



ARQUIVOS DO MUSEU BOCAGE

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COPEPODS ASSOCIATED WITH MARINE INVERTEBRATES IN THE IBERIAN PENINSULA. I: THE GENUS *ASTERICOLA* Rosoll, 1889 (COPEPODA: LICHOMOLGIDAE). (*)

M. CONRADI (**), P. J. LÓPEZ-GONZÁLEZ (***)

J. I. GONZÁLEZ-GORDILLO (***) y J. C. GARCÍA-GÓMEZ (***)

INTRODUCTION

Compared with the remainder European countries, the fauna of copepods associated with marine invertebrates in the Iberian Peninsula was still unknown.

Strait of Gibraltar is a very interesting area for this kind of studies because of its geographical location.

ROSOLL (1889) described the genus *Astericola* based on the type species, *Astericola clausi* collected on Trieste (Italia), associated with *Marthasterias glacialis* (O. F. MÜLLER). Latter, BOCQUET (1952) described a new species of Atlantic copepods associated to *Asterina gibbosa* (PENNANT). This species was *Lichomolgus asterinae*, which STOCK (1957) included into the genus

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(**) Laboratorio de Biología, Facultad de Ciencias del Mar, Universidad de Cádiz, Apdo. 40, 11510-Puerto Real, CADIZ.

(***) Laboratorio de Biología Marina, Facultad de Biología, Universidad de Sevilla, Apdo. 1095, 41080 — SEVILLA.

Stellicola, after making a close examination of specimens from Banyuls-sur-mer associated with the same host.

BOCQUET & STOCK in 1962 included *Astericola clausi* into the genus *Stellicola*. The possibility of conspecificity between *Stellicola clausi* and *S. asterinae* was raised due to the high similarity of both species. The study of CARTON (1964) about the specificity of these copepods regarding habitual host and the biometric study made by BOCQUET, CARTON & SROEHLICH (1970) point out the existence of two different species.

HUMES & STOCK (1973) considered that these two species were the same.

In this work, we propose the establishment of two different species: *A. clausi* and *A. asterinae*. These species are found for the first time in the Iberian littoral. Male and female specimens of *A. clausi* are described, as well as the morphological differences between this species and *A. asterinae*.

MATERIAL AND METHODS

The starfishes (*Marthasterias glacialis* and *Asterina gibbosa*) were collected on stones from infralittoral zone. They were maintained in separate glass bottles and relaxed with Cl_2Mg and sea water. The sea water was filtered (100 μm), the copepods were separated and preserved in formalin (4% in sea water). The specimens were stained with cotton blue, dissected under a stereomicroscope, and semipermanent mounts were made using lactophenol. All figures have been drawn with the aid of a camera lucida. The letter after each figure explanation refers to the scale at which it was drawn.

Fam. Lichomolgidae KOSSMANN, 1877

Gen. *Astericola* ROSOLL, 1889

Astericola clausi ROSOLL, 1889

Astericola clausii ROSOLL, 1889, pp. 197-201, figs. 7-8.

Astericola clausii GRAEFFE, 1900, p. 9.

Astericola clausii CLARK, 1921, p. 636.

Stellicola clausi BOCQUET & STOCK, 1962, pp. 80-90, figs. 1-4.

Stellicola clausi CARTON, 1964, p. 14 (part.).

Stellicola clausi BAREL & KRAMERS, 1970, table 5.

Stellicola clausi BOCQUET, CARTON & SROEHLICH, 1970, pp. 508-516, fig. 9.

Astericola clausi HUMES & STOCK, 1973, pp. 148-149 (part.).

TYPE MATERIAL: 17 ♀♀ y 7 ♂♂ copepods associated with *Marthasterias glacialis*, 25 metres depth in Crinavis (Algeciras Bay, southern of Spain), May 1991; 3 ♀♀ associated with 3 specimens of *M. glacialis*, 6 metres depth in La Ballenera (Algeciras Bay, southern of Spain), Jun 1991; 10 ♀♀ associated with 3 specimens of *M. glacialis*, 3 metres depth in San García (Algeciras Bay, southern of Spain), July 1991.

FEMALE. Body (Fig. 1a) cyclopiriform, length (not including setae on caudal rami) 1240 μm and greatest width 603 μm , based on 5 specimens in 70% ethyl alcohol. Ratio of length to width of prosome, 1.5:1. Ratio of length to width of prosome 1.5:1. Ratio of length of prosome to that of urosome, 2.3:1.

Segment of leg 5 (Fig. 1b) 90 \times 160 μm . Genital segment wider than long, 182 \times 195 μm . Genital areas located dorsolaterally just posterior to widest part of the segment. Each area (Fig. 1c) with two setae, 25 y 19 μm . Two postgenital segments from anterior to posterior 60, 35, and anal segment 60 μm .

Caudal ramus 60 \times 35 μm , longer than wide. One anterior lateral seta 65 μm and naked. Outer posterior lateral seta 80 μm and naked, dorsal seta 55 μm and naked. Innermost terminal seta 175 μm , and two long median terminal setae 325 μm (outer) and 530 μm (inner). Inner side of caudal ramus convex.

Egg sac elongate, 740 \times 340 μm , not extending beyond tips of longest ramal setae, and containing numerous eggs with about 70 μm in diameter.

First antenna (Fig. 1f) about 402 μm long, lengths of 7 segments (measured along their posterior non setiferous margins) 42 (96 μm along anterior margin), 119, 65, 73, 50, 31 and 19 μm respectively. Formula for armature 4, 10, 4, 3, 2 + 1 aesthete and 7 + 1 aesthete. All setae naked.

Second antenna (Fig. 1e) 3-segmented. First segment 91 μm along its outer edge, 25 μm long its inner edge and 41 μm wider, with a short seta on inner side. Second and third segments, with equal length, 39 μm . Second segment with one only seta while third segment bears 2 setae on outer side, 3 apically setae and 2 pointed claws very unequal, 36 and 13 μm . All elements naked.

Labrum (Fig. 2a), with 2 posteroventral lobes. Posteroventral edge of lobes smooth. Paragnates not observed.

Mandibule (Fig. 2b) with concave side having strong denticles and finishing on lash, convex side with spinules.

First maxilla (Fig. 2c) digitiform, bilobated, with four naked setae: one short (10 μm), two subapically (17, 15 μm), and one long terminal seta (37 μm).

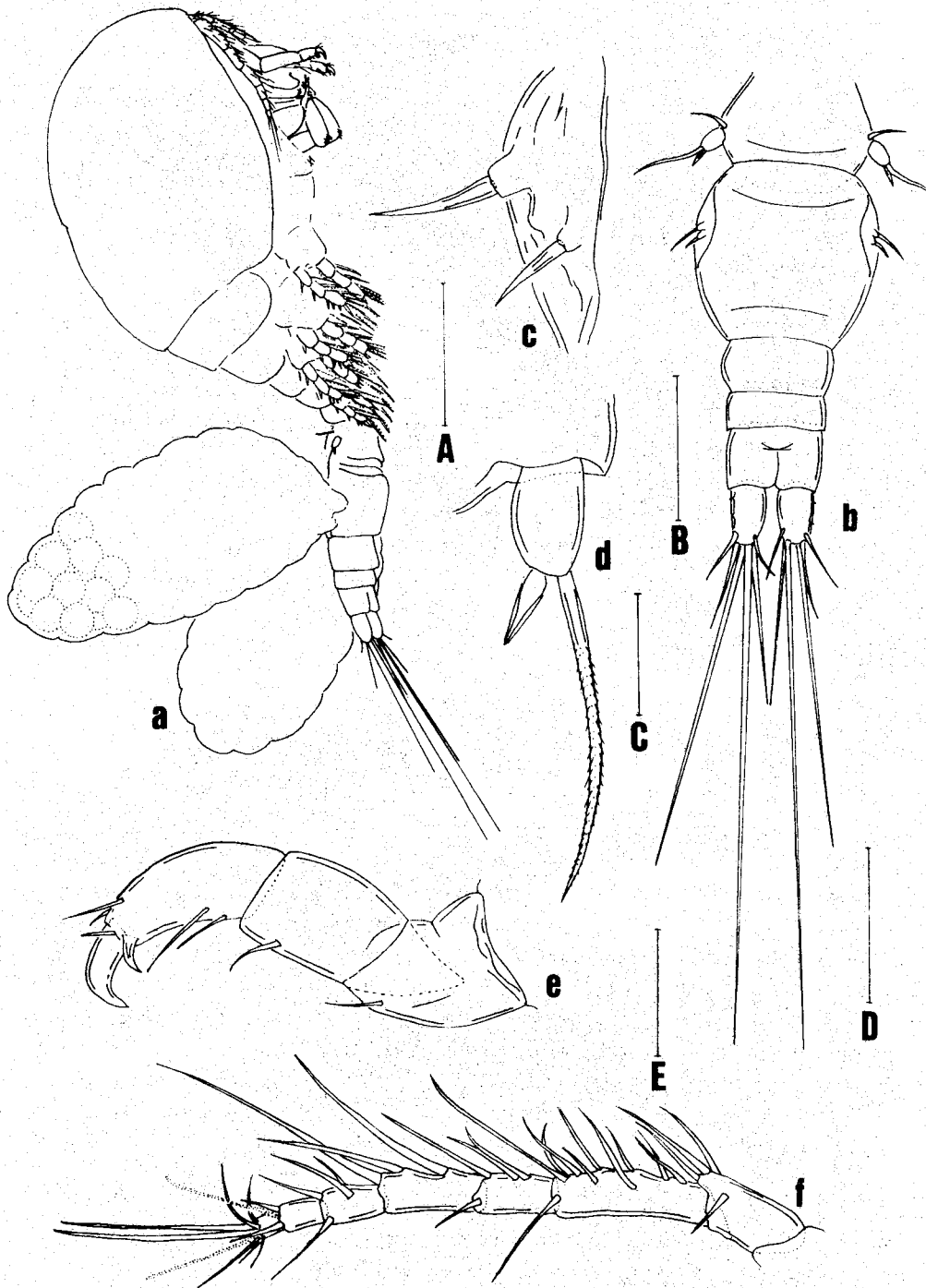


FIG. 1 — *Astericola clausi*, ROSOLL. Female: a, lateral view (A); b, urosome (B); c, genita area (C); d, leg 5 (C); e, second antenna (D); f, first antenna (E). Scales: A, 300 μ m; B, 150 μ m; C, 25 μ m; D, 50 μ m; E, 100 μ m.

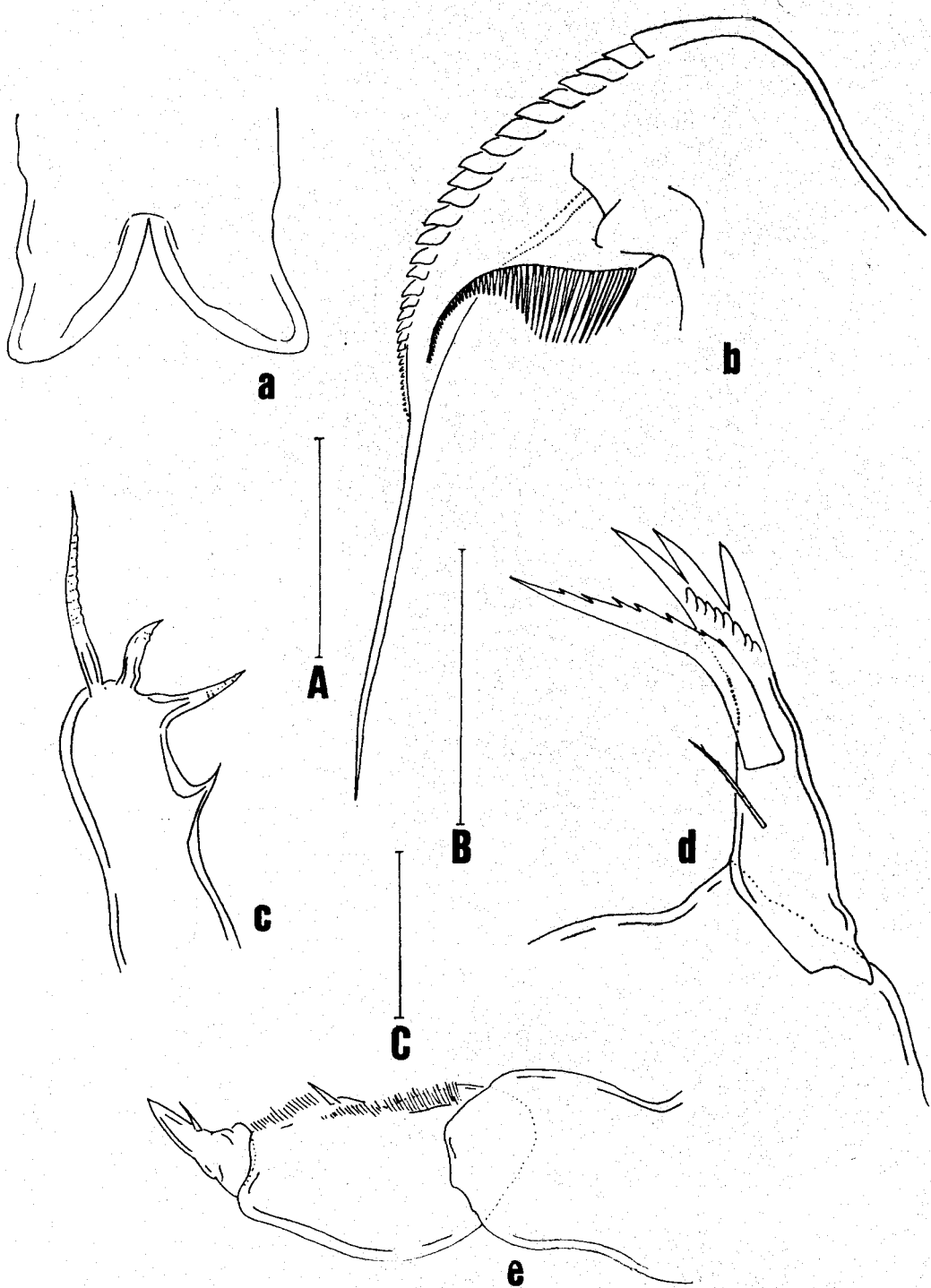


FIG. 2—*Astericola clausi*, ROSOLL. Female: a, labrum (A); b, mandible (B); c, first maxilla (B); d, second maxilla (B); e, maxilliped (C). Scales: A, 100 μ m; B, 50 μ m; C, 50 μ m.

Second maxilla (Fig. 2d), 2-segmented, first segment unarmed. Second segment with three strong denticles which, on its inner edge has a file of 8 small spines more or less overlapped. At the medial portion of the appendage, there is a serrated lobe. Basal portion of second segment with a small seta.

Maxilliped (Fig. 2e) 3-segmented, with first segment unarmed. Second segment with a small seta on inner edge and a row of small setae along all segment. Third segment smallest, with a terminal spiniform process that bears a small seta on inner margin.

Legs 1-4 (Figs. 3a-d) with 3-segmented rami. Formula for armature in Table 1.

Inner coxal setae pinnate.

Leg 5 (Fig. 1d) with free segment longer than wide, $23 \times 15 \mu\text{m}$ with a small spiniform process ($16 \mu\text{m}$) and a long seta naked ($70 \mu\text{m}$). Segment of leg 5 with two small setae, about equal length, $40 \mu\text{m}$.

MALE: Body very similar to that in female. Length (excluding setae on caudal rami) $970 \mu\text{m}$ and greatest width $350 \mu\text{m}$, based on 3 specimens in 70% ethyl alcohol. Ratio of length to width of prosome 1.4:1. Ratio of length of prosome to that of urosome 1.4:1.

TABLE 1 — Armature of legs. (Roman numerals = spines; Arabic numerals = setae; exp = exopod; end = endopod).

Leg	Coxa	Basis	Armature
1st	0-1	1-0	exp: I-0; I-1; III,I,4 end: 0-1; 0-1; I,5
2nd	0-1	1-0	exp: I-0; I-1; III,I,4 end: 0-1; 0-2; III,3
3rd	0-1	1-0	exp: I-0; I-1; III,6 end: 0-1; 0-2; III,2
4th	0-1	1-0	exp: I-0; I-1; II,6 end: 0-1; 0-2; I,2

Segment of leg 5 (Fig. 4b) $60 \times 130 \mu\text{m}$. Genital segment wider than longer, $160 \times 210 \mu\text{m}$. Postgenital segments from anterior to posterior 60, 40, and anal segment $60 \mu\text{m}$.

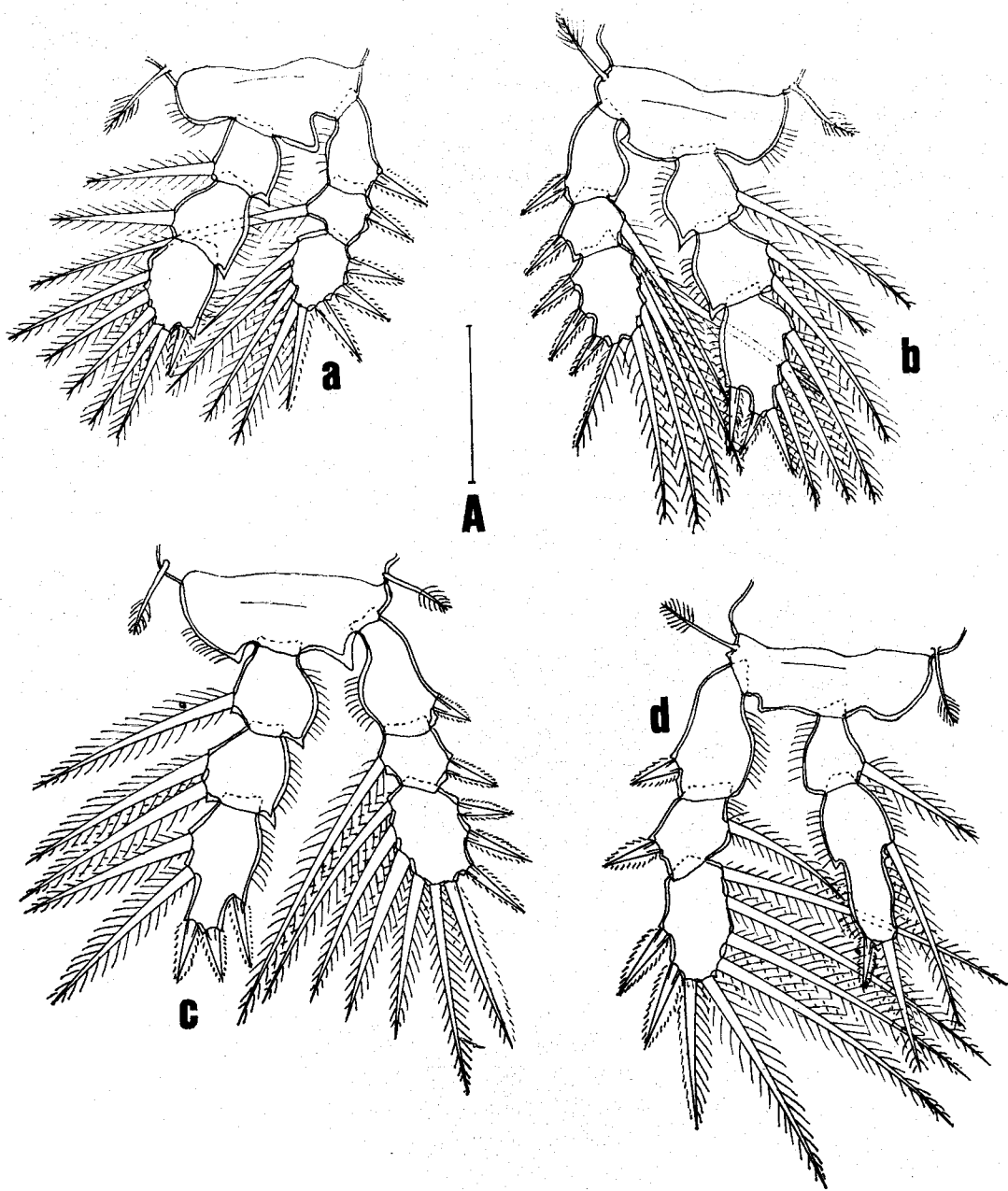


FIG. 3 — *Astericola clausi*, ROSOLL. Female: a, leg 1 (A); b, leg 2 (A); c, leg 3 (A); d, leg 4 (A). Scales: A, 100 μ m.

Caudal ramus resembling that of female, $60 \times 25 \mu\text{m}$.

First antenna (Fig. 4f) with about $327 \mu\text{m}$, similar to that of the female, but without aesthetes.

Second antenna (Fig. 4e) similar to that of the female, but third segment longer ($83 \mu\text{m}$) with two median setae, five apical setae and two unequal claws, with 70 and $50 \mu\text{m}$. The larger one with denticles on inner edge.

Labrum, mandibule (Fig. 5a), first maxilla (Fig. 5b) and second maxilla (Fig. 5b) like those of the female.

Maxilliped (Fig. 5d) 4-segmented, first segment unarmed, second segment with two inner setae. Third segment is long prehensil claw with a long serrated seta and small naked seta on its base.

Legs 1-4 (Fig. 6a-d) with same spinal and setal formula as female.

Leg 5 (Fig. 4c) longer than wide, $30 \times 12 \mu\text{m}$ with spiniform process and external long seta.

Leg 6 (Fig. 4d) consisting of a posteroventral flap on genital segment bearing two unequal setae of $68 \mu\text{m}$ and $38 \mu\text{m}$. These setae are naked.

Astericola asterinae (BOCQUET, 1952)

Lichomolgus asterinae BOCQUET, 1952, pp. 498-501, figs. 1-3.

Stellicola asterinae STOCK, 1960, p. 247.

Stellicola clausi CARTON, 1964, p. 14 (part.).

Stellicola asterinae BOCQUET, CARTON & SROEHLICH, 1970, pp. 500-508, figs. 1-5.

Astericola clausi HUMES & STOCK, 1973, pp. 148-149 (part.).

TYPE MATERIAL: 7 ♂♂ associated with *Asterina gibbosa*, 6 metres depth in La Ballenera (Algeciras Bay, southern Spain), July 1991.

REMARKS: Male of *A. asterinae* is very similar to male of *A. clausi*, but differs in two structures: second maxilla and second antenna.

Second antenna (Fig. 7a) 3-segmented. First and second segments with only one seta on inner margin. Third segment with a seta on inner margin, four apical setae and two very unequal claws.

Second maxilla (Fig. 7b) 2-segmented, with first segment unarmed. Second segment strong finishing in three thick denticles which have at most 8 spines, more or less overlapped on its inner side. At medial portion of appendage there is a serrated lobe. Basal portion of second segment with a small seta.

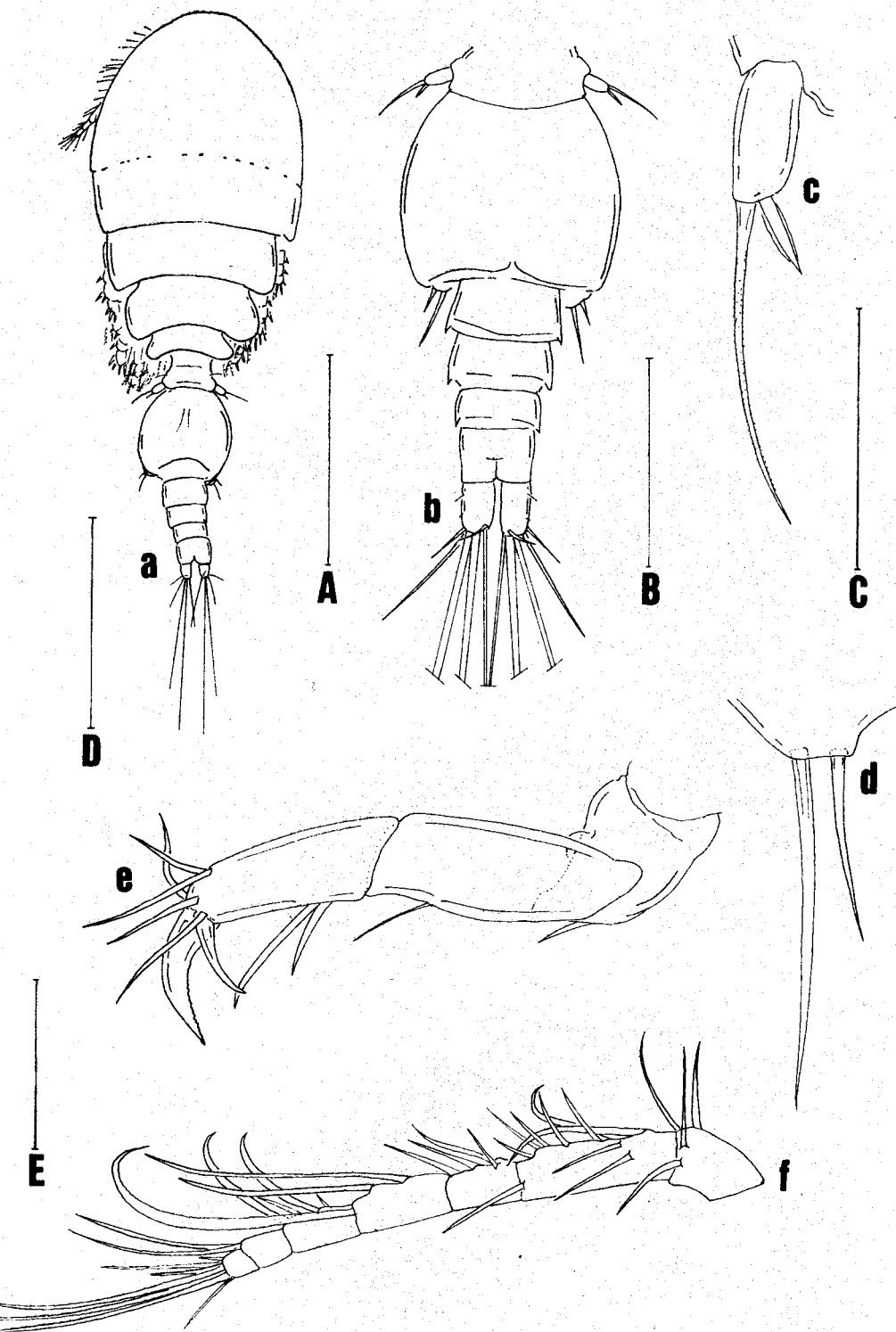


FIG. 4 — *Astericola clausi*, ROSOLL. Male: a, dorsal view (A); b, urosome (B); c, leg 5 (C); d, leg 6 (C); e, second antenna (D); f, first antenna (E). Scales: A, 400 μ m; B, 200 μ m; C, 50 μ m; D, 100 μ m; E, 100 μ m.

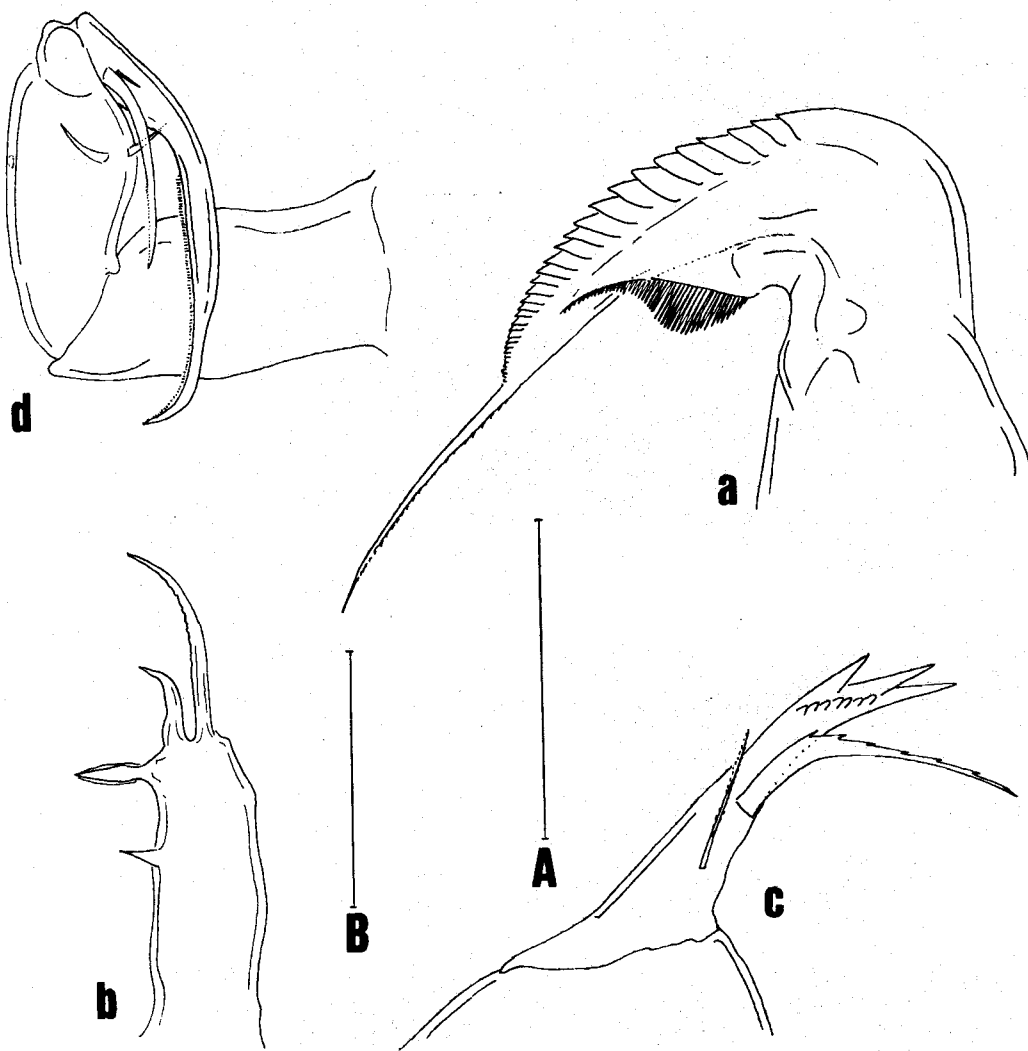


FIG. 5 — *Astericola clausi*, ROSOLL. Male: a, mandible (A); b, first maxilla (A); c, second maxilla (A); d, maxilliped (B). Scales: A, 50 μm ; B, 100 μm .

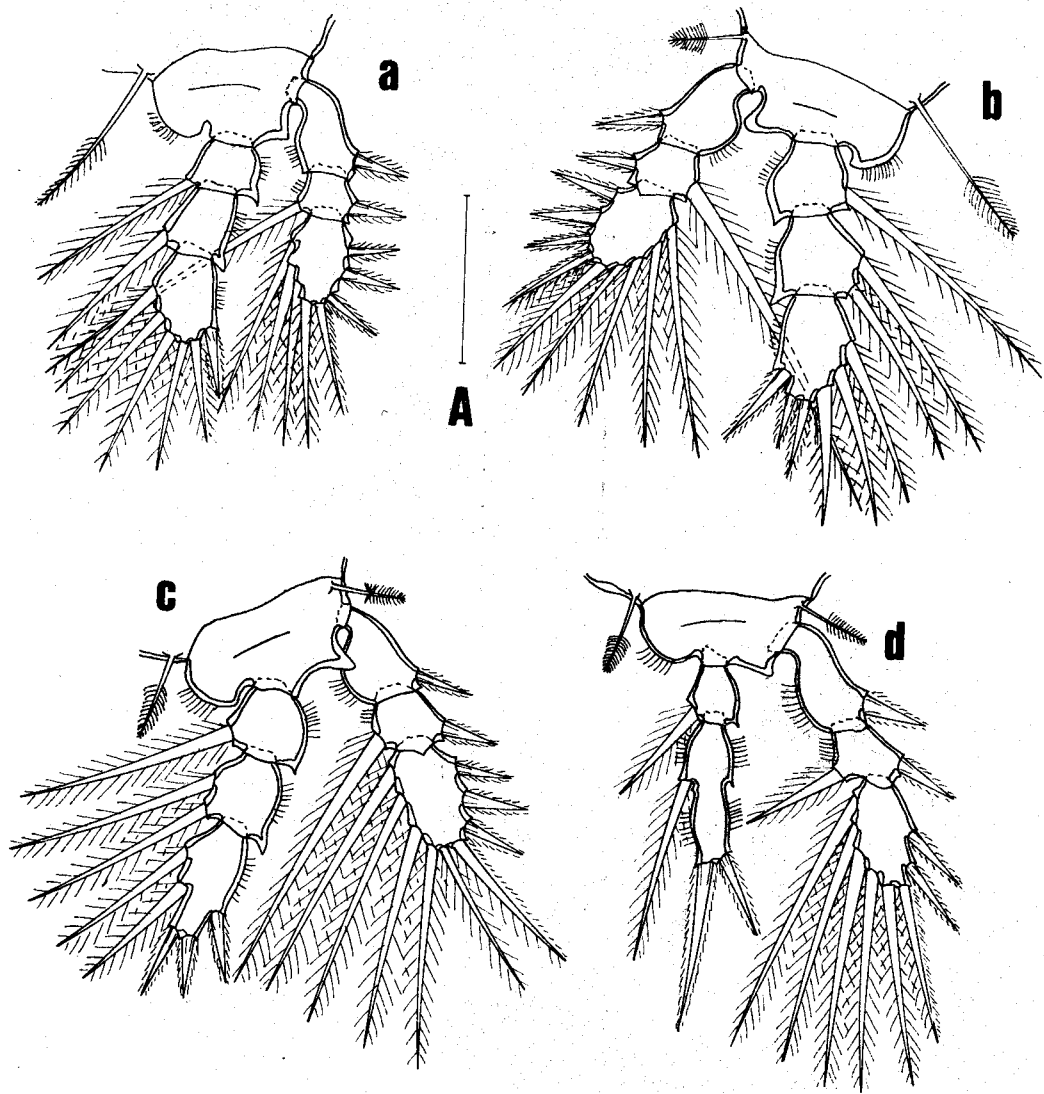


FIG. 6 — *Astericola clausi*, ROSOLL. Male: a, leg 1 (A); b, leg 2 (A); c, leg 3 (A); d, leg 4 (A). Scales: A, 100 μ m.

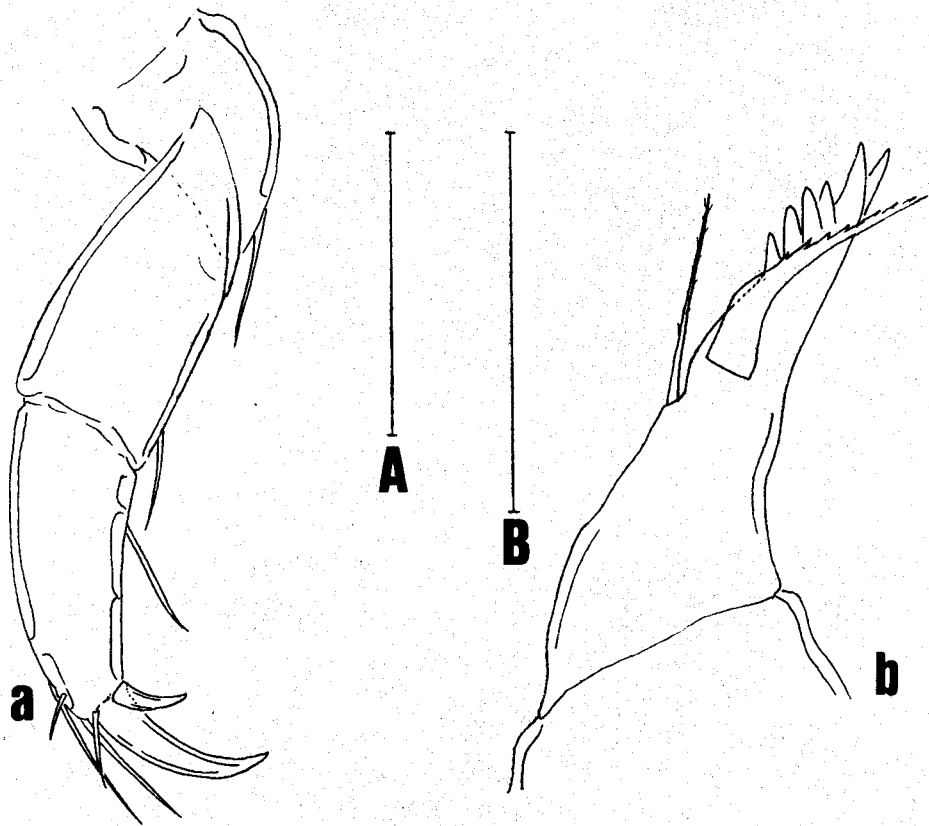


FIG. 7 — *Astericola asterinae*, BOCQUET. Male: a, second antenna (A); b, second maxilla (B). Scales: A, 100 μm ; B, 50 μm .

DISCUSSION

According to BOCQUET & STOCK (1962) there are two species, morphologically very similar showing a few differences related to the length of body, claws of last segment of second antenna, endopodite of leg 4, inner margin of leg 5 and shape of egg sac. However, the number of specimens observed by these authors was not sufficient in order to assure the morphological differences between both species.

CARTON (1964) did some experiences with copepod populations coming from distinct species of asteroids the aim of which was to verify if there are really different parasitic specificity. The outcome demonstrated the existence of a better adaptation, on the part of copepods, to those asteroids corresponding to the original host. The parasitic of *Asterina* are more strict than those of *Marthasterias*.

Some years later BOCQUET, CARTON & SROEHLICH (1970) studied biometrics aspects of both species. These authors regarded *Astericola clausi* and *A. asterinae* as twin species derived from a common ancestor. They established significant differences between both ones on basis of: Length of body, length of egg sac, diameter of eggs, endopod of leg 4, setae of leg 5, third segment of second antenna and second maxilla. Finally, HUMES & STOCK (1973) considered both species as the only one *Astericola clausi* ROSSOLL, 1889.

The differences concerning the two species of the genus *Astericola* from the Iberian Peninsula are fundamentally based on the average dimensions of the specimens and the structure of specific appendages in the male. Claws of last segment of the second antenna and the form of the second maxilla of the male, is very important due to the overlapping of body dimensions of the specimens of both species. Male of *A. clausi* has two unequal claws of last segment of the second antenna, with ratio between the major and minor lengths of the claws being 1.5:1. Inner margin of the major claw is crenulate and the minor claw smooth. In *A. asterinae*, the hooks are very unequal, the ratio between these claws is 2.4:1. Inner margin of both claws are smooth and minor claw is more strong and short than *A. clausi*. Last segment of second maxilla of the genus *Astericola* has an inner margin with some spines that in *A. clausi* ranges from 6 to 8 and in *A. asterinae* from 4 to 6.

In our opinion, these observations, together with the parasitic behaviour studied by CARTON (1964), support the separation of both species.

RESUMEN

Astericola clausi ROSOLL, 1889 y *A. asterinae* (BOCQUET, 1952) son encontradas por primera vez en el litoral ibérico. Tanto la hembra como el macho de *A. clausi* son descritos, y se muestran aquellos caracteres morfológicos de *A. asterinae* que diferencian ésta de la primera especie. Se revisa la problemática establecida por diferentes autores sobre la posible coespecificidad de éstas.

SUMMARY

Astericola clausi ROSOLL, 1889 and *A. asterinae* (BOCQUET, 1952) are found for the first time in the Iberian littoral. Both female and male of *A. clausi* are described, as well as the morphological differences between *A. asterinae* and the former species. In this work, the possible conspecificity of *A. clausi* and *A. asterinae* is revised according to different authors.

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