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LIAGOCERADOCUS ACUTUS ANDRES, 1978, A BLIND ANCHIHALINE AMPHIPOD FROM LANZAROTE: REDESCRIPTION, TAXONOMIC STATUS AND OCCURRENCE

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ABSTRACT

Liagoceradocus acutus Andres, 1978, has been found in different localities on Lanzarote, Canary Islands. A redescription is provided and the taxonomic status of the genus *Liagoceradocus* is discussed. The species shows sexual dimorphism mainly in the morphology of the propodus of gnathopods 1 and 2, but not in the pleopods. It was previously only known from the type-locality, the Jameos del Agua lava tunnel (Lanzarote), but is by no means specific to this kind of of habitat: it occurs regularly, and sometimes in great abundance, in subterranean shafts formerly used to supply the island's salt pits with sea-water.

INTRODUCTION

Liagoceradocus acutus Andres, 1978, was already known from Lanzarote. It was described from, and never found outside, an extensive, anchihaline lava tunnel, called Jameos del Agua. We have collected it in the type-locality again, but it seems by no means common in the Jameos. It is regularly encountered, however, in subterranean supply shafts, formerly used to bring up seawater into (now disused) salt pits of the island of Lanzarote. The seawater in such shafts was usually pumped up by wind pumps, now generally ruined. The wind pumps were fed through underground galleries cut out in the volcanic rocks, in open connection with the sea, and subjected to the tides. Such galleries do not extend far inland, from less than ten to at most a hundred metres. We suppose, therefore, that *L. acutus* will also occur in crevicular habitats in the open sea, and as point of fact, other species of the genus [notably *pusillus* Barnard, 1965, and *dentiferus* (Ledoyer, 1982)] have been found in such habitats.

MATERIAL AND METHODS

Material and methods have been described in a previous paper (Stock & Rondé-Broekhuizen, 1986) to which the reader is referred. All specimens have been

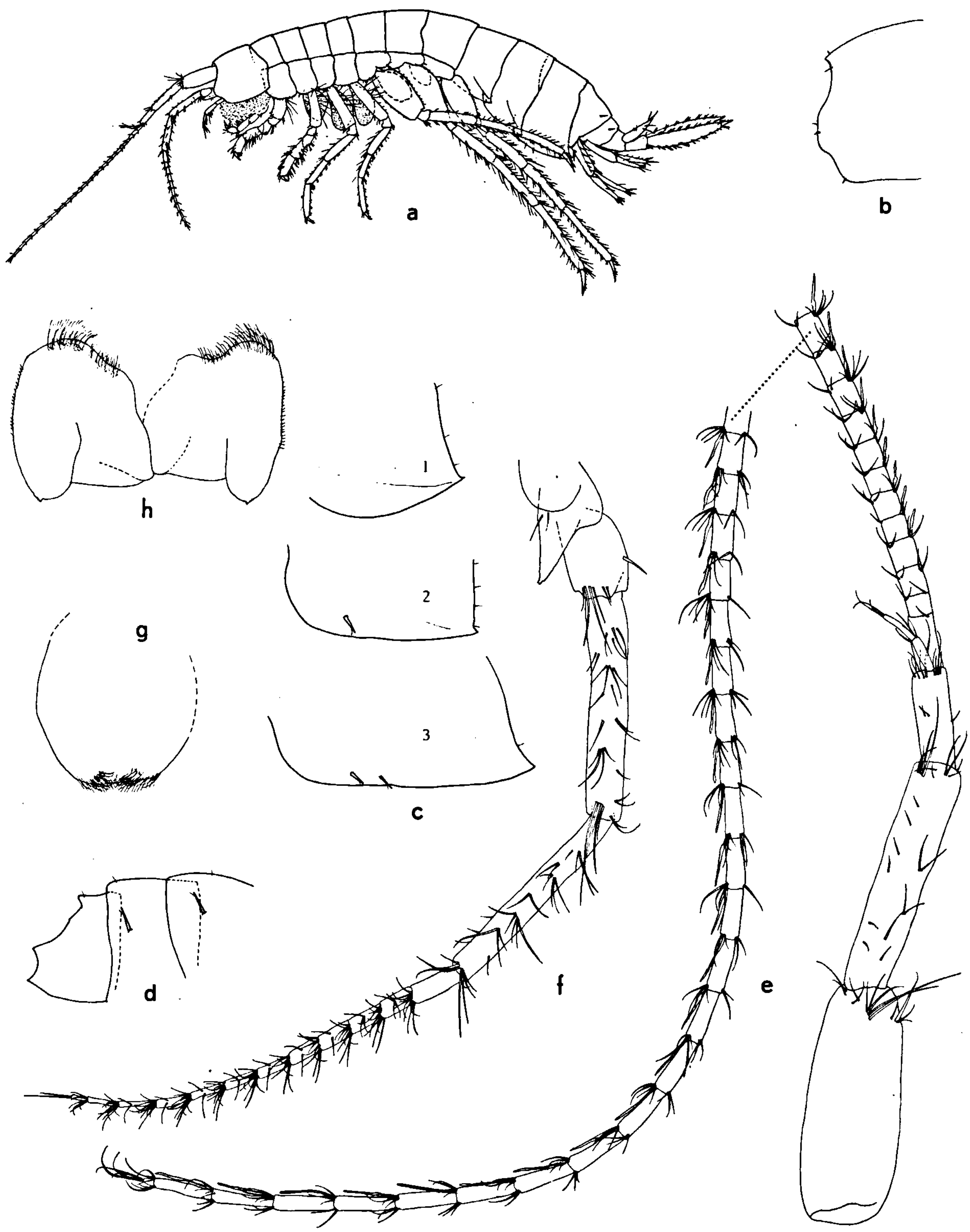

Fig. 1. *Liagoceradocus acutus* Andres, 1978.

a, body, ♀, from the left (free-hand sketch, scale 1); b, cephalosome, ♀, from the left (3); c, epimeral plates 1 to 3 ♀ (3); d, contour of urosome, ♀, from the right (3); e, first antenna, ♀ (2); f, second antenna, ♀ (2); g, upper lip, ♀ (2); h, lower lip, ♀ (2). Scales on fig. 6.

preserved in the Zoölogisch Museum, Amsterdam.

DESCRIPTIVE PART

Liagoceradocus acutus Andres, 1978

Andres, 1978: 249, figs. 1-2.

Material

All from Lanzarote (Canary Islands); water temperatures in °C., conductivity in mS/cm. The coordinates refer to the UTM grid of the Mapa Militar de España, scale 1:50,000.

1♀ (illustrated), Stn. 85-85: Ponta Chica (= NE of Arrecife), old windpump for seawater supply of salt pits (sheet 48-36, coordinates 64365x320620); water table at 14 m, water depth 0.3 m; 21.1°, cond. 36.8; 20 May 1985.

1♂ (illustrated), 3♀, Stn. 85-86: about 100 m south (= seaward) of previous station; old windpump of salt pit (sheet 48-36, 64365x320605); water table at 11 m, water depth 0.25 m; 20.4°, cond. 39.7; 20 May 1985.

1♀, Stn. 85-87: Playa Bastián, old windpump of salt pit (sheet 48-36, 64625x320835); water table at 20 m, water depth 0.25 m; 21.6°, cond. 27.0; 20 May 1985.

4♀, Stn. 85-99: Punta de Mujeres, old windpump of salt pits (sheet 48-35, 65113x322445); water table at 10 m, water depth 0.25 m; 21.6°, cond. 41.2; 21 May 1985.

16♀, Stn. 85-100: Jameos del Agua (sheet 48-35, 65285x322630), washed from sand and gravel and taken free-swimming with a dipnet in the great cave lake (Lago Mayor); depth 0-0.5 m, 18.4°, cond. 40.1; 21 May 1985.

3♀, Stn. 85-107: El Charco, old windpump of salt pits (sheet 48-35, 64815x320905), less than 10 m from the sea; water table at 2 m, water depth 0.3 m; partially filled with garbage and wood debris; 21.1°, cond. 21.9; 22 May 1985.

1♀, Stn. 85-108: closed cistern, ca. 50 m inland from previous station (sheet 48-35, 64805x320905); water table at 3.75 m, water depth 0.3 m; 21.0°, cond. 5.13; 22 May 1985.

4♀, Stn. 85-151: Punta de Mujeres, old windpump of salt pits (sheet 48-35, 65120x322490); water table at 12 m, water depth 0.3 m; salinity 37 ppt; 30 May 1985.

1 juv., Stn. 85-570: Arrecife, Muele de los Mámoles, old windpump of salt pits with disused windpump, near warehouse of Transporto Brito (sheet 48-36, 64380x320615); water table at 6 m, water depth 0.4 m; cond. 36.1; 5 Jan. 1986.

3 juv., Stn. 85-578: same station as 85-99 (vide supra); cond. 32; 6 Jan. 1986.

>100 specimens, Stn. 85-579: same station as 85-151 (vide supra); cond. 33.2; 7 Jan. 1986.

2♀, 1 juv., Stn. 85-580: Orzola, ruined windpump of salt pit (sheet 48-36, 65072x323320); water table at 12 m, water depth 2.5-3 m; almost anoxic, 20.4°, cond. 36.1; 7 Jan. 1986.

3♀, 1♂, Stn. 85-582: same station as 85-570 (vide supra); 7 Jan. 1986.

Stations 85-85 through 85-151 have been sampled by the authors; stations 85-570 through 85-582 were visited by Mr. J.J. Vermeuelen and the second author, during the 1986 cruise of RV "Plancius" to the Canary and Cape Verde Islands.

Accompanying fauna

In the type-locality (Jameos del Agua), *Liagoceradocus* is accompanied by a varied fauna, reviewed by Wilkens & Parzefall, 1974. Our sample 85-100 contained several species of Polychaeta, Sipunculida, Cyclopoidea, Harpacticoidea, Cladocera, *Heteromysis* (Mysidacea), *Bogidiella* (Amphipoda), and *Munidiopsis* (Anomura).

In Stn. 85-86 *Liagoceradocus* was accompanied by *Halosbaena* (Thermosbaenacea) and Calanoida; in Stn. 85-99 by Cyclopoida (Copepoda); in Stn. 85-107 by Cyclopoida, *Bogidiella* and *Caecum* (Gastropoda); in Stn. 85-108 by Cyclopoida and Ostracoda; In Stn. 85-578 by Hydracarina; in Stn. 85-579 by Ostracoda, blind Mysidacea, and Cyclopoida; in Stn. 85-580 by Hydracarina. In the remaining stations, no accompanying fauna was present.

Description

Body length up to 6.8 mm (♀), or 7.2 mm (♂); unpigmented; no eyes (fig. 1a). Cephalosome, metasome and pleonites with some dorsal setules. Urosomites with a pair of dorsal setules; somites 1 and 2 moreover with a strong laterodorsal spine on either side (fig. 1d). Cephalosome with very shallow sinuses (fig. 1b).

First antenna (fig. 1e): very slender and long (almost twice as long as A2). Peduncle segment 1 wider and shorter than segm. 2; segm. 3 almost 40% of the length of segm. 2. Accessory flagellum slender, overreaching the 2nd flagellum segment, 2-segmented. Flagellum very long, with up to 36 segments; segments getting gradually more slender distally. Long, thin (almost setiform) aesthetasks present from segm. 4 to penultimate segment.

Second antenna (fig. 1f) with up to 14 segments in flagellum. Gland cone rather slender, tapering. No calceoli.

Upper lip (fig. 1g) rounded. Lower lip (fig. 1h) with indistinct inner lobes.

Mandibles: right molar with short seta (fig. 2b), left one without seta (fig. 2a). Left lacinia mobilis with 4 teeth (including terminal one), right lacinia complex: larger cusp with 4 teeth (including terminal one), smaller cusp bifid, one branch with 3 small teeth, the other unadorned. Left appendage with 13 molar setae, right one with 10 setae. Palp 3-segmented; segm. 1 long, unarmed; segm. 2 somewhat longer than segm. 1, with 3 or 4 ventral setae; segm. 3 with 9 or 10 long "D"setae, and 3 very long "E" setae, but no "A", "B", or "C"setae.

First maxilla (fig. 2c): inner lobe trapezoidal, with >30 plumose setae. Outer lobe more slender, with 9 denticulated, terminal spines (medialmost spine with 11 teeth, lateralmost spine with 3 teeth, others with 4 to 8 teeth). Palp 2-segmented; segm. 1 unarmed; segm. 2 distally with 6 denticulated spines and 1 plumose seta, and subdistally with 3 plumose setae. Left and right palp practically symmetrical.

Second maxilla (fig. 2d) consisting of 2 lobes. Outer lobe with 2 rows of (sub)terminal, unilaterally ornamented setae; one row consisting of some 12 longer setae; other row of some 15 shorter setae. Inner lobe with mediomarginal row of numerous setae and oblique row of some 28 setae.

Maxilliped (fig. 2e): Inner lobe distally with 3 flattened spines and several plumose setae; a subdistal, oblique row of setae continues along the medial margin. Outer lobe broadly ovate. Palp 3-segmented; segm. 3 swollen; claw strong, inner margin with several setules.

Gnathopod 1 (fig. 3a, b): Coxal plate rounded, inferior margin with 10-15 setules and 1 or 2 spinules. Basis elongate, distally slightly widened; posterior margin with very long setae, arranged in 5 groups; moreover 5 long setae usually point in anterior direction. Carpus longer than propodus, non-lobate; with 3 transverse rows of setae, pointing backward. Propodus rectangular; posterior margin with about 6 setae. Palmar angle distinct, marked by 3 larger and 5 smaller bicuspidate spines. Palmar margin rather short, bearing a row of minute spinules and 10 or more setae (♀); male palmar margin moreover with 7 bicuspidate spines (fig. 3c). Inner margin of claw with 5 (♀) to 7 (♂) spinules.

Coxal gills on P2 through P6. Oostegites linear, on P2 through P5.

Gnathopod 2 (figs. 4a, 5a) sexually dimorphous. Coxal plate longer than wide, inferior margin with some 10 spinules and setules. Coxal gill large, oval, with short stalk. Basis with 8 to 10 long setae on posterior margin; anterior margin with 6 spines in ♀, none in ♂. Carpus lobate; 4 (♀) or 5 (♂) groups of setae are implanted at the basis of the lobe (not on its margin). Propodus elongate subrectangular (♀) to elongate ovate (♂). Palmar angle marked by 2 long spines. Palmar margin of ♀ less than half as long as posterior margin of propodus, that of ♂ nearly as long as posterior margin; in ♀ with 5 unpaired, setule-tipped spines; in ♂ with 22 setule-tipped spines placed in 2 rows; several setae (>10) mixed with the spines (♀, ♂); margin moreover lined with minutes spinules. Claw of ♀ shorter than that of ♂, bearing 7 (♀) to 21 (♂) spinules and as many setules on inner margin.

Pereiopods 3 and 4 (figs. 4b, 5b): without noticeable sexual dimorphism, equally long and similar in morphology. Claw of P4 slightly more slender than that of P3. Coxal plate 4 practically without posterior emargination. Coxal gills smaller and narrower than in P2, with short basal stalk.

Pereiopod 5 (fig. 6a) much longer than P3 and P4. Coxal plate strongly anterolobate. Basis somewhat tapering; posterior margin with 12-14 setules; posterodistal lobe poorly developed. Merus and carpus subequal, propodus longer; all richely armed with slender spines. Claw slender and elongate; outer margin with subbasal, longer, seta and 4 smaller setae.

Pereiopod 6 (fig. 7a) longer than P5. Coxal plate almost equilobate. Coxal gill smaller than in anterior pereiopods. Basis slightly more elongate in shape than in P5. Long segments somewhat more richely spinose than in P5.

Fig. 2. *Liagoceradocus acutus* Andres, 1978.

a, left mandible, ♀ (scale 4); b, right mandible, ♀ (4); c, first maxilla, ♀ ; d, second maxilla, ♀ (4); e, maxilliped, ♀ (4) f, first uropod, ♂ (2); g, first uropod, ♀ (2); h, second uropod, ♂ (2); i, third uropod, ♀ (2). Scales on fig. 6.

Fig. 3. *Liagoceradocus acutus* Andres, 1978.
a, first gnathopod, (scale 4); b, first gnathopod, ♂ (4); c, palma of first gnathopod, ♂ (5). Scales on fig. 6.

Pereiopod 7 (fig. 8) as long as P6, and similar to it, but for coxal plate which is almost non-lobate.

Epimeral plates 1 and 2 with oblique stripe, plate 3 without. Plates 2 and 3 with 1 or 2 ventral spines. Posterior margin of each plate with a few setules. Posteroventral corner produced into a small point (fig. 1c).

Pleopods not sexually dimorphous. Pleopod 1 (fig. 6b): peduncle with 2 or 3 retinacula, each with 2 rows of 3-5 fine teeth. Endopodite a trifle longer than exopodite, bearing 4 clothes-peg spines on medio-proximal margin. Pleopod 2 (fig. 6c): similar to Pl. 1; endopodite with 3 clothes-peg spines. Pleopod 3 (fig. 7b): peduncle shorter than in Pl.1 or Pl. 2, bearing 2 retinacula, each with 2 rows of 3 to 6 denticles; endopodite with 3 clothes-peg spines.

First uropod (fig. 2f, g): posteroventral corner of urosomite 1 with strong spine and setule. Peduncle with robust and long proximoventral spine. Exopodite slightly shorter than endopodite; both rami with 1 or 2 mid-dorsal spines and 5 (sub)terminal spines.

Second uropod (fig. 2h): peduncle with apicomedial row of spines (8-10 small, 1 larger). Exopodite slightly shorter than endopodite; exopodite with 2 medio-dorsal and 4 distal spines, endopodite with 4 dorsal and 5 (sub)distal spines.

Third uropod (fig. 2i): exopodite 2-segmented; distal segment rather short, finger-shaped, armed with some setules. Endopodite overreaching 1st exopodite segment; tip pointed, armed with 1 setule only. Lateral and medial margins of exopodite segm. 1 and of endopodite armed with spines only.

Telson (fig. 7c, d) completely cleft; each lobe pointed-ovate; lateral armature of 2 spines in distal fourth; subdistal armature of 1 or 2 spines and 1 short, thin, plumose seta; medial armature of 2 spines in distal half. Two sensorial setae, implanted on dorsal surface, at about half length of each lobe.

Remarks

The original description of *L. acutus* (see Andres, 1978) is correct in all essentials, but somewhat incomplete. The marked sexual dimorphism was not mentioned, and illustrations of several appendages are lacking (A1, A2, upper lip, mandibular molar, Mx1, Mx2, distal segments of P6 and P7, U1, and U2). Some differences existing between the original and the present descriptions can be explained by the larger size of the specimens examined by us.

The genus *Liagoceradocus* actually comprises 4 remarkably similar species, three from the tropical Indo-Pacific, and one (*L. acutus*) from the warm-temperate Atlantic. The three Indo-Pacific species are *L. pusillus* Barnard, 1965 (in algae, depth 1 m, Ifaluk Atoll, Micronesia), *L. lonomaka* (Barnard, 1977) (lava ponds, Maui, Hawaii), and *L. dentiferus* (Le-doyer, 1982) (reefs of Sarodrano, Madagascar). The Lanzarote taxon, *acutus* , resembles that from Madagascar, *dentiferus*, in the structure of the first maxilla (inner lobe with numerous setae, instead of 9 only as in the Pacific taxa), and of the maxilliped (outer lobe very wide). *L. acutus* differs from *dentiferus* in the tapering, non-lobate condition of the basis of pereiopods 5 to 7.

TAXONOMIC STATUS OF *LIAGOCERADOCUS*

When the genus *Liagoceradocus* was created only some 20 years ago (Barnard, 1965), it was compared with marine genera like *Anelasmopus, Pherusa, Ceradocus,* and *Ceradocopsis.* When its correct affinities (with the *Hadzia* complex of genera) were discovered later, the status of *Liagoceradocus* seesawed between a full genus, a subgenus of *Hadzia*, and a complete synonym of *Hadzia* . This history was briefly reviewed recently by Karaman (1984), who agreed with Ruffo (1982) in considering *Hadzia* a senior synonym of *Liagoceradocus* and *Metahadzia*.

On the other hand, Stock (1983) presented a cladogram of the *Hadzia* complex, in which *Hadzia* is set apart by at least 3 autapomorphous states. This paper was not yet taken into consideration by Karaman (1984) in his review.

With the present material of *Liagoceradocus* at hand, we have found some additional support for the idea that *Liagoceradocus* deserves a distinct status. As the above redescription of *L. acutus* shows, this taxon is apomorphous in several characters not

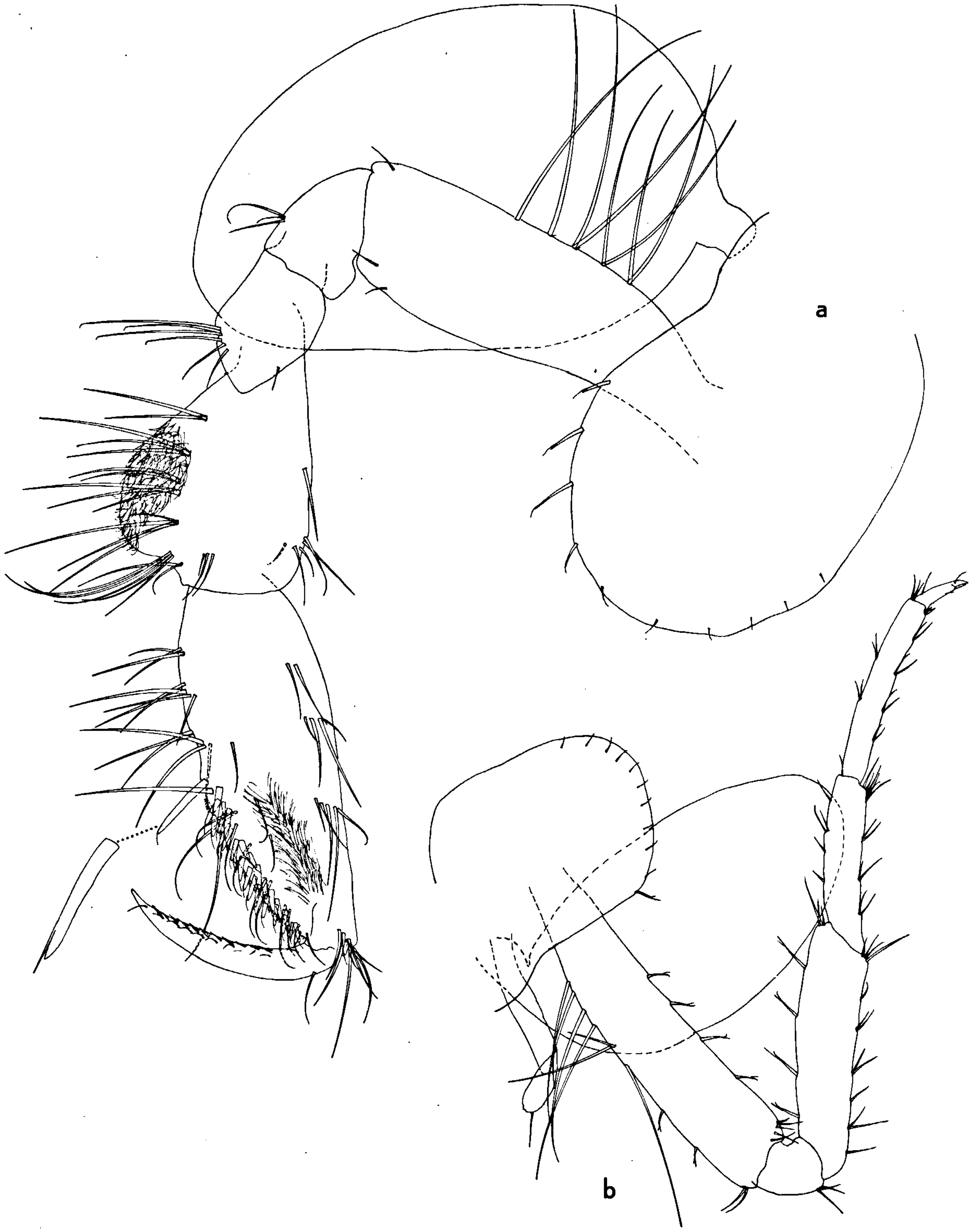

Fig. 4. *Liagoceradocus acutus* Andres, 1978.
a, second gnathopod, ♂ (scale 4); b, third pereiopod, ♀ (2). Scales on fig. 6.

noticed in previous papers: (1) the (syn)apomorphous sexual dimorphism in the length of the palma and the claw of gnathopod 2 (shorter in ♀, longer in ♂); (2) the (aut)apomorphous sexual dimorphism in the armature of the palma of gnathopod 1 (presence of palmar margin spines in ♂); (3) the (aut)-apomorphous widening of the outer lobe of the maxilliped; (4) the absence of plumose setae on both rami of uropod 3 (this feature appears to be an synapomorphous adaptation to a reduced swimming behaviour and an increased crevicular life-style).

Moreover, *L. acutus* is plesiomorphous in relation to other members of the *Hadzia* complex in (5) the presence of spines (instead of setules only) on the palmar margin of gnathopod 2, ♀; (6) the presence of a well-individualized 2nd segment in the accessory flagellum of the first antenna (vestigial of absent in *Hadzia*, the apomorphous state); (7) the presence of dorsolateral spines on urosomites 1 and 2.

The presence of an apicomedial row of spinules on the peduncle of uropod 2 is another peculiarity of *Liagoceradocus* (such a row is not recorded for *Hadzia).* In *Metaniphargus* s. str., a similar row of spinules occurs, and this is considered the plesiomorphous state by Stock (1985: 359).

These observations have induced us to retain *Liagoceradocus* as a distinct genus. Ecological considerations support this opinion: while there cannot be much doubt that *Liagoceradocus* and the *Hadzia* complex have a common marine ancestor, *Liagoceradocus* stayed in marine, meiofaunal and crevicular habitats [eventually penetrating in salty ponds and "marginal caves" (= "Randhöhlen" sensu Riedl, 1966)], whereas *Hadzia* and *Metaniphargus* envolved in brackish anchihaline and freshwater stygohabitats.

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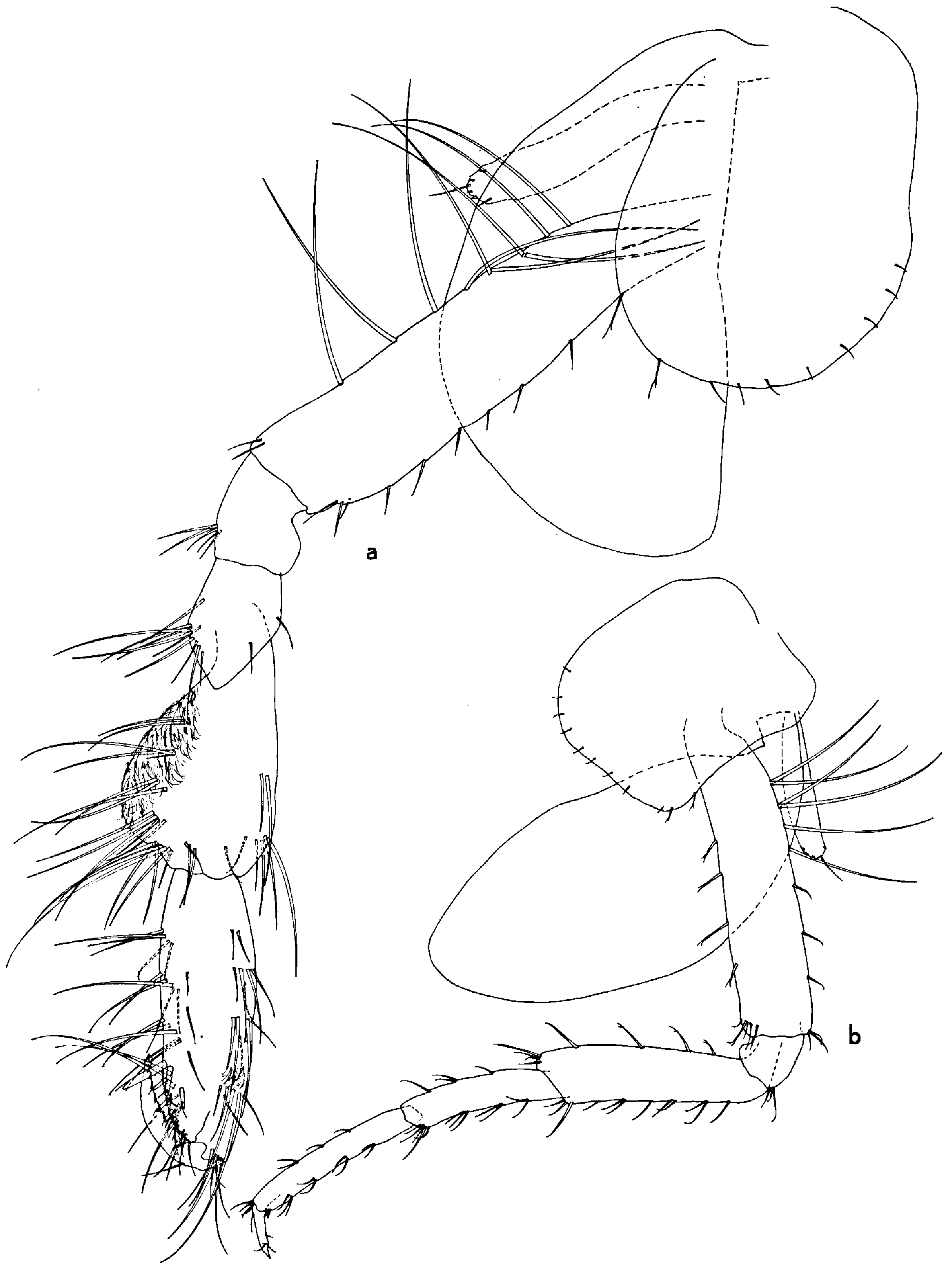

Fig. 5. *Liagoceradocus acutus* Andres, 1978.
a, second gnathopod, ♀ (scale 4); b, fourth pereiopod, ♀ (2). Scales on fig. 6.

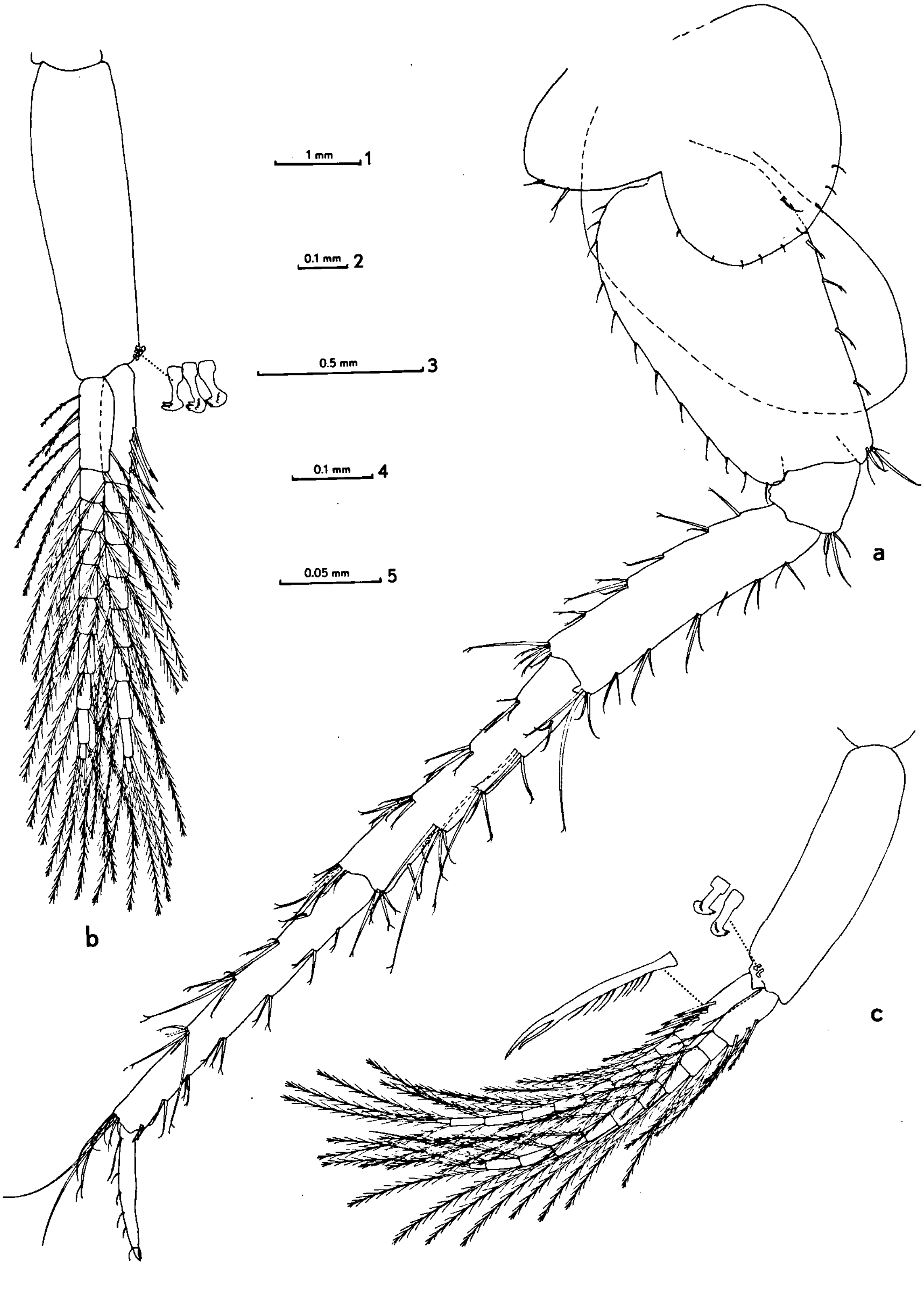

Fig. 6. *Liagoceradocus acutus* Andres, 1978.
a, fifth pereiopod, ♀ (scale 2); b, first pleopod, ♀ (2); c, second pleopod, ♀ (2).

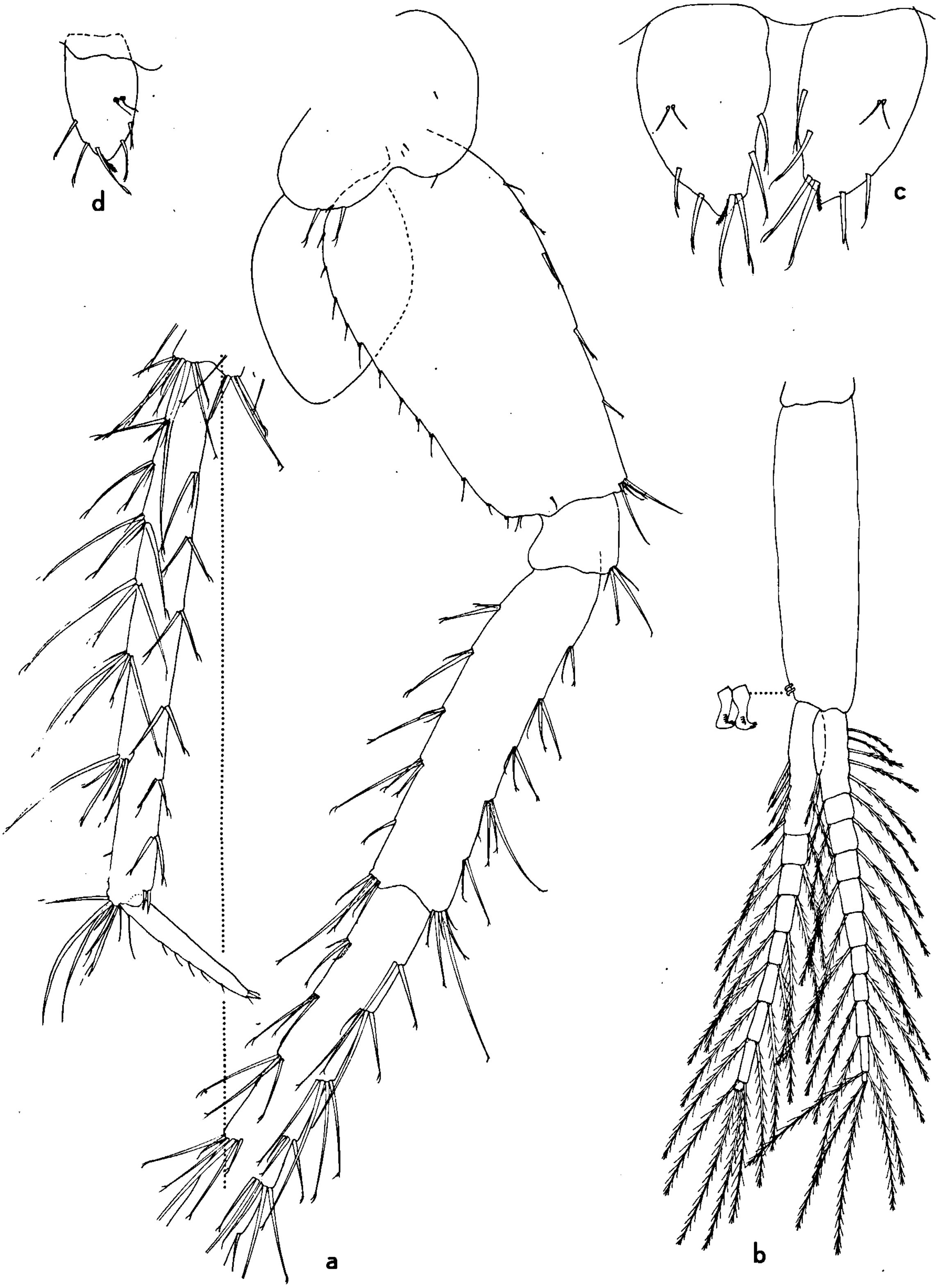

Fig. 7. *Liagoceradocus acutus* Andres, 1978.
a, sixth pereiopod, ♀ (scale 2); b, third pleopod, ♀ (2); c, telson, ♂ (4); d, right telson half, ♀ (2). Scales on fig.

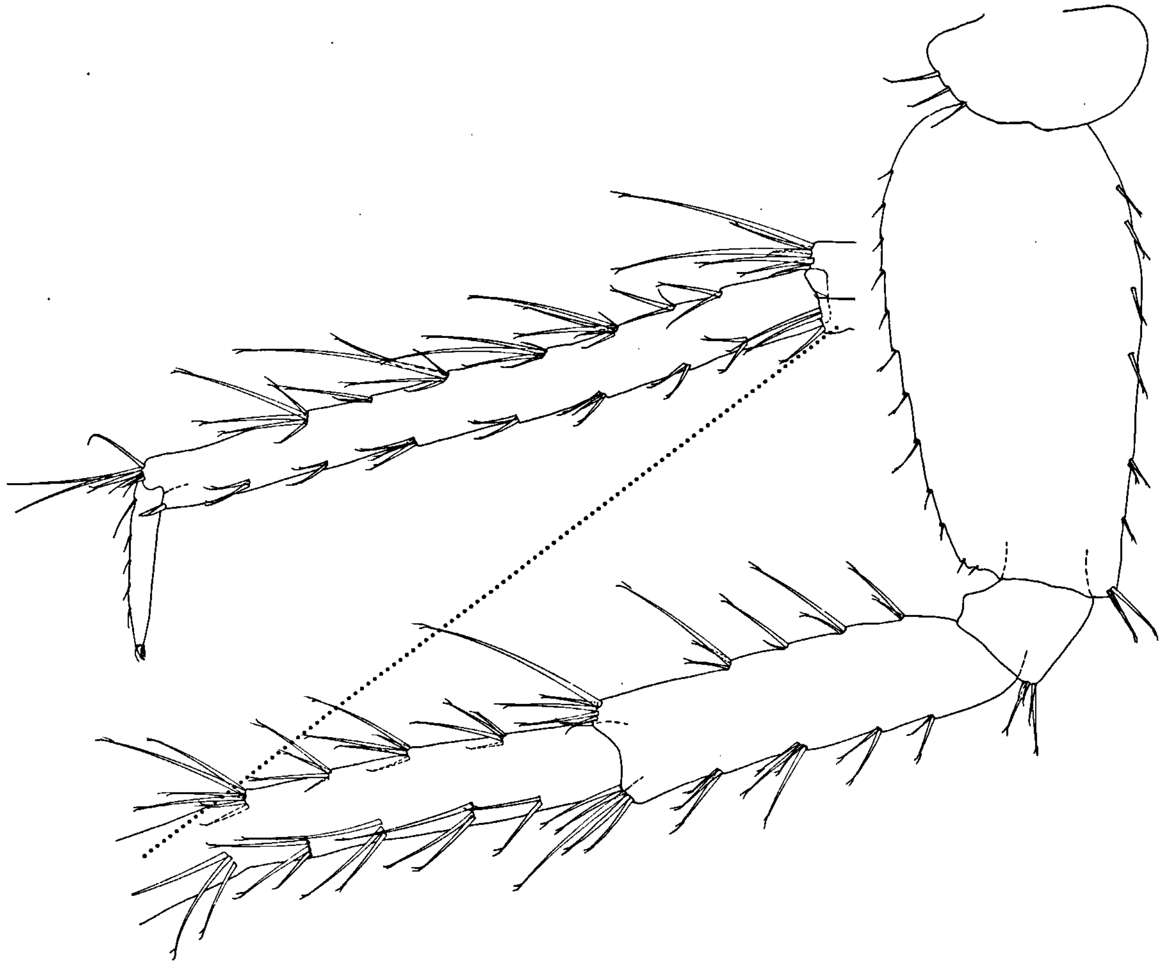

Fig. 8. *Liagoceradocus acutus* Andres, 1978.
Seventh pereiopod, ♀ (scale 2). Scale on fig. 6.