

A new cavehopper (Amphipoda: Talitridae) from lava tubes in La Palma, Canary Islands

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Only two cavernicolous talitrids were known from the entire world. A third species, belonging to a new genus, discovered in lava caves of the island of La Palma (Canary Islands) is described herein. Cave adaptations consist of lack of body pigments, small and partly depigmented eyes, and great elongation of the appendages. This amphipod is the fifth terrestrial troglobite described from La Palma; twelve other obligatory cavernicoles, partly undescribed, are also known from the island.

En todo el mundo sólo se conocían dos talitridos troglobios, pero recientemente se descubrió en los tubos volcánicos de La Palma (Islas Canarias), una tercera especie perteneciente a un género nuevo. Sus adaptaciones a la vida subterránea consisten en una carencia de pigmento corporal, los ojos son pequeños y están parcialmente despigmentados, y los apéndices están alargados. Este anfípodo es el quinto troglobio que se describe de la isla de La Palma, donde en la actualidad se conocen otros doce cavernícolas obligados.

KEYWORDS: Troglobites, Talitridae, *Palmorchestia*, La Palma, Canary Islands.

Introduction

The Talitridae comprise both littoral (beach fleas, etc.) and terrestrial taxa (landhoppers). Although taxonomically less studied than the beach fleas, the landhoppers form a diversified group, especially in tropical regions. Cavernicolous taxa (cavehoppers), however, are very rare: only two members of the family have been recorded from caves and both show certain morphological adaptations to subterranean life: *Orchestia remyi* Schellenberg, 1950 (a microphthalmous species from Corsica), and *Spelaeorchestia koloana* Bousfield & Howarth, 1976 (a blind species from Hawaii) (Ruffo, 1986).

The Canary Islands form one of the better explored areas in the world so far as talitrids are concerned (Chevreux, 1888, 1900; Dahl, 1950, 1967; Andersson, 1962). Therefore, it came as a surprise that sampling by the speleological team of the second author yielded a new, microphthalmous cavehopper from Isla de la Palma. This cavehopper looked superficially like a *Spelaeorchestia*, but the structure of the mouthparts, in particular the maxillipeds, showed that it is more closely related to the supralittoral and forest genus *Orchestia*. It differs from *Orchestia* in several apomorphic characters, such as the neotenic structure of the second gnathopods, the reduced size and armature of the oostegites, and the complete absence of both rami in the

pleopods. Therefore, the Canarian taxon is considered to be a representative of a new genus, erected below: *Palmorchestia*.

***Palmorchestia* n. gen.**

Diagnosis: Talitridae. Antenna 1 reaching to $\frac{1}{4}$ of peduncle segment 5 of antenna 2. Antenna 2 not sexually dimorphic. Buccal mass prognathous. Left lacinia mobilis 4-dentate. Maxillipedal palp segment 2 strongly lobate on medial margin; segments 3 and 4 fused. Outer plate of maxilliped with membranous lobe distally, armature subterminal. First gnathopod subchelate, with slight sexual dimorphism in palmar length. Other legs without important sexual dimorphism. Propodus of gnathopod 2 mitten-shaped. Hind margin of coxal plates 2 to 4 with cusp. Oostegites very small, armed with some minute distal spinules, linear on gnathopod 2, and pereopods 3 and 4, somewhat ovate on pereopod 5. No (or slight) differences in shape and length of segments of pereopods 3 and 4. Pereopods 3 to 7 cuspidactylate. Pleopods 1 to 3 consisting of peduncle only (rami absent); 1 or 2 minute, anchor-shaped retinacula; otherwise, peduncle practically unarmed. Uropods 1 and 2 elongate, both rami with marginal spines.

Type-species: *Palmorchestia hypogaea* n.sp.

Derivatio nominis: The name of the new genus is a contraction of La Palma and *Orchestia*; the specific epithet alludes to the subterranean mode of life of the type-species.

Remarks: The diagnosis of the new genus is based on the cavehopper described below and on an undescribed forest-dweller, likewise from La Palma, which is still under study.

In some respects, the type-species *P. hypogaea* bridges the gap between two of Bousfield's major groups (1982), the 'beach fleas' and the 'cuspidactylate landhoppers'. With the former group, *P. hypogaea* agrees in the possession of a lobate maxillipedal palp and in the relative size of the coxal gills (gills 2 and 6 larger than 3 to 5), with the latter in the shape of the coxal gills (convoluted or bilobed), the mitten-shaped second gnathopod, and the unmodified dactylus of the fourth pereopod.

The new genus shows some resemblance to *Spelaeorchestia* Bousfield & Howarth, 1976, known from lava tubes in Hawaii. Points of similarity are in the morphology of gnathopod 1, the elongation of pereopods 6 and 7, the deep, prognathous buccal mass, the reductions in the pleopods, the mitten-shaped propodus of gnathopod 2 ♂, the bilobed coxal gill on pereopod 5, the reduced broodplates, and the cuspidactylate pereopods†.

Spelaeorchestia differs from *Palmorchestia* in the absence of a medial lobe on maxillipedal palp segment 2, the presence of an articulated 4th segment in the same palp, the non-lobate outer plate of the maxilliped which bears marginal (not submarginal) armature, the absence of marginal armature on the exopodite of uropod 1, the bidentate condition of the left lacinia mobilis‡.

Another landhopper that is more or less similar to *Palmorchestia* is the Australian genus *Austrotroides* Friend, 1982. The most pronounced difference between the two

† The figures in the publication of Bousfield & Howarth do not show this feature, but Bousfield, 1984: 186 includes *Spelaeorchestia* in the cuspidactylate group.

‡ The original description says bidentate, but Bousfield, 1984, includes in in the quadridentate group.

genera being the simplidactylate condition of the pereopods of *Austrotroides* (according to Bousfield, 1984: 186).

Finally, a certain resemblance to the genus *Talitroides* Bonnier, 1898 should be stressed. This genus is represented on the Canary Islands, including the island of La Palma (pers. obs.), by the widely distributed species *T. alluadi* (Chevreux, 1901). As in *Palmorchestia*, the pereopods of *Talitroides* are cuspidactylate, and the outer plate of the maxilliped is lobate and provided with subterminal armature. However, in *Talitroides* the maxillipedal palp is non-lobate, pleopods 1 and 2 possess long rami, the exopodite of uropods 1 and 2 is devoid of marginal armature, and the oostegites are setose.

***Palmorchestia hypogaea* n. sp.**

Material examined: All from lava caves in Isla de la Palma, Canary Islands.

1 ♀ (HOLOTYPE), 1 ♂ (ALLOTYPE), 3 PARATYPES; Cueva de Tacande at Tacande de Arriba (municipality El Paso); Universal Transverse Mercator grid (UTM) coordinates BS 186 715; altitude 650 m; length of lava tunnel 70 m; 16 Nov. 1986; collection GIET of the Departamento de Biología Animal (Zoología), Universidad de La Laguna (DZUL); 6 paratypes (9 July 1986, Zoologisch Museum, Amsterdam, ZMA Amph. 108.263a) and 3 paratypes (27 Aug. 1986, ZMA Amph. 108.263b) all from the type-locality. Accompanying troglobites: *Loboptera fortunata* Krauss (Blattidae), *Licinopsis angustula* Machado (Carabidae), *Lithobius* sp. (Chilopoda).

2 specimens; Cueva de los Franceses at Los Franceses (mun. Garafia); UTM coord. BS 217 922; alt. 400 m; length of cave 250 m; 2 Sep. 1986; ZMA Amph. 108.264. This is a single longitudinal lava tube, recently discovered while constructing the foundations of a house; walls and roof completely covered with clay; amphipods found some 200 m from the entrance. Accompanying troglobites: *Domene* sp. (Staphylinidae) and *Paralimosina* sp. (Sphaeroceridae).

4 specimens; Cueva los Arreboles at Montaña Arreboles (mun. Fuencaliente); UTM coord. BS 223 569; alt. 1000 m; length of cave 70 m; 28 Aug. 1986; ZMA Amph. 108. 265. This is a typical volcanic tube, rather young judging from the absence of terrigenous deposits in the cave. Accompanying troglobites: *Loboptera fortunata*, *Licinopsis angustula*, *Domene* sp., *Paralimosina* sp., and *Lithobius* sp.

4 specimens; Cueva del Ratón at El Faro (mun. Fuencaliente); UTM coord. BS 223 520; alt. 200 m; length of cave 250 m; 2 Sep. 1986; ZMA Amph. 108.267. This is a volcanic tube developed in very recent lava flows, viz. of the eruption of 1677. The amphipods were taken at some distance from the entrance (at least 150 to 200 m). Accompanying troglobites: *Loboptera fortunata*, *Licinopsis angustula*, *Dysdera* sp. (Dysderidae).

3 specimens (17 Aug. 1986) and 3 specimens (11 Sep. 1986); Cueva de los Palmeros at Las Indias (mun. Fuencaliente); UTM coord. BS 208559; alt. 650 m; length of cave 200 m; ZMA Amph. 108.268. This is volcanic tube with abundant terrigenous deposits. Accompanying troglobites: *Loboptera fortunata*, *Licinopsis angustula*, *Apteranopsis* sp. (Staphylinidae), *Dysdera* sp., *Paralimosina* sp.

1 specimen (10 July 1986) and 1 specimen (27 Aug. 1986); Cueva de Barros (or: del Barrial) at Los Barros (mun. Los Llanos de Aridane); UTM coord. BS 166 753; alt. 800 m; length of cave 50 m; ZMA Amph. 108.269. A small and narrow lava tube, entirely devoid of mud. Accompanying troglobites *Loboptera fortunata*, Curculionidae gen. sp. (Coleoptera).

In all localities the cavehoppers inhabit the most humid zones of the cave

(saturation 85–100%), often characterized by the development of a haze of condensed water droplets. In several caves roots penetrate the cave roof. The amphipods live in total darkness, at temperatures fluctuating between 13°C (in the Cueva los Arreboles) and 22°C (in the Cueva del Ratón and the Cueva de Barros).

Description: Body length (♂, ♀) of adults 9–11.5 mm. Colour pale-ivory. Eye very small, circular in some specimens (Fig. 1a), crescent-shaped (through reduction of the lower half of the eye, Fig. 1b) in others, or almost absent. Ocelli in various states of depigmentation (Fig. 1b).

Appendages, in particular second antenna, pereopods 5 to 7, uropods 1 and 2, elongate and slender (Fig. 1a).

First antenna (Fig. 4a) reaching to about $\frac{1}{4}$ of peduncle segment 5 of second antenna. Peduncle segment 1 shortest, segment 3 longest. Flagellum 7-segmented; segments 1 to 6 with several setae and 2 or 3 short, unstalked aesthetascs distally (Fig. 1f); distal segment small, with 4 terminal setae.

Second antenna (Fig. 1c) not sexually dimorphic. Peduncle segment 5 very elongate (about 10 × as long as its diameter). Flagellum 24-segmented (large ♀) or 26-segmented (large ♂); setules on flagellar articles fairly long.

Upper lip (Fig. 1d) parallel-sided, free margin regularly rounded.

Left and right mandible (Fig. 2a) with plumose molar seta. Molar flake represented by bunch of short, plumose setae. Pars incisiva heavy, with 5 teeth. Left lacinia mobilis (Fig. 2b) with 4 coarse teeth, right lacinia (Fig. 2a) bicuspidate, each cusp with numerous fine crenulations.

Lower lip (Fig. 1e) without inner lobes.

First maxilla (Fig. 2c) with minute, 2-segmented palp. Outer lobe with 9 distal spines, bearing 3, 3, 4, 4, 5, 4, 3, 3, and 3 medial teeth, respectively. Inner lobe finger-shaped, narrow, with 2 distal spines.

Second maxilla (Fig. 2d): Each lobe distally with 2 rows of obtuse-tipped setae.

Maxilliped (Fig. 2e): Palp segment 1 with small mediobasal lobe, segment 2 with large mediobasal lobe; segments 3 and 4 fused. Outer plate with membranous distal lobe, 2 rows of setae implanted subterminally, at base of lobe. Inner plate with 3 broadly triangular distal spines, 3 short distal setae, and a subapical row of setae.

Gnathopod 2 (Fig. 4b–d) practically without sexual dimorphism (carpus of ♀ may than basal diameter of claw, smaller than that diameter in ♀. One or 2 palmar angle spines.

Gnathopod 2 (Fig. 4b–d) practically without sexual dimorphism (carpus of ♀ may be slightly shorter than in ♂). Propodus mitten-shaped, distal end produced into rounded 'cushion'; claw very short.

Coxal gills on gnathopod 2 and pereopods 3 through 6; large and somewhat convolved on gnathopod 2 and pereopod 6; small and somewhat convolved on pereopods 3 and 4; small and bilobate on pereopod 5. Oostegites very small (not extending below lower margin of coxal plates), linear and armed with 3 to 5 minute distal spinules on gnathopod 2 and pereopods 3 and 4; small and elongate-ovate, armed with 2 minute spinules, on pereopod 5.

Coxal plates 2 to 4 with posterior cusp; plate 5 bilobate, anterior lobe wider but not deeper than posterior lobe; plate 6 posterolobate; plate 7 non-lobate.

Pereopods 3 and 4 (Fig. 5a–d) similar. Claw of pereopod 4 unnotched. Claw of pereopods 3 to 7 with 2 small cusps on distal end of dactylus; dactylus slender, especially in pereopods 5 to 7 (Figs 6b, 6e, 7b); unguis slender, especially in pereopods 3 and 4.

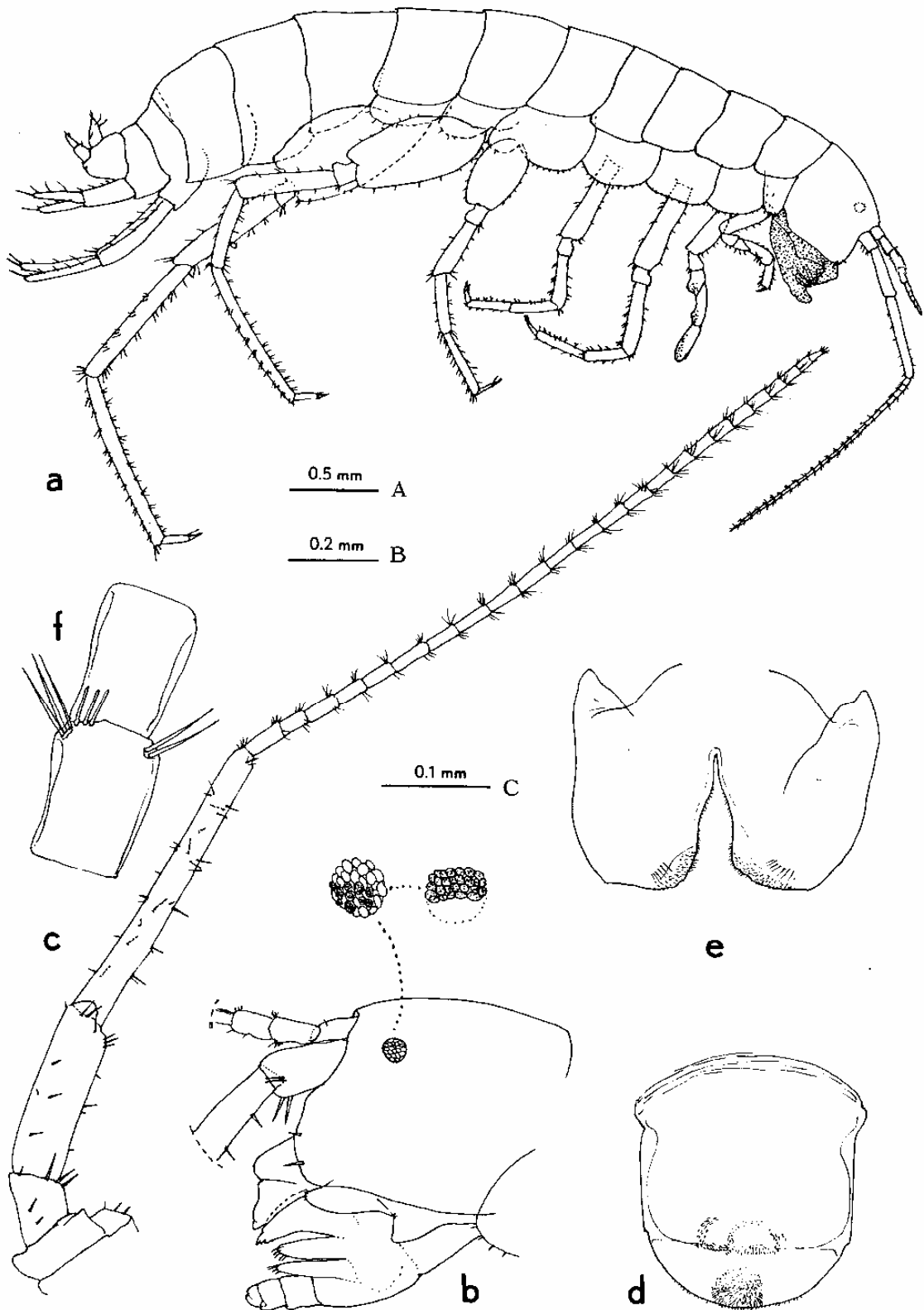


FIG. 1. *Palmorchestia hypogaea* n. gen., n. sp. (paratypes). a, male, form the right (actual size 11 mm); b, head, ♀, from the left (scale A), different eye types (with partly depigmented ocelli) more strongly enlarged; c, second antenna, ♀ (A); d, upper lip, ♀ (B); e, lower lip, ♀ (B); f, detail of flagellum of first antenna, ♀, showing the acesthescs (C).

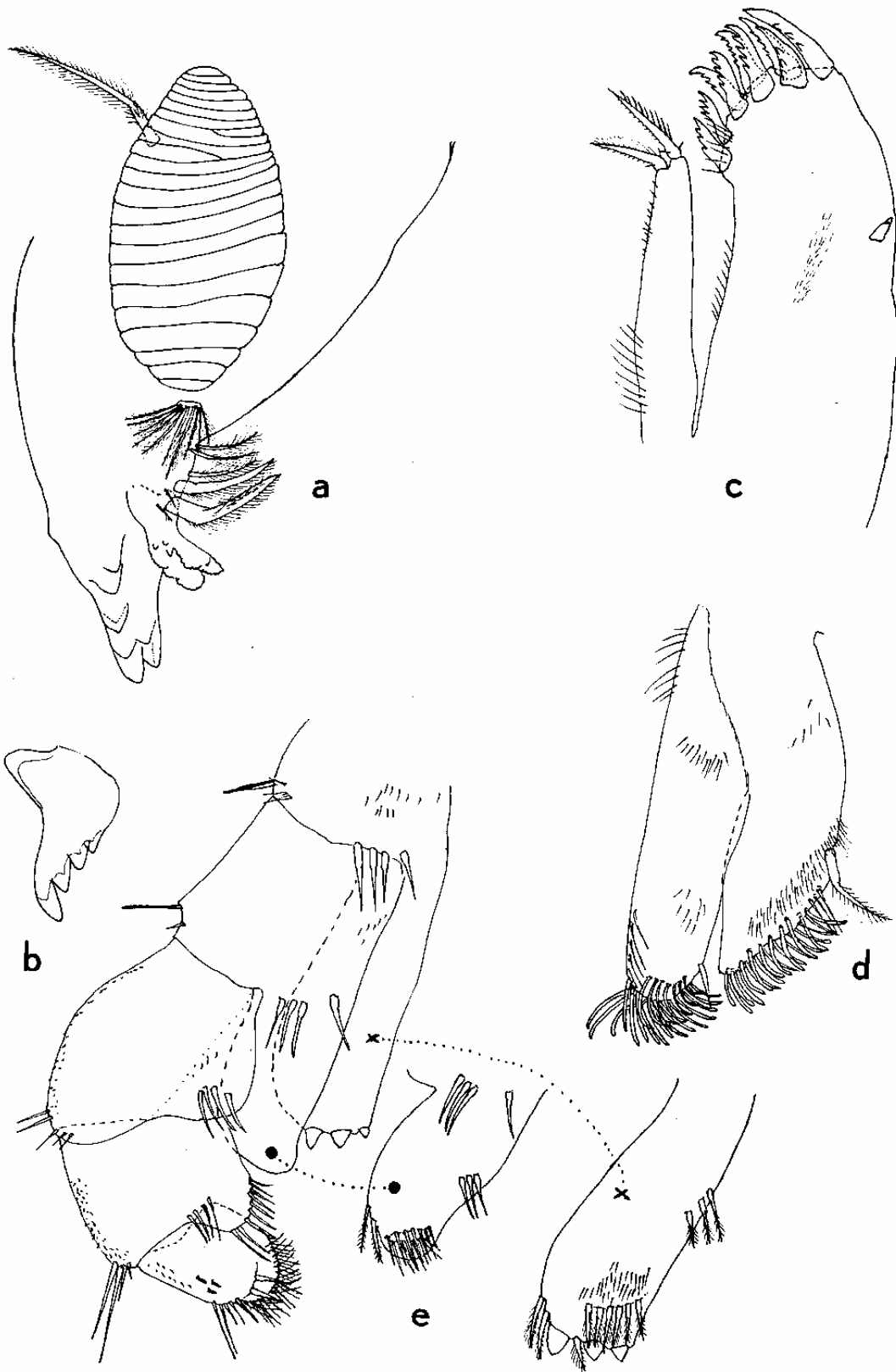


FIG. 2. *Palmorchestia hypogaea* n. gen., n. sp. (paratype). a, right mandible, ♀; b, left lacinia mobilis, ♀; c, first maxilla, ♀; d, second maxilla, ♀. All scale C (scale on Fig. 1).

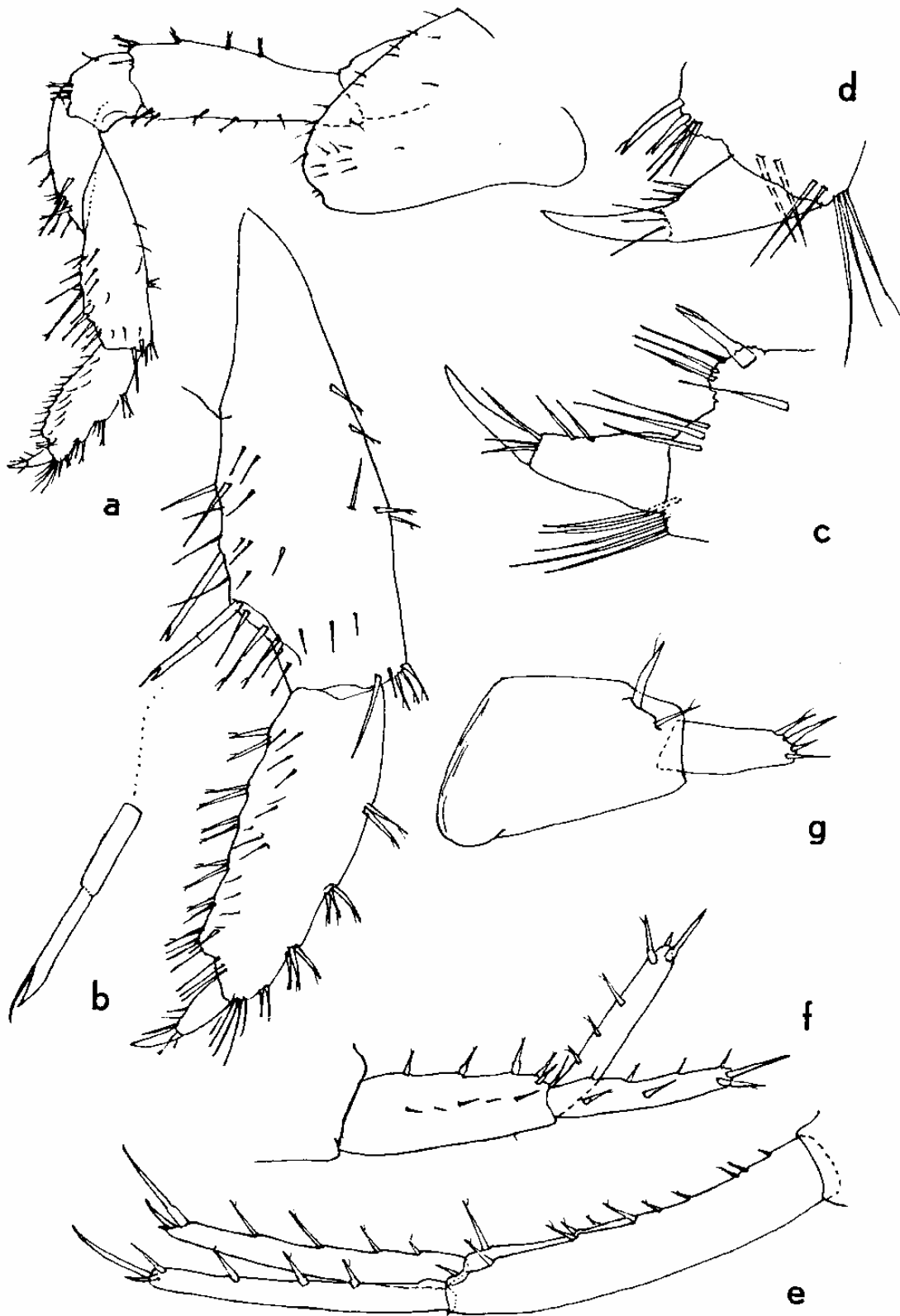


FIG. 3. *Palmorchestia hypogaea* n. gen., n. sp. (paratypes). a, first gnathopod, ♂ (scale D); b, distal segments of same (E); c, palma of first gnathopod, ♂ (F); d, ditto of ♀ (F); e, first uropod, ♀ (D); f, second uropod, ♀ (D); g, third uropod, ♀ (E). Scales D and E on Fig. 4, scale F on Fig. 5.

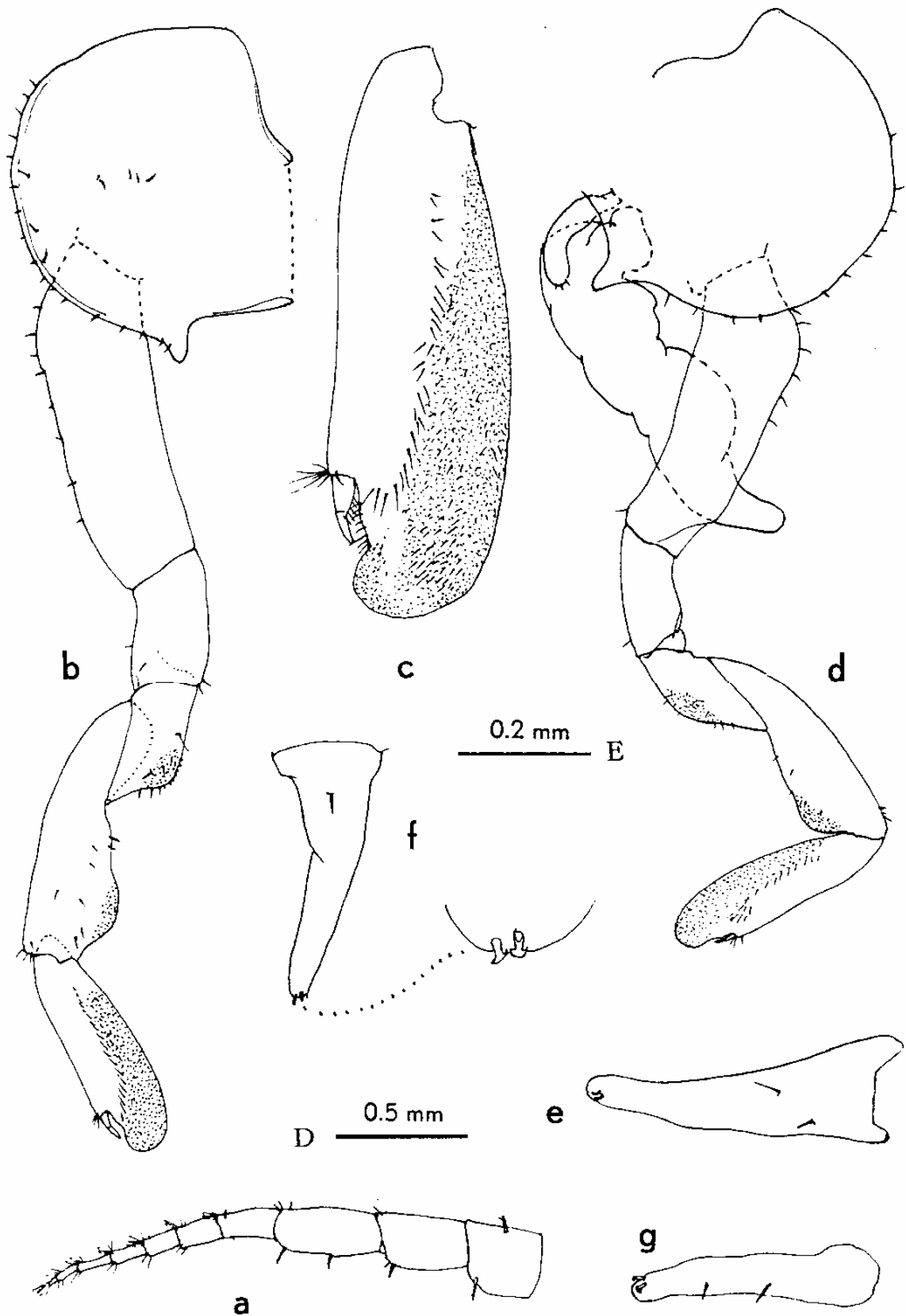


FIG. 4. *Palmorchestia hypogaea* n. gen., n. sp. (paratypes). a, first antenna, ♀ (scale D); b, second gnathopod, ♂ (D); c, propodus of second gnathopod, ♂ (E); d, second gnathopod, ♀ (D); e, first pleopod, ♀ (E); f, second pleopod, ♀ (E), retinacula more strongly enlarged; g, third pleopod, ♀ (E).

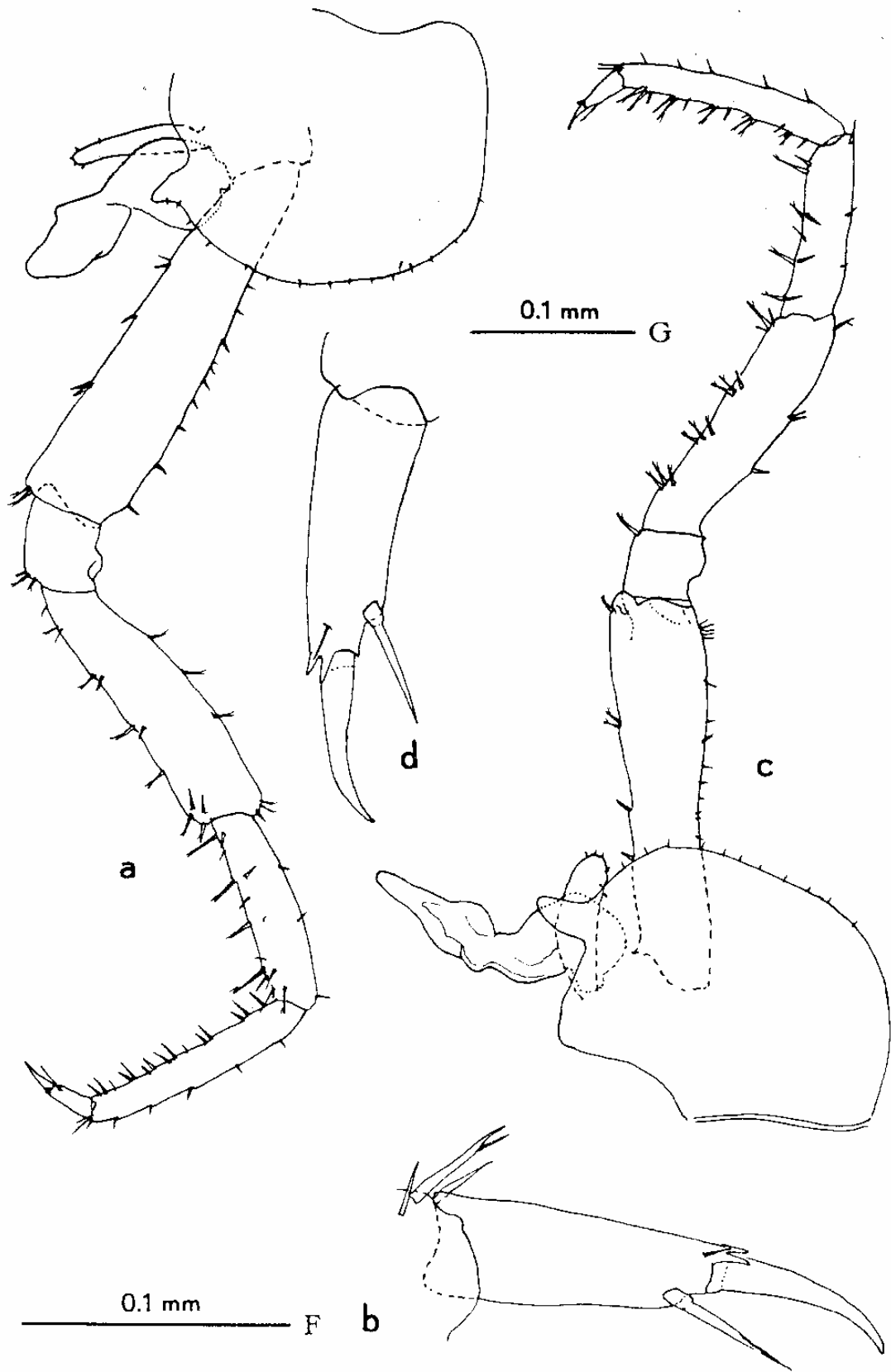


FIG. 5. *Palmorchestia hypogaea* n. gen., n. sp. (paratype). a, third pereiopod, ♀ (scale D); b, claw of same (G); c, fourth pereiopod, ♀ (D); d, claw of same (G). Scale D on Fig. 4.

Basis of pereiopods 5 to 7 (Figs 6a, 6d, 7a) slightly tapering, posterodistal lobe small, rounded (P5, P6) or angular (P7); posterior margin of ♀ with slightly fewer setules than in ♂ (figs. 6c, 6f, 7c). P5 < P6 < P7. Distal segments in particular propodus, very elongate.

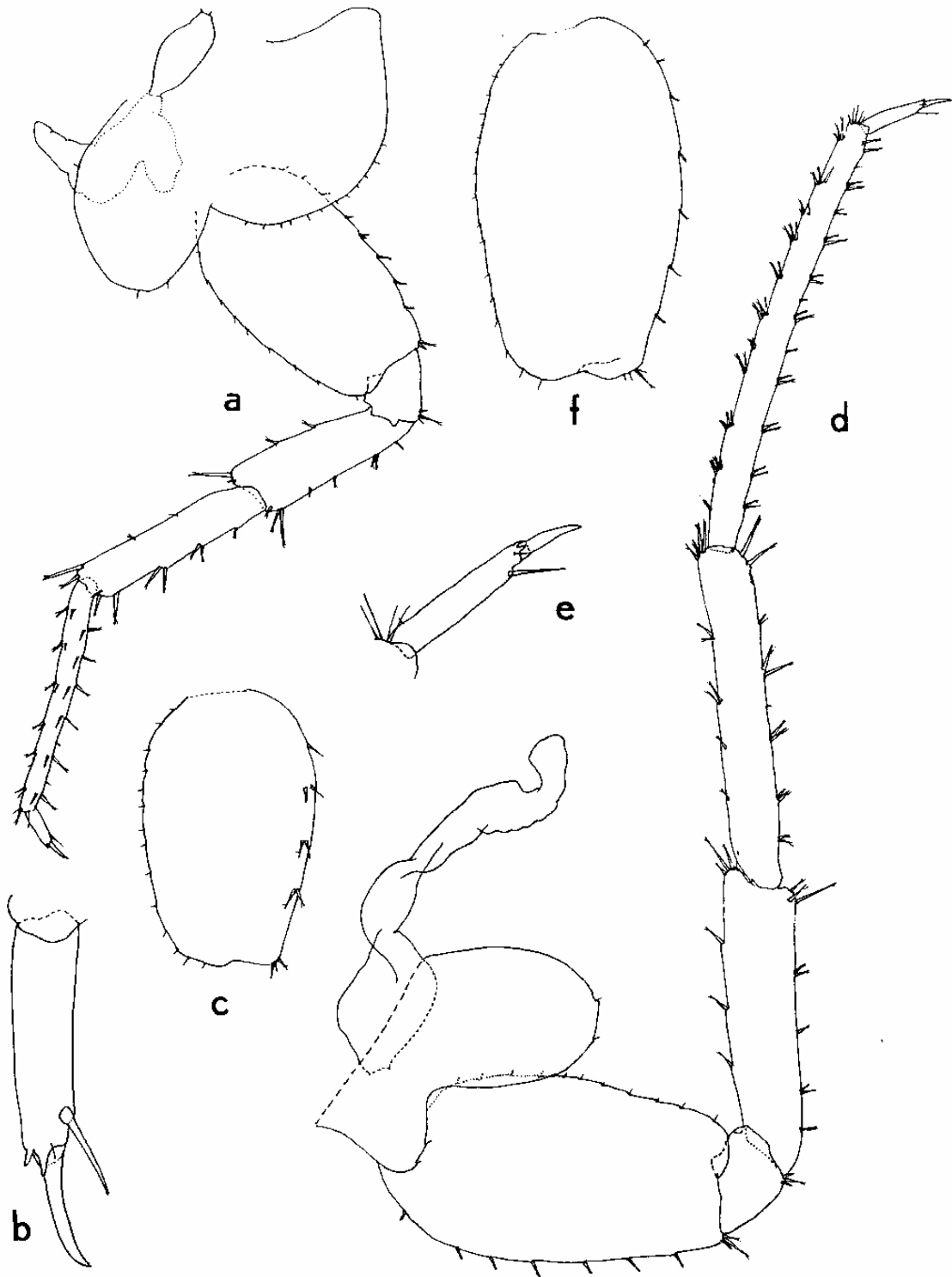


FIG. 6. *Palmorchestia hypogaea* n. gen., n. sp. (paratypes). a, fifth pereiopod, ♀ (scale A); b, claw of same (C); c, basis of fifth pereiopod, ♂ (A); d, sixth pereiopod, ♀ (A); e, claw of same (B); f, basis of sixth pereiopod, ♂ (A). Scales on Fig. 1.

Epimeral plates 1 to 3 (Fig. 7d–f) with small posteroventral tooth; ventral margin unarmed; posterior margin with small setules.

Pleopods strongly reduced (Fig. 4e–g): rami absent. Peduncle elongate digitiform,

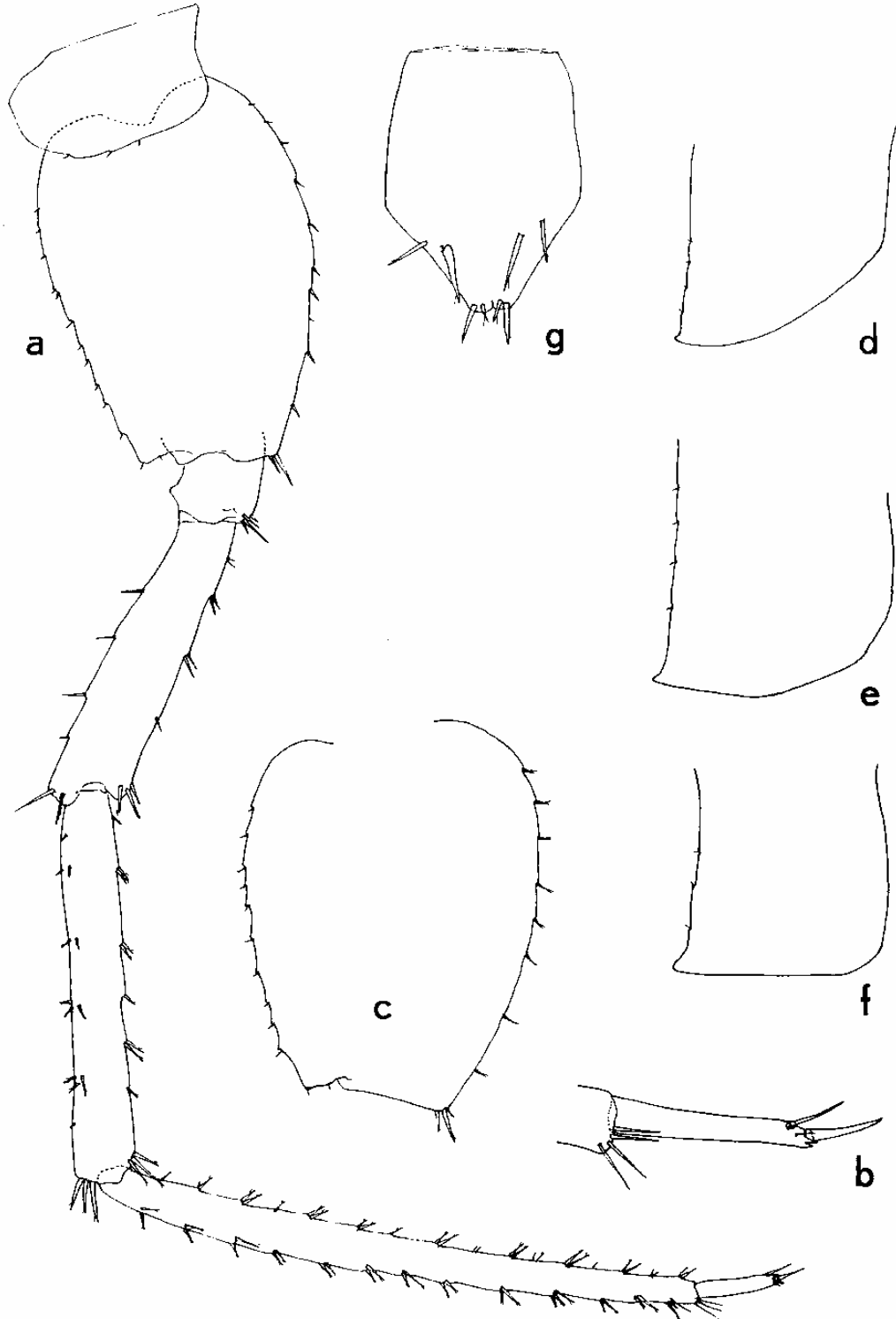


FIG. 7. *Palmorchestia hypogaea* n. gen. n. sp. (paratypes). a, seventh pereiopod, ♀ (scale A); b, claw of same (B); c, basis of seventh pereiopod, ♂ (A); d, first epimeral plate, ♀ (A); e, second epimeral plate, ♀ (A); f, third epimeral plate, ♀ (A); g, telson, ♀ (B). Scales on Fig. 1.

armed with 1 or 2 setules. Retinacula small, anchor-shaped, located on rounded distal end of peduncle, 1 or 2 in number (Fig. 4f).

Uropod 1 (Fig. 3e): peduncle and rami elongate; no proximoventral peduncular spine; interramal spine short, unmodified. Exopodite with 3, endopodite with 4 spines on dorsal margin; each ramus with 3 distal spines, one of which is long.

Uropod 2 (Fig. 3f) not reaching distal end of uropod 1.

Uropod 3 (Fig. 3g): peduncle heavy, tapering, with 2 or 3 dorsodistal spines. Single ramus narrow, much shorter than peduncle, with 4 short distal elements only.

Telson entire (Fig. 7g); margins of basal part slightly diverging, straight; margins of distal part converging, almost straight; distal part with 2 pairs of proximal spines and 4 terminal spines (2 short, 2 longer).

Remarks on the subterranean fauna of La Palma

Thirteen terrestrial troglobite species, belonging to the groups of the Arachnida, Amphipoda, Dermaptera, Blattoidea, Homoptera, Coleoptera, and Diptera, are known from La Palma. Apart from *Palmorchestia hypogaea*, four of these are already described: *Loboptera fortunata* Krauss, 1892 (Blattidae), *Licinopsis angustula angustula* Machado, in press (Carabidae), *Domene* sp. nov. Oromí & Martín, in press (Staphylinidae), and *Anataelia troglobia* Martín & Oromí, in press.

The number of troglobites is markedly lower than that of the neighbouring island of Tenerife, where more than 30 species have been encountered, but is similar to that of the island of El Hierro that likewise harbours 13 cavernicolous species. On the one hand the greater diversity of Tenerife may be correlated with its much greater area, on the other with its older geological age. Generally, the level of adaptation to subterranean life is lower in La Palma than in Tenerife, but higher than in El Hierro. Most troglobites of La Palma have retained remnants of eyes (as is the case in the presently described talitrid), but show more clearly marked adaptations in other characters, such as pigmentation, elongation of the appendages, etc.

There is a clear correlation between the degree of adaptation of the cavernicolous taxa and the age of the islands. Thus, the oldest island, Tenerife, possesses the most highly evolved cavernicoles, whereas the youngest island, El Hierro, harbours the least modified cavernicoles. La Palma, the island which is much younger than Tenerife, but older than El Hierro, shows a level of adaptation intermediate between the two others.

Two troglobites of La Palma belong to groups that do not have representatives in the other islands, viz. the dermapteran *Anataelia troglobia* and the amphipod *Palmorchestia hypogaea*. The question why these groups are not represented in the hypogean fauna of the other islands is not easy to answer, but clearly each island of the Canary archipelago possesses certain exclusive cavernicoles. On the other hand, La Palma is an island showing a certain faunistic disharmony in comparison with the other islands. This is true not only for cavernicoles but for the epigeal fauna as well, e.g. within the vertebrates, the Scincidae have endemic species in the six other major islands of the Canary group, but none in La Palma. Another example is the genus *Calatus* (Carabidae), represented by 22 species in the other islands, but none in La Palma. Yet, there are cases of species found exclusively in La Palma and unknown from the other islands, e.g. the common corvid bird, *Pyrrhocorax pyrrhocorax*.

Palmorchestia hypogaea lives all over the island of La Palma, being in fact one of the few troglobites with such a wide distribution. Without doubt this provides a clear indication that its habitat is not restricted to volcanic caves, but that it occurs in the entire system of crevices in the subsoil. Its presence in the Cueva del Ratón, a lava tube

of some mere 300 years old, proves that the talitrid can rapidly colonize new habitats. We have noticed the greatest densities of *Palmorchestia hypogaea* in caves in the west and south of La Palma. These are the oldest caves of the island and consequently contain the greatest amount of sediments and thus the best feeding possibilities.

A final aspect of the habitat of the cavehopper is that it appears to be limited to the 'Mesocavernous Deep Strata'. Up to now, it has not been found in the 'Mesocavernous Shallow Strata' (MSS) of the island, in contrast to the other troglobites. The reason for this might be that its preferred habitat is mainly at lower altitudes, where the MSS is uninhabitable due to its extreme dryness.

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