAU & BOTOSANEANU, 1973, pointed out, the species of *Angeliiera* fall into two groups: group 1 in which the ♀ operculum has a gently convex posterior margin, and pointed distolateral corners, and group 2 in which the ♀ operculum is heart-shaped, with a narrow median cleft and rounded distolateral corners. It may be added that all species of group 1 have a tapering, pointed epipod on the maxilliped, whereas the species of group 2 (with the

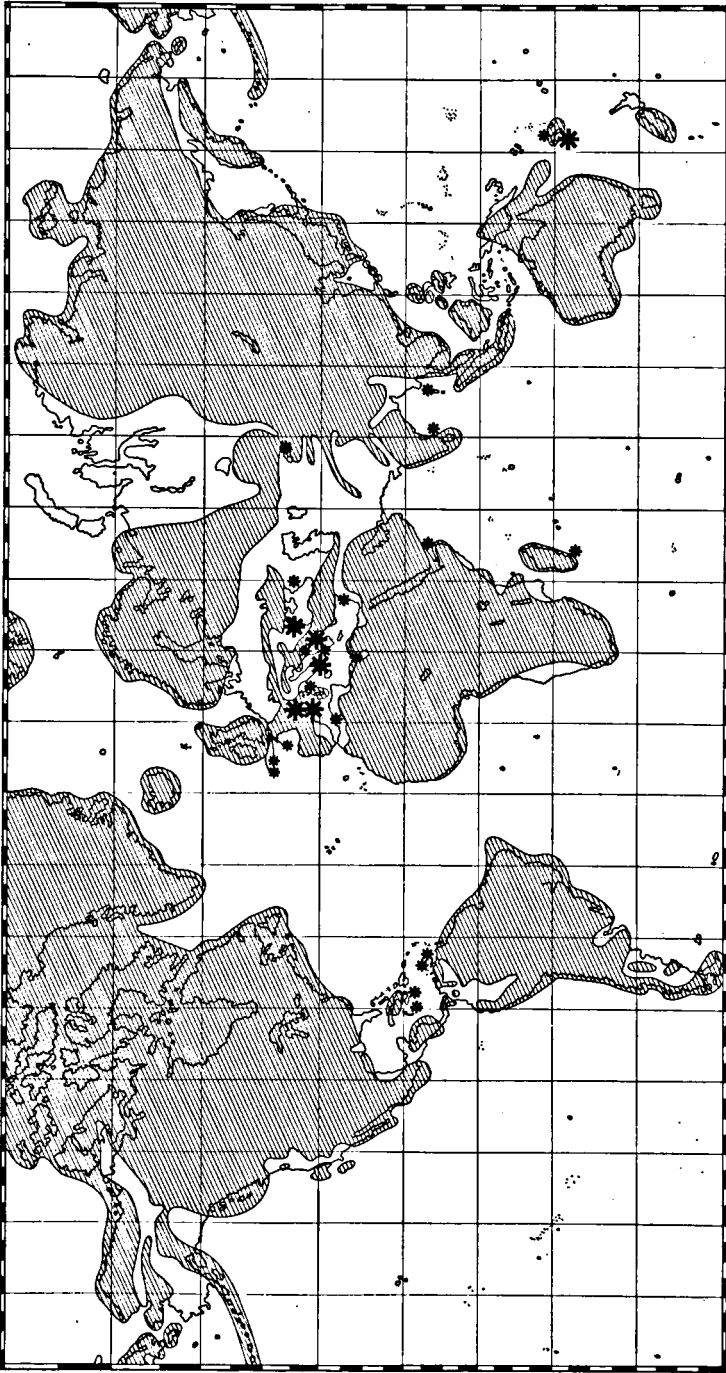


Fig. 25. The known present-day distribution of the family Microparasellidae (Isopoda, Asellota) over the world (genera *Microparasellus*, *Microcharon*, *Paracharon*, *Angelleva*). - Smaller asterisks indicate the presence of one species, larger asterisks the presence two or more species in a particular area. The hatched areas were above sea-level during the Oligocene (after DE LATTIN, 1967, fig. 42). The present-day geomorphological features are shown for orientation. - Notice that all known localities for Microparasellidae are in Oligocene sea areas (mostly in near-shore conditions). Many localities are nowadays far inland. Presumably the "stranding" of the Microparasellidae took place after the Oligocene period, most probably in the Miocene. They are now confined to interstitial habitats in shallow seas, on sandy beaches, in riverine sands, and in caves.

possible exception of *racovitzai*, in which the maxillipedal epipod is not described) have an ovate or sausage-shaped one.

Group 1 includes *gracilis*, *cosettae* and *xariffae*; group 2 unites *racovitzai*, *phreaticola*, and *dubitans*.

It cannot be denied that *dubitans* and *racovitzai* are very closely related. I endeavored, after long hesitation (hence the proposed specific name *dubitans*) to keep the two apart, on the following grounds:

- (1) several, taxonomically important, characters of *racovitzai* remained unknown (uropods, maxillipedal epipod, second antenna, pereopods 1 and 2), which makes comparison a bit difficult;
- (2) several slight differences exist between the description of *racovitzai* and the present material. These differences, indicated already in the above description, pertain to the setosity of the first antenna; the body size; the size of the movable teeth on masticatory blade of the mandible; the number of elements on exo- and endopodite of the first maxilla; the number of setae on the medial arthrite of the second maxilla; the shape of the claw on the maxillipedal palp; the number of elements on the propodus of pereopods 3 to 7, and especially the structure of the dactylar complex in these pereopods, which has one extra claw and several extra setae in *dubitans*.

It is clear that the differences between the various units within *Angeliiera* are quite small. This is reflected for instance by DELAMARE's (1960) treatment of the genus, who considered the populations from the western Mediterranean, Madagascar and Madras to be identical, an opinion that no longer prevails nowadays.

Up to now, all members of *Angeliiera* have been found in interstitial groundwater of marine sandy beaches in warm-temperature and tropical regions. The known distribution includes the Mediterranean Sea, Madagascar, the northern shores of the Indian Ocean, the Gulf of Aden, and the West Indies. The genus is not known from the Pacific so far.

THE ORIGIN OF BRACKISH AND LIMNIC MICROPARASELLIDAE

The actual distribution of the Microparasellidae (a family with 4 genera) is plotted in Fig. 25. Several species are marine, belonging to meiofaunal communities in subtidal habitats and on intertidal sandy beaches. Others are found inland, in the interstitial system of caves, wells, or river sands. The question arises when these inland forms have invaded the limnic regions. The known present-day localities for Microparasellidae all lie in the area covered by the (marine) waters of the Tethys Sea in the Oligocene period (see Fig. 25), and more specifically on or near the Oligocene shore-lines. Presumably the Oligocene Microparasellids were adapted to life in the interstitia of marine macroporous substrates of the sublittoral and littoral zones. They "stranded" during the Miocene regressions of the sea-level, became adapted to the brackish "Küstengrundwasser", and evolved finally into limnic mesopsammal forms living in the underflow of rivers and similar phreatic habitats.

The postulated period of transition from marine to limnic habitats, due to "stranding" and "uplifting" in the Miocene, corresponds well with data found in other groups, like Thermosbeanacea (summary in STOCK, 1976a), the prawn *Typhlocaris*, the isopods *Typhlocirolana* and *Monolistera* (see FRYER, 1965), and presumably a number of other Crustacea with a similar habitat and a similar distribution pattern, like the Bogidiellidae (Amphipoda), the Hadziids (Amphipoda), *Stygiomysis* (Mysidacea), etc.

The origin of the inland microparasellids might, at least partially, be different from that of another group of ancient crustaceans, the Ingolfiellidea (review in STOCK, 1976b) whose distribution is not limited to the area of the former Tethys Sea (they occur, for instance, under limnic conditions in Africa and South America), and whose habitat is not restricted to mesopsammal assemblages (they occur, for instance, in the deep-sea). In several of the Bonaire localities cited in this paper, *Microcharon herrerae* n. sp. coexists with *Ingolfiella putealis* Stock, 1976. This might indicate that at least in certain regions, the stranding and uplifting of these Crustaceans of marine origin has proceeded along the same tracks.

REFERENCES

- COINEAU, N., 1968. Contribution à l'étude de la faune interstitielle - Isopodes et Amphipodes. *Mém. Mus. nation. Hist. nat. (n.S.) (A)* 44 (3): 145-216.
- COINEAU, N. & BOTOSANEANU, L., 1973. Isopodes interstitiels de Cuba. In: T. ORGHIDAN et al., ed., *Rés. Expéd. biospéol. Cubano-Roumaines à Cuba 1*: 191-220, pl. XIII.
- DELAMARE DEBOUTTEVILLE, CL., 1960. Biologie des eaux souterraines littorales et continentales. *Actualités sci. indust.* 1280: 1-740.
- FRYER, G., 1965. Studies on the functional morphology and feeding mechanisms of *Monodella argentarii* Stella (Crustacea: Thermosbaenacea). *Trans. roy. Soc. Edinburgh* 66 (4): 49-90.
- GNANAMUTHU, C. P., 1954. Two new sand-dwelling isopods from the Madras sea-shore. *Ann. Mag. nat. Hist. (12)* 7: 257-274.
- LATTIN, G. DE, 1967. *Grundriss der Zoogeographie*: 1-602. (Gustav Fischer, Jena).
- STOCK, J. H., 1976a. A new genus and two new species of the crustacean order Thermosbaenacea from the West Indies. *Bijdr. Dierk.* 46 (1): 47-70.
- STOCK, J. H., 1976b. A new member of the crustacean suborder Ingolfiellidea from Bonaire, with a review of the entire suborder. *Stud. Fauna Curaçao* 50: 56-76.