

HARPACTICIDS FROM GROUNDWATERS IN THE PHILIPPINES: *PARASTENOCARIS MANGYANS*, NEW SPECIES, *EPACTOPHANES PHILIPPINUS*, NEW SPECIES, AND REDESCRIPTION OF *PHYLLOGNATHOPUS BASSOTI* (COPEPODA)

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ABSTRACT

New data are presented on the taxonomy, ecology, and distribution of harpacticoid copepods belonging to the families Parastenocarididae, Canthocamptidae, and Phyllognathopodidae, all of them from continental fresh water in the Philippines. *Parastenocaris mangyans*, new species, has been collected in superficial and deep phreatic waters of Oriental Mindoro. Its taxonomy has been studied using scanning electron microscopy. The species is characterized by a hyaline integumental window on the ventral genital somite of the female. It differs from other Asiatic species of *Parastenocaris* in the morphology of P4 of the male, which is more similar to the corresponding appendage of species belonging to the *proserpina* species group. *Parastenocaris mangyans* is the first species of this family to be collected in the Philippines. *Epactophanes philippinus*, new species, has been collected in the phreatic waters of a river on Cebu Island. The characteristic features of this new species are primarily the morphology and ornamentation of the mandibular palp in both sexes and of P3 in the male, subordinately the ornamentation of P2-P4 in the female and of P4 in the male. *Phyllognathopus bassoti* has been redescribed on the basis of new material collected from fresh and brackish water wells in Bantayan Island, thus broadening the distribution and the ecology of the species, which had been previously collected only in a lake in Papua New Guinea. The genus *Phyllognathopus* seems to be very adaptable and euryoecious; it is well distributed in any aquatic habitat and in leaf-litter on all continents and several oceanic archipelagos.

Our research group has been working for several years on harpacticoids from subterranean waters of southeastern Asia. Studies concerning marine and brackish water species have already been published (Cottarelli and Mura, 1980, 1981, 1982; Cottarelli, 1985; Cottarelli and Altamura, 1985; Cottarelli *et al.*, 1985a, b; Baldari and Cottarelli, 1986; Cottarelli *et al.*, 1986; Cottarelli and Baldari, 1987; Cottarelli and Puccetti, 1988). Several fresh-water habitats (wells, springs, caves, hyporheos) from many islands in the Philippines and Indonesia have also been investigated.

In this work we describe new or rare species which are interesting from taxonomic, biogeographical, and ecological points of view. *Parastenocaris mangyans*, new species, is the first member of the Parastenocarididae to be collected in the Philippine Islands. *Epactophanes philippinus*, new species, with a very complex and controversial taxonomy, belongs to a genus collected here for the first time. Finally, we redescribe *Phyllognathopus bassoti* Rouch, 1972, previously collected only on Long Island, Papua New Guinea. This

species also belongs to a genus whose taxonomic status needs to be precisely defined.

MATERIALS AND METHODS

Specimens were collected in the phreatic habitat using the Karaman-Chappuis method (Delamare Deboutteville, 1960), and in wells using the Cvetkov method (Vigna Taglianti *et al.*, 1969). Latitude and longitude were determined using a Garmin GPS 38™. Specimens were fixed in 5% buffered Formalin and mounted in permanent slides with Faure's medium. They were drawn at 1,250×, with an oil immersion lens, using a drawing tube mounted on a Zeiss Axioskop phase contrast microscope. For scanning electron microscopy, specimens fixed for 24 h in 10% Formalin were washed twice in cacodylate buffer, pH 7.2, postfixed in 1% osmium tetroxide in the same buffer, dehydrated in a graded ethanol series, critical-point dried in a Balzers Union CPD 020 apparatus and coated with gold in a Balzer Union MED 010 sputter coater. Observations were performed with a 1,200 JEOL JEM EX II scanning electron microscope at 350×, 1,500×, 2,000×, 3,500×, 5,000×, and 7,500×.

The following abbreviations are used, when required, throughout the text and figures: A1 = antennule, A2 = antenna, Bsp = basipodite, Enp = endopodite, Exp = exopodite, Fu = furcal rami, Ga = genital field, Gsg = genital somite, Md = mandible, Mx = maxilla, Mxl = maxillule, Mxp = maxilliped, Op = anal operculum, P1-P5 = thoracic appendages; R = rostrum.

The nomenclature and descriptive terminology follow Dussart and Defaye (1995) and Huys *et al.* (1996). The type material is temporarily deposited in the Dipartimento di Scienze Ambientali, Università della Tuscia, Viterbo (senior author's collection), except for the holotype and one female paratype deposited in the collection of the Museo Civico di Storia Naturale G. Doria, Genoa, Italy.

DESCRIPTIONS

Parastenocarididae Chappuis, 1933

Parastenocaris Kessler, 1913

Parastenocaris mangyans, new species

Type Material.—Holotype: 1 ♂ (V. Cottarelli leg., 14 April 1992) collected in Oriental Province of Mindoro Island, near Talipanan Village, in the phreatic habitat of a fresh-water stream, 300 m above sea level (a.s.l.), 13°30'032"N, 120°53'357"E. The specimen has been dissected and mounted on a slide labeled: Philippines, Oriental Mindoro, Talipanan, *Parastenocaris mangyans* holotype. Paratypes: 4 ♂♂ and 4 ♀♀ (V. Cottarelli leg., 7 April 1997), collected at the same station as the holotype; 1 ♀ (V. Cottarelli leg., 2 August 1995), collected near Sabang Village, 10 km from the type locality, in a fresh-water well about 600 m from the sea, 0 m a.s.l., 13°31'491"N, 120°57'983"E. Four female and 3 male paratypes have been mounted on slides labeled: Philippines, Oriental Mindoro, *Parastenocaris mangyans* paratypes, numbered from 1–7; 1 male and 1 female paratypes have been prepared for scanning electron microscopy, on a stub labeled: Philippines, Oriental Mindoro, *Parastenocaris mangyans* male and female paratypes.

Description of the Holotype.—Body cylindrical and lengthened, unpigmented, eyeless; length, from rostrum to distal apex of furcal rami = 0.315 mm. Cephalosome with round nuchal organ (Fig. 3a). Second, third, and fourth abdominal somites with dorsal hyaline integumental window (Fig. 3g). Spermatophore as in Fig. 1h. Anal operculum (Figs. 2d, 3g) with concave distal margin; transverse row of small spinules under transparent operculum. Furcal rami (Figs. 2d, 3g) elongated and cone-shaped, as long as last abdominal somite; length to width ratio 3.7. One anterolateral seta with 2 accessory short setae, 1 dorsal composite seta. One main inner terminal seta, accompanied by 2 short setae.

Rostrum as in Fig. 1m. Antennule (Fig. 1m) 7-segmented, first segment bare, second segment with 6 distal setae, one of them long and plumose. Third segment with 4 distal setae; fourth segment very enlarged, with 2 proximal spines, an apophysis with 1 seta and 1 aesthetasc, and apical seta. Fifth and sixth segments without ornamentation; seventh segment with 8 setae and 1 aesthetasc. Antenna (Fig. 1a) with 1-segmented exopodite

with 1 apical seta; allobasipodite with no ornamentation. Endopodite bearing distally 2 geniculate, 1 transformed, and 3 normal setae. Remaining ornamentation as in figure.

Mandible (Fig. 1b) with 1-segmented palp having 2 distal setae. Maxillule (Fig. 1c) with arthritis of praecoxopodite with 5 apical curved elements of different lengths. Coxopodite with distal seta, basipodite with 2 apical and 1 subapical setae. Maxilla (Fig. 1d) with syncoxopodite having 1 endite bearing 2 apical setae; basipodite prolonged into apically curved and spinulose tip accompanied by seta. Endopodite reduced to small tubercle with 2 setae. Maxilliped as in Fig. 1e.

P1 (Fig. 11) with basipodite bearing thin seta near insertion of endopodite; exopodite 3-segmented, as long as corresponding endopodite. Third segment with 4 apical setae of different lengths, 2 of them geniculate. Endopodite 2-segmented; second segment with 2 apical setae of different lengths, longer one geniculate. P2 (Fig. 3c) with basipodite having outer seta, exopodite 3-segmented, ornamentation shown in figure. Endopodite shorter than half of exp-1, represented by small cylindrical segment, with lateral tip and 4 spinules of different lengths on distal margin. P3 (Fig. 3d) elongated; basipodite with long seta, pore, and row of spinules on outer margin and row of denticles on internal margin. Endopodite reduced to short seta. First segment of exopodite with 2 rows of spinules on outer margin and 1 distal spine, ending in small round flattened apophysis. Second segment represented by bifid appendix, little shorter than the apophysis, with round tips. P4 (Fig. 1i): basipodite with outer seta; exopodite 3-segmented, ornamentation shown in figure. Endopodite little longer than first half of exp-1, ending in tip, with strong long spine near its insertion.

P5 (Fig. 1f) approximately trapezoidal plate, with spine on internal corner. Distal margin with 2 short setae, 1 short process, and long seta on outer corner.

Description of Male Paratype.—Certain features described for the holotype have been checked in one male paratype with SEM: furcal rami with lateral apical pore (Fig. 10d), P1 basipodite as in Fig. 10c.

Description of Female Paratype.—Length = 0.320 mm. Nuchal organ and integumental

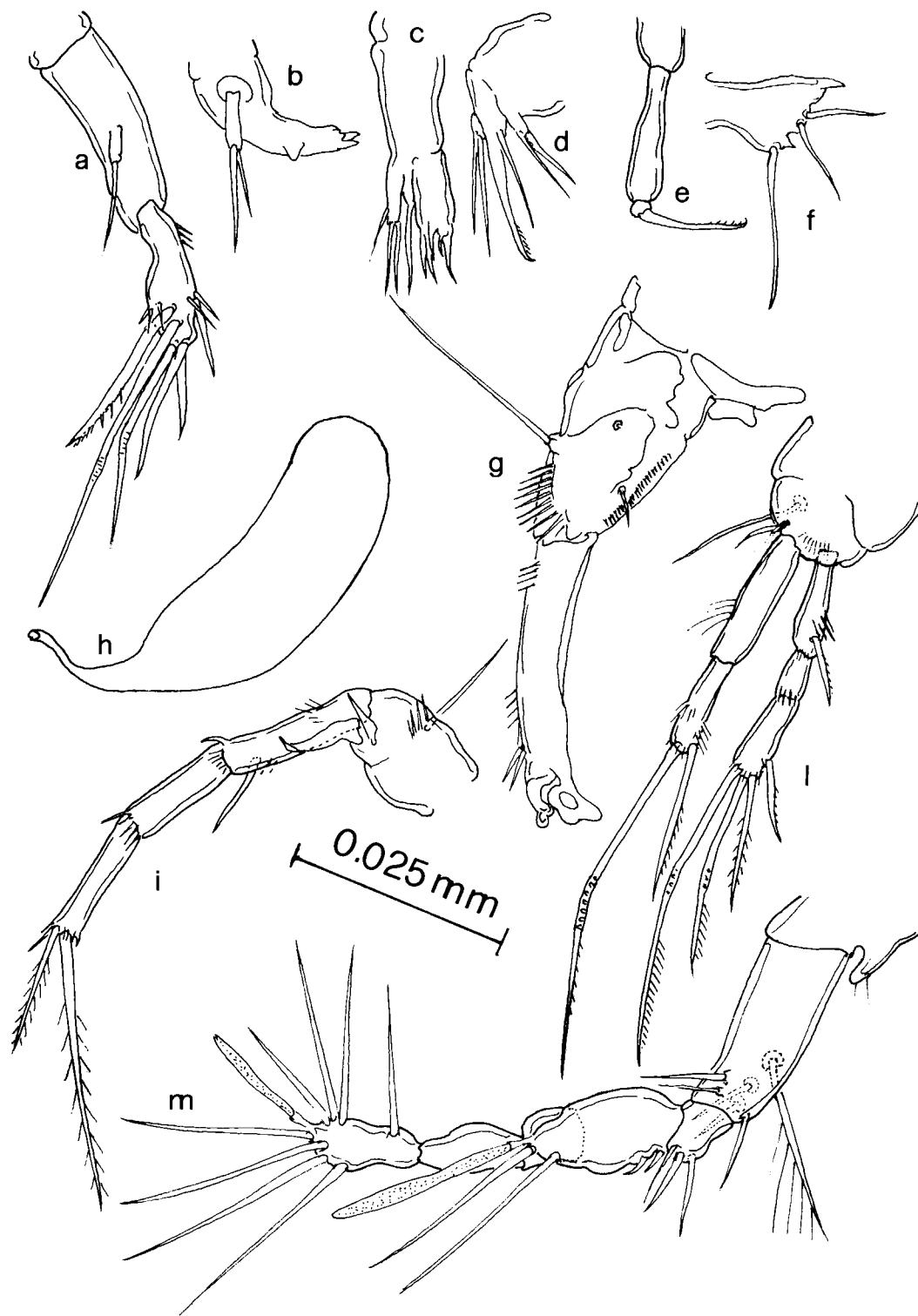


Fig. 1. *Parastenocaris mangyans*, new species (a–f, h–m), holotype male; (g) paratype male, variability: a, antenna; b, mandible; c, maxillule; d, maxilla; e, maxilliped; f, P5; g, P3; h, spermatophore; i, P4; l, P1; m, antennule and rostrum.

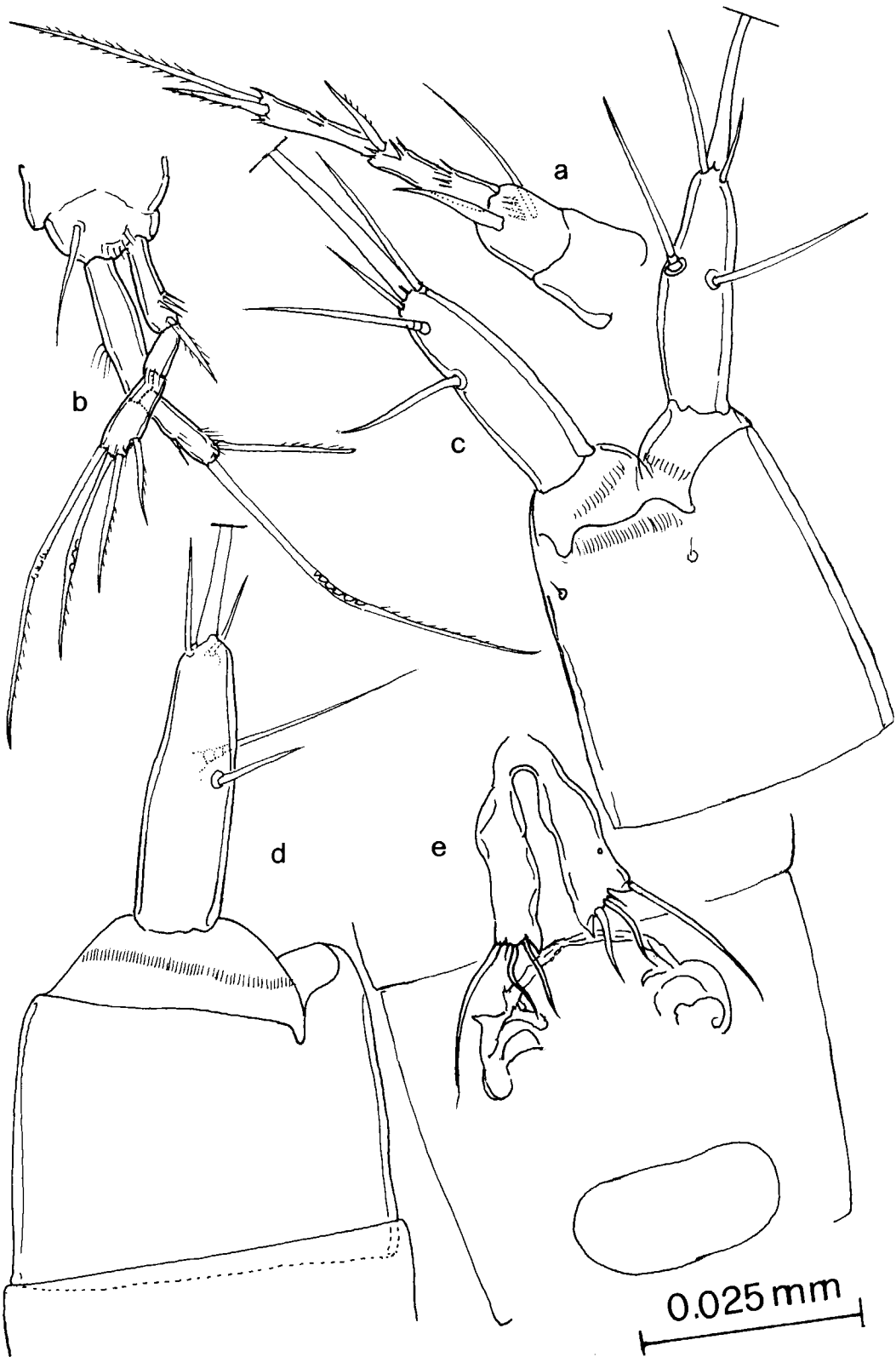


Fig. 2. *Parastenocaris mangyans*, new species (d), holotype male; (a–c, e), paratype female: a, P3; b, P1; c, furcal rami and anal operculum, dorsal view; d, furcal rami and anal operculum, lateral view; e, P5, genital field and ventral integumental window.

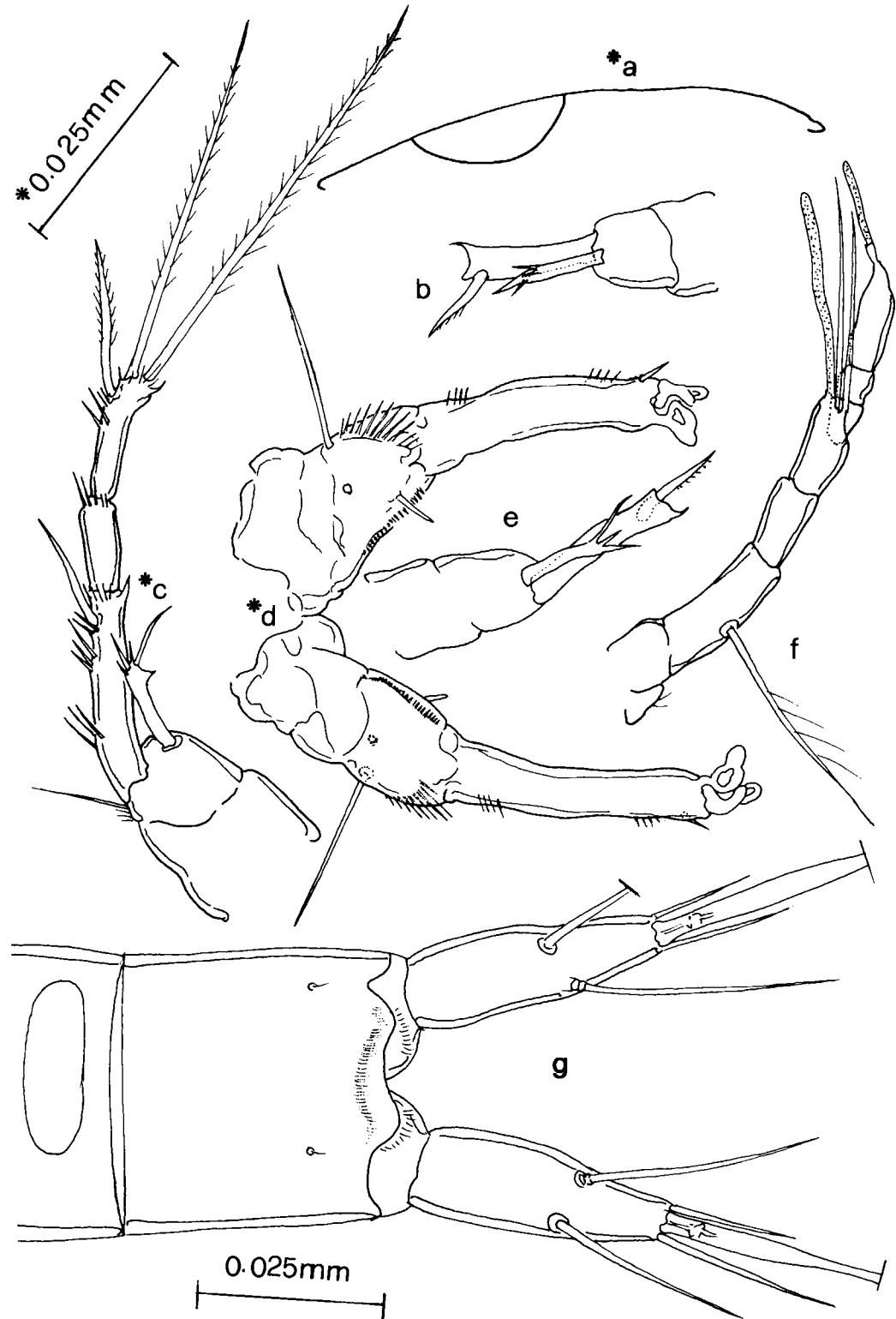


Fig. 3. *Parastenocaris mangyans*, new species (a, c, d, g), holotype male; (b, e, f) paratype female: a, nuchal organ; b, P4; c, P2; d, P3; e, P2; f, antennule and rostrum; g, furcal rami, anal operculum, and dorsal integumental window, dorsal view. (Asterisks near the figure letters a, c, and d refer to the scale marked with *.)

windows as in male, plus ventral hyaline integumental window on genital somite (Fig. 2e). Rostrum, oral appendages, maxilliped, P2 and P4 exopodite, and anal operculum as in male. Genital field as Fig. 2e. Furcal rami (Fig. 2c) similar to those of male but little shorter. Length to width ratio = 3.54.

Antennule (Fig. 3f) 7-segmented. One pinnate seta on second segment, 2 setae and 1 aesthetasc on distal margin of fourth segment. Last segment with aesthetasc.

P1 basipodite without internal seta (Fig. 2b), exopodite and endopodite as in male. P2 endopodite (Fig. 3e) represented by small cylindrical appendix, little longer than half of exp-1, with 3 apical spinules of different lengths. P3 (Fig. 2a) exopodite 2-segmented, ornamentation as in figure. Endopodite 1-segmented, acuminate, shorter than exp-1. P4 endopodite (Fig. 3b) represented by small cylindrical appendix, shorter than exp-1, with pointed tip, with subapical spinules.

P5 (Fig. 2e) long, rectangular, with pore at about two-thirds of outer margin. Sharpened tip on internal corner, distal margin with 2 short setae, 1 short spinule and 1 long seta on outer corner.

As in the case of the male, some features described for the paratype have been checked in one female specimen with SEM: habitus as in Fig. 11a; last abdominal somite with lateral pore (Fig. 11d); furcal rami with lateral apical pore (Fig. 11d); mouth parts as in Fig. 1a; P1 basipodite and endopodite as in Fig. 2b; P5 as in Fig. 2e.

Variability.—All features described above appear to be constant in the typical series except P3 of two males with two apical spines on the apical outer margin of the first segment of the exopodite (Figs. 1g, 10b), and a female P2 endopodite with four apical spinules (Fig. 11c).

Etymology.—The species name is dedicated to the Mangyans tribe, a group of more than 50,000 people living in several localities in Mindoro, including the territory where the species was first collected.

Remarks.—The ventral hyaline integumental window on the female genital somite is a unique feature that distinguishes *Parastenocaris mangyans*, new species, from all the other known species of the genus. The morphology of the male P4 endopodite, a simple

lengthened segment, accompanied by a seta, differs in all the other *Parastenocaris* collected in surrounding countries, including some species, not yet described, that we collected in Taiwan and the Fiji Islands. Only in *P. dammermanni* Menzel, 1921, from Java, and *P. arganoi* Cottarelli *et al.*, 1982, from Malaysia, the endopodite of P4 is a simple segment with no ornamentation, accompanied in *P. arganoi* by a short seta and 2 tubercles. All other features of these two species are different from the corresponding features of *P. mangyans* which resembles, instead, species of the *proserpina* group (Kunz, 1938). In this species group, according to Rouch (1992), there are two kinds of P4 endopodite. In the first type, the inner spine is a more or less developed leaflike plate, with lateral ornamentation (setae, spinules, or tubercles), such as in *P. nipponensis* Chappuis, 1955. In the second type, there is a simple pointed appendix without lateral ornamentation, such as in *P. nolli* Kiefer, 1938, and, remarkably, as in our new species. The shape and ornamentation of endopodite P3 in the male of *P. mangyans*, on the other hand, seem to be typical, and, consequently, the set of features discussed above suffices to distinguish the new species from its congeners.

At present, however, it is difficult to establish precise affinities, since the taxocoenosis of *Parastenocaris* from the Philippines is unknown, even though this taxon is probably well distributed in the area (see below). Convergence in taxa with distant distribution areas may render morphological comparison very difficult.

Canthocamptidae Sars, 1906; Monard, 1927; Lang, 1948

Epactophanes Mrázek, 1893

Epactophanes philippinus, new species

Type Material.—Holotype: 1 ♂ (V. Cottarelli leg., 8 August 1994) collected on Cebu Island, in the phreatic habitat of the Matutinao River, about 2 km up the river, near Matutinao Village, 9°48'644"N, 123°22'007"E. The specimen has been dissected and mounted on a slide labeled: Philippines, Cebu, Matutinao River, *Epactophanes philippinus* holotype. Paratypes: 8 ♂♂ and 11 ♀♀, same date and place, mounted on slides labeled: Philippines, Cebu, Matutinao River. *Epactophanes philippinus* paratypes, numbered from 1–19.

Description of Holotype.—Body long, cylindrical, unpigmented, eyeless; length from rostrum to distal apex of furcal rami = 0.664 mm.

Integumental ornamentation slightly variolated. Cephalosome with nuchal organ of characteristic shape (Fig. 4g) with sensilla. Abdominal somites 2–5 with ventral row of spinules along distal margin. Second abdominal somite with proximal row of smaller spinules. Last abdominal somite with additional ventral row of strong spinules along distal margin, extending laterally (Fig. 4d), and 2 pores. Dorsally, on each somite, pair of hairs. Basipodites of P1–P4 with pore. Anal operculum (Fig. 4d) convex distal margin with 3 strong spines and row of thin spinules. Furcal rami (Fig. 4d) conical, longer than last abdominal somite, length to width ratio 2.41. Armature comprising anterolateral seta, dorsal seta, posterolateral seta, main inner terminal seta, and long outer terminal seta, short inner terminal accessory seta, 3 apical ventral spinules.

Rostrum (Fig. 4e, g) very small with 2 small setae. Antennule (Fig. 4b, e) 7-segmented, first segment bare, second segment with 3 dorsal and 3 ventral setae, and third segment with 5 setae. Fourth segment strong, partially merged with fifth segment, as seen from ventral side, with 5 short ventral setae and apical tubercle with long seta and 1 long aesthetasc. Fifth and sixth segments bare, last segment with 5 setae and 1 aesthetasc. Antenna (Fig. 5a) with 1-segmented exopodite with 2 apical setae; allobasipodite with 1 spine. Endopodite with 2 inner spines near its origin, followed by 3 strong spines. On apex, 3 geniculate setae of different lengths, one-sided pinnate seta, and 1 strong spiniform seta.

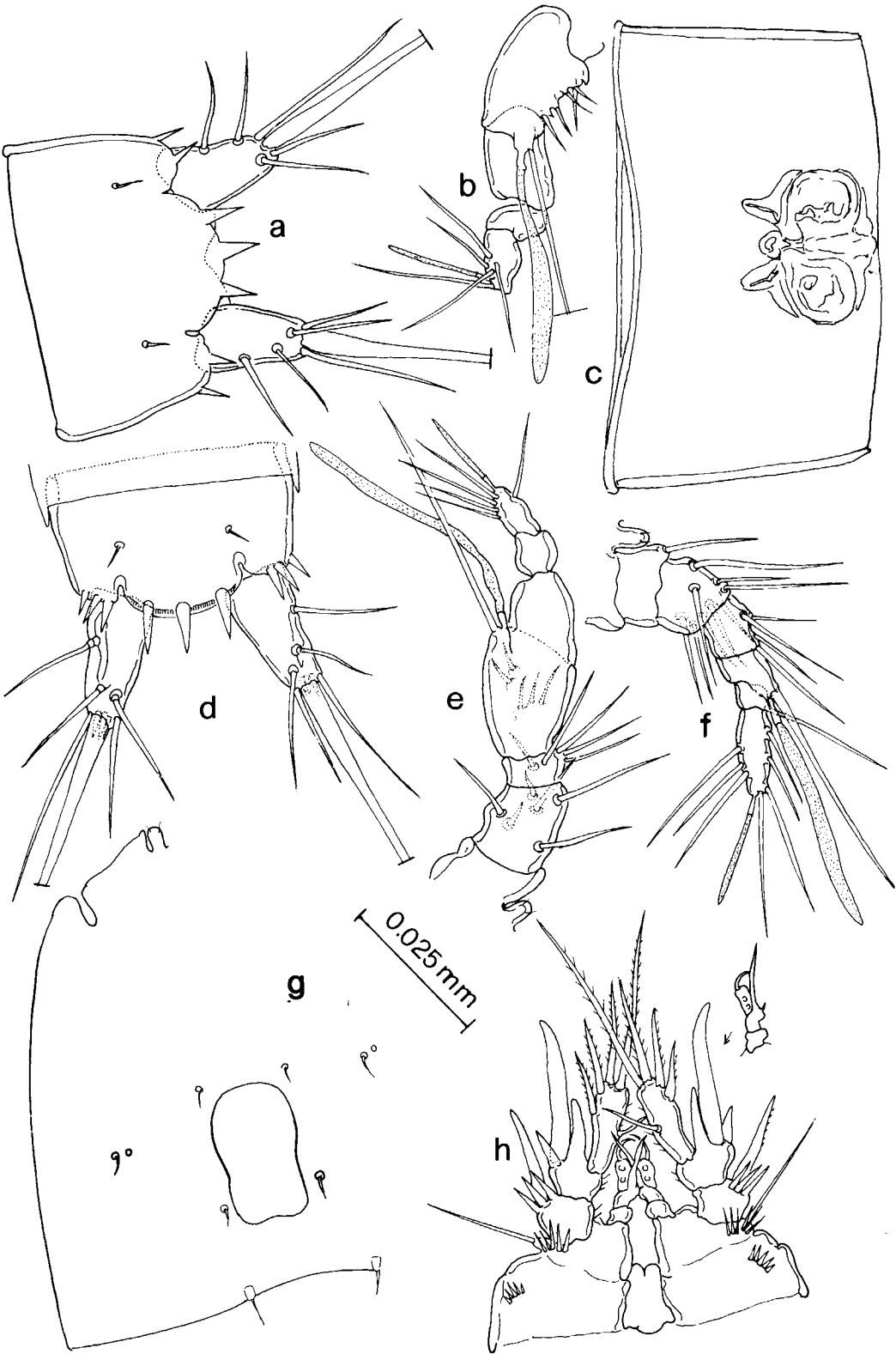
Mandible (Fig. 5b) with long praecoxa, gnathobase dentate with 1 seta. Palp reduced, 1-segmented, with 2 distal setae. Maxillule (Fig. 5c) with arthrite of praecoxopodite having 3 curved spines of same length and long curved spine, all spines pinnate. Coxopodite with 2 distal setae of different lengths. Basipodite with 2 lateral, 1 subapical, and 3 apical setae. Maxilla (Fig. 5d) with syncopodite having 2 endites represented by tubercle with 1 leaflike appendix and 1 seta, and 2 leaflike appendices, respectively. Basipodite prolonged as claw, with 1 short seta. En-

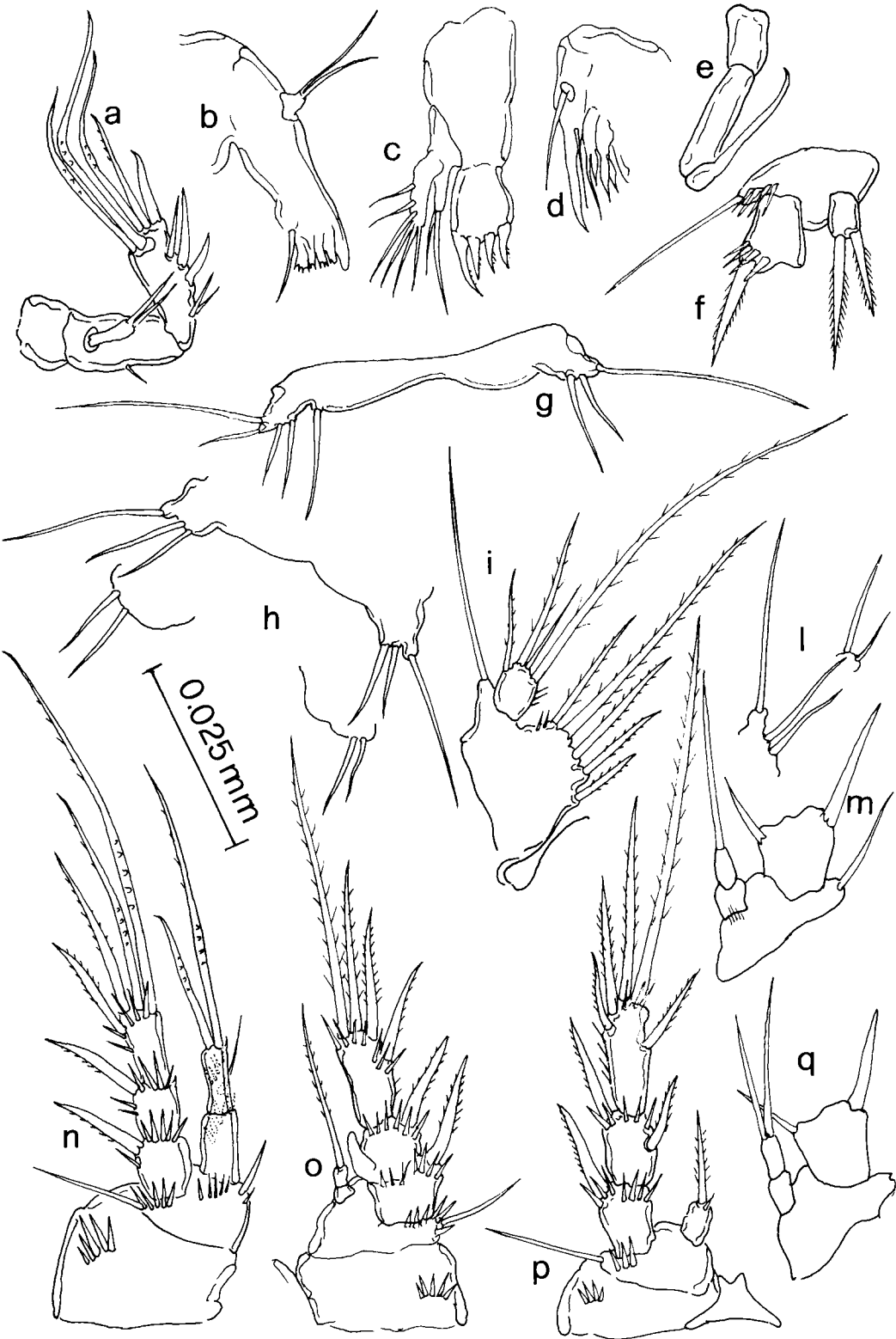
dopodite reduced to 1 seta. Maxilliped as in Fig. 5e.

P1 (Fig. 5n) with basipodite bearing row of spinules and 1 seta near insertion of each ramus. Exopodite 3-segmented, each segment with strong pinnate seta on distal outer corner, spines on distal margin. One, 2, or 3 spines on outer margin of each segment, respectively. Apically, 1 pinnate seta and 2 long geniculate pinnate setae of different lengths. Endopodite 2-segmented, reaching length of exp-3; first segment bare, second segment with 1 short lateral seta and, apically, 2 geniculate setae, longest seta unilaterally pinnate. P2 (Fig. 5o) with basipodite bearing seta near insertion of exopodite, and 1 seta near insertion of endopodite. Exopodite 3-segmented; second segment with inner fingerlike apophysis, last segment with 2 geniculate and 2 pinnate setae apically. Endopodite 2-segmented, reduced, shorter than exp-1, last segment with thin seta at about half of length of inner margin and 2 apical strong geniculate setae. P3 (Fig. 4h) with coxa and basipodite as in figure. Exopodite very strong and transformed, 3-segmented. First segment short and squat, with 3 long strong spines and long strong seta on distal outer corner. Second segment having same length and width as previous segment, with long strong tip slightly curved on distal outer corner, very long strong unarmed spine, apically curved, and smaller spine inserted near tip. Third segment slender, longer than previous 2 segments, with 1 seta at half of inner margin, 2 apical strong pinnate setae of different lengths, and 2 subapical strong setae. Endopodite small, 3-segmented, reaching end of exp-2. First and second segments short, first segment bare, second segment with inner expansion, apically prolonged in tip, with small spine. Third segment long, with apical curved seta and 2 spots aligned on ventral side. P4 (Fig. 5p) with coxa, basipodite, and 3-segmented exopodite as in figure. Endopodite 1-segmented, reduced to tubercle with spinule and pinnate apical seta.

P5 (Fig. 5h) with 2 plates medially merged, both with 3 setae. P6 (Fig. 5h) reduced to small plate with 2 setae.

Fig. 4. *Epactophanes philippinus*, new species (b, d, e, g, h) holotype male; (a, c, f), paratype female: a, furcal rami and anal operculum, dorsal view; b, antennule, distal part, lateral view; c, genital field; d, furcal rami and anal operculum, dorsal view; e, antennule and rostrum; f, antennule and rostrum; g, rostrum and nuchal organ, h, P3.





Description of Female.—Length from rostrum to distal apex of caudal rami = 0.667 mm. Integumental ornamentation, antenna, mouth parts, and P1 as in male. Genital field as in Fig 4c. Anal operculum (Fig. 4a) with convex distal margin with three strong pointed processes. Furcal rami (Fig. 4a) shorter than last abdominal somite, and than furcal ramus of male, length to width ratio = 1.85. Ornamentation as in male but without distal spines.

Antennule (Fig. 4f) 7-segmented. First segment bare, second segment with 1 distal seta, third segment with 9 setae. Fourth segment with 4 lateral setae. Fifth segment with distal tubercle bearing 1 long seta and 1 long aesthetasc. Sixth segment with 1 apical seta, last segment with 7 setae and 1 aesthetasc.

P2 (Fig. 6a) with coxa and basipodite similar to those of male. Exopodite 3-segmented, second segment with lateral inner seta. Third segment longer than previous 2 segments, with 1 lateral inner pinnate seta, and 2 subapical and 2 apical pinnate setae. Endopodite 1-segmented, very small, with distal pinnate seta. P3 (Fig. 6b) with exopodite 3-segmented, second segment with lateral inner seta. Third segment longer than previous 2 segments, with 1 lateral inner seta, 2 subapical and 2 apical pinnate setae. Endopodite 1-segmented, with trace of primitive 2-segmentation, as long as exp-1, with 1 long pinnate apical seta. P4 (Fig. 6g) with exopodite 3-segmented. Second segment with lateral pinnate seta, third segment with transformed seta at about two-thirds of inner margin, 2 subapical and 2 apical pinnate setae. Endopodite 1-segmented, very small, bearing apically pinnate seta and spinules.

P5 (Fig. 5i) with baseoendopodite having five pinnate setae of different lengths; exopodite small, with 1 normal seta and 3 pinnate setae of different lengths, 1 very long.

Variability.—In a male specimen, one of the two P5s has five setae instead of three (Fig. 5g).

Etymology.—The species name, meaning “of the Philippines,” refers to the country where the species was first collected.

Remarks.—*Epactophanes* is a controversial genus, and its definition is to some extent still circumstantial. According to some authors (Lang, 1948; Dussart, 1967; Shen *et al.*, 1979), the only species belonging to the genus, *E. richardi* Mrázek, is a cosmopolitan species with wide variability. For this reason, these authors have attributed all the several varieties and subspecies that have been described later (see Lang, 1948; Dussart and Defaye, 1990) to the nominal species. Borutskii (1952), on the other hand, recognized 12 varieties and provided an identification key for them. According to this key, our species seems to be close to *E. richardi* var. *menzeli* (Chappuis). We have decided to establish a new species after comparing our specimens with other *Epactophanes* that we have collected from several places: Central Italy (Figs. 5f, l, 6d, f), Sardinia, Corsica (Figs. 5m, q, 6e), Mexico (Fig. 6c), and Sri Lanka. Features discussed below seem to be unique to the Philippine specimens; they do not show variability and they cannot be detected from descriptions in the literature. The new species has a typical morphology and ornamentation of the male P3 (Fig. 4h), with a 3-segmented endopodite, the second segment bearing 1 seta not mentioned previously in the literature, and the exopodite showing strong sexual dimorphism. In the exopodite of P3, the first segment bears a strong seta and three strong spines, and the second segment has a long transformed seta, surrounded by two strong processes, on the outer distal corner (Fig. 4h). All varieties of *E. richardi* have only one normal seta and one process (Figs. 5q, 6d). The third segment differs in having a long thin seta at half the length of the internal margin.

These features are, according to us, taxonomically important, because they presumably are linked to reproductive activities. In addition, in both sexes of *E. philippinus*, new species, there is a mandibular palp, even though small, with two setae; in all specimens of *E. richardi*, the mandibular palp is, according to the authors who have dealt with this species, reduced to a seta. The male P5 (Fig. 5h), merged and reduced to a plate, is

Fig. 5. *Epactophanes philippinus*, new species (a–e, h, n–p), holotype male; (i) paratype female; (g) paratype male, variability. *Epactophanes richardi* (f, l), male, Bolsena Lake, Central Italy; (m, q), female, Rizzanese, Corsica: a, antenna; b, mandible; c, maxillule; d, maxilla; e, maxilliped; f, endopodite P4; g, P5; h, P5 and P6; i, P5; l, P5 and P6; m, endopodite P2; n, P1; o, P2; p, P4; q, endopodite P3.

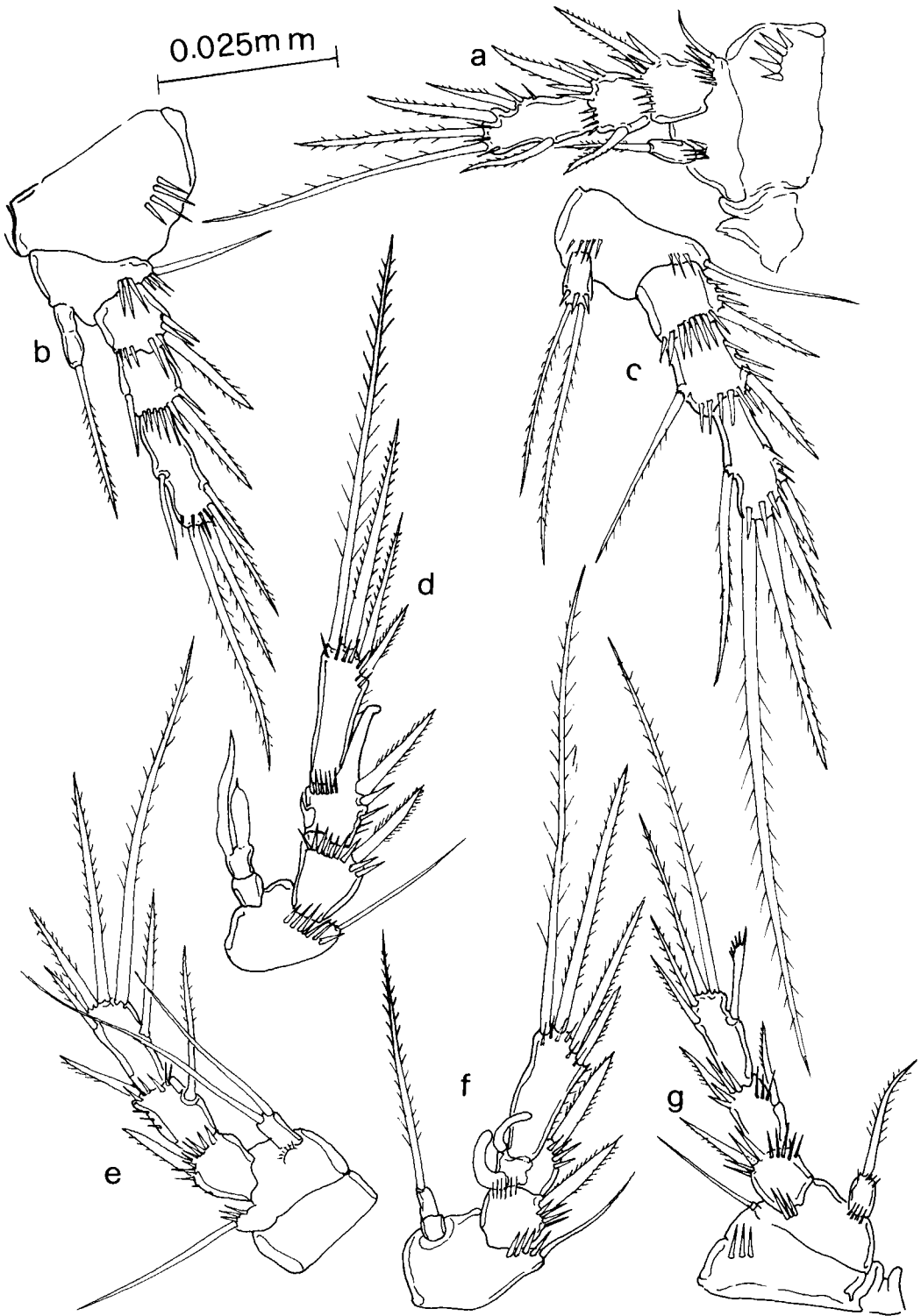


Fig. 6. *Epactophanes philippinus*, new species (a, b, g), paratype female. *Epactophanes richardi* (d, f) male, Bolsena Lake, Central Italy; (c) female, Mexico; (e) female, Rizzanese, Corsica: a, P2; b, P3; c, P4; d, P3; e, P4; f, P2; g, P4.

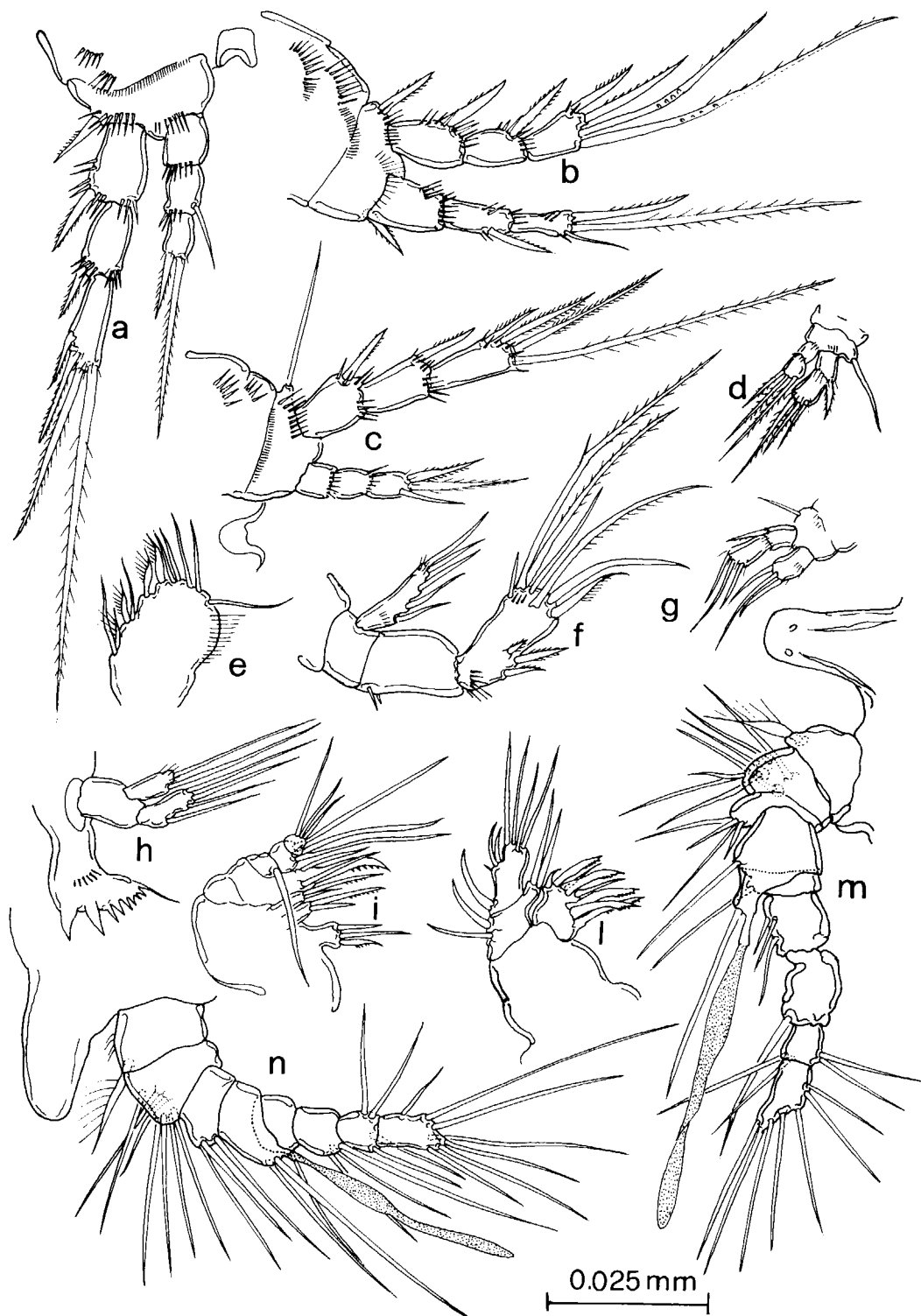


Fig. 7. *Phyllognathopus bassoti* (a–f, h–l, n), female; (m) male; (g) male, variability: a, P2; b, P1; c, P3; d, P4; e, maxilliped; f, antenna; g, P4; h, mandible; i, maxilla; l, maxillule; m, antennule and rostrum; n, antennule and rostrum.

much more developed in *E. philippinus* than in *E. richardi* (Fig. 5l). The morphology and ornamentation of P2–P4 endopodites of the female and endopodite P4 of the male in the new species are different than in *E. richardi* (Fig. 5f, m), since they are 1-segmented or they begin to be transformed in this way (as in the female P3 where the primitive two-segmentation can still be distinguished), and they always bear one distal seta, while in *E. richardi* there are two setae, at least in the female. Another important feature is the inner seta on the last segment of the female P4 exopodite, which is normal in *E. richardi* (Figs. 6c, e) and transformed in *E. philippinus* (Fig. 6g). Furthermore, the male P2 differs in the two species (Figs. 5o, 6f). Other features useful in identification of the new taxon include the typical nuchal organ and a more developed rostrum than in the nominal species.

In short, we think that *E. richardi* shows a considerable morphological variability which is likely due to its being a complex of species or subspecies, and the variability is considerable even in southeast Asia (Shen *et al.*, 1979, for China). However, *E. philippinus*, new species (and perhaps other undescribed *Epactophanes* spp. in the Philippines) has certain unique character states falling outside the normal range of variability found in *E. richardi*, which distinguish and characterize this new species.

Phyllognathopodidae Gurney, 1932

Phyllognathopus Mrázek, 1893

Phyllognathopus bassoti Rouch, 1972

Material.—2 ♀♀ and 1 ♂ (V. Cottarelli leg., 15 August 1994) collected in Bantayan Island (Philippines), in a fresh-water well near Santa Fe; 8 ♀♀ and 2 ♂♂ (V. Cottarelli leg., 15 August 1994) collected in a slightly brackish well in Pooc, about 2 km from Santa Fe. The specimens have been mounted on slides labeled: Philippines, Bantayan, *Phyllognathopus bassoti*, numbered from 1–13.

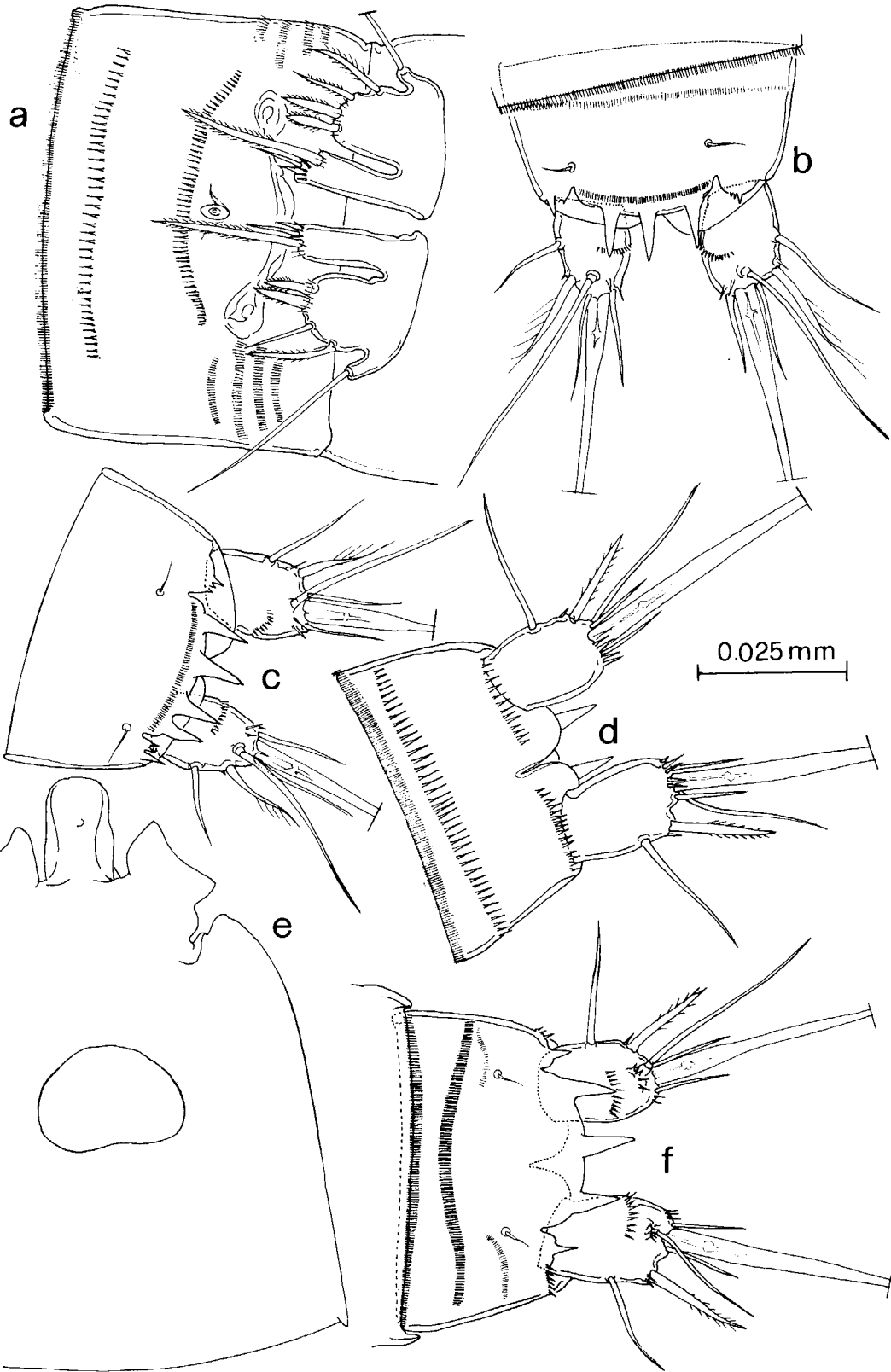
Female.—Body cylindrical and long, unpigmented, eyeless; length from rostrum to distal apex of furcal rami = 0.333 mm. Cephalosome with small round nuchal organ (not pre-

viously described) (Fig. 8e). Abdominal somites with rows of spinules on posterior border of each somite (Fig. 8a). Last abdominal somite with proximal row of spinules around somite, and 2 shorter dorsal rows of transverse spinules. On each side of anal operculum, strong spine and row of spinules surrounding each furcal ramus (Fig. 8f). Genital field as in Fig. 8a. Anal operculum (Fig. 8d, f) with convex distal margin with 3 strong spines. Furcal rami (Fig. 8d, f) shorter than last abdominal somite; length to width ratio = 1.45. Armature represented by anterolateral seta, composite dorsal seta, pinnate posterolateral seta, strong internal terminal seta, short outer terminal and terminal accessory setae, and subdistal ventral spinules. Transverse dorsal row of spinules at about half length of each ramus.

Rostrum as in Figs. 7n, 8e. Antennule (Fig. 7n) large and squat, 8-segmented. First segment with strong pinnate seta on internal distal corner. Second segment with 7 setae. Third segment with 3 setae. Fourth segment with apophysis bearing 2 setae and 1 aesthetasc. Fifth segment with 1 distal seta. Sixth segment with 3 distal setae. Seventh segment with 4 setae. Last segment with 7 setae. Antenna (Fig. 7f) with basipodite. 1-segmented exopodite with 5 setae. First segment of endopodite with 2 lateral spines, distal segment with proximal row of spinules, 3 pinnate strong setae of different lengths at about one-half of internal margin, 3 normal and 3 pinnate setae of different lengths on apex.

Mandible (Fig. 7h) with 2-segmented palp; gnathobase as in figure, basipodite with transverse row of spinules. Exopodite with 2 setae, endopodite with 4 setae. Maxillule (Fig. 7l) with arthritis of praecoxopodite with 5 spinulose claws, 2 short setae and 1 spine; basipodite with 2 setae, coxopodite slender, with 2 inner and 2 outer setae; basipodite one-segmented, with 1 strong curved seta on outer margin (exopodite), 2 short curved subapical setae, and 4 long apical setae. Maxilla (Fig. 7i) with syncoxopodite having 3 endites; internal endite with 2 normal setae and small pinnate seta; 2 following endites each with

Fig. 8. *Phyllognathopus bassoti* (a, d–f), female; (b) male; (c) male, variability: a, P5, genital field and first abdominal somite ornamentation; b, furcal rami and anal operculum, dorsal view; c, furcal rami and anal operculum, dorsal view; d, furcal rami and anal operculum, ventral view; e, cephalosome with rostrum and nuchal organ; f, furcal rami and anal operculum, dorsal view.



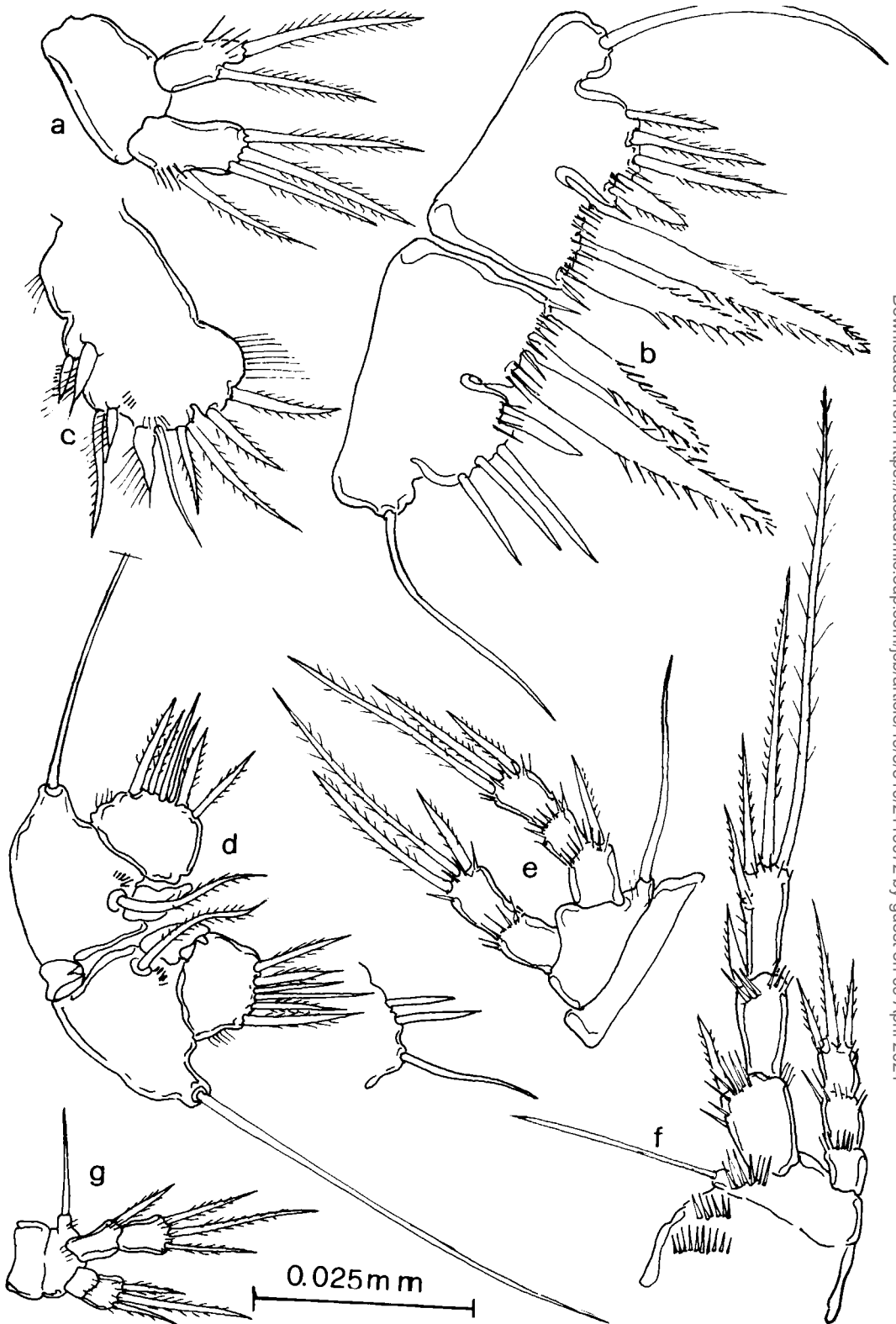


Fig. 9. *Phyllognathopus bassoti* (d, f, g), male; *Phyllognathopus cf. viguieri* (a–c), female; (e) male: a, mandibular palp; b, P5; c, maxilliped; d, P5 and P6; e, P3; f, P3; g, P4.

normal and long pinnate setae. Basipodite prolonged in long strong pinnate tip, with 2 setae near its origin. Endopodite 3-segmented; first segment with long seta, second segment with 3 setae, third segment with 3 setae. Maxilliped (Fig. 7e): transformed as suboval plate, with 7 normal setae and 4 leaflike pinnate setae.

P1 (Fig. 7b) with coxa and basipodite as in figure. Exopodite 3-segmented, little longer than corresponding endopodite. First 2 segments with strong pinnate spine on outer distal corner, third segment with 2 pinnate and 2 long pinnate geniculate setae. Endopodite 3-segmented, second segment with strong pinnate spine on inner margin, third segment with 2 pinnate setae and normal apical seta. P2 (Fig. 7a) with exopodite 3-segmented, last segment of exopodite longer than previous 2 segments, with 2 apical and 2 subapical pinnate setae. Endopodite 3-segmented, as long as exp-2, enp-2 with seta on inner distal corner, third segment with 2 apical pinnate setae of different lengths. P3 (Fig. 7c) with ornamentation of exopodite as in P2. Endopodite 3-segmented, little shorter than exp-2, last segment with pinnate apical seta and normal subapical internal seta. P4 (Fig. 7d) with exopodite 2-segmented, second segment with 3 apical pinnate setae of different lengths. Endopodite 2-segmented, reaching half of length of exp-2; first segment bare, second segment with 3 apical pinnate setae of different lengths.

P5 (Fig. 8a) with exopodite merged with baseoendopodite; internal lobe longer than exopodite, narrow, with parallel margins, with long external pinnate seta, 2 short setae of different lengths, and row of spinules. Outer corner with long terminal seta. Exopodite approximately round, with 2 short strong pinnate setae on apex, and 2 longer thin outer pinnate setae.

Male.—Length from rostrum to distal apex of furcal rami = 0.341 mm. Integumental ornamentation, antenna, rostrum (Fig. 7m), mouthparts, anal operculum, P1, and P2 as in female. Furcal rami (Fig. 8) little shorter than those of female and with same ornamentation, length to width ratio = 1.35.

Antennule (Fig. 7m), not previously described, 9-segmented; first segment with leaflike pinnate seta on inner distal corner; second segment with 7 setae; third segment with round apophysis with 2 short and 2 long

setae. Fourth segment enlarged, with 1 distal seta and 1 tubercle bearing 1 seta and 1 aesthetasc. Fifth segment short, with 1 seta. Sixth segment with 3 short setae. Seventh segment enlarged, with 1 strong distal seta. Eighth segment with 4 distal setae. Ninth segment with 7 setae.

P3 (Fig. 9f), not previously described, similar to that of female, last segment of endopodite with 1 thin internal subapical seta, 2 pinnate apical setae. P4 (Fig. 9g), not previously described, similar to that of female.

P5 (Fig. 9d) with baseoendopodite approximately triangular, internal distal corner bearing 1 pointed curved appendix, having below its origin strong pinnate seta. Outer corner with terminal seta. Exopodite trapezoidal, large and squat, carrying, aligned on apical margin, 4 pinnate and 2 normal setae. P6 (Fig. 9d) small expansion with 3 setae.

Variability.—All features described above appeared to be constant in female specimens. In a male specimen from Pooc, P4 endopodite is one-segmented (Fig. 7g), and the anal operculum has four strong spines instead of three (Fig. 8c).

Remarks.—The description of *Phyllognathopus bassoti* that we have presented above corresponds to the original one (Rouch, 1972), at least for the main morphological features, in particular the shape and ornamentation of the anal operculum and furcal rami in both sexes. The ornamentation of P1–P4 of both sexes are the same, while the female P5 differs slightly in the shape of the inner lobe of the basipodite, which is shorter with one more seta in our specimens, while the ornamentation of the exopodite is the same. P5 of the male is a little different, since for Rouch the inner side of baseoendopodite has one apical pinnate seta, while in our specimens there is a strong seta (Fig. 9d) behind a triangular plate which is separated from the remaining appendage. The exopodite has five setae in specimens of *P. bassoti* of Long Island, and six in our specimens, which also have a bare basis of the mandibular palp. Other small differences in the ornamentation of mx1, mx2, mxp, and abdominal somites can be detected from figures.

Information on collecting sites.—*Parastenocaris mangyans*, new species, has been collected in two different groundwater habitats:



Fig. 10. *Parastenocaris mangyans*, new species, (c, d), paratype male; (a) paratype female; (b) paratype male, variability: a, mouthparts (5,000 \times); b, endopodite P3 (5,000 \times); c, basipodite P1, inner side (7,500 \times); d, furcal rami and anal operculum, lateral view (2,000 \times).



Fig. 11. *Parastenocaris mangyans*, new species, (a, b, d, e), paratype female; (c) paratype female, variability: a, habitus (350 \times); b, P1 (3,500 \times); c, endopodite P2 (3,500 \times); d, last abdominal somite, furcal rami, and anal operculum, lateral view (1,500 \times); e, P5 (3,500 \times).

in small islets of medium-fine sand, along a stream near the Mangyans Village of Talipanan and in a well in Sabang Village, about 6 m deep, 600 m from Big Laguna Beach. *Epactophanes philippinus*, new species, has been collected along the shores with medium-fine sand of the wide Matutinao River, about 3 km from the river mouth. *Phyllognathus bassoti* has been collected in several wells with depth ranging between 3 and 6 m, at a distance between 300 and 1,500 m from the sea at Pooc.

DISCUSSION

Parastenocarididae are widespread in subterranean habitats. We think that the number of *Parastenocaris* from the Philippines will increase. We have already collected another species (2 female copepodites) in the Mountain Province of Luzon Island, near Bontoc Town. The increasing number of descriptions of new *Parastenocaris* renders a revision of the genus even more necessary. In this regard, any peculiar new morphological features, such as the ventral integumental window on the genital somite of the female *P. mangyans* can be useful to define the taxonomic status of the new taxa.

Morphological features with important taxonomic meaning are very often the same or quite similar in taxa geographically very distant. In this case, convergence is the only possible explanation. For example, the morphology of the endopodite of the male P4 of *P. mangyans* resembles European and African species more than Asian species.

From a biogeographical point of view, the collection of *Phyllognathopus bassoti* widens remarkably the distribution area of this species. The species seems to be highly euryoecious and adaptable. It has been collected on a sandy islet in the middle of a volcanic lake, in Papua New Guinea, only 20 months after the formation of the islet, and on small Bantayan Island, located north of the larger Cebu Island, in fresh and slightly brackish wells, close to the sea. The contemporaneous collection of another *Phyllognathopus*, morphologically close to *P. viguieri* (Maupas, 1892) in the phreatic habitat of a river in Mindoro Island (Fig. 9a, b, c, e), demonstrates how these species have a wide distribution, probably because they are greatly adaptable and have colonized many aquatic habitats (Bozic,

1966a; Rouch, 1972) and also, at least for *P. viguieri*, the forest leaf-litter. *Phyllognathus viguieri* has been recently reported, together with *Epactophanes richardi*, on Oahu Island, Hawaii (Evenhuis and Preston, 1995) and in the leaf-litter of a forest of *Elaeocarpus* sp. on Agrihan Island, Micronesia (Kikuchi, 1994).

Species of *Phyllognathopus* are among the most widely distributed harpacticoids, together with species of *Epactophanes*. It is unlikely, according to Rouch (1972) and Bozic (1966b), to think that a single species, such as *P. viguieri*, even if very euryoecious, can be distributed world-wide in all the continents and in several oceanic archipelagos. It seems more logical to consider *P. viguieri* as a group of morphologically very similar species, which should be studied in a more detailed way, using biomolecular and/or biochemical methods, in order to solve this taxonomic problem.

ACKNOWLEDGEMENTS

This work was supported by grants from the Italian Ministero dell'Università e della Ricerca Scientifica e Tecnologica (M.U.R.S.T., funds 40% and 60%). We thank the staff of the Centro Interdipartimentale di Microscopia Elettronica of the Università della Tuscia, who helped us with scanning electron microscopy.

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RECEIVED: 27 April 1998.

ACCEPTED: 7 October 1998.

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ANNOUNCEMENT

The Sixth International Conference and Workshop on Lobster Biology and Management will be held at Key West, Florida, U.S.A., on 10–15 September 2000. Contributions in English on any topic pertaining to lobsters (spiny, slipper, clawed, or scampi) that are of scientific or management interest will be considered. Oral presentations, posters, workshops, and discussions are included. The meeting will be limited to 250 registrants.

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