Crustacea Decapoda:

A revision of the Indo-west Pacific species of palicid crabs

(Brachyura Palicidae)

Peter Castro

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Jody — Thank you help Pete

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ABSTRACT

The taxonomy of the crabs belonging to the family Palicidae Bouvier, 1898 from the Indo-west Pacific region is revised. On the basis of extensive material collected by French expeditions in the Coral Sea and other regions of the Pacific and Indian oceans, as well as material from numerous museums, including most of the types, the present study recognizes two subfamilies, 10 genera, and 43 species. Of these taxa, four are new genera: *Exopalicus*, *Miropalicus*, *Paliculus*, and *Rectopalicus*. *Manella* is synonymized with *Crossotonotus* A. Milne Edwards, 1873. *Parapleurophricoides* Nobili, 1906, sometimes believed to be a palicid, is a xanthoid and it is removed from the Palicidae. Nine nominal species described by previous authors are synonymized and an additional 17 species are described.

RÉSUMÉ

Crustacea Decapoda : Révision des espèces indo-ouest pacifiques de crabes palicides (Brachyura Palicidae).

La taxonomie des crabes de la famille Palicidae Bouvier, 1898, provenant de l'Indo-ouest Pacifique est révisée. Basée sur l'abondant matériel récolté par les expéditions françaises en mer de Corail et dans d'autres régions des océans Pacifique et Indien, ainsi que sur du matériel provenant de nombreux muséums renfermant la plupart des types, la présente étude reconnaît deux sous-familles, dix genres et 43 espèces. Parmi ces taxa, quatre sont des genres nouveaux : *Exopalicus*, *Miropalicus*, *Paliculus*, et *Rectopalicus*. Le genre *Manella* est mis en synonymie avec *Crossotonotus* A. Milne Edwards, 1873. *Parapleurophricoides* Nobili, 1906, parfois considéré comme étant un palicide, est un xanthide et est retiré de la famille Palicidae. Neuf espèces décrites antérieurement sont mises en synonymie, tandis que 17 autres sont décrites comme nouvelles.

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INTRODUCTION

Brachyuran crabs belonging the family Palicidae Bouvier, 1898 are a group rather neglected by taxonomists and ecologists alike, notwithstanding their sometimes frequent occurrence in several marine environments. The feeding habits, locomotion, reproduction, and larval development of palicids remain practically unknown. The evolution and biological significance of the reduced last pair of pereopods of most species remain vexing questions. The taxonomy of the family and its position within the Brachyura have also remained much neglected subjects.

The family Palicidae consisted of four ill-defined genera until the revision of the Indo-west Pacific species by MOOSA & SERÈNE (1981): *Palicus* Philippi, 1838, *Crossotonotus* A. Milne Edwards, 1873, *Pleurophricus* A. Milne Edwards, 1873, and *Manella* Rathbun, 1906. A fifth genus, *Parapleurophrycoides* Nobili, 1906 was questionably included in the family by SERÈNE (1968, as *Pleurophrycoides* [*sic*]). Most species were grouped into one genus, *Palicus*, with RATHBUN (1918) recognizing 21 western Atlantic and eastern Pacific species in six "groups". Three more species from this area (all in *Palicus*) were subsequently described. An additional species, *P. caronii* (Roux, 1830), is Mediterranean and eastern Atlantic in distribution. In the Indo-west Pacific, 24 species (16 in *Palicus*) had been described until 1981 (SERÈNE, 1968; ZARENKOV, 1968). While describing two new western Pacific species, ZARENKOV (1968: 765) briefly commented on RATHBUN's groups of *Palicus* species without revising her classification.

The first and until now the only major revision of Indo-west Pacific palicids was that of MOOSA & SERÈNE (1981). They separated the family into two subfamilies, Palicinae *s. str.* and Crossotonotinae Moosa & Serène, 1981. For the Palicinae, MOOSA & SERÈNE (1981) restricted *Palicus* for the Atlantic, Mediterranean, and eastern Pacific species, and established four new genera (*Neopalicus*, *Palicoides*, *Parapalicus*, and *Pseudopalicus*) for the 26 species they recognized from the Indo-west Pacific. Six new species were described from these genera. Within the subfamily Crossotonotinae, MOOSA & SERÈNE (1981) initially recognized four genera, *Crossotonotus*, *Parapleurophrycoides*, *Pleurophricus*, and *Manella*, with a total of six species. *Parapleurophrycoides* and its only species, however, were "discarded" since the description of the species was based on a juvenile "which cannot be used for the definition of the genus" (MOOSA & SERÈNE, 1981: 52).

Unfortunately, the revision of MOOSA & SERÈNE (1981) was based on limited material. They examined specimens belonging to only nine of the 24 Indo-west Pacific species known at the time and the type material of only one of the nine species. In addition, the identities of several species (such as *Parapleurophrycoides roseus* Nobili, 1906) were left unresolved.

Three Indo-west Pacific species of palicids were described after MOOSA & SERÈNE's revision: *Palicus trituberculatus* Chen, 1981 (its description was apparently published before the revision), *Palicus bidentatus* Sakai, 1983, and *Parapalicus nanshaensis* Dai & Xu, 1991, bringing the total number of nominal species known from the region to 33. About 58% of all the known species of palicids (34 out of 58) are Indo-west Pacific in distribution.

The study of a large collection of palicids from numerous French expeditions (mostly from the Coral Sea but also from several other areas of the Indo-west Pacific region) plus type material and other specimens from museums, institutions, and private collections from around the world provided the opportunity to undertake a more comprehensive revision of the Indo-west Pacific Palicidae.

PRESENTATION AND TERMINOLOGY

A list of complete references is given for each of the species treated, while references for the family are restricted to those where characters or the status of the family are discussed. All geographic names in English follow, whenever possible, the orthography given in the ninth revised edition (1993) of the *Times Atlas* (Times Books, London).

The measurements given in the text, unless specified, refer to carapace length (CL) and carapace width (CW). The length of the carapace was measured across the middle of the carapace from the tip of the longest lobe of the frontal border to the posterior border, including any tubercles along the posterior border. The width of the carapace was measured across the widest breadth, including the longest anterolateral tooth on each side.

The total length of the walking legs (P2-4) was measured along each segment from the proximal edge of the merus to the tip of the dactylus. The fifth pair of pereopods were measured from the proximal edge of the basis-ischium to the tip of the dactylus. The abdomen was treated as consisting of six segments and a telson.

The terminology used to refer to parts of the dorsal surface of the carapace and pereopods is summarized in Fig. 1, while that used to refer to the anterior and ventral surfaces of the carapace, male and female abdomens, and male first pleopods is summarized in Fig. 2.

The depth range reported for each species gives the minimum and maximum depths at which each species was collected with accuracy. Extreme depth values are also given for some species since dredgings depths in some of the stations varied widely and it was impossible to know the exact depths of collection.

The following abbreviations are used to refer to the deposit of the examined material.

AM. — Australian Museum, Sydney, Australia.
ASIO. — Institute of Oceanology, Academia Sinica, Qingdao, China.
ASIZB. — Academia Sinica, Beijing, China.
ASIZT. — Institute of Zoology, Academia Sinica, Taipei, Taiwan.
BMNH. — The Natural History Museum [formerly British Museum (Natural History)], London, U.K.
BPBM. — Bishop Museum, Honolulu, Hawaii, U.S.A.

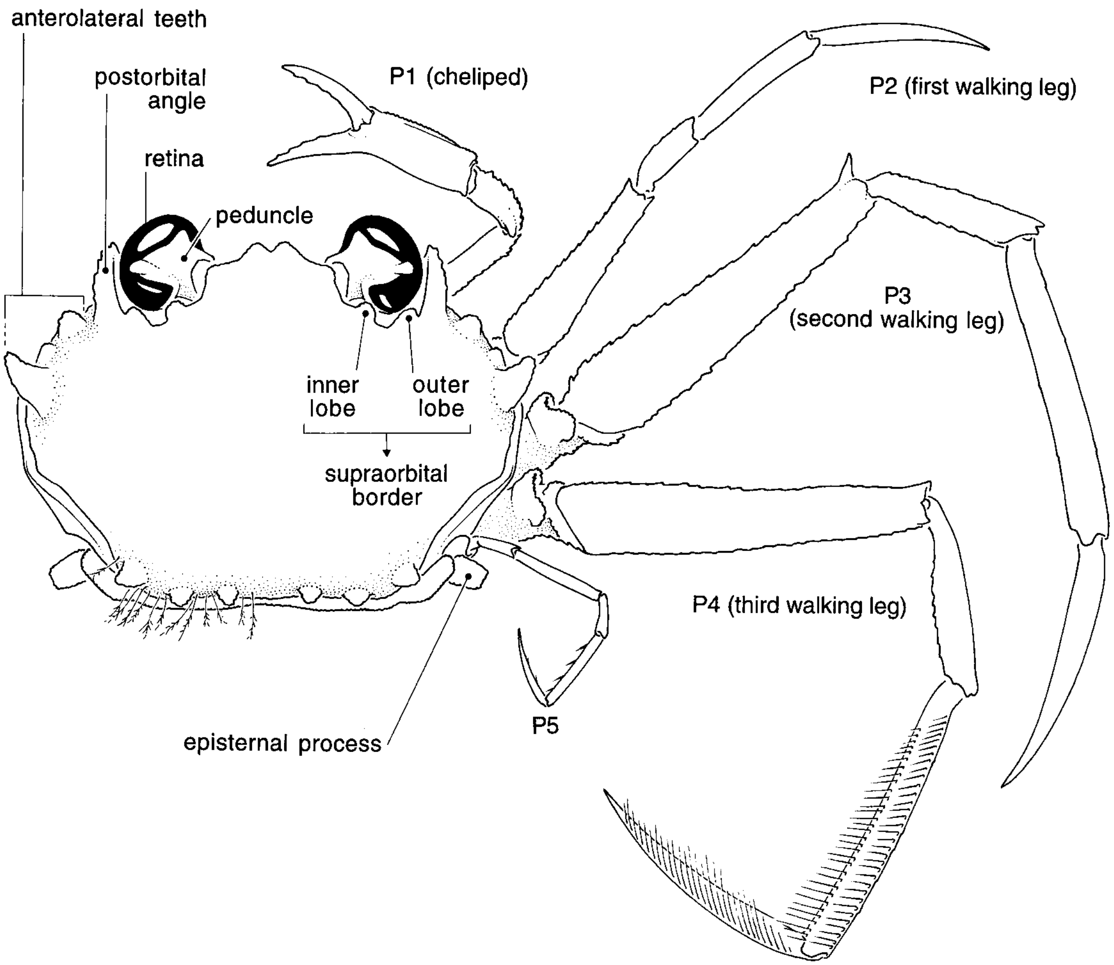

FIG. 1. — Terminology used to describe the carapace and the pereopods.

CBM. — Natural History Museum and Institute, Chiba, Japan.
HSM. — Hayama Shiosai Museum, Hayama, Japan.
KMNH. — Kitakyushu Museum of Natural History, Kitakyushu, Japan.
KPM. — Kanagawa Prefectural Museum of Natural History, Odawara, Japan.
LACM. — Natural History Museum of Los Angeles County, Los Angeles, California, U.S.A.
MCZ. — Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, U.S.A.
MNHN. — Muséum national d'Histoire naturelle, Paris, France.
MZUF. — Museo di Zoologia "La Specola", Università di Firenze, Italy.
NTOU. — National Taiwan Ocean University, Keelung, Taiwan.
PMBC. — Phuket Marine Biological Center, Phuket, Thailand.
QM. — Queensland Museum, Brisbane, Australia.
RDC. — Research & Development Center for Oceanography, Jakarta, Indonesia.
RMNH. — Nationaal Natuurhistorisch Museum (formerly Rijksmuseum van Natuurlijke Historie), Leiden, The Netherlands.
SAM. — South African Museum, Cape Town, South Africa.
SMF. — Forschungsinstitut Senckenberg, Frankfurt am Main, Germany.
UMZ. — University Museum of Zoology, University of Cambridge, Cambridge, United Kingdom.
USNM. — United States National Museum, Smithsonian Institution, Washington, D.C., U.S.A.

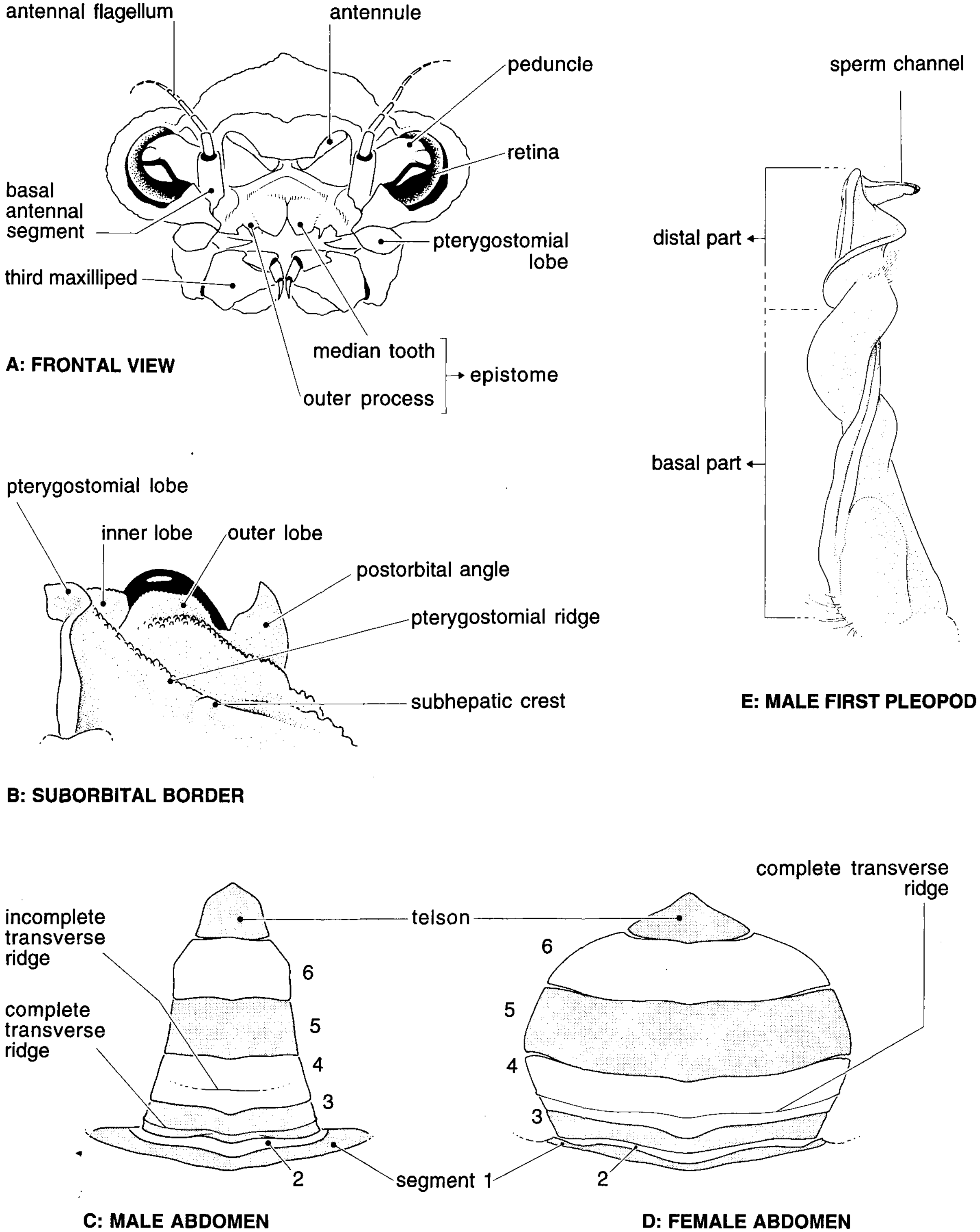

FIG. 2. — Terminology used to describe: **A**, anterior end of the carapace; **B**, suborbital border of the carapace in *Pseudopalicus* and most other genera of palicids; **C**, male abdomen; **D**, female abdomen; **E**, male first pleopod.

WAM. — Western Australian Museum, Perth, Australia.
ZLKU. — Zoological Laboratory, Kyushu University, Fukuoka, Japan (now at Kitakyushu Museum of Natural History, Kitakyushu, Japan).
ZMA. — Zöologisch Museum, Universiteit van Amsterdam, The Netherlands.
ZMB. — Museum für Naturkunde (Zoologisches Museum), Universität Humboldt, Berlin, Germany.
ZMMU. — Zoological Museum, Moskow State University.
ZMUC. — Zoologisk Museum, Københavns Universitet, Copenhagen, Denmark.
ZMUH. — Zoologisches Institut und Zoologisches Museum, Universität Hamburg, Germany.
ZRC. — Zoological Reference Collection, Raffles Museum, Department of Biological Sciences, National University of Singapore, Singapore.

The expedition stations from which material was examined were described in the following publications:

BATHUS 1 to BATHUS 4: RICHER DE FORGES & CHEVILLON, 1996.
BERYX 11: LEHODEY *et al.*, 1992.
BIOCAL: RICHER DE FORGES, 1990.
BORDAU 1: RICHER DE FORGES *et al.*, 2000b
CHALCAL 1: RICHER DE FORGES, 1991.
CHALCAL 2: RICHER DE FORGES, 1990.
CORAIL 2: RICHER DE FORGES, 1991.
CORINDON: MOOSA, 1984.
Expédition MONTROUZIER: BOUCHET, 1994.
HALICAL 1: GRANDPERRIN *et al.*, 1995.
HALIPRO 1: RICHER DE FORGES & CHEVILLON, 1996.
KARUBAR: CROSNIER *et al.*, 1997.
LAGON: RICHER DE FORGES, 1991.
MUSORSTOM 1: FOREST, 1981.
MUSORSTOM 2: FOREST, 1985.
MUSORSTOM 3: FOREST, 1989.
MUSORSTOM 4 to MUSORSTOM 6: RICHER DE FORGES, 1990.
MUSORSTOM 5: RICHER DE FORGES *et al.*, 1986.
MUSORSTOM 7: RICHER DE FORGES & MENOU, 1993.
MUSORSTOM 8: RICHER DE FORGES *et al.*, 1996.
MUSORSTOM 9: RICHER DE FORGES *et al.*, 1996.
MUSORSTOM 10: RICHER DE FORGES *et al.*, 2000a
REVES 2: MARCHAL *et al.*, 1981.
SMIB 3, 4: RICHER DE FORGES, 1990.
SMIB 5, 6: RICHER DE FORGES, 1991; 1993.
SMIB 8: RICHER DE FORGES & CHEVILLON, 1996.
"Vauban" dredgings: RICHER DE FORGES, 1990.
VOLSMAR: LABOUTE *et al.*, 1989.

There is no available report on the LITHIST cruise carried out by R.V. *"Alis"* on the Norfolk Ridge Seamounts (4-8 August 1999).

SYSTEMATIC ACCOUNT

Family PALICIDAE Bouvier, 1898

Cymopoliidae Faxon, 1895: 38. — RATHBUN, 1918: 182. — SAKAI, 1939: 607. — BOUVIER, 1940: 303. — MONOD, 1956: 387. — BALSS, 1957: 1661.

Palicés Bouvier, 1897: 785 [vernacular].
Palici Bouvier, 1898a: 105.
Palicidae - RATHBUN, 1898: 600. — ALCOCK, 1900: 285, 450. — ZARENKOV, 1968: 762, 765. — TAKEDA & SHIMAZAKI, 1974: 75. — GUINOT, 1978: 249; 1979: 111. — MOOSA & SERÈNE, 1981: 22. — WILLIAMS, 1984: 481.
Palicae Bouvier, 1898b: 56, 58.

TYPE GENUS. — *Palicus* Philippi, 1838.

DIAGNOSIS. — Dorsal surface of carapace typically depressed, granular, often with high bosses of varying sizes; confluence of branchial and mesogastric regions depressed. Frontal border of carapace divided into 2-4 lobes. Anterolateral borders each with a varying number (1-4) of triangular, rounded, or truncate teeth. Supraorbital and suborbital borders long, usually with lobes (may be dentiform); orbits deep, wide. Antennae with basal segment rectangular or variously expanded; flagellum well developed. Retina of eyes dorsoventrally flattened or spherical; peduncles typically long, with soft or granular tubercles. Chelipeds small to moderate in size, equal or unequal (particularly in males). Antennules long, transversely folded beneath front; interantennular septum narrow. Epistome ventrally inclined (sunken) or dorsoventrally expanded. Buccal cavity square, mostly but not completely covered by third maxillipeds. Meri of third maxillipeds small, with palp on each inner border. Fifth pair of pereopods (P5) characteristically reduced in size (less than CL in practically all species), conspicuously more slender or of same morphology as anterior walking legs (P2-4). Male opening sternal; sperm ducts under sternal plates, penis soft, curved, free on inner side of coxae. Male first pleopods with helicoidal or sinuous basal parts, distal parts uniramous or biramous. Male and female abdomens with six segments plus telson, some (segments 1-2) can be dorsoventrally compressed, others fused. Male abdomen narrower than sternum, with both sides parallel to each other or triangular; locking mechanism with very low to medium-size tubercle at edge of thoracic sternite 5 and shallow concavity on underside (ventral surface) of abdominal segment 6. Abdomen of mature females rounded, broad, thoracic sternite 8 visible laterally; triangular in immature females. Vulva large, visible on thoracic sternite 5 but actually in sternite 6.

SUBFAMILIES INCLUDED. — Palicinae Bouvier, 1898; Crossotonotinae Moosa & Serène, 1981.

DISCUSSION. — The use of the name Palicidae (with *Palicus* Philippi, 1838 as the type genus) for the family instead of Cymopoliidae (with *Cymopolia* Roux, 1830 as the type genus) is by now accepted. The name *Cymopolia* is preoccupied by an alga, *Cymopolia* Lamouroux, 1816 (see HOLTHUIS & GOTTLIEB, 1958: 104). The use of *Cymopolia* and Cymopolidae has been rejected and the name "Palicidae Rathbun" placed in the official list of valid names (*Bulletin of Zoological Nomenclature*, 1964, 21: 336-351; 338, 341, 342, 344).

The correct authorship of the name Palicidae is a complicated question that fortunately has been clarified by L.B. HOLTHUIS (*in litt.*). RATHBUN (1898: 600) is generally credited as first using the family name Palicidae. It is the author of the family name Palicidae that is placed in the official list of valid names in zoology (see above). BOUVIER (1897: 785) for the first time used the term "Palicés" for a group based on the name of the genus *Palicus* but the name is not valid since it is a vernacular name (International Code of Nomenclature, fourth edition, 1999, article 11.3). An English translation (BOUVIER, 1898a) of BOUVIER's 1897 paper uses "palicids" as a translation of "Palicés" and as a vernacular name it is also invalid. A footnote on the same paper (BOUVIER, 1898a: 105) that is absent in the original paper in French states that the subfamily Dorippinae was to be subdivided into two tribes: "Palici (*Palicus*) and Dorippi (*Ethusa*, *Ethusina*, *Dorripe*)". The name "Palici" is an available name for the family since it was used for a suprageneric taxon and it was written in Latin. The name "Palicae" was also used by BOUVIER (1898b: 56, 58), which was published in the same year. Since its exact publication date could not be determined, 31 December 1898 is adopted as the publication date (International Code of Nomenclature, fourth edition, 1999, article 21.3.2). Palicidae BOUVIER, 1898 (a correction of "Palici"), which was published in January 1898 (BOUVIER, 1898a), thus has priority over Palicidae RATHBUN, 1898, which was published in June 1898.

The systematic position of the family Palicidae within the Brachyura remains uncertain. The placement of the family in relation to other families has varied from author to author (see MOOSA & SERÈNE, 1981: 22; WILLIAMS, 1984: 481). Before the establishment of the family, some of the species now included in the subfamily Crossotonotinae were initially placed in various groups of the Brachyura (see discussion of the subfamily below).

Most evidence places the family close to the family Dorippidae (superfamily Dorippoidea of Heterotremata following GUINOT, 1977). There are similarities in the functional morphology of the male and female reproductive systems (GUINOT, 1979: 112, 113; 1978: 250) and in the circulation of respiratory water (MOOSA & SERÈNE, 1981: 23) as well as in what little is known about the morphology of the larvae (GURNEY, 1942: 275). The investigation of larval development and DNA analyses should provide some fresh evidence to support this or other alternate hypotheses.

The family was divided into two subfamilies by MOOSA & SERÈNE (1981: 23). Although radically different in the shape of their walking legs, *Crossotonotus* and the allied *Pleurophricus*, which are grouped together as the subfamily Crossotonotinae, share many characters with the remaining palicids so their inclusion in the family Palicidae is not in doubt.

Key to the subfamilies of the family Palicidae

1. Fifth pair of pereopods (P5) conspicuously reduced, shorter, more slender than anterior walking legs (P2-4), with articulation to carapace dorsal to those of P2-4. Segments 1-2 of male and female abdomens dorsoventrally compressed and very narrow in comparison to remaining four segments of abdomen .... PALICINAE Bouvier, 1898

— Fifth pair of pereopods (P5) shorter but similar in shape to anterior walking legs (P2-4), with articulation to carapace at same level as those of P2-4. Segments 1-2 of male and female abdomens wide, not dorsoventrally compressed .... CROSSOTONOTINAE Moosa & Serène, 1981

Subfamily PALICINAE Bouvier, 1898

Palicinae Moosa & Serène, 1981: 23.

TYPE GENUS. — *Palicus* Philippi, 1838

DIAGNOSIS. — Fifth pair of pereopods (P5) reduced in size to less than length of carapace, different in shape to anterior walking legs (P2-4); articulation to carapace dorsal to walking legs. Carapace with very conspicuous teeth or pointed tubercles only along anterolateral border. Dorsal surface of carapace typically convex. Episternal process of thoracic sternite 7, sometimes reduced, overhanging each posterolateral border of carapace posterior to fifth pair of pereopods. Epistome dorsoventrally broadened. Abdomen of males and females with segments 1-2 dorsoventrally compressed, some segments may be fused, complete or incomplete, transverse ridges (carinae) may be present.

GENERA INCLUDED. — Nine genera are included, by alphabetical order: *Exopalicus* new genus, *Miropalicus* new genus, *Neopalicus* Moosa & Serène, 1981, *Palicoides* Moosa & Serène, 1981, *Paliculus* new genus, *Palicus* Philippi, 1838, *Parapalicus* Moosa & Serène, 1981, *Pseudopalicus* Moosa & Serène, 1981, *Rectopalicus* new genus.

DISCUSSION. — The subfamily was recognized by MOOSA & SERÈNE, 1981 as a group for all palicids with a reduced and slender fifth pair of pereopods. The subfamily includes all Atlantic, Mediterranean, and eastern Pacific species (all of which make up *Palicus*) as well as eight genera that are restricted to the Indo-west Pacific region. *Palicus* [with *Palicus granulatus* Philippi, 1838, a junior subjective synonym of *Cymopolia caronii* Roux, 1830, as its type species by monotypy] needs to be revised. As it now stands, it is undoubtedly heterogeneous, a suggestion indirectly made by RATHBUN (1918: 184) with her grouping of 21 American species into six different groups.

TABLE 1. — Morphological differences between *Palicus* Philippi, 1838 (as exemplified by *P. caroni* Roux, 1830), *Parapalicus* Moosa & Serène, 1981, *Pseudopalicus* Moosa & Serène, 1981, *Parapalicus* Moosa & Serène, 1981, *Miropalicus* new genus, *Paliculus* new genus, *Rectopalicus* new genus, *Rectopalicus* new genus, *Neopalicus* Moosa & Serène, 1981, and *Palicoides* Moosa & Serène, 1981.

	Palicus Philippi, 1838 (*P. caroni* Roux 1830)	***Pseudopalicus*** Moosa & Serène, 1981	***Parapalicus*** Moosa & Serène, 1981	***Miropalicus*** new genus
Carapace	Subquadrate; granular; four lobes on anterior border	Transversely hexagonal; conspicuous granular bosses; four lobes on anterior border	Transvarseley subovate; granules and mostly shallow bosses; two small lobes (can be secondarilly notched) on anterior border	Transversely subovate; granules and shallow bosses; two small lobes on anterior border
Antennae	Basal antennal segment not expanded; flagellum with setae	Basal antennal segment slender or slightly expanded; flagellum with many conspicuous setae	Basal antennal segment slightly expanded (scale-like); flagellum with setae	Basal antennal segment slender, not expanded; flagellum with setae
Eyes	Cornea spherical, wider than peduncle; conspicuous tubercles on peduncle	Cornea dorso-ventrally flattened or spherical, wider or as wide as peduncle	Cornea dorsoventrally flattened, wider than peduncle	Cornea dorso-ventrally flattened, much wider than peduncule
Supraorbital borders	Two large triangular lobes	Two lobes	1-2 notches	Two shallow, round lobes
Suborbital borders	Two wide, shallow lobes	Two lobes	Typically two teeth-like lobes	Inner lobe limited by large pterygostomial lobe; one shallow, round outer lobe
Anterolateral borders	2-3 large, flat teeth	3-4 typically pointed teeth	One triangular or round tooth	Three round teeth
Epistome	Narrow	Narrow	Dorsoventrally expanded	Narrow
Chelipeds	Large and heavily tuberculated in males; one slender and one larger in females	Heavy, unequal and tuberculated in males; more slender and more equal in females	Very slender, elongate and equal in males and females; small tubercles, teeth, or smooth surface	Large, unequal in males and females; heavy tubercles
Pereopod 2 (leg 1)	Only slightly shorter than P3-4; flattened	More slender and shorter than P3-4; flattened	More slender and shorter than legs P3-4; filiform	More slender and shorter than P3, only sligthly longer than P4; filiform
Pereopod 3 (leg 2)	Long, flattened; meri with unequal tubercles outer border of dactylus entire	Long, flattened; meri with unequal tubercles; posterior border of dactylus entire or with teeth	Very long, slender and filiform; meri with equal tubercles; posterior border of dactylus entire	Very long, slender and filiform; meri with equal tubercles; proximal, posterior border of dactylus with short spines
Pereopod 5	Short, slender; granules on segments, thick spines on merus and propodus	Short, slender, small tubercles and spines; slightly thicker in some species	Short, very slender; granules and spines	Short, very slender; granules and spines
Mature male abdomen	Elongate, sides almost parallel; complete segments; ridge along each segment 1-4	Elongate, sides almost parallel; complete segments; ridge typically along each segment 2-3 but varies according to species	Triangular; segments 3-5 fused; tubercles on segment 3 and usually on 4	Elongate, sides almost parallel; complete segments; ridge along each segment 1-4
First male pleopod	Sinuous basal part	Sinuous basal part; mostly biramous but some uniramous distal part	Sinuous basal part; uniramous or sinuous tips	Straight basal part; uniramous distal part
Mature female abdomen	Complete segments; ridge along each segment 1-4	Complete segments; typically ridge along each segment 2-4 but varies according to species	Segments 3-5 fused; typically ridge along each segment 1-4	Complete segments; ridge along each segment 1-5

	Paliculus new genus	***Rectopalicus*** new genus	***Exopalicus*** new genus
Carapace	Subquadrate; tuberculate; two small lobes on anterior border	Subquadrate or subpyriform; 2-4 lobes on anterior border	Hexagonal; two lobes on anterior border
Antennae	Basal antennal segment slender or slightly expanded; flagellum with conspicuous setae	Basal antennal segment rectangular and thick; flagellum short with few setae	Basal antennal segment short, rectangular; flagellum short with few setae
Eyes	Cornea dorsoventrally flattened; conspicuous tubercles on peduncle	Cornea dorsoventrally flattened; granular tubercles on peduncle	Cornea dorsoventrally flattened; granular tubercles on very short peduncle
Supraorbital borders	One or two lobes	Two lobes	One shallow lobe

Suborbital borders	Inner lobe limited by large pterygostomial lobe; 1-2 outer lobes	Two lobes	Two lobes
Anterolateral borders	1-4 pointed teeth	Shallow, truncate teeth	Three broad and triangular teeth plus tubercles
Epistome	Narrow	Narrow or dorsoventrally expanded	Slightly expanded dorsoventrally
Chelipeds	Unequal in males and females; more slender in females	Unequal or nearly equal in males and females	Equal in males and females
Pereopod 2 (leg 1)	More slender and shorter than P3-4; filiform or flattened	More slender and shorter than P3-4; flattened	More slender and shorter than P3-4; flattened
Pereopod 3 (leg 2)	Very long, slender and filiform or shorter, flattened; merus with equal or unequal tubercles; posterior border of dactylus entire	Long, flattened; merus with nearly equal tubercles; posterior border of dactylus with spines	Long, flattened; merus with nearly equal tubercles; posterior border of dactylus with spines
Pereopod 5	Short, very slender; posterior border of dactylus with spines	Short, thick or slender; posterior border of dactylus with spines	Very short, thick; posterior border of dactylus with few spines
Mature male abdomen	Elongate, sides almost parallel; complete segments; ridge along each segment 1-4	Elongate, sides almost parallel; complete segments; ridge along each segment 1-3 or 1-4	Elongate, sides almost parallel, tuberculate; complete segments; ridge along each segment 1-5
First male pleopod	Straight basal part; biramous distal part	Sinuous basal part; uniramous or biramous distal part	Sinuous basal part; uniramous distal part
Mature female abdomen	Segments 3-5 or 4-6 fused; ridge along each segment 1-3	Segments complete; ridge along each segment 1-4	Segments complete; ridge along each segment 1-4

	Neopalicus Moosa & Serène, 1981	*Palicoides* Moosa & Serène, 1981
Carapace	Subquadrate; large granules in horizontal rows and shallow bosses; two lobes on anterior border, each followed by notch	Subquadrate; large granules and shallow bosses; two lobes on anterior border
Antennae	Basal antennal segment expanded as thick or V-shaped process; flagellum with very few setae	Basal antennal segment expanded as thick, scale-like process; segments 2-3 expanded and with many long setae; flagellum short with few setae
Eyes	Cornea spherical, almost as wide as peduncle; conspicuous (round, not crescent-shaped) tubercle on peduncle	Cornea spherical, almost as wide as peduncle; conspicuous crescent-shaped process on peduncle
Supraorbital borders	1-2 triangular lobes	1-2 triangular lobes
Suborbital borders	Two triangular lobes	Two lobes
Anterolateral borders	Two slightly salient, truncate teeth	Two trucate teeth
Epistome	Dorsoventrally expanded	Dorsoventrally expanded
Chelipeds	Long and slender, thicker in males; very small to large tubercles	Long and slender, nearly equal in males and females, heavier and longer in males; small tubercles
Pereopod 2 (leg 1)	More slender and shorter than P3-4; flattened	More slender and shorter than P3-4; flattened
Pereopod 3 (leg 2)	Long, flattened; merus with unequal tubercles; anterior border of propodus with convex expansion; posterior border of dactylus entire	Long, flattened; merus with unequal tubercles; posterior border of dactylus entire
Pereopod 5	Short, thick and granular; thick spines on posterior border of propodus	Short, thick and granular; thick spines on posterior border of propodus
Mature male abdomen	Elongate, sides almost parallel; complete segments; ridge along each segment	Elongate, sides almost parallel; fusion of segments varies according to age and species; ridge typically along each segment
First male pleopod	Sinuous basal part; biramous distal part	Sinous basal part; biramous distal part
Mature female abdomen	Complete segments; ridge along each segment	Segments 2-6 fused; ridge along each segments 1-2 and two along fused segment 3-6.

Key to the Indo-west Pacific genera of the subfamily Palicinae

1. Walking legs (P2-4) not slender, with flattened carpi and propodi; meri with unequal tubercles or teeth (rounded tubercles if equal or nearly equal) along upper and lower borders; dactyli may be armed with teeth or spines along complete length of posterior borders .. **2**
— Walking legs (P2-4) typically very slender, with elongate meri, filiform (long, very narrow) propodi and dactyli; meri with equal or nearly equal, small (or flat, rounded if not small) tubercles along upper and lower borders; dactyli without teeth or spines along complete length of posterior borders **6**

2. Carapace transversely hexagonal (clearly wider than long), with conspicuously curved anterolateral borders that are armed with triangular and pointed or rounded teeth **3**
— Carapace subquadrate (almost as wide as long), with straight or only slightly curved anterolateral borders that are armed with truncate teeth **4**

3. Dorsal border of carapace slightly convex. Eye peduncles long. Walking legs long to very long, P3 much longer than carapace length (1.5 CL or more) .... ***PSEUDOPALICUS*** Moosa & Serène, 1981
— Dorsal border of carapace conspicuously convex, almost hemispherical in outline. Eye peduncles very short (Fig. 38a). Walking legs conspicuously short, P3 only slightly longer than carapace length (1.2 CL or less) .... ***EXOPALICUS*** new genus

4. Supraorbital borders with rounded or rectangular lobes. Posterior borders of propodi and dactyli of walking legs (P2-4) with spines .... ***RECTOPALICUS*** new genus
— Supraorbital borders with triangular, dentiform lobes. Posterior borders of propodi and dactyli of walking legs (P2-4) entire, without spines **5**

5. Eye peduncles with rounded, granular tubercles. Anterior borders of propodi of P3-4 with wide, convex enlargement .... ***NEOPALICUS*** Moosa & Serène, 1981
— Eye penduncles with thin, calcified, crescent-shaped process on anterior border. Anterior borders of propodi of P3-4 without conspicuous enlargement .... ***PALICOIDES*** Moosa & Serène, 1981

6. One triangular or rounded tooth on anterolateral side of carapace. Abdomen of males triangular. Basal antennal segment slightly expanded distally, forming scale-like structure .... ***PARAPALICUS*** Moosa & Serène, 1981
— Two to four narrow, pointed teeth or 2-5 rounded tubercles on anterolateral side of carapace. Abdomen of males elongate (sides almost parallel to each other). Basal antennal segment rectangular or, if expanded distally, not forming scale-like structure **7**

7. Supraorbital borders with two very short lobes. Two to five rounded tubercles on anterolateral side of carapace. Abdomen of mature females with all segments free .... ***MIROPALICUS*** new genus
— Supraorbital borders with 1-2 rounded or pointed lobes. Two to four narrow, pointed teeth on anterolateral side of carapace. Abdomen of mature females with segments 3-6 or 4-6 fused .... ***PALICULUS*** new genus

Genus *PSEUDOPALICUS* Moosa & Serène, 1981

Pseudopalicus Moosa & Serène, 1981: 35.

TYPE SPECIES. — *Palicus serripes* Alcock & Anderson, 1895 by original designation (MOOSA & SERÈNE, 1981). Gender: masculine.

DIAGNOSIS. — Frontal border of carapace divided into four elongate or rounded lobes, inner pair more advanced anteriorly than outer pair. Anterolateral borders each with 3-4 triangular or rounded teeth. Dorsal surface of carapace typically with high, granular bosses. Eyes dorsoventrally flattened or spherical; peduncle with small, typically granular tubercles. Supraorbital borders each with two triangular or rounded lobes. Suborbital borders each typically with two rounded or square lobes. Each basal antennal segment rectangular, typically slender, without distal expansion. Epistome narrow, vertically inclined; border with at least two triangular or rounded median teeth. Chelipeds increasingly unequal with increasing body size (particularly in males), smallest typically more slender in females. First three pairs of walking legs (P2-4) with flattened (not filiform) carpi, propodi, and (with one exception) dactyli. First pair (P2) shorter than second and third pairs (P3-4); third pair slightly shorter or about as long as second pair. Borders of meri of P2-4 with thick tubercles or triangular teeth; posterior border of dactyli smooth or armed with teeth or spines. Fifth pair of pereopods (P5) reduced (0.6-0.9 CL), slender. Abdomen of males elongate (sides almost parallel to each other), with segments free, one transverse ridge each along some or all segments. Male first pleopods long, slender; basal parts straight or sinuous but not helicoidal; each distal part biramous, rarely uniramous. Abdomen of mature females with all segments free, one transverse ridge along each segment 1-4.

REDESCRIPTION. — Carapace transversely hexagonal, broader than long, with conspicuous, granular bosses that vary in sizes and arrangements. Anterolateral borders each with 3-4 triangular or rounded teeth, below which carapace slightly rounded. Confluence of branchial and mesogastric regions depressed, smooth; no conspicuous sulcus between hepatic and branchial regions. Thoracic sternite 7 typically with reduced process (episternal process) at each outer edge and posterior to insertion of fifth pair of pereopods (P5), visible dorsally as very short process below posterolateral border of carapace.

Frontal border divided into four elongate or rounded lobes, inner pair more advanced anteriorly than outer pair. Supraorbital borders each with two triangular or rounded lobes. Postorbital angles conspicuous, typically with long, pointed tips. Cornea of eyes dorsoventrally flattened, wider than base of eye peduncle, or spherical and as wide as base of peduncle; peduncle with granular tubercles at least on distal border. Orbits deep.

Suborbital borders each with two broadly rounded or rectangular lobes. Pterygostomial lobe at each anterolateral angle of buccal frame often projects ventrally.

Each basal antennal segment rectangular, usually slender, without distal expansion. Epistome narrow, not expanded dorsoventrally, vertically inclined. Border of epistome with two median teeth (plus two triangular outer processes in most species) connecting distally with each pterygostomial lobe. Meri of third maxillipeds smaller and narrower than ischia.

Chelipeds increasingly unequal with increasing size (particularly in males), smallest typically more slender in females. Fingers of larger cheliped with cutting edge, sometimes with broadly rounded teeth; those of smaller cheliped with short, triangular teeth, pollex becoming flatter with increasing size. First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair slightly shorter or as long as second. First three pairs of walking legs (P2-4) with flattened carpi, propodi, and (with one exception) dactyli; anterior (dorsal) and posterior (ventral) borders of meri with thick tubercles or triangular teeth, often rows of tubercles on dorsal and ventral surfaces; posterior border of dactyli smooth or armed with teeth or spines. Last two pairs of walking legs (P3-4) each with broad coxae, having laminar, thin-edged anterior and posterior borders. Fifth pair of pereopods (P5) reduced (0.6-0.9 CL), slender; basis-ischia and meri often short, tuberculate; one row of small spines along posterior border of dactyli.

Abdomen of mature males elongate, with both sides almost parallel to each other, with all segments free, segments 1-2 dorsoventrally compressed, one transverse ridge each along some or all segments. Male first pleopods long, slender; basal parts straight or sinuous but not helicoidal; each distal part biramous (with two typically flattened processes) or uniramous (with simple tip). Second male pleopods short, thin, slightly curved; distal segment with blunt tip.

Abdomen of mature females broad, rounded, with all segments free, segments 1-2 dorsoventrally compressed, one transverse ridge each along segments 1-4. Abdomen of immature females triangular (but broader than in males), segments 1-2 dorsoventrally compressed, 3-5 or 3-6 fused, transverse ridge along each segment 1-3 or 1-4.

SPECIES INCLUDED. — There are 11 known species of *Pseudopalicus*, by alphabetical order: *P. acanthodactylus* sp. nov., *P. amadaibai* (Sakai, 1963), *P. declivis* sp. nov., *P. glaber* sp. nov., *P. investigatoris* (Alcock, 1900), *P. macromeles* sp. nov., *P. oahuensis* (Rathbun, 1906), *P. pictus* sp. nov., *P. serripes* (Alcock & Anderson, 1895), *P. sexlobatus* (Kensley, 1969), *P. undulatus* sp. nov. A possible new species, being referred to as *Pseudopalicus* sp., is known from only one incomplete specimen.

SEXUAL DIMORPHISM. — There is a considerable difference in size between males and females, with females being larger. The chelipeds are unequal in size in both sexes but the difference is more apparent in males. The smaller cheliped is usually more slender in females. There is no evidence of differences between the sexes in the length or shape of the walking legs or fifth pair of pereopods.

DISCUSSION. — *Pseudopalicus* was established by MOOSA & SERÈNE (1981) for eight Indo-west Pacific species formerly included in *Palicus* Philippi, 1838. However, they actually examined specimens of only two species, *P. amadaibai* (Sakai, 1963) and *P. serripes* (Alcock & Anderson, 1895). Two of the original eight species, *P. fisheri* (Rathbun, 1906) and *P. cyrenae* (Ward, 1942), are being placed in synonymy with *P. investigatoris* (Alcock, 1900). The present definition of the genus has therefore been amended to include characters present in the 12 recognized species, including six new ones, that were examined in this study.

The shape of the carapace and walking legs of *Pseudopalicus* agree with the same characters of group 1 (or "typical" group) as defined by RATHBUN (1918: 184) for six western Atlantic and eastern Pacific species of *Palicus*. Four of these species have four anterior lobes as in *Pseudopalicus*: *Palicus affinis* A. Milne Edwards & Bouvier, 1899, *P. alternatus* Rathbun, 1897, *P. faxoni* Rathbun, 1897, and *P. lucasii* Rathbun, 1898. They all have two anterolateral teeth on each side of the carapace, however, unlike the four typical of *Pseudopalicus*. None of these species seem to have the convex carapace with conspicuous bosses typical of *Pseudopalicus* (see RATHBUN, 1918; WILLIAMS, 1984; MELO, 1996). *P. velerae* (Garth, 1939) from the eastern Pacific has a carapace with four anterior lobes, five anterolateral teeth on each side, and short walking legs similar to *Pseudopalicus*, but prominent episternal processes as in *Parapalicus*. It perhaps belongs to group 4 of RATHBUN on account of the presence of conspicuous episternal processes. There are also similarities with the three western Atlantic and eastern Pacific species in group 5 of RATHBUN (1918: 184): *P. dentatus* (A. Milne Edwards, 1880), *P. obesus* (A. Milne Edwards, 1880), and *P. tuberculatus* (Faxon, 1893). These species have four anterior lobes, convex carapace, conspicuous bosses, and short walking legs. They differ from *Pseudopalicus* in having two or three anterolateral teeth (see RATHBUN, 1918; MELO, 1996). There is unfortunately incomplete information on the morphology of the abdomen and no published information on the male first pleopods of these western Atlantic and eastern Pacific species.

An unidentified palicid (USNM) from off the coast of northern Peru in the eastern Pacific had a carapace very similar to that of *Pseudopalicus*, with four anterior lobes, well-developed bosses, four anterolateral teeth on each side, and two supraorbital and two suborbital lobes on each side. The male first pleopods, however, had long, helicoidal basal parts and each distal part consisting of a rounded, flat, proximal process and a very long, slightly-curved, pointed process, quite unlike the male pleopods of *Pseudopalicus* species. Furthermore, the epistome lacked teeth, each basal antennal segment had a flat, scale-like, distal extension, the fifth pereopods were thicker than those in *Pseudopalicus*, and the fingers of the chelipeds were much longer than in any species of *Pseudopalicus*.

There is very little information on the male pleopods of the Atlantic and eastern Pacific species of palicids. The male first pleopods of *Palicus caronii* (Roux, 1830) of the Mediterranean and eastern Atlantic were illustrated by MONOD (1956, figs 549-551). The pleopods of a specimen from an unknown location (SMF 4712) had sinuous basal parts and hatchet-like, uniramous distal parts. The male first pleopods of *Palicus alternatus* Rathbun, 1897 were described by WILLIAMS (1984: 482) as "stout and twisted, tip bilobed, inner lobe thinner and longer than outer" and "weaker, not twisted, and tip less spreading".

The elongate male abdomen with all segments free suggests a less specialized, and perhaps more plesiomorphic condition. The morphologies of the male first pleopods differ strikingly, although they share a sinuous, non-helicoidal basal part. The distal part can be uniramous or of several biramous patterns. Species that share a general body type and many other characters have very dissimilar male pleopods. The significance of this remains unknown. It may be suggested that the group is speciating rapidly. Another possibility is that *Pseudopalicus* may not be a natural group after all. The uniramous male pleopods of *P. investigatoris*, *P. serripes*, and *P. pictus* sp. nov., for example, sets these species apart from their congeners. The three species, plus an undescribed species close to *P. serripes*, also share a squarish carapace and conspicuous teeth on the pterygostomial ridge.

Key to the species of *PSEUDOPALICUS*

1. Anterolateral border of carapace with four typically pointed teeth (last tooth may be very small) 2
— Anterolateral border of carapace with three rounded teeth (last tooth may be very small) **10**

2. Dactyli of walking legs (P2-4) with teeth or spines along posterior border **3**
— Dactyli of walking legs (P2-4) entire, without teeth or spines along posterior border **8**

3. Suborbital border with one triangular or pointed tooth on inner edge. One or two sharp teeth on proximal portion of ridge that connects pterygostomial lobe with pterygostomial region of carapace (Figs 9a-b, 11b) **4**
— Suborbital border with one rectangular or rounded lobe on inner edge. No sharp teeth on proximal portion of ridge that connects pterygostomial lobe with pterygostomial region of carapace **6**

4. Dorsal surface of carapace with few, low, granular bosses. Male first pleopods with thick distal parts that are sharply bent distally (Figs 11d-e) .... ***P. pictus*** sp. nov.
— Dorsal surface of carapace with conspicuous bosses, 10 of which cross branchial and metagastric regions. Male first pleopods with simple, straight distal parts (Figs 4b-d) ... **5**

5. Dense cluster of setae on inner surface of cheliped propodi of males. Supraorbital border with lobes having rounded tips (Fig. 12c). Dactyli of walking legs broad (P4 0.2-0.3 CL) .... ***P. serripes*** (Alcock & Anderson, 1895)
— Inner surface of cheliped propodi of males smooth. Supraorbital border with lobes having narrow, pointed tips (Fig. 12b). Dactyli of walking legs slender (P4 0.5-0.6 CL) .... ***P. investigatoris*** (Alcock, 1900)

6. Posterior third of carapace smooth, without conspicuous, high bosses. Posterior border of carapace entire, without tubercles (Fig. 5d) .... ***P. glaber*** sp. nov.
— Posterior third of carapace with conspicuous, high bosses. Posterior border of carapace with six low tubercles **7**

7. Two very short supraorbital lobes (Fig. 3a) .... ***P. acanthodactylus*** sp. nov.
— Two conspicuous supraorbital lobes with rounded tips (Fig. 5b) .... ***P. amadaibai*** (Sakai, 1963)

8. Second, pointed anterolateral tooth on side of carapace larger than first, which has rounded or lobate borders (Fig. 12a). Upper and lower borders of meri of walking legs (P2-4) with thin, pointed, nearly equal tubercles .... ***P. oahuensis*** (Rathbun, 1906)
— Anterolateral teeth gradually decrease in size posteriorly. Upper and lower borders of meri of walking legs (P2-4) with tubercles of different sizes and shapes **9**

9. Male first pleopods with distal part consisting of two processes, one broad and one thin, armed with minute teeth (Fig. 6d-e) .... ***P. declivis*** sp. nov.
— Male first pleopods with distal part uniramous and teeth along inner and outer borders (Kensley, 1969, fig. 2d) .... ***P. sexlobatus*** Kensley, 1969

10. Posterior border of carapace with 4-6 rounded, granular tubercles. Supraorbital border with two triangular lobes (Fig. 13a) .... ***P. macromeles*** sp. nov.
— Posterior border of carapace with six low, elongate tubercles (Figs 12f, 14a). Supraorbital border with two short lobes, inner rectangular, outer rounded ...... ***P. undulatus*** sp. nov.

Pseudopalicus acanthodactylus sp. nov.

Figs 3, 5a, 55, 60a

MATERIAL EXAMINED. — **New Caledonia.** CHALCAL 2: stn CC 2, 24°55.48'S, 168°21.29'E, 500 m, 28.10.1986: 1 ♂, 2 ♀ (MNHN-B 26861); 1 ♀ (MNHN-B 26862). — Stn CP 21, 24°54.00'S, 168°21.61'E, 500 m, 28.10.1986: 1 ♀ (MNHN-B 26863). — Stn DW 72, 24°54.5'S, 168°22.3'E, 527 m, 28.10.1986: 3 ♀ (MNHN-B 26864). — Stn DW 74, 24°40.36'S, 168°38.38'E, 650 m, 29.10.1986: 1 ♀ (MNHN-B 26676). — Stn DW 75, 24°39.31'S, 168°39.67'E, 600 m, 29.10.1986: 2 ♂ paratypes 6.9 x 9.0 mm, 7.3 x 9.7 mm (MNHN-B 26675), 1 ♀ (MNHN-B 26865). — Stn DW 76, 23°40.5'S, 167°45.2'E, 470 m, 30.10.1986: 2 ♂, 5 ♀ (MNHN-B 26866). — Stn DW 77, 23°38.35'S, 167°42.68'E, 435 m, 30.10.1986: 3 ♀ (MNHN-B 26867).

SMIB 3: stn DW 6, 24°56'S, 168°21'E, 505 m, 21.05.1987: 1 ♂, 4 ♀ (MNHN-B 26868). — Stn DW 9, 24°42'S, 168°08'E, 265 m, 21.05.1987: 1 ♂ (MNHN-B 26869). — Stn DW 12, 23°37.7'S, 167°41.5'E, 470 m, 22.05.1987: 1 ♂, 2 ♀ (MNHN-B 26870). — Stn DW 13, 23°37.5'S, 167°41.6'E, 448 m, 22.05.1987: 1 ♂, 2 ♀ (MNHN-B 26871).

SMIB 4: stn DW 58, 22°59.8'S, 167°24.2'E, 560 m, 9.03.1989: 1 ♀ paratype 10.6 x 13.0 mm (MNHN-B 26674).

BERYX 11: stn CP 7, 24°55'S, 168°21'E, 510-550 m, 15.10.1992: 1 ♀ (MNHN-B 26872). — Stn CP 8, 24°54'S, 168°21'E, 540-570 m, 15.10.1992: 1 ♂ (MNHN-B 26873). — Stn CP 10, 24°53'S, 168°21'E, 565-600 m, 15.10.1992: 2 ♀ (MNHN-B 26874). — Stn DW 27, 23°37'S, 167°41'E, 460-470 m, 18.10.1992: 1 ♀ paratype 12.3 x 14.9 mm (MNHN-B 26673), 2 ♂, 2 ♀ (MNHN-B 26737). — Stn CP 32, 23°38'S, 167°43'E, 420-460 m, 18.10.1992: 1 ♀ (MNHN-B 26875).

SMIB 8: stn DW 146, 24°55.2'S, 168°21.7'E, 514-522 m, 27.01.1993: 1 holotype ♂ 8.9 x 10.5 mm (MNHN-B 26672). — Stn DW 147, 24°54.9'S, 168°21.8'E, 508-532 m, 27.01.1993: 1 ♀ 9.6 x 13.5 mm (MNHN-B 26876). — Stn DW 150, 24°54.3'S, 168°22.2'E, 519-530 m, 27.01.1993: 1 ♂, 1 ♀ (MNHN-B 26877). — Stn DW 152, 24°54.3'S, 168°22.2'E, 514-530 m, 27.01.1993: 1 ♀ (MNHN-B 26878). — Stn DW 166, 23°37.8'S, 167°42.7'E, 433-450 m, 29.01.1993: 3 ♀ (MNHN-B 26879). — Stn DW 167, 23°38.1'S, 168°43.1'E, 430-452 m, 29.01.1993: 1 ♂, 3 ♀ (MNHN-B 26880), 1 ♀ 13.8 x 16.7 mm (MNHN-B 26738). — Stn DW 168, 23°37.7'S, 168°42.5'E, 433-450 m, 29.01.1993: 1 ♂, 5 ♀ (MNHN-B 26881). — Stn DW 169, 23°37.7'S, 167°42.5'E, 447-450 m, 29.01.1993: 4 ♀ (MNHN-B 26882).

SMIB 10: stn DW 202, 24°55'S, 168°22'E, 525-513 m, 10.01.1995: 1 ♀ (MNHN-B 26883).

LITHIST: stn CP 2, 23°37.07'S, 167°41.14'E, 442 m, 10.08.1999: 3 ♀, 1 ♀ (MNHN-B 26969). — Stn CP 3, 23°37.01'S, 167°49'E, 447 m, 10.08.1999: 1 ♂, 3 ♀ (MNHN-B 26967). — Stn DW 5, 23°38.25'S, 167°42.94'E, 433-500 m, 11.08.1999: 8 ♀ (MNHN-B 26968), 1 ♂ paratype 8.4 x 10.3 mm, 1 ♀ paratype 12.0 x 14.8 mm (USNM), 1 ♂ paratype 8.4 x 10.4 mm, 1 ♀ paratype 11.8 x 14.4 mm (ZRC 1999.1425-1426). — Stn CP 8, 24°54.24'S, 168°21.35'E, 540 m, 11.08.1999: 1 ♀ (MNHN-B 26970). — Stn CP 11, 24°46.69'S, 168°08.33'E, 254-283 m, 11.08.1999: 1 ♂, 1 ♀ (MNHN-B 26971).

TYPES. — *Holotype*: 1 ♂ 8.9 x 10.5 mm, SMIB 8, stn DW 146 (MNHN-B 26672).

Paratypes: 2 ♂ 6.9 x 9.0 mm, 7.3 x 9.7 mm, CHALCAL 2, stn DW 75 (MNHN-B 26675); 1 ♀ 10.6 x 13.0 mm, SMIB 4, stn DW 58 (MNHN-B 26674); 1 ♀ 12.3 x 14.9 mm, BERYX 11, stn DW 27 (MNHN-B 26673); 1 ♂ 8.4 x 10.3 mm, 1 ♀ 12.0 x 14.8 mm, LITHIST, stn DW 5 (USNM); 1 ♂ 8.4 x 10.4 mm, 1 ♀ 11.8 x 14.4 mm, LITHIST, stn DW 5 (ZRC 1999.1425-1426).

TYPE LOCALITY. — Norfolk Ridge, south of New Caledonia, 24°55.2'S, 168°21.7'E, 514-522 m.

DIAGNOSIS. — Carapace (Figs 3a, 5a, 60a) with four anterolateral teeth on each side, first tooth usually rounded, blunt, second and third larger, pointed, and fourth very small. Dorsal surface of carapace with medium-size bosses, 12 of which form an almost straight row across branchial and metagastric regions in larger specimens; posterior border with six low, elongate tubercles. Supraorbital borders each with two very short lobes. Suborbital borders (Fig. 3b) each with one broad, square outer lobe; one higher, narrower, rounder inner lobe. Outer surfaces of cheliped propodi each with 2-3 rows of blunt tubercles. Dactyli of walking legs (P2-4) with short, thick spines along posterior border (2-4 spines in P4; Fig. 3c). Abdomen of mature males (Fig. 3d) with all segments free, one complete transverse ridge along each segment 1-3, incomplete ridge along median portion of segment 4. Male first pleopods (Figs 3e-f) with sinuous basal parts; each distal portion with broad ventral process having small teeth, two dorsal, wing-like extensions. Abdomen of mature females with all segments free (Fig. 3g), one complete transverse ridge along each segment 1-4.

Color: The carapace of the live male holotype (Fig. 60a) had a pattern of irregular, very fine yellow blotches on a red-brown background. The same pattern was repeated on the chelipeds and walking legs. The distalmost tubercle on each eye peduncles was red, color still visible in specimens that had been preserved for one month.

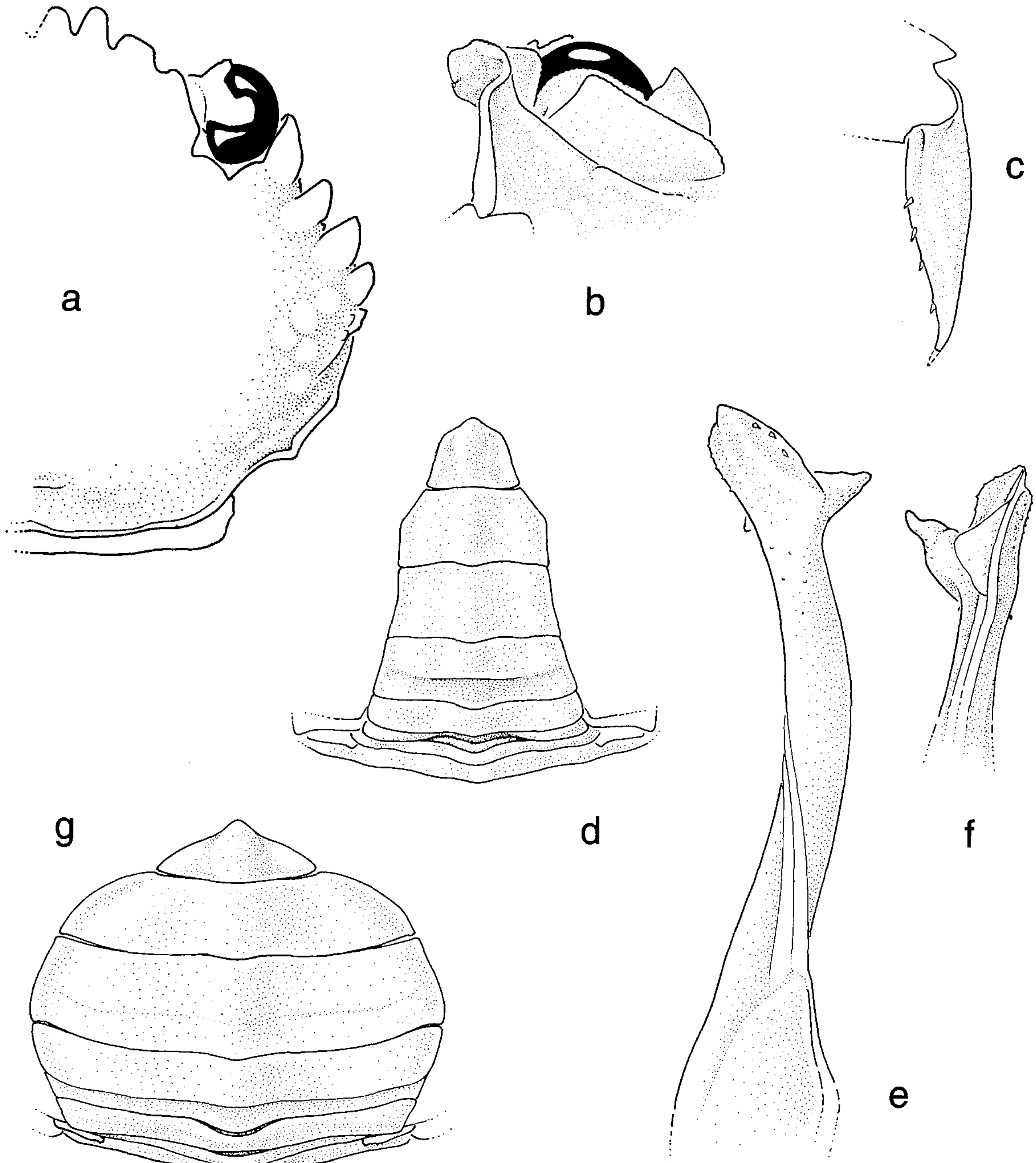

FIG. 3. — *Pseudopalicus acanthodactylus* sp. nov.: **a-f**, ♂ holotype 8.9 x 10.5 mm, Norfolk Ridge, south of New Caledonia, SMIB 8, stn DW 146, 514-522 m (MNHN-B 26672): **a**, carapace, dorsal surface; **b**, suborbital border; **c**, dactylus, right fourth pereopod, dorsal view; **d**, abdomen; **e**, left male first pleopod, ventral view; **f**, left male first pleopod, distal part, lateral (inner side) view. — **g**, ♀ paratype 10.6 x 13.0 mm, Norfolk Ridge, south of New Caledonia, SMIB 4, stn DW 58, 560 m (MNHN-B 26674): abdomen.

DESCRIPTION. — Carapace (Figs 3a, 5a, 60a) transversely hexagonal, wider than long (CW/CL = 1.2-1.3); dorsal surface covered with coarse granules and rows of conspicuous granular bosses. Confluence of branchial and mesogastric regions depressed, granular, usually darker in color. Anterolateral borders of carapace each with four anterolateral teeth, first usually rounded, blunt, second and third larger, pointed, and fourth very small. Dorsal surface of carapace with medium-size bosses, 12 of which form an almost straight row across branchial and metagastric regions in larger specimens (up to 14, not in straight row, in smaller specimens). Posterior border with six low, elongate tubercles (almost continuous in larger specimens) and no plumose setae.

Frontal border of carapace divided into four narrow, rounded lobes, inner lobes longer and typically more pointed, particularly in larger specimens. Borders between frontal lobes and supraorbital borders anteriorly rounded (slightly pointed in some specimens), folded upward slightly, and ending in sharp angle, forming very shallow, U- or L- shaped fissure before supraorbital border. Supraorbital borders each with two very short, nearly straight, or slightly rounded lobes. Postorbital angles short (not extending beyond dorsal border of retracted eye), slightly pointed inward. Cornea of eyes dorsoventrally flattened, wider than base of short eye peduncle; each peduncle with two flat, granular tubercles on distal border.

Suborbital borders (Fig. 3b) each with one broad, square outer lobe; one higher, narrower, rounder inner lobe. Pterygostomial lobes project ventrally, forming flat, semicircular structure posterior to each inner suborbital lobe.

Each basal antennal segment slender, rectangular; flagellum long, with few, simple setae. Epistome vertically inclined, with two broad (rounded or pointed), flat median teeth, each flanked by narrow, pointed outer process and thin, rounded margin before pterygostomial lobe. Inner border of ischia of third maxillipeds straight; surface coarsely granular, upper borders rounded. Meri much narrower than ischia; straight-edged, triangular upper borders.

Dorsal and outer borders of cheliped propodi with rows of rounded, sometimes elongate tubercles. Fingers of largest cheliped with cutting edges (rounded teeth in small specimens), 4-8 rounded to triangular teeth in smallest cheliped. Carpi short, outer borders with low, rounded tubercles; meri slender, outer borders with low, rounded tubercles.

First three pairs of walking legs (P2-4; Fig. 5a, 60a) flattened. Upper and lower borders of meri with tubercles of different sizes and shapes (some pointed, some rounded; smaller but on two anterior rows in P2); distalmost tubercle on each anterior border much wider at base, much higher, slender, pointed, directed distally (only in P2-3 in some small specimens). Anterior borders of carpi tuberculate; borders of propodi entire. Each P2 with one dorsal, one ventral carina on carpus; two dorsal, two ventral carinae on propodus; one dorsal, two ventral carinae, 0-3 spines along posterior border of dactylus. Each P3 with one dorsal, one ventral row of tubercles on merus; two dorsal, two ventral carinae on carpus; one dorsal, two ventral carinae on propodus; one dorsal, two ventral carinae, 0-4 spines along posterior border of dactylus. Each P4 with two dorsal, one ventral rows of tubercles on merus (absent in some); two dorsal, two ventral carinae on each carpus and propodus; one dorsal, two ventral carinae, 2-4 short, thick spines along posterior border of dactylus (Fig. 3c). Meri of all walking legs with scattered plumose setae; dorsal surfaces of propodi and dactyli of P3-4 each with one row of conspicuous plumose setae along anterior border.

First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair slightly shorter than second. Fifth pair of pereopods (P5) short (0.7-0.8 CL); each merus wide in larger specimens (slender in smaller specimens), tuberculate surface, 4-5 triangular tubercles (proximal largest) along posterior border, and scattered plumose setae; each propodus with low tubercles (2-4 short spines in largest specimens) along posterior border; each dactylus with row of 11-13 short, thick spines along posterior border, 2-3 distally on anterior border, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.1	1.8-2.0	1.5-2.0	0.7-0.8
Merus length/CL	0.3-0.4	0.6	0.4-0.6	0.2
Dactylus length/Cl	0.2	0.3-0.4	0.3	0.2

Abdomen of mature females (Fig. 3g) with all segments free. One transversal ridge along each segment 1-4.

Abdomen of mature males (Fig. 3d) with all segments free. One complete transverse ridge along each segment 1-3, incomplete ridge along median portion of segment 4. Male first pleopods (Fig. 3e-f) with sinuous basal parts; each distal part with broad ventral process with small teeth and two dorsal, wing-like extensions.

DISCUSSION. — *P. acanthodactylus* can be easily distinguished from congeners by its short supraorbital lobes, which make the eyes seem prominent, and the short, thick spines on the posterior border of the dactyli of the walking legs (P2-4; Fig. 3c).

SIZE. — Maximum size among specimens examined: 13.8 x 16.7 mm (female, MNHN-B 26738); 9.4 x 11.5 mm (male, MNHN-B 26737).

ETYMOLOGY. — From *akantha*, Greek for spine, and *daktylos*, Greek for finger, in reference to the diagnostic spiny dactyli of the walking legs (P2-4).

DISTRIBUTION. — Known only from the Norfolk Ridge south of New Caledonia (Fig. 55). Depth: 265-650 m.

Pseudopalicus amadaibai (Sakai, 1963)

Figs 4a, 5b, 53

Palicus oahuensis - BALSS, 1922: 120, fig. 6. — YOKOYA, 1933: 206, 212 [non *Palicus oahuensis* Rathbun, 1906].
Cymopolia oahuensis - SAKAI, 1939: 609, fig. 90a; 1956: 52. — NAKAZAWA & SAKAI, 1947: 665, unnumb. fig. [non *Palicus oahuensis* Rathbun, 1906].
Palicus amadaibai Sakai, 1963: 227, fig. 7a. — SAKAI, 1965: 183, pl. 89, fig. 1; 1976: 593, pl. 205, fig. 1. — SERÈNE, 1968: 96. — TAKEDA & MIYAKE, 1969: 464. — MURAOKA, 1998: 49.
Pseudopalicus amadaibai - MOOSA & SERÈNE, 1981: 39, fig. 6, pl. 2, fig. B. — TAKEDA, 1982a: 205, fig. 608.

MATERIAL EXAMINED. — **Japan**. *Tosa Bay*. Mimase, 1959, dry specimen with red tag, possible part of type material: 1 ♀ 14.2 x 17.0 mm (SMF 24698). — Kochi, Mimase, K. SAKAI coll.: 1 ♂ 12.6 x 14.5 mm (KPM-NH 107132). — K. SAKAI coll., 15.04.1963: 1 ♀ 15.5 x 18.6 mm (SMF 24699); 20.03.1964: 1 ♀ (SMF 24700); 10.1961-04.1963: 1 ♂ (SMF 24701).

Sagami Bay. Okinoyama Bank, 34°59'N, 139°39'E, 105-113 m, coarse sand and shell fragments, T. KOMAI coll., 21.04.1995: 1 ♀ (CBM-ZC 2004).

Kii Peninsula. Off Shionomisaki, 33°26.13'N, 135°40.64'E, 160 m, S. NAGAI coll., 16.01.1997: 1 ♀ (CBM-ZC 3602); 33°26.72'N, 135°29.20'E, 180 m: 1 juv. ♂ (CBM-ZC 4953). — Off Kirimezaki, 150-180 m, H. IKEDA coll., 09.1981: 1 ♂ (HSM). — Kii Strait, trawl, M. OZAKI coll. from Sakaihama fish market: 1 ♂, 1 ♀ (SMF 24702).

Goto Islands. *"Soyo Maru"*: stn 440, 152 m, 19.07.1929: 1 ♂ (KMNH).

No location. 1 ♀ (SMF 24703). — 1 ♀ (SMF 24704). — 1 ♀ (SMF 24705). — 1 ♀ (SMF 24706).

Philippine Islands. *Verde Island Passage*. MUSORSTOM 2: stn DG 32, 13°40'N, 120°54'E, 192-220 m, 24.11.1980: 1 ♂ 12.1 x 14.7 mm (MNHN-B 26804).

Indonesia. *Tanimbar Islands*. KARUBAR: stn DW 49, 08°00'S, 132°59'E, 206-209 m, 29.10.1991: 1 ♂ (MNHN-B 26739). — Stn CP 86, 09°26'S, 131°13'E, 223-225 m, 4.11.1991: 1 ♀ 12.3 x 14.5 mm (MNHN-B 26828).

New Caledonia. BATHUS 1: stn DW 690, 20°32.94'S, 165°00.83'E, 352 m, 16.03.1993: 1 juv. ♂ (MNHN-B 26815).

Fiji. BORDAU 1: stn DW 1450, 16°44'S, 179°58'E, 327-420 m, 4.03.1999: 1 ♂, 1 ♀ (MNHN-B 27133).

TYPES. — *Holotype* of *Palicus amadaibai* Sakai, 1963: 1 ♂ 12 x 15 mm (SAKAI, 1963), EMPEROR OF JAPAN coll. (Showa Memorial Institute, National Science Museum, Tsukuba, Japan; NSMT-Cr R: 2506).

Allotype: 1 ♀, same locality as holotype. Deposit unknown.

Paratypes: 1 ♂, 2 ♀, west of Jyogashima light, Sagami Bay, Japan, 65-85 m, EMPEROR OF JAPAN coll. — 2 ♂, 1 ♀, Tosa Bay, Japan, K. SAKAI coll. Deposit unknown.

Possible paratype: 1 ♀ 14.2 x 17.0 mm, Tosa Bay, Japan (SMF 24698).

TYPE LOCALITY. — Amadaiba fishing grounds off Hayama (Kannonzuka-dashi, Aoyama-dashi), Sagami Bay, Japan, 65-85 m.

DIAGNOSIS. — Carapace (Fig. 5b) with four broad, slightly pointed anterolateral teeth on each side; teeth decrease in size posteriorly. Dorsal surface of carapace with large granular bosses, 12 of which form an almost straight row across branchial and metagastric regions in large specimens; posterior border with six low, elongate tubercles (almost continuous in larger specimens). Supraorbital borders each with two rounded lobes. Suborbital borders each with two broad, slightly rounded to straight-edged lobes; inner border slightly higher than outer. Dorsal borders of cheliped propodi each with row of thin, elongate, rounded tubercles; outer surface with scattered blunt tubercles. Dactyli of walking legs (P2-4) with short, thick spines along posterior border (2-3 in P4). Abdomen of mature males with all segments free, one complete transverse ridge along each segment 1-3, incomplete ridge along median portion of segment 4. Male first pleopods (Fig. 4a; MOOSA & SERÈNE, 1981, fig. 6) with sinuous basal parts; each distal portion with four distal tips (three thick, mammillate; one slender with spinules). Abdomen of mature females with all segments free, one complete transverse ridge along each segment 1-4 (very low ridge may be present along segment 5).

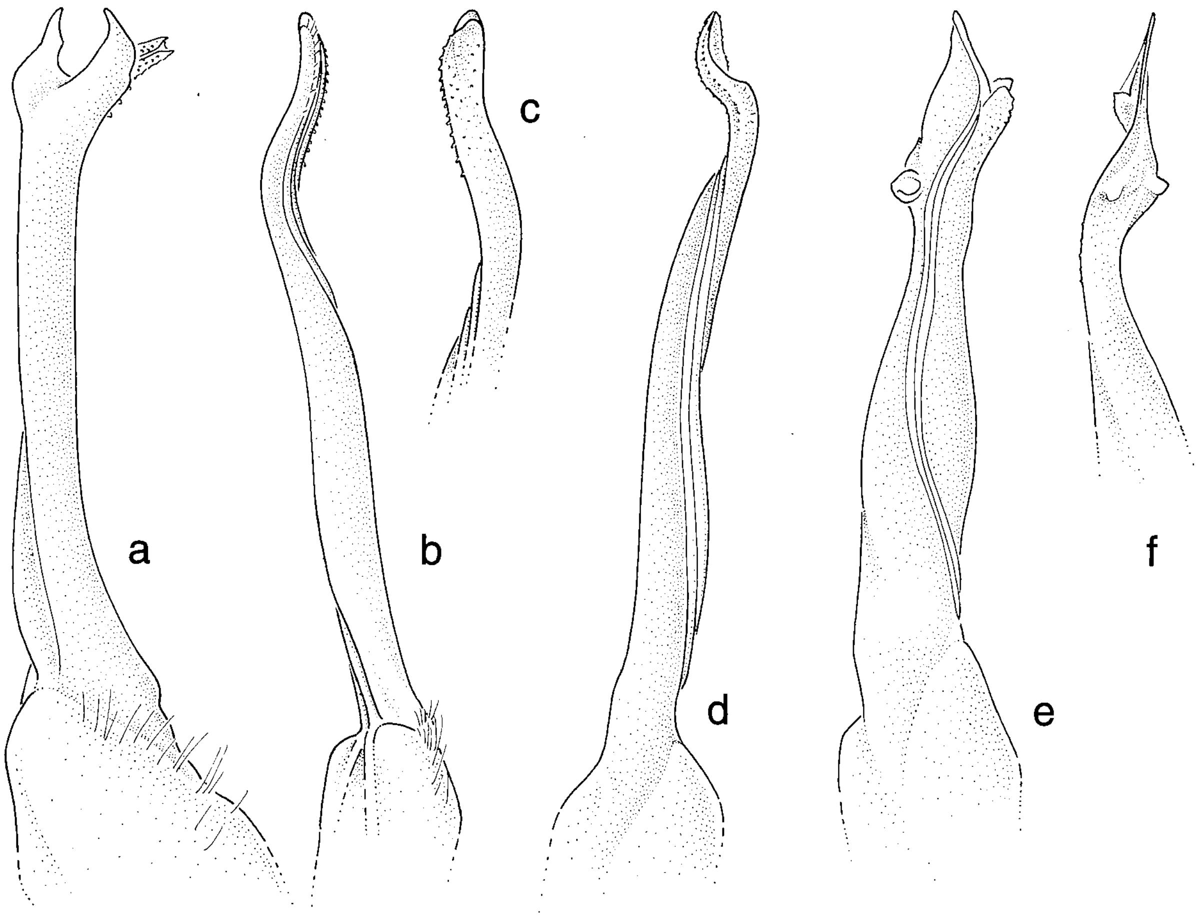

FIG. 4. — **a**, *Pseudopalicus amadaibai* (Sakai, 1963), ♂ 12.1 x 14.7 mm, Verde Island Passage, Philippine Islands, MUSORSTOM 2, stn DG 32, 192-220 m (MNHN-B 26804): left male first pleopod, ventral view. — **b-c**, *Pseudopalicus investigatoris* (Alcock, 1900), ♂ 10.3 x 12.0 mm, South China Sea, Philippine Islands, MUSORSTOM 1, stn 57, 107-96 m (MNHN-B 26805): **b**, left male first pleopod, ventral view; **c**, left male first pleopod, distal part, dorsal view. — **d**, *Pseudopalicus serripes* (Alcock & Anderson, 1895), ♂ 10.4 x 11.0 mm, Seychelles, REVES 2, stn 21, 55-60 m (MNHN-B 26750): left male first pleopod, lateral (inner side) view. — **e-f**, *Pseudopalicus oahuensis* (Rathbun, 1906), ♂ 7.8 x 10.4 mm, Norfolk Ridge, south of New Caledonia, SMIB 4, DW 56, 260 m (MNHN-B 26806): **e**, left male first pleopod, lateral (outer side) view; **f**, left male first pleopod, distal part, ventral view.

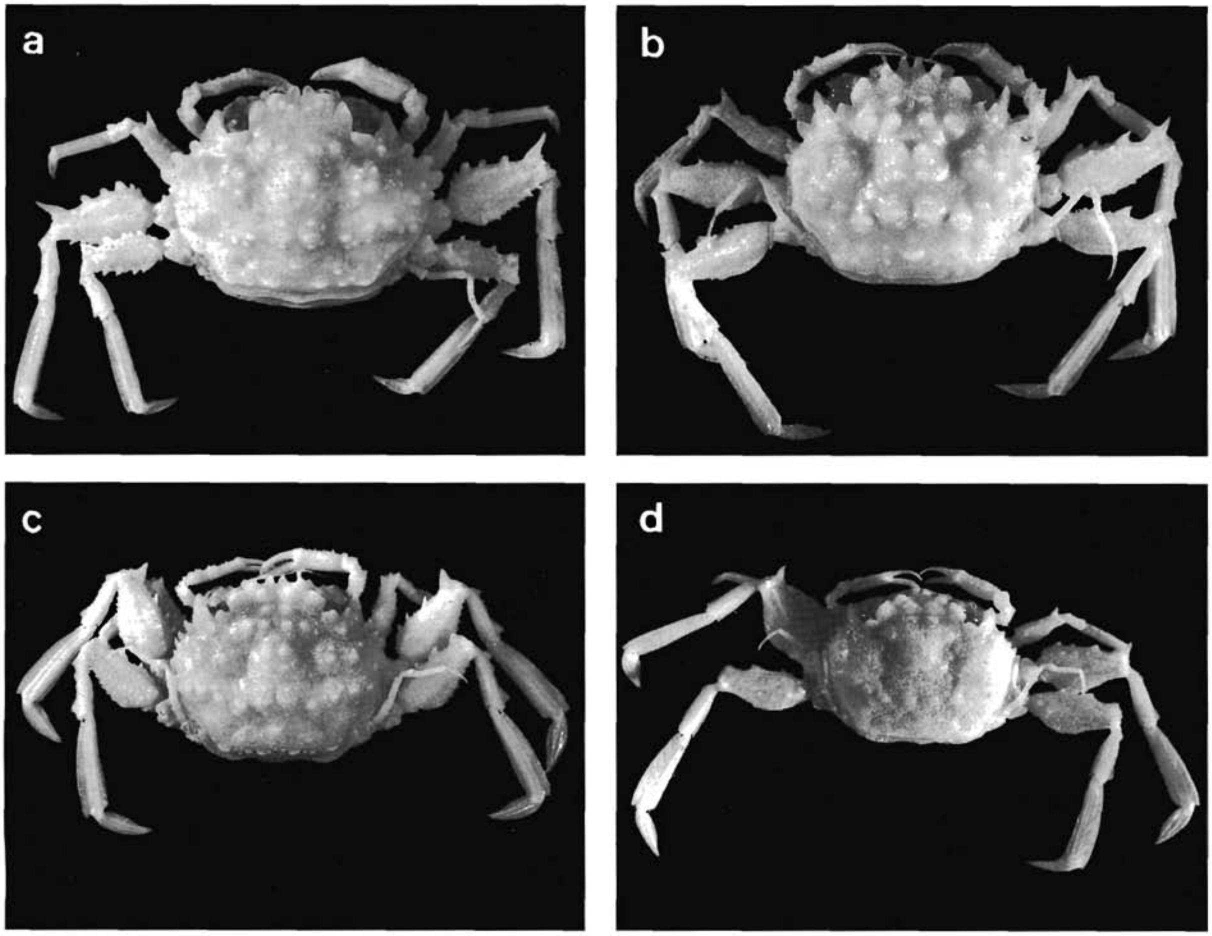

FIG. 5. — **a**, *Pseudopalicus acanthodactylus* sp. nov., ♀ 9.6 x 13.5 mm, Norfolk Ridge, south of New Caledonia, CHALCAL 2, stn DW 74, 650 m (MNHN-B 26676): dorsal view. — **b**, *Pseudopalicus amadaibai* (Sakai, 1963): ♀ 12.3 x 14.5 mm, Tanimbar Islands, Indonesia, KARUBAR, stn CP 86, 223-225 m (MNHN-B 26828): dorsal view. — **c**, *Pseudopalicus declivis* sp. nov., ♀ paratype 15.5 x 18.1 mm, Grand Passage, north of New Caledonia, MUSORSTOM 4, stn DW 196, 450 m (MNHN-B 26680): dorsal view. — **d**, *Pseudopalicus glaber* sp. nov., ♀ paratype 9.8 x 12.3 mm, Norfolk Ridge, north of New Caledonia, SMIB 5, stn DW 103, 315 m (MNHN-B 26687): dorsal view.

DISCUSSION. — Comparison of material collected throughout the western Pacific with material from the type locality, central Japan (including material examined by T. SAKAI and most probably some of his type material), confirms previous characterizations of the species. SAKAI (1963) named his new species after the Amadaiba fishing grounds in Sagami Bay, Japan, but erroneously used "amadaibai" instead of the correct "amadaibaiensis" to name the species.

MOOSA & SERÈNE (1981) noted that no mention was made in SAKAI's description of the presence of spines along the posterior border of the walking legs, even though they were shown in SAKAI (1963, fig. 7a). It is assumed that MOOSA & SERÈNE were referring specifically to the dactyli of the walking legs, which SAKAI (1963: 228) described as having "two or three denticles".

Other characteristics of *P. amadaibai* include a carapace with a frontal border that is divided into four narrow and rounded lobes (inner lobes are more pointed in large specimens), followed by a broad, rounded, and folded-upward lobe before the supraorbital border. The postorbital angles are short (not extending beyond the dorsal border of the retracted eye) and only slightly pointed inward. Each basal antennal segment is slender and rectangular (but slightly expanded along the outer border in large specimens) and slightly tuberculate. Each eye peduncle has two low, granular tubercles on the distal border and, in alcohol-preserved specimens, large red-orange spots ventrally. The pterygostomial lobes project ventrally, forming a flat, semicircular structure (triangular when seen ventrally) posterior to each inner suborbital lobe. The epistome is vertically inclined, with two short, rounded median teeth flanked on each side by a triangular outer process and a thin, rounded margin before joining pterygostomial lobe. The third pair of walking legs (P4) have slender meri (0.4-0.5 CL; Fig. 5b) each armed with one row of teeth along upper border and one conspicuously pointed distal tooth; the dactyli are slender (0.3 CL), each armed with 2-3 microscopic teeth along the posterior border. The fifth pair of pereopods (P5) are short (0.8 CL), each merus is smooth or with several low tubercles along the posterior border, and dactylus with a row of 4-5 thick spines along the posterior border, 1-3 distally on the anterior border.

P. amadaibai was initially confused with *P. oahuensis* (Rathbun, 1906) (BALSS, 1922; YOKOYA, 1933; SAKAI, 1939; 1956; NAKAZAWA & SAKAI, 1947) but their resemblance is only superficial. In addition to the clear differences between the male first pleopods, the dactyli of the walking legs (P2-4) are unarmed in *P. oahuensis* but armed in *P. amadaibai.*

MOOSA & SERÈNE (1981) pointed out rather superficial similarities between *P. amadaibai* and *P. investigatoris*, which unfortunately they did not examine. *P. investigatoris* can be easily distinguished by its very pointed anterolateral teeth, presence of a pointed tooth on the inner border of the suborbital border, and very simple male first pleopods (see discussion for *P. investigatoris* below).

The figure of the male first pleopods given by MOOSA & SERÈNE (1981, fig. 6) shows three thick and pointed processes, two being of the same size, with the third smaller. Most of the specimens examined in this study only had two equal processes (Fig. 4a).

An unusual abnormality, the presence of one inner lobe along the anterior border of the carapace instead of the normal two (for a total of three lobes instead of four), was observed in a male from the Tanimbar Islands, Indonesia (MNHN-B 26739). It was probably due to damage and subsequent growth.

SIZE. — Maximum size among specimens examined: 15.5 x 18.6 mm (female, SMF 24699); 12.6 x 14.5 mm (male, KPM-NH 107132).

DISTRIBUTION. — Japan (BALSS, 1922; YOKOYA, 1933; SAKAI, 1939, 1956, 1963, 1965, 1976; NAKAZAWA & SAKAI, 1947; TAKEDA & MIYAKE, 1969; TAKEDA, 1982a; MURAOKA, 1998), and the Philippine Islands (MOOSA & SERÈNE, 1981). It is here recorded for the first time from the Arafura Sea (Indonesia), New Caledonia and Fiji (Fig. 53). SAKAI (1976) recorded it from soft bottoms. Depth: known reliably between 65 m (SAKAI, 1963) and 352 m, also collected in a trawl between 327-420 m.

Pseudopalicus declivis sp. nov.

Figs 5c, 6, 55

MATERIAL EXAMINED. — **Philippine Islands**. *South China Sea*. MUSORSTOM 2: stn CP 19, 14°00'N, 120°16'E, 189-192 m, 22.11.1980: 1 ♂, 2 ♀ (MNHN-B 26740).

Indonesia. *Kai Islands*. KARUBAR: stn DW 18, 05°18'S, 133°01'E, 205-212 m, 24.10.1991: 1 juv. ♂ (MNHN-B 26884).

Chesterfield Islands. MUSORSTOM 5: stn 379, 19°53.20'S, 158°39.50'E, 370-400 m, 20.10.1986: 1 ♂ paratype 10.2 x 12.0 mm (MNHN-B 26678).

Vanuatu. MUSORSTOM 8: stn CP 1024, 17°48.21'S, 168°38.77'E, 335-370 m, 28.09.1994: 1 ♀ (MNHN-B 26885).

New Caledonia. *"Vauban"* DREDGINGS 1978: stn D3, 22°17'S, 167°12'E, 390 m, 23.05.1978: 1 ♀ (MNHN-B 26886). — Stn D4, 22°17'S, 167°13'E, 400 m, 23.05.1978: 1 ♂ (MNHN-B 26887). — Stn D16, 22°17'S, 167°12'E, 390 m, 23.05.1978: 1 ♂ (MNHN-B 26888).

BIOCAL: stn CP 105, 21°31'S, 166°22'E, 330-335 m, 8.09.1985: 1 ♂ (MNHN-B 26889), 1 ♂ paratype 10.5 x 12.9 mm, 1 ♀ paratype 14.5 x 17.8 mm (ZRC 1999.1427-1428).

MUSORSTOM 4: stn CP 180, 18°56'S, 163°17.7'E, 440 m, 18.09.1985: 1 ♂ (MNHN-B 26890). — Stn DW 181, 18°57.2'S, 163°22.4'E, 350 m, 18.09.1985: 3 ♀ (MNHN-B 26891). — Stn CP 193, 18°56.3'S, 163°23.2'E, 415 m, 19.09.1985: 2 ♂, 3 ♀ (MNHN-B 26892). — Stn DW 196, 18°55.0'S, 163°23.7'E, 450 m, 20.09.1985: 1 ♀ paratype 15.5 x 18.1 mm (MNHN-B 26680), 1 ♂, 1 ♀ (MNHN-B 26893). — Stn DW 222, 22°57.6'S, 167°33.0'E, 410-440 m, 30.09.1985: 1 ♀ paratype 14.2 x 16.3 mm (MNHN-B 26681).

LAGON: stn DW 1152, 18°58.2'S, 163°23.9'E, 335 m, shark teeth and stylasterids, 29.10.1989: 1 ♂ (MNHN-B 26894).

SMIB 6: stn DW 120, 18°58.5'S, 163°25.6'E, 310-325 m, sponges and stylasterids, 3.03.1990: 1 ♀ paratype 11.5 x 12.6 mm (MNHN-B 26682).

SMIB 8: stn DW 189, 23°17.6'S, 168°05.5'E, 400-402 m, 31.01.1993: 1 ♀ (MNHN-B 26895).

BATHUS 1: stn CP 701, 20°57.54'S, 165°35.86'E, 302-335 m, 18.03.1993: 1 ♂, 3 ♀ (MNHN-B 26896), 1 ♂ paratype 10.4 x 12.6 mm, 1 ♀ paratype 11.4 x 14.1 mm (USNM). — Stn CP 710, 21°43.16'S, 166°36.35'E, 320-386 m, 19.03.1993: 1 ♀ (MNHN-B 26897).

BATHUS 2: stn DW 718, 22°46.70'S, 167°14.45'E, 430-436 m, 11.05.1993: 1 ♂ (MNHN-B 26898). — Stn DW 729, 22°52.42'S, 167°11.90'E, 400 m, 12.05.1993: 1 ♂ (MNHN-B 26899). — Stn DW 730, 23°02.56'S, 166°58.30'E, 397-400 m, 12.05.1993: 2 ♂, 1 ♀ (MNHN-B 26900). — Stn 737, 23°03.42'S, 166°59.97'E, 350-400 m, 13.05.1993: 1 ♂ 12.4 x 14.7 mm (MNHN-B 26741).

BATHUS 3: stn DW 827, 23°22'S, 167°01'E, 381-469 m, sand and gravel, 29.11.1993: 1 ♂ holotype 11.1 x 13.4 mm (MNHN-B 26677). — Stn CP 847, 23°03'S, 166°58'E, 405-411 m, 1.12.1993: 3 ♀ (MNHN-B 26901).

BATHUS 4: stn DW 894, 20°15.77'S, 163°52.03'E, 245-268 m, 3.08.1994: 1 ♂ (MNHN-B 26902). — Stn DW 925, 18°54.55'S, 163°23.75'E, 370-405 m, 7.08.1994: 1 ♂, 1 ♀ (MNHN-B 26903). — Stn DW 926, 18°56.80'S, 163°25.36'E, 325-330 m, 7.08.1994: 2 ♂, 1 ♀ (MNHN-B 26904). — Stn DW 927, 18°55.48'S, 163°22.11'E, 452-444 m, 7.08.1994: 1 ♂ (MNHN-B 26905).

HALICAL 1: stn DW 1, 18°54.96'S, 163°24'E, 380-400 m, 23.11.1994: 1 ♂ (MNHN-B 26906). — Stn DW 4, 18°55'S, 163°23.29'E, 350-365 m, 29.11.1994: 1 ♂ paratype 10.4 x 11.0 mm (MNHN-B 26679).

Loyalty Islands. MUSORSTOM 6: stn DW 406, 20°40.65'S, 167°06.80'E, 373 m, 15.02.1989: 1 ♀ (MNHN-B 26907). — Stn DW 460, 21°01.72'S, 167°31.45'E, 420 m, 20.02.1989: 1 ♂ (MNHN-B 26908). — Stn CP 464, 21°02.30'S, 167°31.60'E, 430 m, 21.02.1989: 1 ♀ (MNHN-B 26909).

TYPES. — *Holotype*: 1 ♂ 11.1 x 13.4 mm, BATHUS 3, stn DW 827 (MNHN-B 26677).

Paratypes: 1 ♂ 10.2 x 12.0 mm, MUSORSTOM 5, stn 379 (MNHN-B 26678); 1 ♂ 10.4 x 11.0 mm, HALICAL 1, stn DE 4 (MNHN-B 26679); 1 ♀ 15.5 x 18.1 mm, MUSORSTOM 4, stn DW 196 (MNHN-B 26680); 1 ♀ 14.2 x 16.3 mm, MUSORSTOM 4, stn DW 222 (MNHN-B 26681); 1 ♀, New Caledonia 11.5 x 12.6 mm, SMIB 6, stn DW 120 (MNHN-B 26682); 1 ♂ 10.4 x 12.6 mm, 1 ♀ 11.4 x 14.1 mm, BATHUS 1, stn CP 701 (USNM); BIOCAL, stn CP 105, 1 ♂ paratype 10.5 x 12.9 mm, 1 ♀ paratype 14.5 x 17.8 mm (ZRC 1999. 1427-1428).

TYPE LOCALITY. — Norfolk Ridge, south of New Caledonia, 23°22'S, 167°01'E, 381-469 m, sand and gravel.

DIAGNOSIS. — Carapace (Figs 5c, 6a) with four pointed anterolateral teeth on each side; teeth gradually decrease in size posteriorly. Dorsal surface of carapace with small granular bosses, 10 of which form an almost straight row across branchial and metagastric regions; posterior border with 6-8 low, elongate tubercles. Supraorbital borders each with two slightly rounded to triangular lobes. Suborbital borders (Fig. 6b) each with one square or slightly rounded outer lobe; one slightly higher, rounded, or obliquely-directed inner lobe. Outer surfaces of cheliped propodi with scattered blunt tubercles of various sizes. Dactyli of walking legs (P2-4) very slender, with posterior borders entire (Fig. 6c). Abdomen of mature males with all segments free, one complete transverse ridge along each segment 1-4 (low ridge may be present along median portion of 5-6). Male first pleopods (Figs 6d-e) with sinuous basal parts; each distal part with two processes, inner broad, longer, outer narrow, shorter, armed with minute teeth. Abdomen of mature females with all segments free, one complete transverse ridge along each segment 1-4 (low ridge sometimes along segment 5).

DESCRIPTION. — Carapace (Figs 5c, 6a) transversely hexagonal, wider than long (CW/CL = 1.1-1.2). Anterolateral borders of carapace each with four pointed anterolateral teeth gradually decreasing in size posteriorly (last tooth may be missing or greatly reduced in smaller specimens). Dorsal surface of carapace with medium-size, rounded, granular bosses, 10 of which form an almost straight row across branchial and metagastric regions. Posterior border with 6-8 low, elongate tubercles and elongate plumose setae.

Frontal border of carapace divided into four narrow, rounded lobes, inner lobes longer and typically more pointed (outer lobes always shorter but may be pointed in some specimens). Borders between frontal lobes and supraorbital borders straight, folded upward, slightly pointed anteriorly in some specimens, and ending in sharp angle, forming U-shaped fissure before supraorbital border. Supraorbital borders each with two large, slightly rounded to triangular lobes. Postorbital angles short (not extending beyond dorsal border of retracted eye), only slightly pointed inward. Cornea of eyes dorsoventrally flattened, wider than base of short eye peduncle; each peduncle with three granular tubercles on distal border (most ventral tubercle conspicuous, protuberant).

Suborbital borders (Fig. 6b) each with one slightly rounded outer lobe; one slightly higher, narrower, obliquely-directed inner lobe; wide gap or notch at confluence of outer and inner lobes. Pterygostomial lobes project ventrally, forming flat, semicircular (sometimes notched), or pointed structure posterior to each inner suborbital lobe.

Each basal antennal segment thick, tuberculate, rectangular, slightly expanded distally; flagellum long, with few, simple setae. Epistome vertically inclined, with two broadly rounded (narrower, triangular in small specimens), short median teeth flanked on each side by very broad, curved margin connecting directly with pterygostomial lobe. Inner border of ischia of third maxillipeds straight; surface coarsely granular, upper borders obliquely cut. Meri much narrower than ischia; upper lobes straight with rounded outer borders.

Outer border of each cheliped propodus with one row of 1-5 thin, rounded tubercles. Fingers of largest cheliped with cutting edges (rounded teeth in small specimens), 3-5 rounded to triangular teeth in smallest cheliped (only sinuous edge in largest specimens). Carpi short, outer borders with low, rounded tubercles; meri slender, distal portions of outer borders with rounded or pointed tubercles.

First three pairs of walking legs (P2-4; Fig. 5c) flattened. Upper and lower borders of meri with tubercles of different sizes and shapes (some pointed, some rounded; smaller but on two anterior rows in P2); distalmost tubercle on each anterior border much wider at base, much higher, slender, pointed, directed distally (only rounded to triangular in P4). Anterior border of carpi of walking legs (P2-4) tuberculate; borders of propodi and dactyli (Fig. 6c) entire. Each P2 with one row of tubercles of dorsal, two rows on ventral surface of merus; two dorsal, two ventral carinae each on carpus and propodus; one dorsal, one ventral carinae on dactylus. Each P3 with one dorsal row of tubercles on merus; two dorsal, two ventral carinae each on carpus and propodus; one dorsal, 2-3 ventral carinae on dactylus. Each P4 with two dorsal rows of tubercles on merus; two dorsal, two ventral carinae each on carpus and propodus; one dorsal, 2-3 ventral carinae on dactylus. Meri of all walking legs with scattered to numerous plumose setae; dorsal surfaces of propodi and dactyli of P3-4 with one row of conspicuous plumose setae along anterior border.

First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair slightly shorter than second. Fifth pair of pereopods (P5) short (0.7-0.8 CL); each merus slender, surface with microscopic tubercles, many microscopic tubercles and 1-6 short spines along posterior border; each propodus with 4-7 spines along posterior border; each dactylus with 2-6 short, thick spines along posterior border (up to 7 spines along anterior border in some specimens), one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.1-1.2	2.0	1.9-2.0	0.7-0.8
Merus length/CL	0.3-0.4	0.6	0.5-0.6	0.2
Dactylus length/Cl	0.2-0.3	0.4-0.5	0.3-0.4	0.2

Abdomen of mature males with all segments free. One complete transverse ridge along each segment 1-4, and incomplete, low ridge along median portions of segments 5-6. Male first pleopods (Figs 6d-e) with sinuous basal parts; each distal part with two bilobed processes, inner one broad, longer and outer one (with gonopodal duct) narrow, shorter, and provided with minute teeth.

Abdomen of mature females with all segments free. One transversal ridge along each segment 1-4 (low ridge along segment 5 in most specimens).

DISCUSSION. — *P. declivis* is characterized by anterolateral teeth that decrease in size from first to fourth, and walking legs (P2-4) with entire, unarmed dactyli. The dactyli are also unarmed in *P. oahuensis* but they are not as long and slender as in *P. declivis*. *P. declivis* shares with *P. sexlobatus* (Kensley, 1969) anterolateral teeth that decrease in size and unarmed dactyli. All three species can be easily distinguished by examining their characteristic male first pleopods.

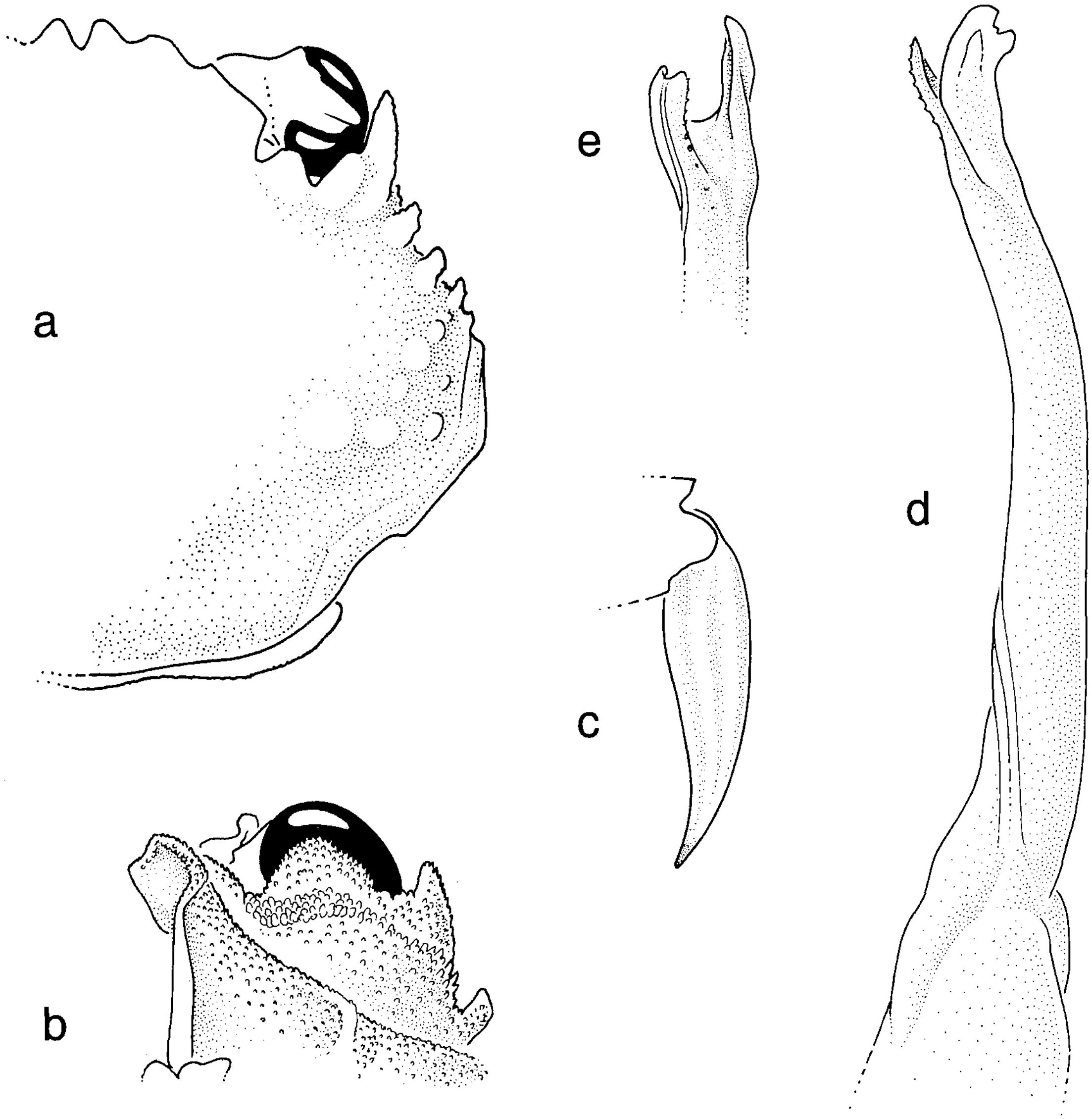

FIG. 6. — *Pseudopalicus declivis* sp. nov., ♂ holotype 11.1 x 13.4 mm, Norfolk Ridge, south of New Caledonia, BATHUS 3, stn DW 827, 381-469 m (MNHN-B 26677): **a**, carapace, dorsal surface; **b**, suborbital border; **c**, dactylus, right fourth pereopod, dorsal view; **d**, left male first pleopod, dorsal view; **e**, left male first pleopod, apex, ventral view.

SIZE. — Maximum size among specimens examined: 18.5 x 22.6 mm (female, MNHN-B 26740); 12.4 x 14.7 mm (male, MNHN-B 26741).

ETYMOLOGY. — From *declivis*, Latin for downhill, in reference to the decrease in size in a posterior, or downward, direction of the anterolateral teeth.

DISTRIBUTION. — Known from the South China Sea (off the Philippine Islands), Banda Sea (Indonesia), and the Coral Sea (Vanuatu, Chesterfield Islands, New Caledonia, and the Loyalty Islands) (Fig. 55). Depth: 189-469 m.

Pseudopalicus glaber sp. nov.

Figs 5d, 7, 55, 60b

MATERIAL EXAMINED. — **New Caledonia**. MUSORSTOM 4: stn DW 164, 18°33.2'S, 163°13.0'E, 255 m, 16.09.1985: 1 ♂ (MNHN-B 26991). — Stn DW 183, 19°01.8'S, 163°25.8'E, 280 m, 18.09.1985: 1 ♂ holotype 9.1 x 10.9 mm (MNHN-B 26683).

CHALCAL 2: stn DW 78, 23°41.3'S, 167°59.6'E, 233 m, 30.10.1986: 1 ♀ (MNHN-B 26985). — Stn DW 83, 23°20.3'S, 168°05.5'E, 200 m, 31.10.1986: 1 ♂, 1 ♀ (MNHN-B 26986).

SMIB 3: stn DW 14, 23°40'S, 168°00'E, 246 m, 22.05.1987: 1 ♂, 3 ♀ (MNHN-B 27028). — Stn DW 18, 23°41.5'S, 167°59.4'E, 338 m, 23.05.1987: 1 ♀ (MNHN-B 27016). — Stn DW 20, 23°40'S, 168°00'E, 280 m, 23.05.1987: 1 ♂, 1 ♀ (MNHN-B 27029).

SMIB 4: stn DW 57, 23°21.5'S, 168°04.6'E, 260 m, 9.03.1989: 1 ♀ 8.4 x 10.6 mm (MNHN-B 26812).

SMIB 5: stn DW 70, 23°40.6'S, 168°01.1'E, 270 m, 7.09.1989: 1 ♀ (MNHN-B 26980). — Stn DW 71, 23°41.3'S, 168°00.7'E, 265 m, 7.09.1989: 2 ♂, 2 ♀ (MNHN-B 27026). — Stn DW 72, 23°42.0'S, 168°00.8'E, 400 m, 7.09.1989: 1 ♀ (MNHN-B 27019). — Stn DW 73, 23°41.4'S, 168°00.6'E, 240 m, 7.09.1989: 1 ♀ paratype 11.7 x 15.0 mm (MNHN-B 26686). — Stn DW 74, 23°40.2'S, 168°00.9'E, 245 m, 7.09.1989: 1 ♀ (MNHN-B 26981). — Stn DW 75, 22°40.9'S, 168°00.8'E, 270 m, 7.09.1989: 6 ♀ (MNHN-B 27030). — Stn DW 76, 23°41.2'S, 168°00.5'E, 280 m, 7.09.1989: 1 ♂ paratype 11.0 x 13.5 mm (MNHN-B 26684), 2 ♀ (MNHN-B 26983). — Stn DW 77, 23°40.0'S, 168°01.1'E, 270 m, 7.09.1989: 2 ♀ (MNHN-B 27020). — Stn DW 78, 23°40.8'S, 168°00.2'E, 245 m, 7.09.1989: 1 ♀ (MNHN-B 26988). — Rocky bottom, no station number, 250 m, 13.09.1989: 1 ♂ paratype 7.7 x 9.0 mm (MNHN-B 26685), 2 ♀ (MNHN-B 26977). — Stn DW 85, 22°20.0'S, 168°42.9'E, 260 m, 13.09.1989: 1 ♀ (MNHN-B 26987). — Stn DW 88, 22°18.6'S, 168°40.2'E, 350 m, 13.09.1989: 1 ♀ (MNHN-B 27018). — Stn DW 91, 22°18.4'S, 168°41.1'E, 340 m, 13.09.1989: 1 ♀ (MNHN-B 26973). — Stn DW 101, 23°21.2'S, 168°04.9'E, 270 m, 14.09.1989: 4 ♀ (MNHN-B 27027), 1 ♂ paratype 7.1 x 8.4 mm, 1 ♀ paratype 8.5 x 10.8 mm (ZRC 1999.1429-1430). — Stn DW 102, 23°19.6'S, 168°04.7'E, 305 m, 14.09.1989: 1 ♂, 1 ♀ (MNHN-B 27007). — Stn DW 103, 23°17.4'S, 168°04.8'E, 315 m, 14.09.1989: 1 ♀ 9.8 x 12.3 mm (MNHN-B 26687). — Stn DW 105, 23°14.3'S, 168°04.5'E, 310 m, 14.09.1989: 1 ♀ (MNHN-B 27024).

BERYX 11: stn DW 40, 23°41'S, 168°01'E, 240-300 m, 20.10.1992: 2 ♀ (MNHN-B 27023).

SMIB 8: stn DW 155, 24°45.7'S, 168°08.2'E, 257-262 m, 28.01.1993: 1 ♀ (MNHN-B 26978). — Stn DW 163, 24°49.1'S, 168°08.9'E, 310-460 m, 28.01.1993: 2 ♂ (MNHN-B 26984). — Stn DW 170, 23°41.2'S, 168°00.5'E, 241-244 m, 29.01.1993: 4 ♀ (MNHN-B 27011), 1 ♂ paratype 11.4 x 14.0 mm, 1 ♀ paratype 10.6 x 13.4 mm (USNM). — Stn DW 181, 23°17.7'S, 168°04.8'E, 311-330 m, 31.01.1993: 2 ♀ (MNHN-B 26975). — Stn DW 182, 23°19.3'S, 168°04.8'E, 314-340 m, 31.01.1993: 2 ♂ (MNHN-B 27015). — Stn DW 183, 23°18.3'S, 168°04.9'E, 330-367 m, 31.01.1993: 1 ♀ (MNHN-B 27021). — Stn DW 184, 23°18.3'S, 168°04.8'E, 305-320 m, 31.01.1993: 1 ♂ (MNHN-B 26974). — Stn 185, 23°16'S, 168°04.3'E, 305-355 m, 31.01.1993: 1 ♂, 1 ♀ (MNHN-B 26989). — Stn DW 187, 23°17.7'S, 168°05.6'E, 390-540 m, 31.01.1993: 1 ♀ (MNHN-B 27014). — Stn 190, 23°18.5'S, 168°04.9'E, 305-310 m, 31.01.1993: 2 ♂ (MNHN-B 27022).

BATHUS 2: stn DW 727, 22°48.03'S, 167°29.03'E, 299-302 m, 12.05.1993: 1 ♀ (MNHN-B 27013).

BATHUS 3: stn CP 804, 23°41'S, 168°00'E, 244-278 m, 27.11.1993: 1 ♀ (MNHN-B 26979). — Stn CP 805, 23°41'S, 168°01'E, 278-310 m, 27.11.1993: 6 ♀ (MNHN-B 27009). — Stn DW 829, 23°21'S, 168°02'E, 386-390 m, detritic rubble, 29.11.1993: 3 ♂, 2 ♀ (MNHN-B 26742). — Stn DW 830, 23°20'S, 168°01'E, 361-365 m, 29.11.1993: 1 ♂, 1 ♂ feminized by sacculinid, 6 ♀ (MNHN-B 27008).

BATHUS 4: stn DW 924, 18°54.85'S, 163°24.34'E, 344-360 m, 7.08.1994: 2 ♂ (MNHN-B 26982). — Stn DW 925, 18°54.55'S, 163°23.75'E, 370-405 m, 7.08.1994: 4 ♀ (MNHN-B 27025). — Stn DW 926, 18°56'S, 163°25'E, 325-330 m, 7.08.1994: 1 ♂, 1 ♀ (MNHN-B 27010). — Stn DW 931, 18°55.38'S, 163°24.36'E, 360-377 m, 7.08.1994: 2 ♀ (MNHN-B 26972). — Stn CP 936, 19°03.67'S, 163°28.05'E, 258-252 m, 8.08.1994: 1 ♀ paratype 16.5 x 20.4 mm (MNHN-B 26688).

HALICAL 1: stn DW 1, 18°54.95'S, 163°24'E, 380-400 m, 23.11.1994: 1 ♀ (MNHN-B 26990). — Stn DW 2, 18°55.86'S, 163°24.18'E, 252-397 m, 23.11.1994: 1 ♀ (MNHN-B 27012). — Stn DW 4, 18°55'S, 163°23.29'E, 350-365 m, 29.11.1994: 1 ♂, 1 ♀ (MNHN-B 26976).

Gemini Seamounts. VOLSMAR: stn DW 51, 20°58.5'S, 170°03.4'E, 450 m, 4.07.1989: 1 ♀ (MNHN-B 27017).

TYPES. — *Holotype*: 1 ♂ 9.1 x 10.9 mm, MUSORSTOM 4, stn DW 183 (MNHN-B 26683).

Paratypes: 1 ♂ 11.0 x 13.5 mm, SMIB 5, stn 76 (MNHN-B 26684); 1 ♂ 7.7 x 9.0 mm, SMIB 5, no station number (MNHN-B 26685); 1 ♀ 11.7 x 15.0 mm SMIB 5, stn 73 (MNHN-B 26686); 1 ♀ 9.8 x 12.3 mm, SMIB 5, stn DW 103 (MNHN-B 26687); 1 ♀ 16.5 x 20.4 mm, BATHUS 4, stn CP 936 (MNHN-B 26688); 1 ♂ 11.4 x 14.0 mm, 1 ♀ 10.6 x 13.4 mm, SMIB 8, stn DW 170 (USNM); 1 ♂ 7.1 x 8.4 mm, 1 ♀ 8.5 x 10.8 mm, SMIB 5, stn DW 101 (ZRC 1999.1429-1430).

TYPE LOCALITY. — Grand Passage, north of New Caledonia, 19°01.8'S, 163°25.8'E, 280 m.

DIAGNOSIS. — Carapace (Figs 5d, 7a, 60b) with four pointed anterolateral teeth on each side; first three teeth almost equal in size, larger than very small last tooth. Dorsal surface of carapace with few, mostly low, granular bosses, leaving posterior third of carapace relatively smooth. Supraorbital borders each with two rounded lobes. Suborbital borders (Fig. 7b) each with two broad, slightly rounded lobes, Dorsal borders of cheliped propodi each with one row of thin, rounded tubercles. Dactyli of walking legs (P2-4) with short spines along posterior borders (3-5 spines in P4; Fig. 7c). Abdomen of mature males with all segments free, one complete transverse ridge along each segment 1-3, incomplete ridge along each median portions of segments 4-6. Male first pleopods (Figs 7d-f) with sinuous basal parts; each distal part with pointed, spinous dorsal tip, ventral process with two superimposed foliaceous portions. Abdomen of mature females with segments free, one complete transverse ridge along each segment 1-4 (low ridge may be present along segment 5).

Color: A female from New Caledonia photographed live (Fig. 60b) had a white vertical band through the center of the carapace. A brown spot was located on each area anterior and posterior of the white band. The rest of the carapace was light green and light brown, with small blue spots throughout the branchial regions. The walking legs were light green with light brown bands.

DESCRIPTION. — Carapace (Figs 5d, 7a, 60b) transversely hexagonal, wider than long (CW/CL = 1.2-1.3); dorsal surface covered with small granules and few, mostly low, granular bosses (most conspicuous bosses 3-4 on branchial region, particularly very large specimens), leaving posterior third of carapace relatively smooth. Anterolateral borders of carapace each with four pointed teeth, first three of which almost equal in size (first slightly larger, rounder in many specimens) and larger than very small last tooth (differences more apparent in larger specimens). Posterior border with an evenly raised edge, no separate tubercles (except in very small specimens), scattered plumose setae.

Frontal border of carapace divided into four narrow, rounded lobes (inner lobes narrower, longer, and very close to each other; outer lobes may be broad in some specimens). Borders between frontal lobes and supraorbital borders straight, folded upward, slightly pointed to conspicuously pointed anteriorly (giving anterior border six-lobed appearance in largest specimens), ending in sharp angle, forming V-shaped fissure before supraorbital border. Supraorbital borders each with two rounded lobes. Postorbital angles moderately long (extend almost to dorsal border of retracted eye), slender, slightly pointed inward. Cornea of eyes dorsoventrally flattened, wider than base of short eye peduncle; each peduncle with one conspicuous, granular tubercle on distal border.

Suborbital borders (Fig. 7b) each with broad, rectangular outer lobe, similar in shape (but slightly rounded in larger specimens); slightly higher, inner lobe. Pterygostomial lobes project ventrally, forming flat, semicircular structure posterior to each inner suborbital lobe.

Each basal antennal segment thick, rectangular, rounded distal margin; flagellum long, with few, simple setae. Epistome vertically inclined, with two triangular, pointed (short, rounded in small specimens) median teeth, each flanked by triangular outer process and thin, rounded margin before pterygostomial lobe. Inner border of ischia of third maxillipeds straight; surface coarsely granular, upper borders rounded. Meri much narrower than ischia; anterior upper lobes much reduced, with rounded outer borders.

Outer surfaces of cheliped propodi each with one row of 1-4 thin, rounded tubercles. Fingers of largest cheliped with cutting edges (broadly rounded teeth in some specimens), 2-7 rounded to triangular teeth in smallest cheliped (only sinuous edge in largest specimens). Carpi short, outer borders with one thin, broadly rounded or triangular tubercle and several low, rounded tubercles; merus slender, distal portions of outer borders with low, rounded tubercles.

First three pairs of walking legs (P2-4; Figs 5d, 60b) flattened. Upper borders of meri with mostly large, triangular tubercles; lower borders with few, low tubercles; distalmost tubercle on each anterior border much wider at base, much higher, slender, pointed, directed distally (only rounded to triangular in P4). Anterior border of carpi of walking legs (P2-4) each with two large, triangular tubercles; borders of propodi entire. Each P2 with one dorsal, 1-2 ventral rows of tubercles on merus; one dorsal, one ventral carinae on carpus; one dorsal carina on propodus; two dorsal, 1-2 ventral carinae, 4-5 short, thick spines on dactylus. Each P3 with one dorsal, two ventral rows of tubercles on merus (very low in some specimens); two dorsal, one ventral carinae on carpus; two dorsal, two ventral carinae on propodus; two dorsal, 2-3 ventral carinae, 3-4 short, thick spines on dactylus. Each P4 with 1-2 dorsal rows of tubercles on merus (very low in some specimens); two dorsal, one ventral carinae on carpus; two dorsal, two ventral carinae on propodus; one dorsal, 2-3 ventral carinae, 3-5 short, thick spines on dactylus (Fig. 7c). Meri of all walking legs with scattered plumose setae; dorsal surfaces of propodi and dactyli of P3-4 each with one row of conspicuous plumose setae along anterior border.

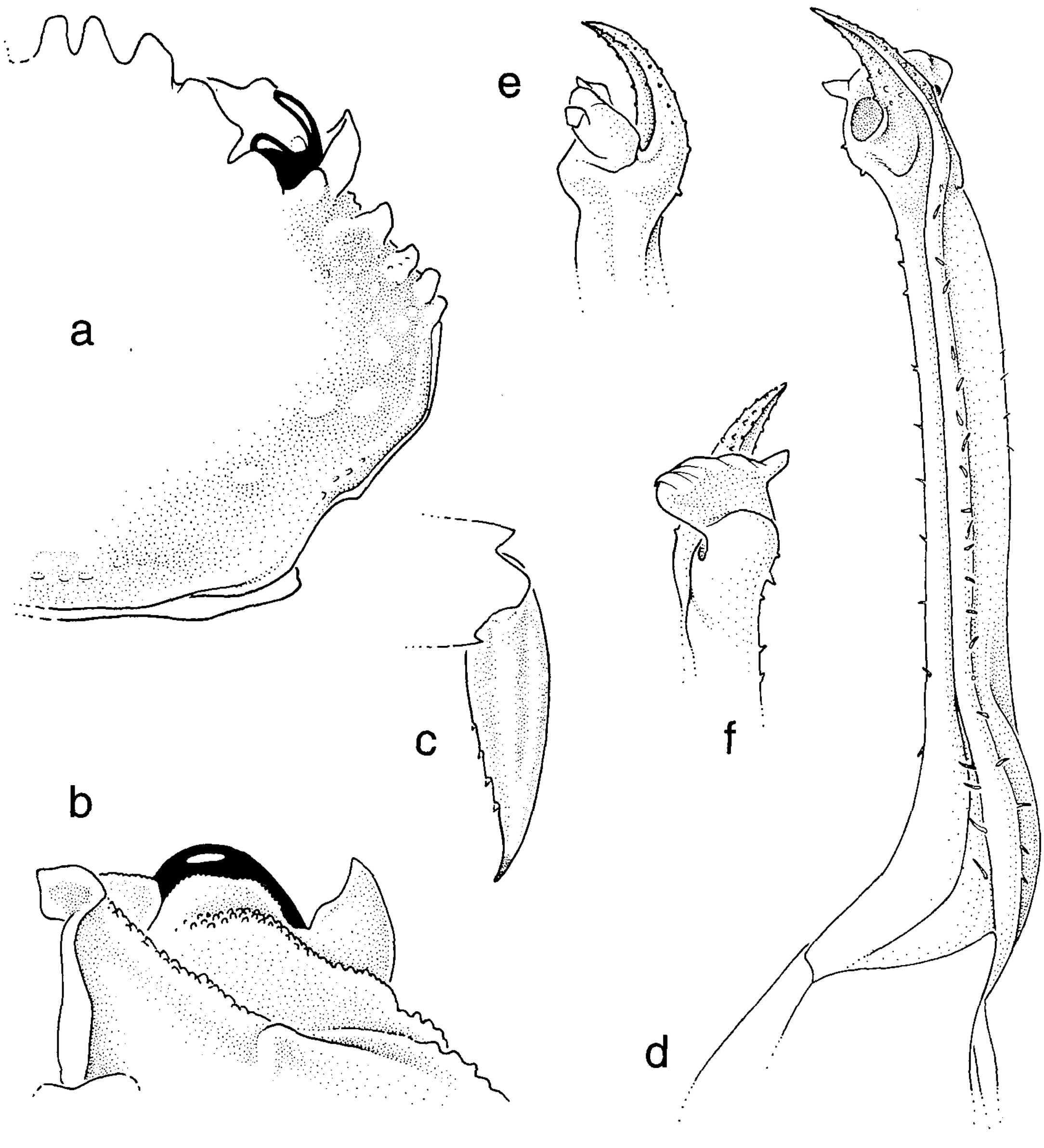

FIG. 7. — *Pseudopalicus glaber* sp. nov., ♂ paratype 7.7 x 9.0 mm, Norfolk Ridge, south of New Caledonia, SMIB 5, unknown station, 250 m (MNHN-B 26685): **a**, carapace, dorsal surface; **b**, suborbital border; **c**, dactylus, right fourth pereopod, dorsal view; **d**, left male first pleopod, dorsal view; **e**, left male first pleopod, apex, lateral (outer side) view; **f**, left male first pleopod, apex, ventral view.

First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair slightly shorter than second. Fifth pair of pereopods (P5) short (0.8 CL); each merus slender, surface with microscopic tubercles, many microscopic tubercles, plumose setae along posterior border; each propodus with 4-6 spines along posterior border; each dactylus with 3-8 short, thick spines along posterior border (mostly along distal portion), 5-10 short spines along anterior border, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.0-1.1	1.7-2.1	1.6-2.0	0.8
Merus length/CL	0.3-0.4	0.5-0.6	0.5-0.6	0.2-0.3
Dactylus length/Cl	0.2	0.3-0.4	0.3-0.4	0.2

Abdomen of mature males with all segments free. One complete transverse ridge along each segment 1-3, and incomplete ridge along each median portions of segments 4-5 (low, incomplete ridge in segment 6 in some specimens). Male first pleopods (Figs 7d-f) with sinuous basal parts; each distal part with pointed, spinous dorsal tip and ventral process with two superimposed foliaceous portions.

Abdomen of mature females with all segments free. One transversal ridge along each segment 1-4 (low ridge may be present along segment 5).

DISCUSSION. — *P. glaber* is easily distinguished from other species of *Pseudopalicus* by the smooth appearance of the posterior third of the carapace. Only a few small specimens showed low tubercles along the posterior border of the carapace.

SIZE. — Maximum size among specimens examined: 16.5 x 20.4 mm (female paratype, MNHN-B 26688); 11.0 x 12.8 mm (male, MNHN-B 26742).

ETYMOLOGY. — From *glaber*, Latin for smooth, in reference to the relatively smooth dorsal surface, particularly the posterior portion, of the carapace.

DISTRIBUTION. — Known from New Caledonia (including the Norfolk Ridge south of New Caledonia) and the Gemini Seamounts east of New Caledonia (Fig. 55). Depth: known reliably between 200 and 450 m; also collected in a trawl between 390 and 540 m.

Pseudopalicus oahuensis (Rathbun, 1906)

Figs 4e-f, 12a, 54, 60c

Palicus oahuensis Rathbun, 1906: 836, fig. 2, pl. 7, fig. 4. — EDMONDSON, 1933: 268; 1946: 309. — MCNEILL, 1968: 81, pl. 2, figs 5-6.
Cymopolia oahuensis - EDMONDSON, 1962: 9.
Pseudopalicus oahuensis - MOOSA & SERÈNE, 1981: 37 (in key).
non *Palicus oahuensis* - BALSS, 1922: 120, fig. 6. — YOKOYA, 1933: 206, 212 [= *Pseudopalicus amadaibai* (Sakai, 1963)].
non *Cymopolia oahuensis* - SAKAI, 1939: 609, fig. 90a; 1956: 52. — NAKAZAWA & SAKAI, 1947: 665, unnumb. fig. [= *Pseudopalicus amadaibai* (Sakai, 1963)].

MATERIAL EXAMINED. — **Taiwan**. *Tai-Shi*. M.-S. JENG coll., 29.04.1998: 1 ♀ (ASIZT 72007).

Indonesia. *Kai Islands*. KARUBAR: stn CP 17, 05°15'S, 133°01'E, 459-439 m, 24.10.1991: 1 ♂ (MNHN-B 26925).

Australia. GREAT BARRIER REEF EXPEDITION: stn 15, Cook's Passage, east of Lookout Point, 384 m, 8.03.1929: 1 ♀ (BMNH 1950.12.1.23).

Chesterfield Islands. MUSORSTOM 5: stn DW 306, 22°07.66'S, 159°21.40'E, 375-415 m, 12.10.1986: 2 ♀ (MNHN-B 26931).

New Caledonia. BIOCAL: stn CP 67, 24°55'S, 168°22'E, 500-510 m, 3.09.1985: 1 ♀ (MNHN-B 26928).

MUSORSTOM 4: stn CP 194, 18°52.8'S, 163°21.7'E, 545 m, 19.09.1985: 1 ♀ (MNHN-B 26929). — Stn CP 195, 18°54.8'S, 163°22.2'E, 465 m, 19.09.1985: 2 ♂, 5 ♀ (MNHN-B 26923), 1 ♂ 10.6 x 16.9 mm (MNHN-B 26744). — Stn CP 238, 22°13.0'S, 167°14.0'E, 500-510 m, 2.10.1985: 1 ♀ 11.7 x 15.8 mm (MNHN-B 26930).

CHALCAL 2: stn DW 73, 24°39.9'S, 168°38.1'E, 573 m, 29.10.1986: 1 juv. ♂, 1 ♂, 2 ♀ (MNHN-B 26932). — Stn DW 74, 24°40.36'S, 168°38.38'E, 650 m, 29.10.1986: 1 ♀ (MNHN-B 26933). — Stn DW 75, 24°39.31'S, 168°39'67'E, 600 m, 29.10.1986: 1 ♀ 8.2 x 10.7 mm (MNHN-B 26813).

SMIB 4: stn DW 56, 23°20.6'S, 168°05.2'E, 260 m, 9.03.1989: 1 ♂ 7.8 x 10.4 mm (MNHN-B 26806).

BERYX 11: stn CP 7, 24°55'S, 168°21'E, 510-550 m, 15.10.1992: 1 ♀ (MNHN-B 26934). — Stn DW 9, 24°52'S, 168°22'E, 635-680 m, 15.10.1992: 2 ♀ (MNHN-B 26935).

SMIB 8: stn DW 146, 24°55.2'S, 168°21.7'E, 514-522 m, 27.01.1993: 1 ♀ (MNHN-B 26936). — Stn DW 149, 24°54.9'S, 168°21.8'E, 508-510 m, 27.01.1993: 1 ♂ (MNHN-B 26937). — Stn DW 150, 24°54.3'S, 168°22.2'E, 519-530 m, 27.01.1993: 1 ♀ (MNHN-B 26938), 2 ♂ (MNHN-B 26743).

BATHUS 4: stn DW 927, 18°55.48'S, 163°22.11'E, 452-444 m, 7.08.1994: 1 ♀ (MNHN-B 26924).

Loyalty Islands. *"Vauban"* DREDGINGS 1977: 20°30'S, 166°48'E, 375 m, 22.02.1977: 1 ♂ (MNHN-B 26992).

Loyalty Ridge. BATHUS 3: stn DW 798, 23°35'S, 169°37'E, 657-660 m, rocks, 26.11.1993: 1 ♀ (MNHN-B 26993). — Stn DW 800, 23°35'S, 169°37'E, 655 m, rocks and gravel, 26.11.1993: 1 ♀ (MNHN-B 26994).

Vanuatu. MUSORSTOM 8: stn CP 983, 19°21.61'S, 169°27.76'E, 480-475 m, 23.09.1994: 3 ♂ (MNHN-B 26926). — Stn CP 1026, 17°30.35'S, 168°39.33'E, 437-504 m, 28.09.1994: 1 ♂ (MNHN-B 26927).

French Polynesia. SMCB (J. POUPIN coll.). *Society Islands. Maupiti Island*: stn D 92, 16°28.40'S, 151°14.00'E, 397 m, 12.05.1991: 1 ♀ (MNHN-B 26273).

Tubai Islands: stn 350, 23°20.7'S, 147°32.4'W, 350-200 m, 5.12.1990: 1 ♀ (MNHN-B 26274).

Hawaiian Islands. *"Albatross"*: stn 3919, Oahu, off south coast, 470-402 m, : 1 ♀ holotype of *Palicus oahuensis* Rathbun, 1906 7.2 x 10.0 mm (USNM 29374).

TYPES. — *Holotype* of *Palicus oahuensis* Rathbun, 1906: 1 ♀ 7.2 x 10.0 mm, *"Albatross"*, stn 3919 (USNM 29374).

TYPE LOCALITY. — Off south coast, Oahu, Hawaiian Islands, 470-402 m.

DIAGNOSIS. — Carapace (Figs 12a, 60c) with four anterolateral teeth on each side; first tooth rounded, blunt, followed by two larger, pointed teeth (second usually slightly larger that third) and one very small last tooth. Dorsal surface of carapace with large, granular bosses, 10 of which form an almost straight row across branchial and metagastric regions in large specimens; posterior border with four salient, elongate tubercles, 4-6 smaller, anterior tubercles in large specimens. Supraorbital borders each with two short, straight-edged lobes. Suborbital borders each with two broad, rounded lobes; inner slightly higher. Anterior borders of cheliped propodi with rounded tubercles of various sizes. Anterior and posterior borders of meri of walking legs (P2-4) with thin, nearly equal, dentiform tubercles (Figs 12a, 60c). Dactyli of walking legs (P4) with posterior border entire. Abdomen of mature males with all segments free, sutures between segments 4-5 and 3-4 with median U-shaped constriction, one complete transverse ridge along each segment 1-3, incomplete ridge on segment 4. Male first pleopods (Figs 4e-f) with sinuous basal parts; each distal part broad, flattened, pointed ventrally, two small ventral processes at base. Abdomen of mature females with all segments free, one complete transverse ridge along each segment 1-4 (low ridge may be present along segment 5).

Color: Both the carapace and walking legs of a female from New Caledonia photographed live (Fig. 60c) were pink and light blue. Most tubercles on the dorsal surface of the carapace were light orange.

DISCUSSION. — In addition to the male first pleopods, diagnostic for *P. oahuensis* is a first anterolateral tooth that is short and rounded in contrast to the more prominent and pointed second and third teeth. The meri of the walking legs (P2-4) are prominent and have nearly equal, dentiform tubercles along both the anterior and posterior borders that give the legs a frilly, almost lace-like appearance (Figs 12a, 60c; MCNEILL, 1968, pl. 2, fig. 5).

Other characters of *P. oahuensis* include a carapace with a frontal border that is divided into a pair of narrow and pointed inner lobes, and broad and rounded outer lobes (but narrow and pointed in some small specimens). The frontal lobes are followed by a folded-upward and rounded border before the supraorbital border. The postorbital angles are short (not extending beyond the dorsal border of the retracted eye) and blunt. Each basal antennal segment is slender, rectangular, and tuberculate on its ventral surface. Each eye peduncle has two granular tubercles on the distal border. The pterygostomial lobes project ventrally, forming a flat, semicircular structure posterior to each inner suborbital lobe. The epistome is vertically inclined, with two broadly rounded median teeth flanked on each side by a triangular outer process and a thin, rounded margin before joining the anterior process of the buccal frame. The third pair of walking legs (P4) has relatively slender meri (0.5-0.6 CL), pointed teeth all along both borders, and one blunt distal tooth on each anterior border. The fifth pair of pereopods (P5) is short (0.7-0.8 CL), each merus and propodus has numerous pointed tubercles along the posterior border, and each dactylus with 5-12 short spines along the posterior border and two thick distal spines in addition to the terminal tooth.

SIZE. — Maximum size among specimens examined: 12.7 x 17.3 mm (female, MNHN-B 26743); 10.6 x 16.9 mm (male, MNHN-B 26744).

DISTRIBUTION. — This species has a relatively wide distribution throughout the Pacific basin (Fig. 54). It has been recorded from the Hawaiian Islands (RATHBUN, 1906; EDMONDSON, 1933, 1946, 1962) and the Great Barrier Reef, Queensland, Australia (MCNEILL, 1968). It is now also known from Taiwan, Banda Sea (Indonesia), Coral Sea (Vanuatu, New Caledonia, and the Loyalty Islands), and French Polynesia. A record of a specimen from a shallow-water reef in the Hawaiian Islands (EDMONDSON, 1930: 17; 1962: 9) is most probably a misidentification. Depth: known reliably between 260 and 660 m; also collected in trawls between 200-350 and 635-680 m.

Pseudopalicus sexlobatus (Kensley, 1969)

Fig. 52

Palicus sexlobatus Kensley, 1969: 156, fig. 2a-e; 1981: 50.
Pseudopalicus sexlobatus - MOOSA & SERÈNE, 1981: 37 (in key).

MATERIAL EXAMINED. — **Mozambique Channel**. *"Anton Bruun"*: stn 371F, 24°46'S, 35°18'E, rock dredge, 110 m, 18.08.1964: 1 ♂ holotype of *Palicus sexlobatus* Kensley, 1969 8.2 x 9.7 mm (SAM A 12642).
Mauritius. Tombeau Bay, stn 43, 238 m, T. MORTENSEN coll., 11.10.1929: 1 ♀ 12.5 x 15.8 mm (ZMUC).

TYPES. — *Holotype* of *Palicus sexlobatus* Kensley, 1969: 1 ♂ 8.2 x 9.7 mm (SAM A 12642).

TYPE LOCALITY. — Mozambique Channel, 24°46'S, 35°18'E, 110 m.

DIAGNOSIS. — Carapace (KENSLEY, 1969, fig. 2a) with four pointed anterolateral teeth on each side; teeth decrease in size posteriorly. Dorsal surface of carapace with relatively low, granular bosses; posterior border with six low, elongate tubercles. Supraorbital borders each with two triangular, pointed lobes. Suborbital borders (KENSLEY, 1969, fig. 2b) each with one broad outer lobe and one rectangular inner lobe. Dorsal borders of cheliped propodi (KENSLEY, 1969, fig. 2c) with pointed tubercles. Dactyli of walking legs (P2-4) with posterior border entire (KENSLEY, 1969, fig. 2e). Abdomen of mature males and females unknown. Male first pleopods (KENSLEY, 1969, fig. 2d) with sinuous basal parts; each distal part uniramous, with triangular teeth along inner and outer borders and square tip. Abdomen of mature females with all segments free, one complete transverse ridge along each segment 1-4.

DISCUSSION. — The holotype and an adult female are the only specimens examined. Other characters include a frontal border that is divided into two pointed inner and two rounded outer lobes, followed by a border that is slightly pointed near the middle before the supraorbital border. The postorbital angles are relatively long (they extend to the dorsal border of the retracted eye) and pointed. The walking legs (P2-4) have slender meri, each armed with one row of teeth along the anterior upper border and one large, pointed distal tubercle.

SIZE. — Size of the only two specimens examined: 12.5 x 15.8 mm (female, ZMUC); 8.2 x 9.7 mm (holotype male, SAM A 12642).

DISTRIBUTION. — Known only from the Mozambique Channel (KENSLEY, 1969) and Mauritius (Fig. 52). Depth: 110-238 m.

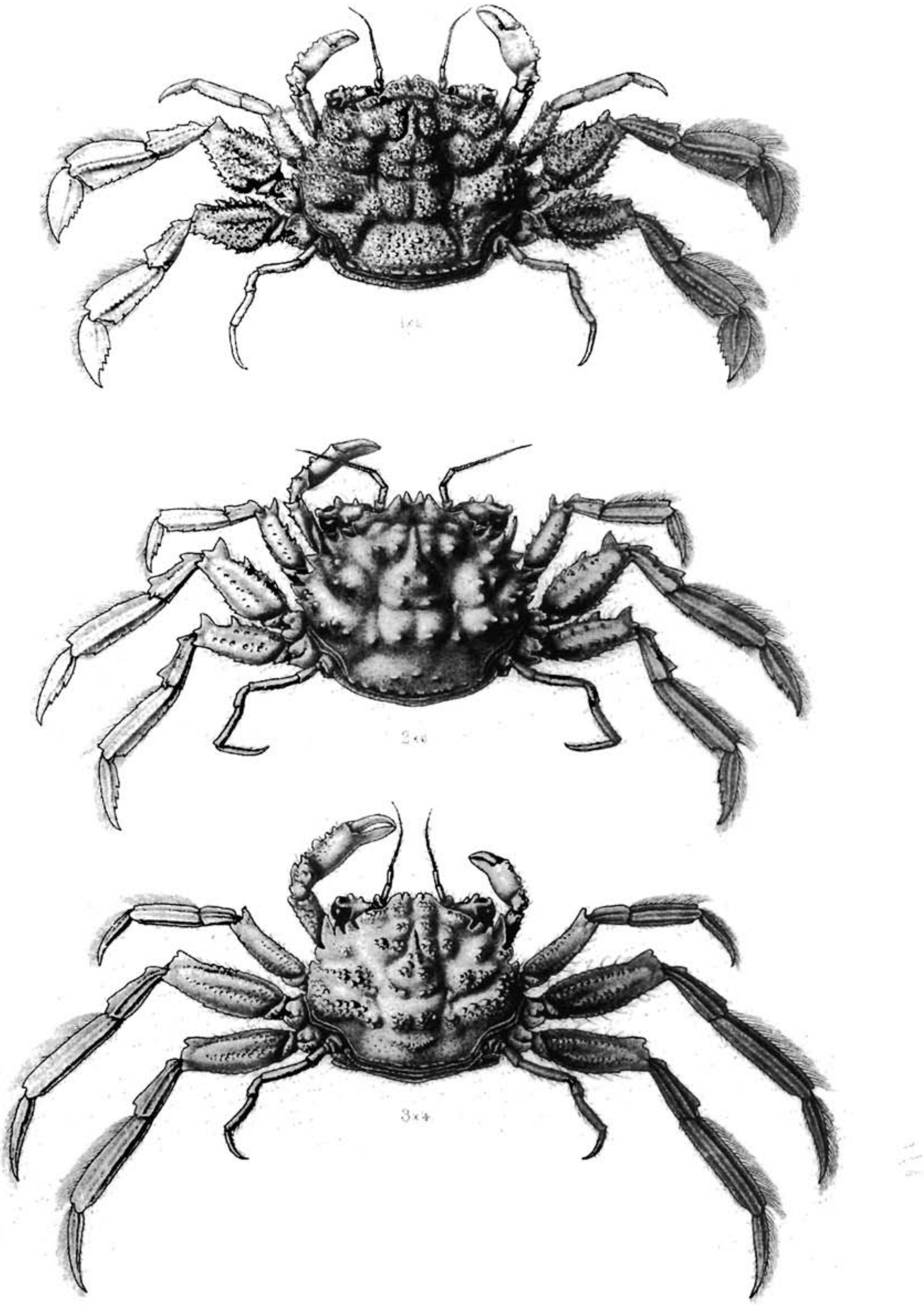

FIG. 8. — **a**, *Pseudopalicus serripes* (Alcock & Anderson, 1895). — **b**, *Pseudopalicus investigatoris* (Alcock, 1900). — **c**, *Rectopalicus woodmasoni* (Alcock, 1900). Plate 67 from ALCOCK & MCARDLE, 1903.

Pseudopalicus investigatoris (Alcock, 1900)

Figs 4b-c, 8b, 9a, 12b, 52, 60d

Palicus investigatoris Alcock, 1900: 455. — ALCOCK & MCARDLE, 1903: pl. 67, fig. 2.
Cymopolia fisheri Rathbun, 1906: 835, fig. 1, pl. 7, fig. 5.
Palicus fisheri - EDMONDSON, 1933: 268; 1946: 310.
Cymopolia cyrenae Ward, 1942a: 46, pl. 4, figs 1-2; 1942b: 53. — MICHEL, 1964: 33; 1974: 134. — GUINOT, 1967: 280.
Pseudopalicus fisheri - MOOSA & SERÈNE, 1981: 36 (in key).
Pseudopalicus cyrenae - MOOSA & SERÈNE, 1981: 36 (in key).
Pseudopalicus investigatoris - MOOSA & SERÈNE, 1981: 36 (in key).
non *Palicus investigatoris* - MACGILCHRIST, 1905: 265 [= *Pseudopalicus serripes* (Alcock & Anderson, 1895)].

MATERIAL EXAMINED. — **Madagascar**. *Off Nosy Be. "Vauban"*: stn 52, trawl, 15°21.0'S, 46°12.5'E, 150 m, A. CROSNIER coll., 8.11.1972: 1 juv. ♂ (MNHN-B 26910).

Mauritius. Tombeau Bay, stn 34, 366 m, T. MORTENSEN coll., 26.09.1929: 1 ♀ (ZMUC).

Western Australia. *"Diamantina"*: stn 33, west of Garden Island, 32°15.7'S, 115°06.7'E, 176-182 m, 18.03.1972: 1 ♀ (WAM C.23578). — Stn 56, west of Dongara, 29°18'S, 114°04'E, 170-174 m, 20.03.1992: 1 ♀ (WAM C.23571). — Stn 66, northwest of Green Head, 29°59'S, 114°25'E, 146 m, 22.03.1972: 1 ♀ (WAM C.23569).

Japan ?. No location: 1 ♂ 18.7 x 24.4 mm (SMF 24707).

Philippine Islands. MUSORSTOM 1: stn 57, 13°53.1'N, 120°13.2'E, 107-96 m, 26.03.1976: 1 ♂ 10.3 x 12.0 mm (MNHN-B 26905).

Landsdowne-Fairway Banks. CHALCAL 1: stn D 3, 120-150 m, 21°14.00'S, 162°16.40'E, 18.05.1984: 1 ♀ (MNHN-B 26915).

New Caledonia. BIOCAL: stn CP 84, 20°43'S, 167°01'E, 150-210 m, 6.09.1985: 1 ♀ 22.3 x 26.3 mm (MNHN-B 26745).

LAGON: stn 116, 43 m, sand and gravel, 22°25.2'S, 166°43.7'E, 08.1984: 1 ♀ (MNHN-B 26916). — Stn 390, 155 m, stylasterids and boulders, 22°42.6'S, 167°01.6'E, 22.01.1985: 1 ♀ (MNHN-B 26917).

MUSORSTOM 4: stn DW 183, 280 m, 19°01.8'S, 163°25.8'E, 18.09.1985: 1 ♂ (MNHN-B 26918).

SMIB 5: stn DW 95, 200 m, 22°59.7'S, 169°19.8'E, 14.09.1989: 1 ♀ (MNHN-B 26919).

BATHUS 4: stn CP 938, 280-288 m, 19°00.16'S, 163°26.45'E, 8.08.1994: 1 ♀ (MNHN-B 26920). — Stn DW 942, 270-264 m, 19°04.26'S, 163°27.36'E, 8.08.1994: 3 ♀ (MNHN-B 26921).

Vanuatu. MUSORSTOM 8: stn CP 1077, 180-210 m, 16°04.00'S, 167°06.09'E, 5.10.1994: 1 ♂ (MNHN-B 26911), 1 ♀ 11.7 x 14.5 mm (MNHN-B 26746), 1 ♀ (MNHN-B 26912). — Stn CP 1078, 194-230 m, 16°03.65'S, 167°26.18'E, 5.10.1994: 1 ♀ (MNHN-B 26913). — Stn CP 1086, 182-215 m, 15°36.58'S, 167°16.32'E, 5.10.1994: 1 ♀ 8.8 x 10.1 mm (MNHN-B 26747), 1 ♀ (MNHN-B 26914).

Fiji. MUSORSTOM 10: stn 1323, 17°16.10'S, 177°45.75'E, 143-173 m, 7.08.1998: 1 juv. ♂ (MNHN-B 26922). — Stn. 1324, 17°17.37'S, 177°47.05'E, 102-104 m, 7.08.1998: 1 ♀ 8.2 x 9.5 mm (MNHN-B 26748).

Hawaiian Islands. *Kauai*. *"Albatross"*: stn 3987, 73-426 m: 1 ♂ holotype of *Cymopolia fisheri* Rathbun, 1906, 11.9 x 14.0 mm (USNM 29368).

Oahu. 30-300 m, M. KING coll., 1959: 1 ♀ (LACM).

TYPES. — *Holotype* of *Palicus investigatoris* Alcock, 1900: 1 ♂ 7 x 8 mm, Andaman Islands, India (ALCOCK, 1900). Deposit unknown: Zoological Survey of India, Calcutta ?

Holotype of *Cymopolia fisheri* Rathbun, 1906: 1 ♂ 11.9 x 14.0 mm, off Kauai, Hawaiian Islands, 73-426 m (USNM 29368).

Holotype of *Cymopolia cyrenae* Ward, 1942: 1 ♀ CW 15 mm (WARD, 1942), Mauritius. Deposit unknown: Mauritius Institute, Port Louis, Mauritius ?

TYPE LOCALITY. — Andaman Islands, India, unknown depth.

DIAGNOSIS. — Carapace (Figs 8b, 12b, 60d; ALCOCK & MCARDLE, 1903, pl. 67, fig. 2) with four pointed anterolateral teeth on each side; first three teeth usually of similar size but always much larger than fourth (second and third teeth may be fused into wider tooth in smaller specimens). Dorsal surface of carapace with large granular bosses, 10 of which form an almost straight row across branchial and metagastric regions in large specimens; posterior border with 8-10 pointed or elongate tubercles. Supraorbital borders each with two triangular, pointed lobes. Suborbital borders (Fig. 9a) each with one broad, rounded outer lobe; long, pointed tooth on inner portion.

Typically two (sometimes one), sharply pointed teeth on pterygostomial ridge connecting pterygostomial lobe with pterygostomial region of carapace (Fig. 9a). Dorsal borders of cheliped propodi each with several rounded or pointed tubercles, at least one sharp tooth on proximal portion; inner surface of propodi of males smooth, without dense cluster of plumose setae; sharp teeth on dorsal surfaces of carpi and meri. Propodi and dactyli of walking legs (P3-4) with teeth along anterior borders. Dactyli of walking legs slender (P4 0.5-0.6 CL), with large teeth along posterior borders (2-3 teeth in P4; Figs 8b, 12b). Abdomen of mature males with all segments free, one complete but low ridge along segment 3. Male first pleopods (Figs 4b-c) with sinuous basal parts; simple distal part with small teeth along inner border. Abdomen of mature females with all segments free, one complete transverse ridge along each segment 1-4 (low ridge may be present along segment 5).

Color: A large female (11.7 x 14.5 mm; MNHN-B 26746) from Vanuatu photographed live (Fig. 60d) had a multicolored but mostly red-brown carapace and dark green depressed areas at the confluence of the branchial and mesogastric regions. A small immature female (8.8 x 10.1 mm; MNHN-B 26747) from the same region was light brownish yellow with bright orange depressed areas. An almost identical color pattern, light brownish yellow with bright orange depressed areas, was recorded in a female from Fiji that had been preserved for only nine months [8.2 x 9.5 mm (MNHN-B 26748), Fig. 12b].

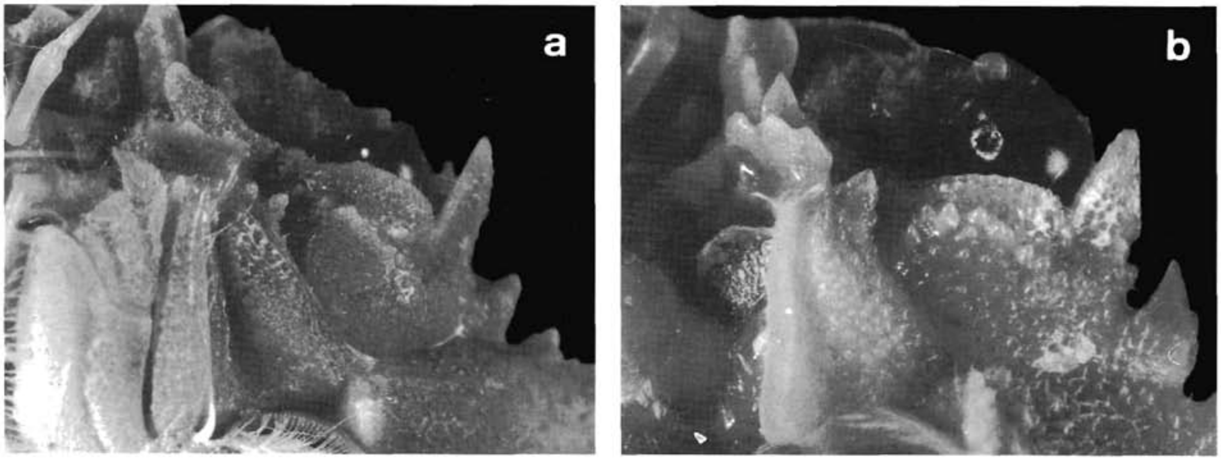

FIG. 9. — **a**, *Pseudopalicus investigatoris* (Alcock, 1900), ♀ 8.2 x 9.5 mm, Fiji, MUSORSTOM 10, stn CP 1324, 102-104 m (MNHN-B 26748): suborbital region. — **b**, *Pseudopalicus serripes* (Alcock & Anderson, 1895), ♂ 10.4 x 11.0 mm, Seychelles, REVES 2, stn 21, 55-60 m (MNHN-B 26750): suborbital region.

DISCUSSION. — Additional morphological characters of *P. investigatoris* are a spherical or slightly flattened cornea of the eyes, which are wider than the base of the eye peduncle. Each peduncle is long and it has two conspicuous granular tubercles on the distal border. The inner edge of each suborbital border is marked by one very conspicuous, pointed tooth slightly higher than the postorbital angle. The tooth is often but not always separated distally from the outer portion of the suborbital border by a narrow notch. The anterior tip of each pterygostomial lobe projects ventrally, thus forming a flat, semicircular structure (often with 1-3 pointed tips when seen ventrally; Fig. 9a) posterior to the inner suborbital tooth. The epistome is vertically inclined, with two narrow, triangular median teeth with very pointed tips flanked on each side by a similar outer process and a rounded margin before joining the pterygostomial lobe. The fingers of the larger cheliped have a cutting edge and no teeth; the fingers of the smaller cheliped are flattened, have triangular teeth, and thick tips. The third pair of walking legs (P4) has relatively short meri (0.5 CL), each with one row of teeth along upper border and one large and conspicuously pointed distal tooth; dactyli are slender (0.3 CL), each with 2-3 large teeth along the posterior border. The fifth pair of pereopods (P5) are short (0.7-0.8 CL), meri each with 5-6 microscopic teeth and tubercles along the posterior border, propodi each with 6-8 slender spines along the posterior border, and dactyli each with 3-5 short spines (thicker distally) along the posterior border, 5-12 along anterior border, and one terminal pointed tooth.

P. investigatoris was described from only one specimen, a "non-adult" male (7 x 8 mm) from the Andaman Islands. Its detailed description (ALCOCK, 1900) and excellent figure (ALCOCK & MCARDLE, 1903, pl. 67, fig. 2; reproduced here as Fig. 8b) has confirmed the status of this species as a distinct one, notwithstanding its close proximity to *P. serripes* (Alcock & Anderson, 1895) and the unavailability of the holotype.

P. investigatoris shares with *P. serripes* very similar characters: 10 large granular bosses that form an almost straight row across the branchial and metagastric regions of the carapace of large specimens; four pointed anterolateral teeth, first three usually of similar size but always much larger than the fourth; a squarish carapace; two triangular and pointed supraorbital lobes; suborbital borders each with one broad and rounded lobe continuous with narrow and straight or slightly rounded inner portion; long and pointed postorbital angles; teeth on the posterior border of the dactyli of the walking legs; epistome with two triangular, pointed median teeth (although long, thin tips are characteristic of *P. investigatoris* and only in some small specimens of *P. serripes*). They also share very similar male first pleopods: simple distal parts armed with small teeth along the inner border. Several characters of *P. investigatoris*, however, separate it from *P. serripes*, some of which are apparent in the figures of ALCOCK & MCARDLE (1903, pl. 67, figs 1-2; reproduced as Figs 8a-b). Differences are summarized in Table 2.

TABLE 2. - Morphological differences between *Pseudopalicus investigatoris* (Alcock, 1900) and *P. serripes* (Alcock & Anderson, 1895).

	Pseudopalicus investigatoris (Alcock, 1900)	***Pseudopalicus serripes*** (Alcock & Anderson,1895)
Frontal lobes	Longer and pointed	Shorter and round
Dorsal surface of carapace	Well-defined and elevated granular bosses	Shallower granular bosses
P3-4 dactyli	Narrower and more slender (P4 0.5-0.6 CL)	Shorter and wider (P4 0.2-0.3 CL)
Teeth on posterior border of P4 dactyli	2-3	3-5
Teeth on ridge connecting pterygostomial lobe with pterygostomial region	2 (1 in some juveniles), sharply pointed	1 broad, round
Distal edge of anterior border of P3-4 meri	Long, pointed tooth-like tubercle	Short, blunt tubercle
Inner surface of cheliped propodi	Smooth	Dense cluster of plumose setae in males
Dorsal surface of cheliped propodi	Pointed tubercles (at least one sharp tubercle on proximal portion)	Round tubercles
Postorbital angles	Long and pointed, extending beyond retracted eye	Shorter and less pointed, extending to just dorsal surface of retracted eye
Posterior border of carapace	Salient, pointed tubercles	Shallow, elongate tubercles
Basal antennal segment	Slender, with pointed distal portion (in ventral view) and relatively shallow tubercles along ventral surface	Expanded along outer border (in ventral view) and one row of conspicuous, round tubercles (particularly larger specimens)
Inner suborbital tooth	Conspicuous and always pointed	Smaller, round or pointed
First male pleopod	Distal part slightly curved and with one dorsal row of teeth (Figs 4b-c)	Distal part S-shaped and with two dorsal rows of teeth (Fig. 4d)

The male first pleopods are only slightly different from those of *P. serripes* in contrast to the sharp differences between other species of palicids. The male first pleopods of *P. investigatoris* are slender, each distal part dorsoventrally flattened, slightly curved, and armed with one dorsal row of small teeth (Figs 4b-c), whereas they are of similar shape (each distal part typically sharply curved and S-shaped) but armed with two dorsal rows of smaller teeth in *P. serripes* (Fig. 4d; MOOSA & SERÈNE, 1981, fig. 5).

Some of the characters given by ALCOCK (1900) as diagnostic for *P. investigatoris* were found to be absent in the largest or smallest specimens. The bosses of the carapace, although described by ALCOCK (1900: 455) as "aureolae... capped by sharp little tubercles" in contrast to "granules" in *P. serripes*, were found to be mostly covered with granules in the larger specimens of *P. investigatoris*. The suborbital border, described by ALCOCK (1900: 455) as having "no fissure" along its inner end in contrast to an inner "fissure" and an outer notch in *P. serripes*, is a variable character in both species. A notch may be present in some individuals. Similarly, the anterior borders of the carpi of the second and third pairs of walking legs (P3-4) may be serrated in *P. investigatoris* as in *P. serripes*, and they are not always smooth as indicated by ALCOCK (1900: 455).

The examination of the holotype of *Cymopolia fisheri* Rathbun, 1906 shows that it is a subjective junior synonym of *P. investigatoris*. RATHBUN (1906: 836) differentiated her new species from *P. investigatoris* by following ALCOCK's premise that the carapace of *P. investigatoris* is covered by tubercles, not granules as in *P. serripes*. She also stated that the frontal lobes of her species were less acute than in *P. investigatoris*. Although the holotype (USNM 29368) has granules, the specimen clearly shows the characters diagnostic for *P. investigatoris* that are illustrated in ALCOCK's figure of the species (ALCOCK & MCARDLE, 1903, pl. 67, fig. 1; reproduced as Fig. 8b), including the more pointed frontal lobes and the slender dactyli of the walking legs.

Although the holotype of *Cymopolia cyrenae* Ward, 1942 (supposedly still at the Mauritius Institute, Port Louis, Mauritius) was not available for examination, WARD's description and poor photograph (WARD, 1942a: 46, pl. 4, figs 1-2) nevertheless provide enough evidence to conclude that his only female specimen is actually conspecific with *P. investigatoris*. WARD referred to *C. cyrenae* as "allied to *C. investigatoris* Alcock" and differentiated the two species by three characters: the presence in *C. cyrenae* of "two petaloid spines" on the carpi of the walking legs, dactyli each with three spines, and by "all the spines" being longer in the new species. Only one distal, pointed tubercle is visible on the merus of each of the second walking legs, the only legs shown on WARD's photograph, not two as he indicated. Although the figure of *P. investigatoris* given by ALCOCK & MCARDLE (1903, pl. 67, fig. 2; reproduced as Fig. 8b) and the only that could have been available to WARD shows only two teeth on each second leg, this is a variable character.

The most important diagnostic characters of *P. investigatoris* are apparent in WARD's photograph: conspicuously pointed supraorbital lobes and postorbital angles, and slender dactyli of the walking legs. Other characters are typical of *P. investigatoris*. The tubercles along the posterior border of the carapace were described by WARD (1942a: 46) as "ten or eleven dentiform spines" (but shown as pointed tubercles on the photograph), each supraorbital border as "cut into three broad spines, the median of which is broadly truncate, the other two sharp, and there is a large spine at the external orbital angle" and shown in the photograph as two pointed suborbital lobes and an elongate, pointed postorbital angle. Each anterolateral border, however, was described as having "three broad acuminate spines". Although only three can be seen in the photograph, it is very possible that the fourth, always the smallest, was much reduced (and therefore not visible in the poor photograph) and not defined as an "acuminate spine" by WARD. The eye peduncles were described as having "spines" which is assumed to refer to pointed tubercles. The character was nevertheless used as a diagnostic feature in the key to the species of *Pseudopalicus* that was given by MOOSA & SERÈNE (1981: 36).

SIZE. — Maximum size among specimens examined: 22.3 x 26.3 mm (female, MNHN-B 26745); 18.7 x 24.4 mm (male, SMF 24707).

DISTRIBUTION. — Mauritius (WARD, 1942a, 1942b; as *Cymopolia cyrenae*), Andaman Islands (ALCOCK, 1900) and the Hawaiian Islands (RATHBUN, 1906; EDMONDSON, 1933, 1946; all as *Cymopolia fisheri*). Its distribution is now extended to Madagascar, Western Australia, Japan ?, South China Sea (off the Philippine Islands), Coral Sea (Vanuatu, New Caledonia, and the Landsdowne-Fairway Banks), and Fiji (Fig. 52). Depth: known reliably between 43 and 366 m; also collected in trawls between 30-300 and 73-426 m.

Pseudopalicus serripes (Alcock & Anderson, 1895)

Figs 4d, 8a, 9b, 12c, 52

Cymopolia serripes Alcock & Anderson, 1895: 208; 1896: pl. 24, fig. 7. — SAKAI, 1935: 86, fig. 17; 1936: 208, fig. 111, pl. 58, fig. 1; 1939: 608, 726, pl. 71, fig. 1; 1956: 52.
Palicus serripes - BOUVIER, 1897: 65. — ALCOCK, 1900: 454. — CALMAN, 1900: 32, pl. 2, figs 20-22. — DE MAN, 1902: 546. — ALCOCK & MCARDLE, 1903: pl. 67, fig. 1. — LAURIE, 1906: 431. — SAKAI, 1976: 594, pl. 205, fig. 2.
Palicus investigatoris - MACGILCHRIST, 1905: 265 [non *Pseudopalicus investigatoris* (Alcock, 1900)].
Pseudopalicus serripes - MOOSA & SERÈNE, 1981: 37, fig. 5, pl. 2, fig. A. — TAKEDA, 1982a: 205, fig. 607.
? *Palicus* aff. *serripes* - TAKEDA & KURATA, 1976: 132, fig. 6e.

MATERIAL EXAMINED. — **Somalia**. *"Anton Bruun"*, cruise 9: stn 447, 10°00'N, 51°15'E, 59-61 m, 16.12.1964: 2 ♀ (USNM).

Seychelles. REVES 2: stn 21, 05°22.9'S, 56°10.4'E, 55-60 m, 6.09.1980: 1 juv. ♂, 1 ♂ 10.4 x 11.0 mm (MNHN-B 26750).

Sri Lanka. Gulf of Manaar, W.A. HERDMAN coll.: 1 ♀ (BMNH 1934.1.16.165).

Japan. Boso Peninsula. Tateyama Island, 30-60 m, sand, M. OSAWA coll., 22.05.1990: 1 ♂ (CBM-ZC 307).

"Misago": Izu Peninsula (between Ito and Hatsushima), 06.1934: 1 ♂ (SMF 24708).

Indonesia. *Moluccas. Ternate.* W. KÜKENTHAL coll.: 1 ♀ (SMF 4714).

Australia. *Torres Strait.* A.C. HADDON coll.: 1 ♀ (BMNH 1900.11.26.516).

Chesterfield Islands. CORAIL 2: stn DW 9, 20°53.00'S, 161°35.32'E, 62 m, *Halimeda* sand, 20.07.1988: 1 ♀ (MNHN-B 26829). — Stn DW 34, 19°21.62'S, 158°55.77'E, 47 m, foraminiferans and boulders, 23.07.1988: 1 ♀ (MNHN-B 26830). — Stn DW 61, 19°14.96'S, 158°53.60'E, 54 m, *Halimeda* sand, 24.08.1988: 1 ♂ (MNHN-B 26831).

Chesterfield-Bellona Plateau. CHALCAL 1: stn D 55, 21°23.90'S, 158°59.60'E, 55 m, 25.07.1984: 1 ♂, 1 ♀ (MNHN-B 26832).

New Caledonia. MUSORSTOM 4: stn DW 231, 22°33.7'S, 167°10.5'E, 75 m, 1.10.1985: 1 ♀ (MNHN-B 26833). SMIB 5: stn DW 100, 23°22.9'S, 168°05.2'E, 120 m, 14.09.1989: 1 ♀ 10.4 x 11.3 mm (MNHN-B 26749).

Futuna Island. MUSORSTOM 7: stn DW 498, 14°19'S, 178°03'W, 105-160 m, 10.05.1992: 1 ♂ (MNHN-B 26834).

TYPES. — *Holotype* of *Palicus serripes* Alcock & Anderson, 1895: 1 ♀ 9.5 x 11 mm, India (ALCOCK & ANDERSON, 1895). Deposit unknown: Zoological Survey of India, Calcutta ?

TYPE LOCALITY. — Off Madras coast, southeastern India, shallow water.

DIAGNOSIS. — Carapace (Figs 8a, 12c; ALCOCK & MCARDLE, 1903, pl. 67, fig. 1) with four pointed anterolateral teeth on each side; first three teeth usually of similar same size but always much larger than fourth. Dorsal surface of carapace with relatively low, conspicuously granular bosses; posterior border with 10-12 low, elongate tubercles. Supraorbital borders each with two narrow, rounded lobes. Suborbital borders (Fig. 9b) each with one broad, rounded outer lobe; long, pointed tooth on inner portion. One rounded tooth on each pterygostomial ridge connecting pterygostomial lobe with pterygostomial region of carapace (Fig. 9b). Dorsal borders of cheliped propodi with several rounded tubercles; inner surface of propodi of males with dense cluster of plumose setae (see SAKAI, 1936, fig. 111c); rounded tubercles on dorsal surfaces of carpi and meri. Propodi and dactyli of walking legs (P3-4) with teeth along anterior borders. Dactyli of walking legs short, broad (P4 0.2-0.3 CL), with teeth along posterior borders (3-5 teeth in P4; Fig. 8a, 12c). Abdomen of mature males with all segments free; one almost complete transverse ridge along segment 3. Male first pleopods (Fig. 4d) with sinuous basal parts; each distal part, with small teeth along inner border. Abdomen of mature females with all segments free, one complete transverse ridge along each segment 1-4 (low ridge may be present along segment 5).

DISCUSSION. — Besides the characters outlined in the diagnosis and those discussed in its differentiation from *P. investigatoris* (see discussion for *P. investigatoris* above), other characters for *P. serripes* include a frontal border of the carapace that is divided into four rounded lobes (inner pair narrower and pointed in some specimens), followed by a border that is folded upward and very slightly pointed anteriorly before the supraorbital border. The postorbital angles are relatively long (they extend to the dorsal border of the retracted eye) and pointed. Each basal antennal segment is slender and rectangular (but expanded along its outer border in larger specimens), and with a row of rounded tubercles along the ventral surface. Each eye peduncle is long and has two granular tubercles on the distal border and several along the dorsal border. The inner edge of each suborbital border is marked by one blunt to pointed tooth that is slightly higher than the suborbital border; the tooth is sometimes separated distally from the outer portion of the suborbital border by a narrow notch. Each pterygostomial lobe projects ventrally, forming a flat, semicircular structure (with 2-3 pointed tips when seen ventrally; Fig. 9b) posterior to each inner suborbital tooth. The epistome is vertically inclined, with two narrow, triangular median teeth with rounded tips (thin and pointed in some small specimens) flanked on each side by a narrow, triangular outer process. It continues ventrally as two rounded lobes around the buccal region. The third pair of walking legs (P4) has short meri (0.4 CL), one row of teeth along the upper border, and one small and rounded distal tubercle. The fifth pair of pereopods (P5) is short (0.6-0.7 CL). Each merus has 5-7 microscopic teeth (some of which with one spine) arranged as two rows along the posterior border; propodus with 6-9 thick spines along the posterior border; each dactylus with 3-4 slightly more slender spines (longer distally) along the posterior border, 2-3 along the anterior border and one terminal pointed tooth.

P. serripes is very close to *P. investigatoris*. Differences between the two species are outlined in the discussion of *P. investigatoris* (see above) and summarized in Table 2. Reliable characters for the identification of *P. serripes* are the presence of a conspicuous cluster of plumose setae on the inner surfaces of the chelipeds of males (SAKAI, 1936, fig. 111c) and the short and broad dactyli of the walking legs (P2-4; Figs 8a, 12c). Juvenile specimens, however, are difficult to identify.

The male first pleopods are very close in both species. Their shape is very similar, with dorsoventrally flattened distal parts, although it was found to be sharply more sinuous (S-shaped) in most of the specimens of *P. serripes* that were examined in this study. It is armed with two distal rows of smaller teeth in *P. serripes* (Fig. 4d) but only one row of slightly coarser teeth in *P. investigatoris* (Figs 4b-c). The figure given by MOOSA & SERÈNE (1981, fig. 5), however, does not clearly show the two rows of teeth and the distal part is not as sinuous as in most specimens of *P. serripes*. The three specimens examined by them certainly belong to *P. serripes*, not *P. investigatoris* (which they did not examine), because the chelipeds were described as having "inner surface of the palm setose" (MOOSA & SERÈNE, 1981: 39).

A male specimen from the Persian Gulf identified as an undescribed variety of *Palicus investigatoris* by MACGILCHRIST (1905: 265) seems from its description to belong instead to *P. serripes*. The location of the specimen is unknown and could not be examined, but the presence of tubercles along the posterior border that are "broad and blunt" (indeed described as to "resemble more those of *P. serripes*") and outer frontal lobes that are "broad, blunt, and rounded at the end" strongly suggests *P. serripes*. Two other characters that were given, the presence of a fissure on each suborbital border and "densely and finely granular" surface between "sharp little tubercles on the aureolae of the carapace", are present in specimens of both species.

SIZE. — Maximum size among specimens examined: 10.4 x 11.3 mm (female, MNHN-B 26749); 10.4 x 11.0 mm (male, MNHN-B 26750).

DISTRIBUTION. — Persian Gulf (MACGILCHRIST, 1905; as *Palicus investigatoris*); southern India and Sri Lanka (ALCOCK, 1900; LAURIE, 1906); Ternate (DE MAN, 1902) and Banda Sea (Ceram, Aru Islands, and Kai Islands), Indonesia (MOOSA & SERÈNE, 1981); Japan (SAKAI, 1935, 1936, 1939, 1956, 1976; TAKEDA, 1982a), and Torres Strait, Queensland, Australia (CALMAN, 1900). It is now recorded for the first time from Somalia, Seychelles, Coral Sea (Chesterfield Islands, Chesterfield-Bellona Plateau, and New Caledonia), and Futuna Island, southwestern Pacific Ocean (Fig. 52). SAKAI (1976: 594) records it from "muddy sand or broken shells" in Japan. Depth: known reliably between 30 m (SAKAI, 1976) and 120 m; also collected in a trawl between 105-160 m.

Pseudopalicus sp.

Fig. 10

MATERIAL EXAMINED. — **Japan.** *Ryukyu Islands.* Okinawa, off Horseshoe Cliffs, west-northwest Onna Village, stn RFB 966, 26°30.0'N, 127°50.9'E, 79 m, R.F. BOLLAND coll., 14.11.1981: 1 ♀ 6.3 x 7.5 mm (USNM).

DIAGNOSIS. — Carapace (Fig. 10a) with four pointed anterolateral teeth on each side; first three teeth of similar same size but much larger than fourth. Dorsal surface of carapace with relatively low, conspicuously granular bosses; posterior border with eight low, elongate tubercles. Supraorbital borders each with one rounded inner lobe; one very short, rounded outer lobe. Suborbital borders (Fig. 10b) each with one pointed inner lobe; outer lobe divided into two pointed, close-together lobes. Dorsal borders of cheliped propodi with several rounded tubercles. Propodi and dactyli of walking legs (P3-4) with conspicuous teeth along anterior borders. Dactyli of walking legs (Fig. 10c) slender (P4 0.2 CL), with triangular teeth along posterior borders. P5 thick, with thick spines along posterior borders of propodi and anterior and posterior borders of dactyli.

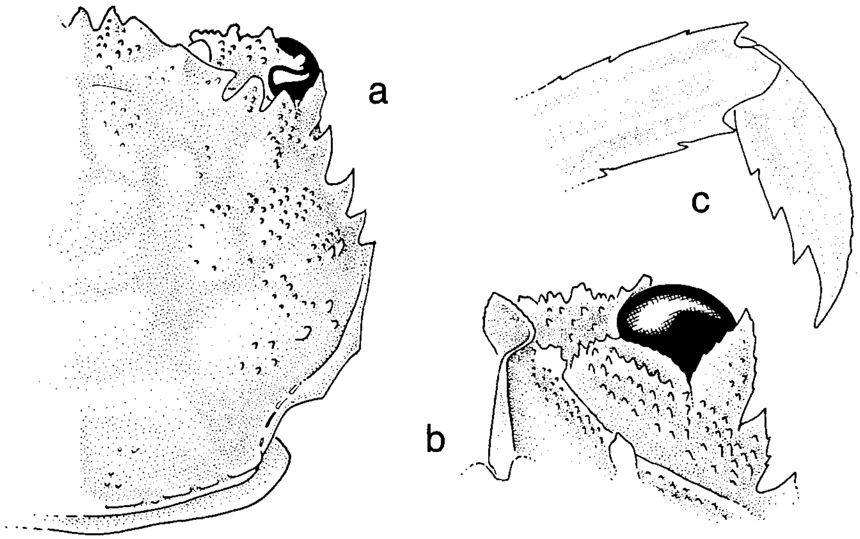

FIG. 10. — *Pseudopalicus* sp., ♀ 6.3 x 7.5 mm, Okinawa, Ryukyu Islands, Japan, stn RFB 966, 79.2 m (USNM): **a**, carapace, dorsal surface; **b**, suborbital border; **c**, dactylus, right fourth pereopod, dorsal view.

DISCUSSION. — An incomplete female specimen (missing the abdomen and one each of the chelipeds, P3, P4, and P5) from the Ryukyu Islands was found to share some superficial characters with *P. serripes*, but the presence of several features unique to the genus suggests that it probably represents a new species. As there is only one incomplete female specimen available, however, the species is not described as new here.

Similar to *P. serripes* are the morphology of the dorsal surface of the carapace, chelipeds, and walking legs. Significant differences are the broad and rounded frontal lobes (narrower in *P. serripes*), eight elongate tubercles along the posterior border of the carapace (10-12 in *P. serripes*), supraorbital borders, each with one rounded inner lobe and one very broad and short outer lobe (both lobes narrow, rounded, and nearly equal in *P. serripes*), suborbital borders each with one pointed inner lobe and an outer lobe that is uniquely divided into two pointed, close-together lobes (pointed tooth on inner border and one broad, rounded outer lobe in *P. serripes*), and the pterygostomial lobes are straight and pointed (ventrally inclined and with 2-3 pointed tips in *P. serripes*; Figs 9b, 10b). The posterior borders of the propodi and dactyli of P2-4 are armed with spines and teeth. Another unique feature is the fifth pair of pereopods (P5). They are thick, short (0.7 CL), the surface of each merus is covered with small tubercles and long, plumose setae. The meri and propodi are also unusually spiny, with several rows of thick spines of various sizes (a total of 17 along posterior border of each propodus) and similar spines along both borders of the thick and short (0.01 CL) dactyli (three thick spines along each posterior side and one along anterior side, plus several smaller spines). There are also spines on the basis-ischia and carpi.

SIZE. — Only specimen known: 6.3 x 7.5 mm (female, USNM).

DISTRIBUTION. — Known only from Okinawa, Ryukyu Islands, Japan. Depth: 79 m.

Pseudopalicus pictus sp. nov.

Figs 11, 12d, 54, 60e

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn DW 965, 20°20.40'S, 169°51.36'E, 361-377 m, 21.09.1994: 1 ♀ paratype 9.7 x 11.2 mm (MNHN-B 26693). — Stn DW 1042, 16°52.61'S, 168°27.65'E, 200-265 m, 30.09.1994: 1 ♂ holotype 8.6 x 10.4 mm (MNHN-B 26690).

French Polynesia. *Marquesas Islands. Eiao Island.* MUSORSTOM 9: stn CP 1159, 07°58.3'S, 140°43.7'W, 145 m, 23.08.1997: 1 ♀ (MNHN-B 26818), 1 ♂ paratype 7.4 x 8.9 mm (MNHN-B 26692), 1 ♀ paratype 9.0 x 9.9 mm (USNM).

Hiva Oa Island. MUSORSTOM 9: stn DW 1218, 09°44.5'S, 138°50.9'W, 125-135 m, 30.08.1997: 1 juv. ♀ paratype 8.8 x 10.8 mm (MNHN-B 26694), 1 ♀ (MNHN-B 26816). — Stn DW 1236, 09°41'S, 139°04'W, 250-400 m, 31.08.1997: 1 ♂ (MNHN-B 26817). — Stn CP 1237, 09°41.9'S, 139°03.6'W, 95-305 m, 31.08.1997: 1 ♂ paratype 6.8 x 8.2 mm (MNHN-B 26691).

Fatu Hiva Island. MUSORSTOM 9: stn DW 1242, 10°28.1'S, 138°41.1'W, 119-122 m, 1.09.1997: 1 juv. ♂, 2 juv. ♀ (MNHN-B 26819).

TYPES. — *Holotype*: 1 ♂ 8.6 x 10.4 mm, MUSORSTOM 8, stn DW 1042 (MNHN-B 26690).

Paratypes: 1 ♂ 6.8 x 8.2 mm, MUSORSTOM 9, stn CP 1237 (MNHN-B 26691); 1 ♂ 7.4 x 8.9 mm, MUSORSTOM 9, stn CP 1159 (MNHN-B 26692); 1 ♀ 9.7 x 11.2 mm, MUSORSTOM 8, stn DW 965 (MNHN-B 26693); 1 juv. ♀ 8.8 x 10.8 mm, MUSORSTOM 9, stn DW 1218 (MNHN-B 26694); 1 ♀ 9.0 x 9.9 mm, MUSORSTOM 9, stn CP 1159 (USNM).

TYPE LOCALITY. — Off southeast coast of Epi Island, Vanuatu, 16°52.61'S, 168°27.65'E, 200-265 m.

DIAGNOSIS. — Carapace (Figs 11a, 12d, 60e) with four pointed anterolateral teeth on each side; second tooth slightly wider than the rest. Dorsal surface of carapace covered by large granules and few small, low granular bosses, mostly on branchial and metagastric regions; posterior border with 9-10 elongate tubercles. Supraorbital borders each with two triangular, pointed lobes. Suborbital borders (Fig. 11b) each with one slightly rounded lobe; long, pointed tooth on inner portion. Dorsal borders of cheliped propodi with several rounded or pointed tubercles. Propodi and dactyli of walking legs (P3-4) with teeth along anterior borders (1-4 large teeth on each dactylus of P4; Fig. 11c). Abdomen of mature males with all segments free, each with complete transverse ridge, one complete but low ridge along segments 1-3. Male first pleopods (Figs 11d-e) with sinuous basal parts; each distal part thick, with pointed, toothed tip sharply bent distally. Abdomen of mature females with all segments free, one complete transverse ridge along each segment 1-3 (short ridge at each edge of segment 4).

Color: Live specimens (Fig. 60e) with irregular, dark-brown pattern on the carapace and dark-brown legs distally banded with white, which remains in preserved specimens as a variegated red-brown pattern.

DESCRIPTION. — Carapace (Figs 11a, 12d, 60e) transversely hexagonal, slightly squarish, wider than long (CW/CL = 1.1-1.2); dorsal surface covered with large granules and few, low, granular bosses (most conspicuous bosses on branchial and metagastric regions). Anterolateral borders of carapace each with four pointed teeth, second slightly wider, fourth much smaller than first three. Row of low, rounded tubercles along each posterolateral border. Posterior border with 9-10 elongate or rounded tubercles, iridescent plumose setae.

Frontal border of carapace divided into four pointed lobes (inner lobes narrower). Borders between frontal lobes and supraorbital borders slightly pointed anteriorly, folded upward, concave, ending in pointed tip, forming U- or V-shaped fissure before supraorbital border. Supraorbital borders each with two pointed lobes with slightly rounded tips. Postorbital angles moderately long (extend just to dorsal border of retracted eye), slender, pointed. Cornea of eyes dorsoventrally flattened, wider than base of moderately long eye peduncle; each peduncle with four conspicuous, granular tubercles: two median (most ventral conspicuously elongate, pointed), two on distal border.

Suborbital borders (Fig. 11b) each with one broadly rounded outer lobe (limited on outer and inner edges by notch or wide fissure); conspicuous, pointed tooth on inner limit of suborbital border. Pterygostomial lobes project ventrally, forming flat, semicircular structure (sometimes notched on inner side) as long as or slightly shorter than tooth on inner limit of each suborbital border. Sharp tooth on each pterygostomial ridge connecting pterygostomial lobe with pterygostomial region of carapace.

Each basal antennal segment slender, rectangular (slightly pointed distal border in ventral view); flagellum long, with few, simple setae. Epistome vertically inclined, with two triangular median teeth with thin, pointed tips, each flanked by triangular outer process and thin, rounded margin before pterygostomial lobe. Inner border of ischia of third maxillipeds straight; surface coarsely granular, upper borders rounded. Meri much narrower than ischia; upper lobes straight with rounded outer borders.

Dorsal and outer borders of cheliped propodi each with one row of 2-9 thin, rounded (some pointed) tubercles, at least one of which expanded as high, thin, semicircular process. Fingers of largest cheliped with cutting edges (broadly rounded teeth in some specimens); smallest cheliped only with sinuous edge except some males (5-7 rounded teeth). Carpi short, outer borders with one thin, broadly rounded tubercle, several pointed tubercles; meri slender, with few pointed tubercles.

First three pairs of walking legs (P2-4; Figs 12d, 60e) flattened. Upper and lower borders of meri with tubercles of different sizes and shapes (mostly pointed, some rounded; smaller but on two anterior rows in P2-3); distalmost tubercle on each anterior border much wider at base, much higher, slender, pointed, directed distally. Anterior borders of carpi of walking legs (P2-4) with pointed tubercles; anterior borders of propodi and carpi with teeth. Each P2 with one ventral row of tubercles on merus; 1-2 dorsal, 1-2 ventral row of tubercles on carpus; two dorsal, 2 ventral carinae, 4-5 teeth along posterior border of broad propodus; 1-2 dorsal, two ventral carinae, two teeth on dactylus. Each P3 with one ventral row of tubercles on merus; two dorsal, one ventral row of tubercles on carpus; 1-2 dorsal, two ventral carinae, 2-6 teeth along posterior border of broad propodus; 1-2 dorsal, two ventral carinae, 1-4 teeth on dactylus. Each P4 with two dorsal, one ventral row of tubercles on carpus; one dorsal, two ventral carinae, 4-5 teeth along the posterior border of broad propodus; 1-2 dorsal, 1-2 ventral carinae, 1-4 teeth on dactylus (Fig. 11c). Meri of all walking legs (and carpi, propodi of P3-4) with numerous iridescent plumose setae; distal border of propodi and dorsal surface of anterior borders of propodi and dactyli of P3-4 each with one row of conspicuous plumose setae.

First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair slightly shorter than second. Fifth pair of pereopods (P5) short (0.8-0.9 CL); each merus slender, surface with microscopic tubercles, many microscopic tubercles and plumose setae along posterior border; each propodus with 4-6 spines along posterior border; each dactylus with 3-9 short, thick spines along posterior border, 3-8 short spines along anterior border, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	0.9-1.1	1.5-1.9	1.5-1.7	0.8-0.9
Merus length/CL	0.3	0.4-0.5	0.5	0.3
Dactylus length/Cl	0.2-0.3	0.3-0.4	0.3-0.4	0.2-0.3

Abdomen of mature males with all segments free. One complete transverse ridge along each segment 1-3. Male first pleopods (Figs 11d-e) with sinuous basal parts; each distal part thick, with pointed, toothed tip sharply bent distally.

Abdomen of mature females with all segments free. One transversal ridge along each segment 1-3; short ridge at each outer edge of segment 4.

DISCUSSION. — *P. pictus* shares with *P. investigatoris* and *P. serripes* a similar shape of the carapace (squarish, with pointed anterolateral teeth), teeth on the propodi and dactyli of the walking legs (P2-4), a similar arrangement of the suborbital borders (broad outer lobe and large tooth on the inner limit of the border), and a tooth on the proximal portion of the ridge that connects the pterygostomial lobe with the pterygostomial region (Fig. 11b). It can be clearly differentiated from both species, however, by its unique male first pleopods, which have thick, sharply bent distal parts (Figs 11d-e), and the smoother appearance of the surface of its carapace. As in *P. investigatoris*, the inner surfaces of the male chelipeds lack clusters of setae, in contrast to the cluster of plumose setae in the male of *P. serripes*.

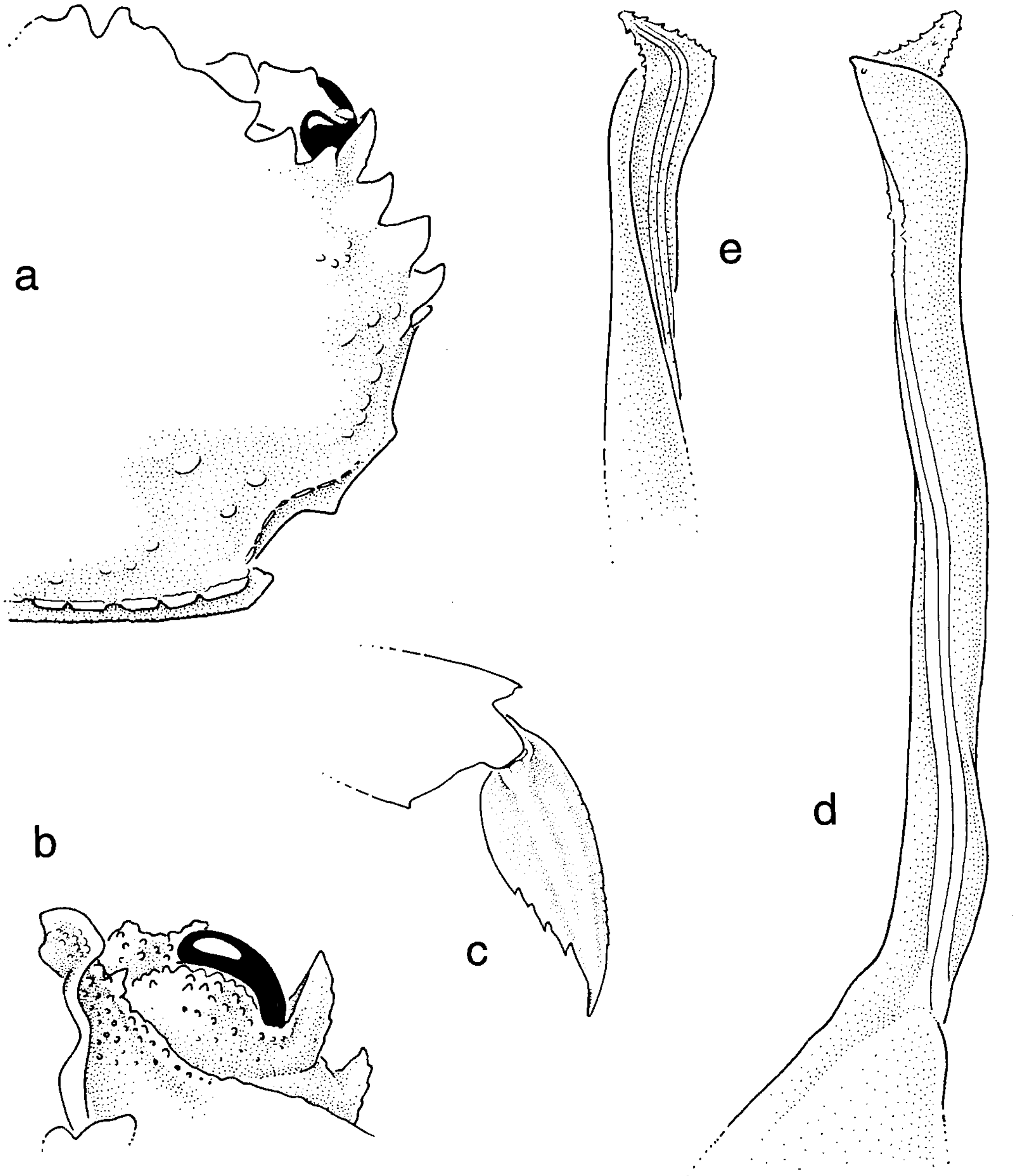

FIG. 11. — *Pseudopalicus pictus* sp. nov., ♂ holotype 8.6 x 10.4 mm, southeast of Epi Island, Vanuatu, MUSORSTOM 8, stn DW 1042, 200-265 m (MNHN-B 26690): **a**, carapace, dorsal surface; **b**, suborbital border; **c**, dactylus, right fourth pereopod, dorsal view; **d**, left male first pleopod, ventral view; **e**, left male first pleopod, distal part, dorsal view.

SIZE. — Maximum size among specimens examined: 9.7 x 11.2 mm (female, MNHN-B 26693); 8.6 x 10.4 mm (male, MNHN-B 26690).

ETYMOLOGY. — From the Latin *pictus*, for painted, in reference to the variegated color pattern of the carapace and the banded legs, which remain evident in preserved specimens, and the color effect that results from the numerous iridescent plumose setae.

DISTRIBUTION. — Coral Sea (Vanuatu) and French Polynesia (Fig. 54). Depth: known reliably between 120 and 370 m; also collected in trawls between 95-305 and 250-400 m.

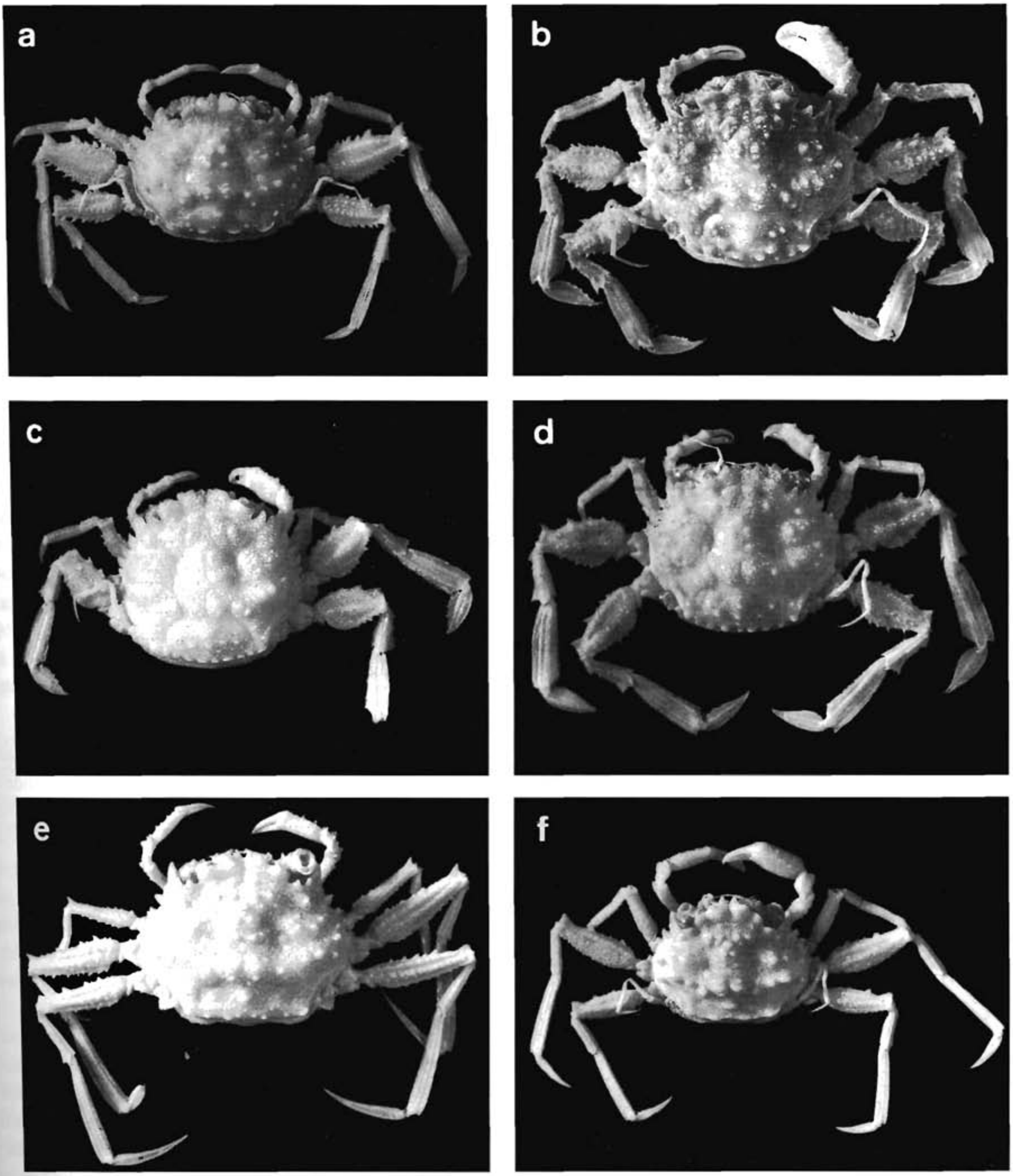

FIG. 12. — **a**, *Pseudopalicus oahuensis* (Rathbun, 1906): ♀ 11.7 x 15.8 mm, off southwest coast of New Caledonia, MUSORSTOM 4, stn CP 238, 500-510 m (MNHN-B 26749): dorsal view. — **b**, *Pseudopalicus investigatoris* (Alcock, 1900), ♀ 8.2 x 9.5 mm, Fiji, MUSORSTOM 10, stn CP 1324, 102-104 m (MNHN-B 26748): dorsal view. — **c**, *Pseudopalicus serripes* (Alcock & Anderson, 1895), ♀ 10.4 x 11.3 mm, Norfolk Ridge, south of New Caledonia, SMIB 5, stn DW 100, 120 m (MNHN-B 26749): dorsal view. — **d**, *Pseudopalicus pictus* sp. nov., juv. ♀ paratype 8.8 x 10.8 mm, Marquesas Islands, French Polynesia, MUSORSTOM 9, stn DW 1218, 125-135 m (MNHN-B 26694): dorsal view. — **e**, *Pseudopalicus macromeles* sp. nov., ♀ 9.7 X 11.7 mm, *"Diamantina"* , west of Rottnest Island, Western Australia, stn 78, 146-150 m (WAM C.23580): dorsal view. Unidentified, tubiculous polychaete worm on right eye. — **f**, *Pseudopalicus undulatus* sp. nov., ♂ paratype 7.3 x 9.0 mm, Vanuatu, MUSORSTOM 8, stn DW 977, 410-505 m (MNHN-B 26696): dorsal view.

Pseudopalicus macromeles sp. nov.

Figs 12e, 13, 52

MATERIAL EXAMINED. — **Western Australia**. *"Diamantina"*, cruise DM 6/63: stn 225, west of Rottnest Island, 32°00'S, 115°16'E, 137-143 m, 12.10.1963: 1 ♂ paratype 7.5 x 8.6 mm (WAM C.24386), 1 ♀ paratype 10.2 x 12.1 mm (WAM C.24387), 1 ♂ 8.0 x 9.4 mm, 21 ♀ (WAM C.23575); 1 ♂ paratype 6.8 x 7.5 mm, 1 ♀ paratype 8.5 x 10.3 mm (MNHN-B 26689).

"Diamantina", cruise DM 1/72: stn 8, northwest of Bunbury, 32°37.5'S, 114°48'E, 139-122 m, 15.03.1972: 2 ♀ (WAM C.23582). — Stn 34, west of Garden Island, 32°19'S, 115°07'E, 148-154 m, 18.03.1972: 1 ♀ (WAM C.23574). — Stn 55, west of Dongara, 29°15'S, 114°01'E, 146 m, 20.03.1972: 5 ♀ (WAM C.23577). — Stn 61, west southwest of Dongara, 29°31'S, 114°11'E, 227-221 m, 21.03.1972: 1 ♀ (WAM C.23572). — Stn 64, northwest of Green Head, 29°58'S, 114°27'E, 197-219 m, 22.03.1972: 1 ♀ (WAM C.23570). — Stn 66, northwest of Green Head, 29°59'S, 114°25'E, 146 m, 22.03.1972: 1 ♀ 10.4 x 12.6 mm (WAM C.23569). — Stn 68(1), northwest of Green Island, 30°34'S, 114°44'E, 146-139 m, 22.03.1972: 1 ♀ (WAM C.23567). — Stn 68(3), northwest of Green Island, 30°34'S, 114°44'E, 128 m, 22.03.1972: 3 ♀ (WAM C.23568). — Stn 73(1), west southwest of Lancelin, 31°04'S, 113°50'E, 256 m, 23.03.1972: 1 ♂, 2 ♀ (WAM C.23576). — Stn 78, west of Rottnest Island, 32°00'S, 115°15'E, 146-150 m, 23.03.1972: 1 ♂ holotype 7.4 x 8.6 mm (WAM C.24385), 1 ♀ paratype 8.1 x 10.0 mm (WAM C.24388), 1 ♂, 9 ♀ (WAM C.23580). — Stn 78(2), west of Rottnest Island, 32°00'S, 115°15'E, 137-146 m, 23.03.1972: 2 ♀ (WAM C.23581). — Stn 79, west of Rottnest Island, 31°59'S, 115°14'E, 182 m, 23.03.1973: 2 ♂ (WAM C.23579). — 03.1972: 1 ♂, 4 ♀ (WAM C.23573).

"Sprightly": stn 22, 75 km west of Cliff Head, 29°31'S, 114°15'E, 145 m, 18.02.1976: 1 ♀ (WAM C.14325).

TYPES. — *Holotype*: 1 ♂ 7.4 x 8.6 mm, *"Diamantina"*, stn 78 (WAM C.24385).

Paratypes: 1 ♂ 7.5 x 8.6 mm, *"Diamantina"*, stn 225 (WAM C.24386); 1 ♀ 10.2 x 12.1 mm, *"Diamantina"*, stn 225 (WAM C.24387); 1 ♀ 8.1 x 10.0 mm, *"Diamantina"*, stn 78 (WAM C.24388); 1 ♂ 6.8 x 7.5 mm, 1 ♀ 8.5 x 10.3 mm, *"Diamantina"*, stn 225 (MNHN-B 26689).

TYPE LOCALITY. — West of Rottnest Island, Western Australia, 32°00'S, 115°15'E, 146-150 m.

DIAGNOSIS. — Carapace (Figs 12e, 13a) with three granular anterolateral teeth on each side; teeth decrease posteriorly in size. Dorsal surface of carapace covered by large granules and several granular bosses, some rounded, high, particularly 6-7 on each branchial region; posterior border with 4-6 rounded, granular tubercles. Supraorbital borders each with two triangular lobes. Suborbital borders (Fig. 13b) each with two rounded lobes (high, narrow inner lobe, broad outer lobe). Dorsal borders of cheliped propodi with several rounded or pointed tubercles. Dactyli of walking legs (P2-4) very slender, with posterior borders entire (Fig. 13c). Abdomen of mature males with all segments free, one complete transverse ridge along each segment 1-3, incomplete ridge along segment 4. Male first pleopods (Figs 13d-e) with sinuous basal parts; each distal part with two broad lateral processes, inner one broader, bordered by thicker portion, outer one narrower, armed with teeth. Abdomen of mature females with all segments free, one complete transverse ridge along each segment 1-4.

DESCRIPTION. — Carapace (Figs 12e, 13a) transversely hexagonal, wider than long (CW/CL = 1.1-1.2); dorsal surface covered with large conspicuous granules and granular bosses (most conspicuous 6-7 on each branchial region, continuing as a row of smaller bosses to two salient bosses on metagastric region). Sulcus between hepatic and branchial regions apparent. Anterolateral borders of carapace each with three granular, anteriorly pointed teeth decreasing posteriorly in size (last one can be very small, as in holotype; Fig. 13a). Episternal processes granular, reduced (short, rounded) in males and immature females, more pronounced (elongate) in females. Posterior border with 4-6 rounded, granular tubercles, scattered plumose setae.

Frontal border of carapace divided into four rounded to pointed lobes (inner lobes longer). Borders between frontal lobes and supraorbital borders folded upward, nearly straight (slightly rounded in some specimens), and ending in sharp angle, forming U- or V-shaped fissure before supraorbital border. Supraorbital borders each with two triangular, pointed (tips slightly rounded in some specimens) lobes. Postorbital angles long (extend beyond dorsal border of retracted eye), pointed inward. Cornea of eyes dorsoventrally flattened, wider than base of short eye peduncle; each peduncle with three granular tubercles on distal border (two dorsal tubercles most conspicuous).

Suborbital borders (Fig. 13b) each with high, narrow, rounded inner lobe; broadly rounded outer lobe. Pterygostomial lobes project ventrally, forming semicircular structure posterior to each inner suborbital lobe.

Each basal antennal segment slender, rectangular (slightly expanded distally, with pointed distal border in ventral view), and tuberculate; flagellum long, with few, simple setae. Epistome vertically inclined, with two short, triangular median teeth and wide, rounded margin before pterygostomial lobe. Inner border of ischia of third maxillipeds straight; surface coarsely granular, upper borders obliquely-directed. Meri much narrower than ischia; upper lobes much reduced, with straight outer borders.

Chelipeds equal or slightly unequal in females, conspicuously unequal in males. Dorsal borders of propodi of small chelipeds of both sexes each with one row of pointed, thin, elongate tubercles, outer border with 1-2 rows of low, rounded tubercles. Large cheliped of males with high propodus armed with 3-4 rows of conspicuous, rounded tubercles decreasing in size ventrally. Fingers of small chelipeds of both sexes each with 3-4 broadly rounded or triangular (particularly in males) teeth or cutting edges. Carpi of small and large chelipeds of both sexes short, outer borders with conspicuous pointed, rounded tubercles; meri slender, with pointed, rounded tubercles.

First three pairs of walking legs (P2-4; Fig. 12e) very slender, without filiform propodi. Upper and lower borders of meri with tubercles of different sizes and shapes (mostly rounded, some pointed; smaller in P2); distalmost tubercle on each anterior border of meri of P2-3 much wider at base, much higher, slender, pointed or rounded, directed distally (short, truncate in P4). Carpi and dactyli of walking legs (P2-4) elongate; anterior borders of carpi tuberculate; borders of propodi and dactyli (Fig. 13c) entire. Each P2 with one ventral row of tubercles on merus; one dorsal, one ventral carinae on carpus; one dorsal, 1-2 ventral carinae on propodus; one dorsal, two ventral carinae on dactylus. Each P3 with one dorsal, one ventral row of tubercles on merus (very low in some specimens); two dorsal, two ventral carinae each on carpus, propodus, and dactylus. Each P4 with two dorsal, one ventral row of tubercles on merus; one dorsal, one ventral carinae on carpus; two dorsal, two ventral carinae on propodus; one dorsal, two ventral carinae on dactylus. Meri of all walking legs with scattered plumose setae, few on carpi; dorsal surfaces of propodi and dactyli of P3-4 each with one row of conspicuous plumose setae along anterior border.

First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair slightly shorter than second. Fifth pair of pereopods (P5) short (0.9 CL); each merus slender, surface with microscopic tubercles, 2-4 spines along posterior border, 0-2 thick spines along anterior border; each propodus with 6-9 long spines along anterior border; each dactylus with 0-3 spines along posterior border, 0-2 thick spines along anterior border, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.4-1.6	2.3-2.5	2.2-2.3	0.9
Merus length/CL	0.4-0.5	0.7-0.8	0.6-0.7	0.3
Dactylus length/Cl	0.4	0.6	0.6	0.2

Abdomen of mature males with all segments free. One complete transverse ridge along each segment 1-3, low, incomplete ridge along most of segments 4-6 (very low, if present, in segments 5-6). Male first pleopods (Figs 13d-e) with sinuous basal parts; each distal part with two broad lateral processes, inner one broader and bordered by thicker portion, outer one (with sperm channel) narrower and armed with teeth.

Abdomen of mature females with all segments free. One transversal ridge along each segment 1-4 (very low in segment 4 and, if present, in segment 5).

DISCUSSION. — An unusual feature of *P. macromeles* is its very long walking legs (P2-4; Fig. 12e), a characteristic of species of *Parapalicus* and *Miropalicus*. However, in contrast to *Miropalicus*, and as in *Pseudopalicus* and *Parapalicus*, the last pair of walking legs (P4) is about the same length as the second pair (P3) and much longer than the first pair (P2). The total length of the walking legs, however, is a function of the shape of the dactyli, which varies among the species of *Pseudopalicus* but are always slender and long in *Parapalicus*. Thus, total length of the P3 varied between 2.3-2.5 CL in males and females of *Pseudopalicus macromeles*,

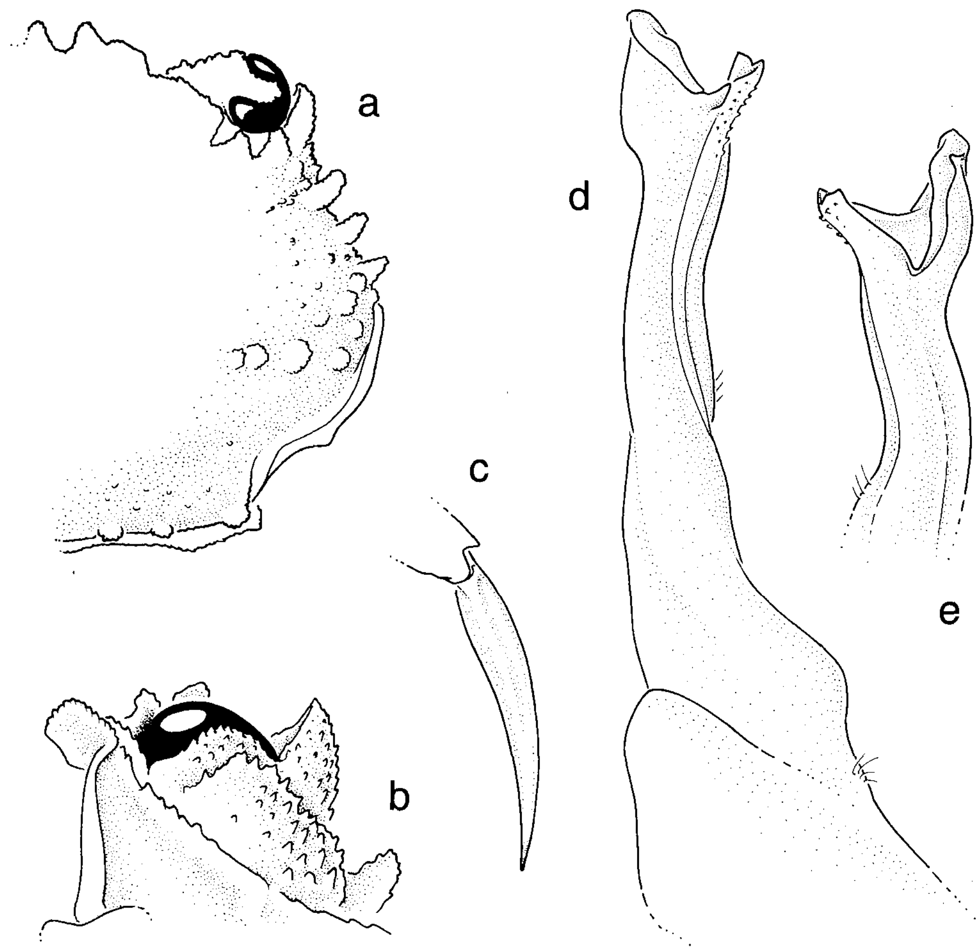

FIG. 13. — *Pseudopalicus macromeles* sp. nov., ♂ holotype 7.4 x 8.6 mm, west of Rottnest Island, Western Australia, *"Diamantina"*, stn 78, 146-150 m (WAM C.24585): **a**, carapace, dorsal surface; **b**, suborbital border; **c**, dactylus, right fourth pereopod, dorsal view; **d**, left male first pleopod, ventral view; **e**, left male first pleopod, distal part, dorsal view.

2.0 CL in *Pseudopalicus declivis* (a species with slender dactyli), 1.7 CL in *Pseudopalicus serripes* (a species with short dactyli), and 2.7 CL in both *Parapalicus ambonensis* (Moosa & Serène, 1981) and *P. unidentatus* (Zarenkov, 1968). Furthermore, the walking legs of *P. macromeles* are morphologically identical to the legs of the other species of *Pseudopalicus*. They all have relatively short and broad meri with unequal tubercles arranged as rows along anterior and posterior sides and as a single row of unequal (some much broader and triangular) tubercles along both the upper (dorsal) and lower (ventral) borders; the carpi are short and their upper borders have irregular, triangular tubercles, particularly on the proximal and distal portions; and the coxae of each P3-4 are broad, laminar, with thin anterior and posterior borders. In contrast, the walking legs among the species of *Parapalicus* have longer, narrower meri with more homogenous tubercles throughout their surface and much longer, more slender carpi with only microscopic tubercles (an exception being *P. armatus*, with equal, pointed tubercles on the carpi of P3-4; see Fig. 17a); and the coxae are not broad and laminar, with the anterior and posterior borders rounded.

Another character *P. macromeles* shares with *Parapalicus* is the presence in females of conspicuous episternal processes that protrude from each posterolateral margin of the carapace. It is reduced, as in other species of *Pseudopalicus*, in the male and immature females. The functional significance of this character is unknown. It may act as stabilizers in larger, heavier individuals, like mature females, for sliding over soft sediments as live individuals of *Parapalicus* species have been observed doing (B. RICHER DE FORGES, personal communication). *Miropalicus vietnamensis* (Zarenkov, 1968), however, has very long, slender walking legs but the episternal process is substantially reduced. It may be suggested that *P. macromeles* has departed from the basic *Pseudopalicus*-type walking legs and has secondarily evolved by convergence longer *Parapalicus*-type legs, as an adaptation for sliding. No other species of *Parapalicus* have ever been collected along the Indian Ocean coast of Western Australia, where *P. macromeles* is only known to occur.

Otherwise, the structure of the carapace (including anterior, anterolateral, supraorbital, and suborbital borders), antennae, epistome, and abdomen of *P. macromeles* are like those characteristic of *Pseudopalicus* and different from *Parapalicus* (see Table 1). The chelipeds of the males are like those in the other species of *Pseudopalicus*, where the fingers of the larger cheliped have cutting edges or rounded teeth and the smaller cheliped has triangular teeth and becomes flatter with increasing size. In females, however, both chelipeds are about the same size, with slender fingers armed with triangular teeth.

P. macromeles is close to *P. undulatus* sp. nov. They are the only two species of *Pseudopalicus* with only three conspicuous anterolateral teeth. They also share male first pleopods where the sperm channel follows a strongly sinuous (S-shaped), although not helicoidal, path along each basal part of the pleopods. This is a departure from the slightly sinuous basal part that is characteristic of congeners. The remaining characters of the pleopods, however, are very different in both species. In *P. undulatus* (Figs 14d-e), there is a unique median tubercle (present also in *Rectopalicus amphiceros* sp. nov.; Fig. 35d) and the distal part is dorsoventrally-flattened and bordered with teeth. In *P. macromeles*, in contrast, there are two broad processes similar to those in *P. acanthodactylus* (Figs 3e-f), *P. declivis* (Figs 6d-e), and *P. oahuensis* (Figs 4e-f).

SIZE. — Maximum size among specimens examined: 10.4 x 12.6 mm (female, WAM C.23569); 8.0 x 9.4 mm (male, WAM C.23575).

ETYMOLOGY. — From *makros*, Greek for long, and *melos*, Greek for limb, to refer to the diagnostic, very long walking legs (P2-4).

DISTRIBUTION. — Known only from the eastern Indian Ocean off the coast of Western Australia (Fig. 52). Depth: 128-256 m.

Pseudopalicus undulatus sp. nov.

Figs 12f, 14, 53

MATERIAL EXAMINED. — **Japan**. *Izu Islands*. Hyotan-se Bank, 34°20.75'N, 139°20.00'E, 275-350 m, T. KOMAI coll., 15.10.1997: 1 ♂ 8.2 x 10.0 mm paratype (CBM-ZC 4625).

Philippine Islands. MUSORSTOM 2: stn CP 15, 13°55.1'N, 120°28.4'E, 326-330 m, 2.11.1980: 1 ♀ 9.9 x 11.9 mm (MNHN-B 26697). — Stn CP 83, 13°55.2'N, 120°30.5'E, 320 m, 2.12.1980: 1 ♀ (MNHN-B 26820).

Indonesia. *Kai Islands*. KARUBAR: stn DW 14, 05°18'S, 132°38'E, 245-246 m, 24.10.1991: 1 ♂ feminized by sacculinid (MNHN-B 26821). — Stn DW 32, 05°47'S, 132°51'E, 170-206 m, 26.10.1991: 1 ♀ (MNHN-B 26822).

Tanimbar Islands. KARUBAR: stn CP 46, 08°01'S, 132°51'E, 271-273 m, 29.10.1991: 1 ♂ holotype 8.4 x 10.8 mm (MNHN-B 26695).

Vanuatu. MUSORSTOM 8: stn DW 977, 19°24.89'S, 169°28.61'E, 410-505 m, 22.09.1994: 1 ♂ paratype 7.3 x 9.0 mm (MNHN-B 26696).

Fiji. BORDAU 1: stn Dw 1448, 16°45'S, 179°59'E, 410-500 m, 4.03.1999: 1 ♂, 4 ♀ (MNHN-B 27132). — Stn DW 1465, 18°09'S, 178°39'W, 290-300 m, 6.03.1999: 1 ♂ 7.8 x 9.4 mm (MNHN-B 27134).

TYPES. — *Holotype*: 1 ♂ 8.4 x 10.8 mm, KARUBAR, stn CP 46 (MNHN-B 26695).

Paratypes: 1 ♂ 7.3 x 9.0 mm, MUSORSTOM 8, stn DW 977 (MNHN-B 26696); 1 ♂ 8.2 x 10.0 mm, Hyotan-se Bank, Japan (CBM-ZC 4625); 1 ♀ paratype 9.9 x 11.9 mm, MUSORSTOM 2, stn CP 15 (MNHN-B 26697).

TYPE LOCALITY. — Tanimbar Islands, Indonesia, 08°01'S, 132°51'E, 271-273 m.

DIAGNOSIS. — Carapace (Figs 12f, 14a) transversely subovate with three anterolateral teeth on each side; teeth (rounded or slightly pointed upward in shape) decrease posteriorly in size. Dorsal surface covered by large granules and several granular bosses, some rounded, high, particularly two on branchial region close to border of carapace; branchial region slightly inflated; posterior border with 4-6 elongate, curved tubercles, giving border sinuous appearance. Supraorbital borders each with one short, rectangular inner lobe; short, rounded outer lobe. Suborbital borders (Fig. 14b) each with high, narrow inner lobe; high, rounded outer lobe. Dorsal borders of cheliped propodi with rounded or pointed tubercles. Dactyli of walking legs (P2-4) very slender (P4 0.3-0.4 CL), with posterior borders entire (Fig. 14c). Abdomen of mature males with all segments free, one complete transverse ridge along segments 1-3, incomplete ridge along segment 4. Male first pleopods (Figs 14d-e) with sinuous basal parts; each distal part dorsoventrally flattened, with tubercle on ventral side, long row of teeth along outer edge (shorter row on inner edge). Abdomen of mature females with all segments free, one complete transverse ridge along each segment 1-4.

DESCRIPTION. — Carapace (Figs 12f, 14a) transversely subovate, wider than long (CW/CL = 1.2-1.3); dorsal surface covered with small granules and granular bosses (conspicuous and high are two rounded bosses on each branchial region along anterolateral borders, 2-3 similar bosses on center and upper border of each branchial region, two elongate bosses on metagastric region flanked by one rounded boss on each side, and one elongate boss on intestinal region immediately above the posterior border of carapace). Anterolateral borders of carapace each with three rounded or slightly pointed teeth decreasing posteriorly in size. Branchial region slightly inflated. Posterior border with 4-6 elongate, curved tubercles (giving border sinuous appearance), scattered plumose setae.

Frontal border of carapace divided into four narrow, rounded lobes (inner lobes narrower, much longer). Two conspicuous, broadly rounded bosses behind outer lobes. Borders between frontal lobes and supraorbital borders folded upward, rounded or slightly pointed medially, ending in sharp angle, forming V-shaped fissure before supraorbital border. Supraorbital borders each with one short, rectangular inner lobe; short, rounded outer lobe. Postorbital angles short (extending two-thirds of dorsal border of retracted eye), slightly narrower proximally, pointed. Cornea of eyes dorsoventrally flattened, wider than base of short eye peduncle; each peduncle with two granular tubercles on distal border.

Suborbital borders (Fig. 14b) each with high, narrow, inner lobe; high, rounded, outer lobe only slightly lower than postorbital angle. Pterygostomial lobes project ventrally, forming flat, semicircular structure posterior to each inner suborbital lobe.

Each basal antennal segment slender, rectangular (slightly pointed distal border in ventral view); flagellum long, with few, simple setae. Epistome vertically inclined, with two triangular median teeth with slightly rounded tips, each flanked by triangular, narrow, pointed outer process and thin, rounded margin before pterygostomial lobe. Inner border of ischia of third maxillipeds straight; surface coarsely granular, upper borders rounded. Meri much narrower than ischia; upper lobes broadly rounded.

Outer borders of cheliped propodi each with 3-4 rows of rounded tubercles (more pronounced in small cheliped). Fingers of largest cheliped with 3-4 broadly rounded teeth, 4-8 rounded to triangular teeth (or none) in smallest cheliped. Carpi short, outer borders with several low, rounded tubercles; meri slender, each with one row of conspicuous rounded tubercles (distalmost one more salient) and other rounded tubercles throughout.

First three pairs of walking legs (P2-4; Fig. 12f) flattened. Upper and lower borders of meri with tubercles of different sizes and shapes (mostly rounded, some pointed; smaller in P2); distalmost tubercle on each anterior border much wider at base, much higher, slender, pointed or rounded, directed distally. Carpi of walking legs (P2-4) elongate; borders of propodi and dactyli (Fig. 14c) entire. Each P2 with one dorsal, 1-2 ventral rows of tubercles on merus; two dorsal, 1-2 ventral carinae on carpus; one dorsal, two ventral carinae on propodus; one dorsal, one ventral carinae on dactylus. Each P3 with 1-2 dorsal rows of tubercles on merus (very low in some specimens); two dorsal, one ventral carinae on carpus; two dorsal, two ventral carinae on propodus; one dorsal, two ventral carinae on dactylus. Each P4 with two dorsal, one ventral (very low) rows of tubercles on merus; two dorsal, two ventral carinae on carpus; one dorsal, one ventral carinae on propodus; one dorsal, two ventral carinae on dactylus. Meri, carpi, and propodi of all walking legs with scattered plumose setae; dorsal surfaces of propodi and dactyli of P3-4 each with one row of conspicuous plumose setae along anterior borders.

First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair shorter than second. Fifth pair of pereopods (P5) short (0.8-0.9 CL); each merus very slender, surface with microscopic tubercles, many microscopic teeth, plumose setae along posterior border; each propodus with many microscopic teeth, 0-3 short spines, plumose setae along posterior border; each dactylus with 2-9 thick spines (thicker distally) along posterior border, 1-5 small spines along anterior border, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.2-1.3	2.2	2.0-2.1	0.8-0.9
Merus length/CL	0.4-0.5	0.7	0.6	0.2-0.3
Dactylus length/Cl	0.2-0.3	0.4	0.3-0.4	0.2

Abdomen of mature males with all segments free. One complete transverse ridge along each segment 1-3; low, incomplete ridge along most of segment 4. Male first pleopods (Figs 14d-e) with sinuous basal parts; each distal part dorsoventrally flattened, with tubercle on ventral side, long row of teeth along outer edge, shorter row on inner edge.

Abdomen of mature females with all segments free. One transversal ridge along each segment 1-4.

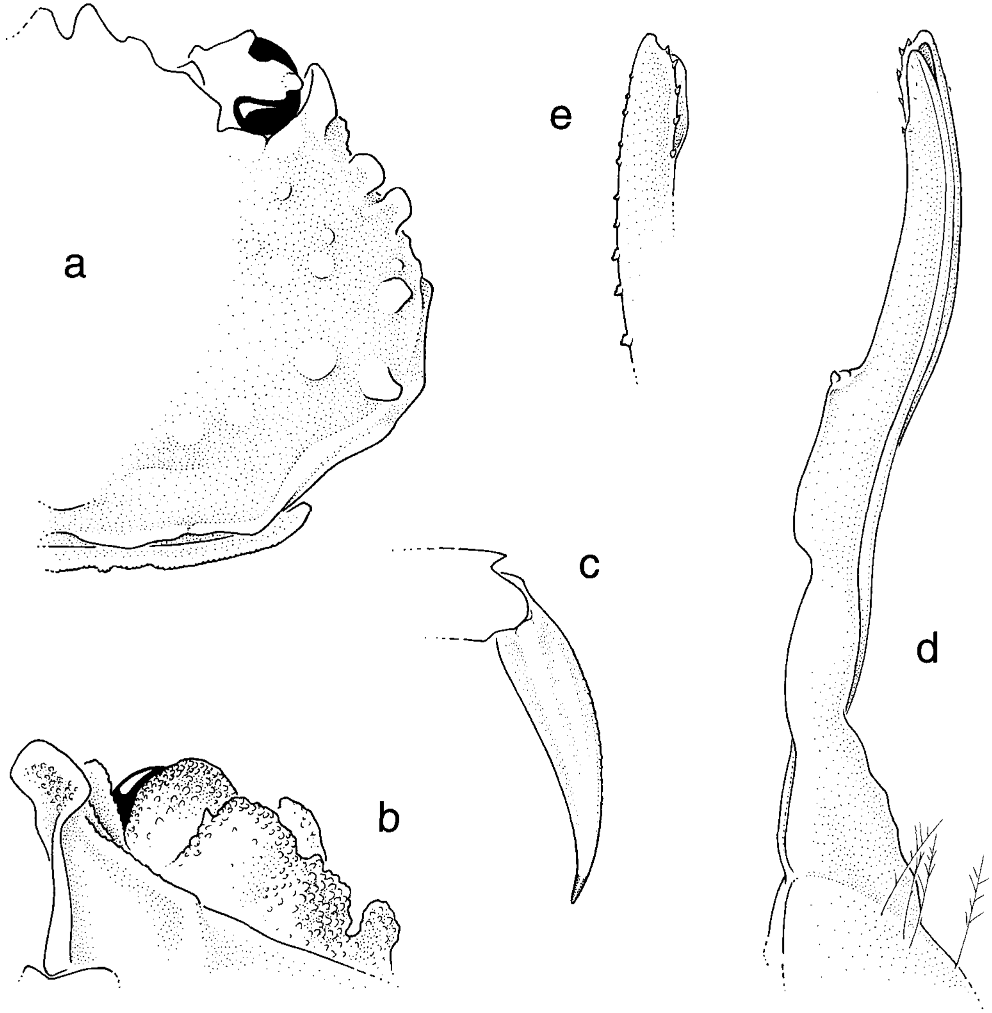

FIG. 14. — *Pseudopalicus undulatus* sp. nov., ♂ holotype 8.4 x 10.8 mm, Tanimbar Islands, Arafura Sea, Indonesia, KARUBAR, stn CP 46, 271-273 m (MNHN-B 26695): **a**, carapace, dorsal surface; **b**, suborbital border; **c**, dactylus, right fourth pereopod, dorsal view; **d**, left male first pleopod, lateral (outer side) view; **e**, left male first pleopod, apex, lateral (inner side) view.

DISCUSSION. — Diagnostic for *P. undulatus* is the presence of only three anterolateral teeth in contrast to four in most other known species of *Pseudopalicus*, although in some of these species the last tooth may be very small in some specimens. *P. undulatus* and *P. macromeles* are exceptional in the genus for having only three conspicuous anterolateral teeth. Also diagnostic for *P. undulatus* is the presence of conspicuously unequal supraorbital lobes, the inner lobe being short and the outer higher and rounded. The branchial region is slightly higher (in part accentuated by the three high bosses on its surface) than in other species of *Pseudopalicus* so that the carapace has a transversely subovate appearance (Fig. 12f) rather than the more hexagonal appearance characteristic of the genus.

More significant than these characters are the unusual male first pleopods. The basal parts are strongly sinuous (although not helicoidal as in *Parapalicus*) and a tubercle is present on each median, ventral surface. *P. macromeles* has male first pleopods with strongly sinuous basal parts (Fig. 13d); those of *Rectopalicus amphiceros* sp. nov. also have a median tubercle (Fig. 35d). The distal ends were thin, straight, and obliquely oriented in an inner direction in a small, perhaps juvenile male from Fiji (7.8 x 9.4 mm; MNHN-B 27134).

SIZE. — Maximum size among specimens examined: 9.9 x 11.9 mm (female, MNHN-B 26697); 8.4 x 10.8 mm (male, MNHN-B 26695).

ETYMOLOGY. — From *unda*, Latin for wave, in reference to the wavy appearance of the posterior border of the carapace due to the presence of elongate and curved tubercles along the margin.

DISTRIBUTION. — Japan, South China Sea (off the Philippine Islands), Banda and Arafura seas (Indonesia), Coral Sea (Vanuatu) and Fiji (Fig. 53). Depth: known reliably between 206 and 410 m; also collected in trawls between 170-206 and 410-505 m.

Genus ***PARAPALICUS*** Moosa & Serène, 1981

Parapalicus Moosa & Serène, 1981: 25.

TYPE SPECIES: *Palicus trituberculatus* Chen, 1981. Gender: masculine

DIAGNOSIS. — Frontal border of carapace divided into two small lobes (sometimes secondarily notched). Anterolateral borders each with one triangular or rounded tooth. Dorsal surface of carapace typically with small granules and high granular bosses. Eyes dorsoventrally flattened; peduncles with small, typically soft tubercles. Supraorbital borders each with one or two notches but no conspicuous lobes. Suborbital borders each typically with two dentiform lobes; outer lobe, if present, smaller than inner lobe. Each basal antennal segment slightly expanded distally (scale-like). Epistome expanded dorsoventrally; thin carina-like process along median portion without protruding median teeth. Chelipeds small, propodi and fingers slender; equal or nearly equal in males and females. First three pairs of walking legs (P2-4) very slender, with elongate meri and filiform (long, very narrow) propodi and dactyli. First pair (P2) much shorter than second and third pairs (P3-4); third pair slightly shorter or about as long as second pair. Borders of meri of P2-4 with equal or nearly equal tubercles; carpi entire, without teeth (tubercles rare); propodi and dactyli entire. Fifth pair of pereopods (P5) reduced (0.8-0.9 CL) and very slender. Abdomen of mature males triangular, with segments 3-5 fused into segment much wider than segment 6 and telson; typically two tubercles on segment 3, one on 4. Male first pleopods short; basal parts helicoidal; each distal part with one blade-like process or helicoidal pointed tips. Abdomen of mature females with segments 3-5 fused; typically one complete or reduced transverse ridge along each segment 1-4.

REDESCRIPTION. — Carapace transversely subovate, broader than long, conspicuously covered with granules of varying size, often grouped in clusters forming bosses. Anterolateral borders of carapace each with one typically conspicuous, triangular or rounded, tooth, below which carapace slightly rounded. Confluence of branchial and esogastric regions depressed, smooth; sulcus between hepatic and branchial regions. Thoracic sternite 7 with conspicuous, protuberant process (episternal process) at each outer edge posterior to insertion of fifth pair of pereopods (P5), visible dorsally as rounded or oblong process below posterolateral border of carapace.

Frontal border divided into two small lobes (sometimes secondarily notched). Supraorbital borders each with one or two notches but no conspicuous lobes. Postorbital angles short, slightly pointed or rounded tips. Cornea of eyes dorsoventrally flattened, much wider than base of eye peduncle (reniform); peduncles with small, soft or granular tubercles. Orbits deep.

Suborbital borders each typically with two pointed or rounded, dentiform lobes; outer lobe, if present, smaller than inner lobe. Pterygostomial lobe at each anterolateral angle of buccal frame projects ventrally, rounded to pointed in shape.

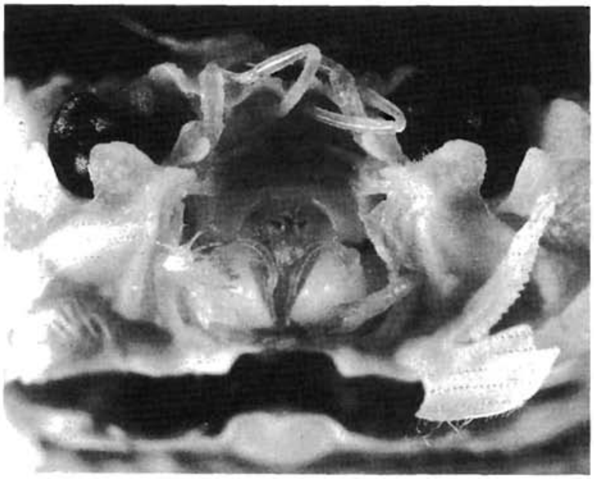

FIG. 15. — *Parapalicus clinodentatus* sp. nov., ♀ 8.6 x 12.2 mm, off southeast coast of New Caledonia, BATHUS 2, stn CP 742, 340-470 m (MNHN-B 26753): epistome.

Each basal antennal segment slightly expanded distally (scale-like); flagellum long with conspicuous setae. Epistome (Fig. 15) expanded dorsoventrally, forming broad, nearly flat surface between antennular fossae and anterior border of endostome; no median teeth, only low, thin, carina-like process along median portion flanked on each side by an outer process connecting with pterygostomial lobe. Meri of third maxillipeds smaller and narrower than ischia.

Chelipeds small, equal or nearly equal in males and females. Cheliped propodi slender; dorsal borders with small teeth or tubercles, or smooth; fingers with pointed tips, typically with triangular or rounded distal teeth. First three pairs of walking legs (P2-4) very slender, with elongate meri and filiform (long and very narrow) propodi and dactyli. Upper and lower borders of meri with equal or nearly equal tubercles; carpi entire, without teeth (tubercles rare); borders of propodi and dactyli entire. First pair of walking legs (P2) much shorter and slender than second and third pairs (P3-4); third pair slightly shorter or about as long as second pair. Last two pairs of walking legs (P3-4) each with rounded coxae, having rounded (not expanded, thin-edged) anterior and posterior borders. Fifth pairs of pereopods (P5) reduced (0.8-0.9 CL) and very slender; basis-ischia slender, smooth; few spines along posterior border of dactyli, sometimes on propodi.

Abdomen of mature males with segments 1-2 dorsoventrally compressed, 3-5 fused (but traces of sutures usually visible) into segment much wider than segment 6 and telson, giving abdomen triangular appearance. Typically two tubercles on segment 3, one on 4. Telson with fine granules. Male first pleopods short; basal parts helicoidal, each distal part with one blade-like process or helicoidal pointed tips. Second male pleopods short, thin, slightly curved; distal segment with blunt tip.

Abdomen of mature females broad, rounded, segments 1-2 dorsoventrally compressed, 3-5 fused (but traces of suture usually visible), typically one complete or reduced transverse ridge along each segment 1-4. Abdomen of immature females triangular (but broader than in males), segments 1-2 dorsoventrally compressed, 3-5 or 3-6 fused, transverse ridge along each segment 1-4.

SPECIES INCLUDED. — There are 13 known species of *Parapalicus*, by alphabetical order: *P. ambonensis* Moosa & Serène, 1981, *P. armatus* sp. nov., *P. clinodentatus* sp. nov., *P. denticulatus* sp. nov., *P. elaniticus* (Holthuis, 1977), *P. inanis* sp. nov., *P. inermis* sp. nov., *P. microphthalmus* sp. nov., *P. nanshaensis* Dai & Xu, 1991, *P. piruensis* Moosa & Serène, 1981, *P. trispiralis* sp. nov., *P. trituberculatus* (Chen, 1981), *P. unidentatus* (Zarenkov, 1968).

SEXUAL DIMORPHISM. — There is only a marked difference in size, females being much larger. The chelipeds are equal or almost equal in size in both males and females. There is no evidence of differences in the length or shape of the walking legs or fifth pair of pereopods.

DISCUSSION. — *Parapalicus* is a relatively homogenous genus described by MOOSA and SERÈNE (1981) to include seven species, two of which are now placed in other genera. The description of 10 additional species (eight here) and the description of new genera, however, necessitates the addition of characters to the brief original definition.

In defining the genus and separating it from other genera of palicids, MOOSA and SERÈNE (1981: 24, 25) described the first pair of walking legs (P2) of *Parapalicus* as "much slenderer" than the remaining two pairs in contrast to the other three genera of the subfamily Palicinae they described, where the first pair is only "a little smaller" than the remaining pairs. This is misleading since, although in *Parapalicus* the second pair is slightly more slender (that is, narrower) than the other legs, there is actually no difference in the total length between the genera.

The long, slender legs and general carapace shape of *Parapalicus* are closer to RATHBUN's group 2 of the western Atlantic species of *Palicus* Philippi, 1838 (RATHBUN, 1918: 184): *P. acutifrons* (A. Milne Edwards, 1880), *P. cursor* (A. Milne Edwards, 1880), *P. floridanus* (Rathbun, 1918), *P. gracilis* (Smith, 1883), and *P. gracilipes* (A. Milne Edwards, 1880). None of these five species fully agree with the characters used in the definition of *Parapalicus* and the other Indo-west Pacific genera of palicids. Nevertheless, ZARENKOV (1968) placed his species, *Parapalicus unidentatus* (Zarenkov, 1968), under group 1 of RATHBUN. He suggested that several species had independently evolved the long legs of group 2 as a specialization for greater depths (ZARENKOV, 1968: 766).

The three western Atlantic species placed by RATHBUN (1918: 184) in her group 4 [*P. angustus* Rathbun, 1897, *P. depressus* Rathbun, 1897, and *P. sica* (A. Milne Edwards, 1880)] are characterized by a structure ("broad, projecting plates of abdomen and sternum which are conspicuous in dorsal view"; "laminate crest projecting behind third and fourth walking legs" in WILLIAMS, 1984: 484) that is analogous, and perhaps homologous, to the episternal process of *Parapalicus*. None of these Atlantic species, however, have the very slender walking legs with filiform propodi and dactyli, the single anterolateral tooth on each side of the carapace, and the dentiform suborbital lobes diagnostic of *Parapalicus*.

All known species of *Parapalicus* appear to be restricted to muddy sediments in the Indo-west Pacific region. They have been collected at depths of 55-778 m. Recently dredged, live specimens have been observed to slide over sediment by using their long and slender walking legs (B. RICHER DE FORGES, personal communication).

MOOSA and SERÈNE (1981) designated *P. marielae* Moosa & Serène, 1981 as the type species of their new genus *Parapalicus*. It has been found to be a junior subjective synonym of *P. trituberculatus* (Chen, 1981) (see below). The type species is now fixed (under Article 70.3 of the International Code of Nomenclature, fourth edition, 1999) as *Parapalicus trituberculatus* (Chen, 1981) misidentified as *Parapalicus marielae* Moosa & Serène, 1981 in the original designation of MOOSA & SERÈNE (1981).

Key to the species of *PARAPALICUS*

1. Dactyli of chelipeds with blunt teeth closed together at tip of fingers (DAI & XU, 1991, fig. 28-4) .... ***P. nanshaensis*** Dai & Xu, 1991
— Dactyli of chelipeds with triangular teeth extending along two-thirds to one-half (rarely one-third) of fingers **2**

2. Dorsal border of cheliped propodi with conspicuous, pointed tubercles (Fig. 17c). Outer border of carpi of walking legs (P2-4) with conspicuous pointed tubercles (Fig. 17a) .... ***P. armatus*** sp. nov.
— Dorsal border of cheliped propodi smooth, with minute teeth, or two rounded, proximal tubercles. Outer border of carpi of walking legs (P2-4) smooth or with microscopic tubercles **3**

3. Only one suborbital lobe, leaving straight border between tooth-like inner lobe and postorbital angle (Fig. 23b) .... ***P. inanis*** sp. nov.
— Two dentiform suborbital lobes before postorbital angle **4**

4. Gap between inner and outer suborbital lobe long, narrow, V-shaped **5**
— Gap between inner and outer suborbital lobes wide, U-shaped, or short when outer lobe much smaller than outer lobe **6**

5. Anterolateral tooth on side of carapace rounded, bent at slight angle in relation to carapace (Figs 18a, 19c) .... ***P. clinodentatus*** sp. nov.
— Anterolateral tooth on side of carapace triangular (ZARENKOV, 1968, fig. 3A) .... ***P. unidentatus*** (Zarenkov, 1968)

6. Dorsal border of cheliped propodus with two proximal tubercles **7**
— Dorsal border of cheliped propodus smooth or with microscopic teeth **8**

7. Rounded tubercle on distal edge of supraorbital border and proximal to postorbital angle, giving angle bilobed appearance (HOLTHUIS, 1977, fig. 3a) .... ***P. elaniticus*** (Holthuis, 1977)
— Supraorbital angle without conspicuous, distal tubercle proximal to postorbital angle .... ***P. ambonensis*** sp. nov.

8. Outer suborbital lobe very small, less than one-third as long as inner suborbital lobe ... **9**
— Outer suborbital lobe at least one-half as long as inner suborbital lobe **10**

9. Supraorbital border sinuous, with two notches but no lobes. Dorsal borders of cheliped propodi smooth .... ***P. piruensis*** Moosa & Serène, 1981
— Supraobital border with two very small lobes (Fig. 27a). Dorsal borders of cheliped propodi with microscopic teeth (Fig. 27c) .... ***P. trispiralis*** sp. nov.

10. Inner suborbital lobes narrow, pointed, bordered by pointed tubercles (Fig. 24b). Male first pleopods with helicoidal distal ends (Figs 24d-e). Eyes narrow, small (Fig. 24a) .... ***P. microphthalmus*** sp. nov.
— Inner suborbital lobes not narrow, with rounded tips. Male first pleopods with simple, blade-like distal ends. Eyes not narrow **11**

11. Eye peduncles covered with small, granular tubercles. Gap between inner and outer suborbital lobes very broad, nearly circular (CHEN, 1981, pl. 2, fig. 1) .... ***P. trituberculatus*** (Chen, 1981)
— Eye peduncles covered with few, soft tubercles. Gap between inner and outer suborbital lobes broad but V- or L-shaped (Figs 20b, 22b) **12**

12. Dorsal borders of cheliped propodi with rows of microscopic teeth (Fig. 20c). Trigger-like process at proximal portion of distal part of male first pleopods (Fig. 20e) .... ***P. denticulatus*** sp. nov.
— Dorsal borders of cheliped propodi with barely visible microscopic teeth (Fig. 22c). Proximal portion of distal parts of male first pleopods smooth, without process (Fig. 22e) .... ***P. inermis*** sp. nov.

Parapalicus ambonensis Moosa & Serène, 1981

Figs 16, 19a, 58

Parapalicus ambonensis Moosa & Serène, 1981: 29, figs 2a, 3a, pl. 1, fig. D.

MATERIAL EXAMINED. — **Thailand** *(Andaman Sea coast).* Off Phuket Island. Stn 8, 80 m, triangular dredge, 18.02.1998: 1 ♀ (PMBC).

Indonesia. *Haruku Island.* MARIEL KING MEMORIAL EXPEDITION: stn AH I/4, north of Cape Batang Kapal, 03°36'S, 128°24'E, shell sand and rubble, 110-115 m, 31.05.1970: 1 ♀ holotype 5.4 x 7.6 mm (RDC CB2733).

Kai Islands. KARUBAR: stn DW 29, 05°36'S, 132°56'E, 181-184 m, 26.10.1991: 1 ♂ (MNHN-B 26963).

Vanuatu. MUSORSTOM 8: stn CP 963, 20°20.10'S, 169°49.08'E, 400-440 m, 21.09.1994: 2 ♀ (MNHN-B 27078). — Stn CP 971, 20°18.87'S, 169°53.12'E, 250-315 m, 21.09.1994: 1 ♂ (MNHN-B 27079). — Stn CP 1017, 17°52.80'S, 168°26.20'E, 294-295 m, 27.09.1994: 1 ♂, 2 ♀ (MNHN-B 27080). — Stn CP 1018, 17°52.88'S, 168°25.08'E, 300-301 m, 27.09.1994: 1 ♀ (MNHN-B 27081). — Stn CP 1086, 15°36.58'S, 167°16.32'E, 182-215 m, 5.10.1994: 1 ♀ 6.3 x 8.7 mm (MNHN-B 26707), 1 ♂ 5.1 x 7.2 mm (MNHN-B 26708), 1 ♂, 1 ♀ (MNHN-B 27082). — Stn DW 1093, 15°10.91'S, 167°11.19'E, 275 m, 6.10.1994: 1 ♂ 5.2 x 7.4 mm (MNHN-B 26709). — Stn DW 1097, 15°05.13'S, 167°10.76'E, 281-288 m, 7.10.1994: 2 ♂ (MNHN-B 27083). — Stn CP 1102, 15°03.82'S, 167°08.68'E, 210-208 m, 7.10.1994: 1 ♀ (MNHN-B 27084). — Stn CP 1134, 15°39.94'S, 167°02.79'E, 230-287 m, 11.10.1994: 1 ♀ (MNHN-B 27085). — Stn CP 1135, 15°40.50'S, 167°02.43'E, 282-375 m, 11.10.1994: 3 ♀ (MNHN-B 27086).

Chesterfield-Bellona Plateau. CHALCAL 1: stn CP 11, 20°04.40'S, 158°47.41'E, 300 m, 07.1984: 1 ♂ (MNHN-B 26964).

MUSORSTOM 5: stn 345, 19°39.70'S, 158°32.40'E, 305-310 m, 16.10.1986: 1 ♂, 1 ♀ (MNHN-B 27087).

New Caledonia. MUSORSTOM 4: Grand Passage, stn 173, 19°02.50'S, 163°18.80'E, 250-290 m, 17.09.1985: 1 ♂ 5.2 x 7.3 mm (MNHN-B 26706).

"Kandjar", dredging between 22°40'-22°50'S and 167°10'-167°30'E, 200-350 m, 7-10.10.1986: 1 ♀ (MNHN-B 26966).

BATHUS 1: stn DW 640, 21°52.33'S, 166°47.93'E, 174 m, 10.03.1993: 1 ♀ (MNHN-B 27088). — Stn CP 713, 21°45.28'S, 166°36.83'E, 250 m, 19.03.1993: 1 ♀ (MNHN-B 27089).

BATHUS 3: stn DW 836, 23°02'S, 166°59'E, 295-306 m, rocks and gravel, 30.11.1993: 1 ♂, 2 ♀ (MNHN-B 27090).

BATHUS 4: stn DW 901, 19°02.72'S, 163°15.39'E, 297 m, 4.08.1994: 3 ♀ (MNHN-B 27091). — Stn CP 905, 19°02'S, 163°15'E, 294-296 m, 4.08.1994: 3 ♂, 11 ♀ (MNHN-B 26754).

Loyalty Islands. MUSORSTOM 6: stn CP 419, 20°41.65'S, 167°03.70'E, 283 m, 16.02.1989: 1 ♂ (MNHN-B 27092). — Stn DW 452, 21°00.30'S, 167°25.50'E, 300 m, 20.02.1989: 1 ♀ (MNHN-B 27093). — Stn DW 462, 21°05.10'S, 167°26.85'E, 200 m, 21.02.1989: 1 ♀ 6.7 x 9.1 mm (MNHN-B 26710).

Futuna Island. MUSORSTOM 7: stn CP 515, 14°13'S, 178°10'W, 224-252 m, 12.05.1992: 1 ♀ (MNHN-B 26965).

TYPES. — *Holotype*: 1 ♀ 5.4 x 7.6 mm, MARIEL KING MEMORIAL EXPEDITION, stn AH I/4 (RDC CB2733).

TYPE LOCALITY. — North of Cape Batang Kapal, Haruku Island, Moluccas, Indonesia, 03°36'S, 128°24'E, shell sand and rubble, 110-115 m.

DIAGNOSIS. — Carapace (Figs 16a, 19a; MOOSA & SERÈNE, 1981, fig. 2a) with anterolateral tooth on each side; tooth with truncate outer border and short, rounded upper border. Small, tooth-like tubercle between anterolateral tooth and postorbital angle. Supraorbital borders each with three notches. Suborbital borders each with narrow, V-shaped gap between inner and outer suborbital lobes; outer lobe much smaller than inner lobe. Dorsal borders of cheliped propodi each with two proximal tubercles, distalmost rounded, conspicuous. Abdomen of mature males (Fig. 16b) with two triangular tubercles on segment 3 and larger one on segment 4. Male first pleopods (Fig. 16c) with helicoidal basal parts; each distal portion beak-like, with spinules along dorsal margin. Abdomen of mature females (Fig. 16d) with one transverse ridge along each segment 1-3 (segment 3 slightly constricted twice medially); short ridge at each outer edge of segment 4.

DISCUSSION. — *P. ambonensis* was until now know from only one female specimen. Only the last pair of legs was present, MOOSA & SERÈNE (1981) did not give any information on the morphology of the chelipeds or of the suborbital borders, and the only photograph given is of poor quality. The examination of the holotype (RDC CB2733) and the presence of its distinctive characters in specimens collected from the Andaman Sea to the Coral Sea confirms its status as a distinctive species. This is the first time the male first pleopod is described and illustrated.

The examination of the holotype also showed that one diagnostic character given in its description, the presence of "teeth" along the inner borders of the third maxillipeds, was a misinterpretation of the serrate nature of the borders. Although only the right maxilliped remains in the holotype, its inner border does not have separate, distinctive teeth as shown in the figure of the left maxilliped (MOOSA & SERÈNE, 1981, fig. 3a).

Other characters useful in its identification are the presence of a basal antennal segment that is expanded distally as a rounded process and a small, tooth-like tubercle between each anterolateral tooth and the postorbital angle. Its size varies, sometimes hardly visible on one side but larger on the opposite side of the same specimen.

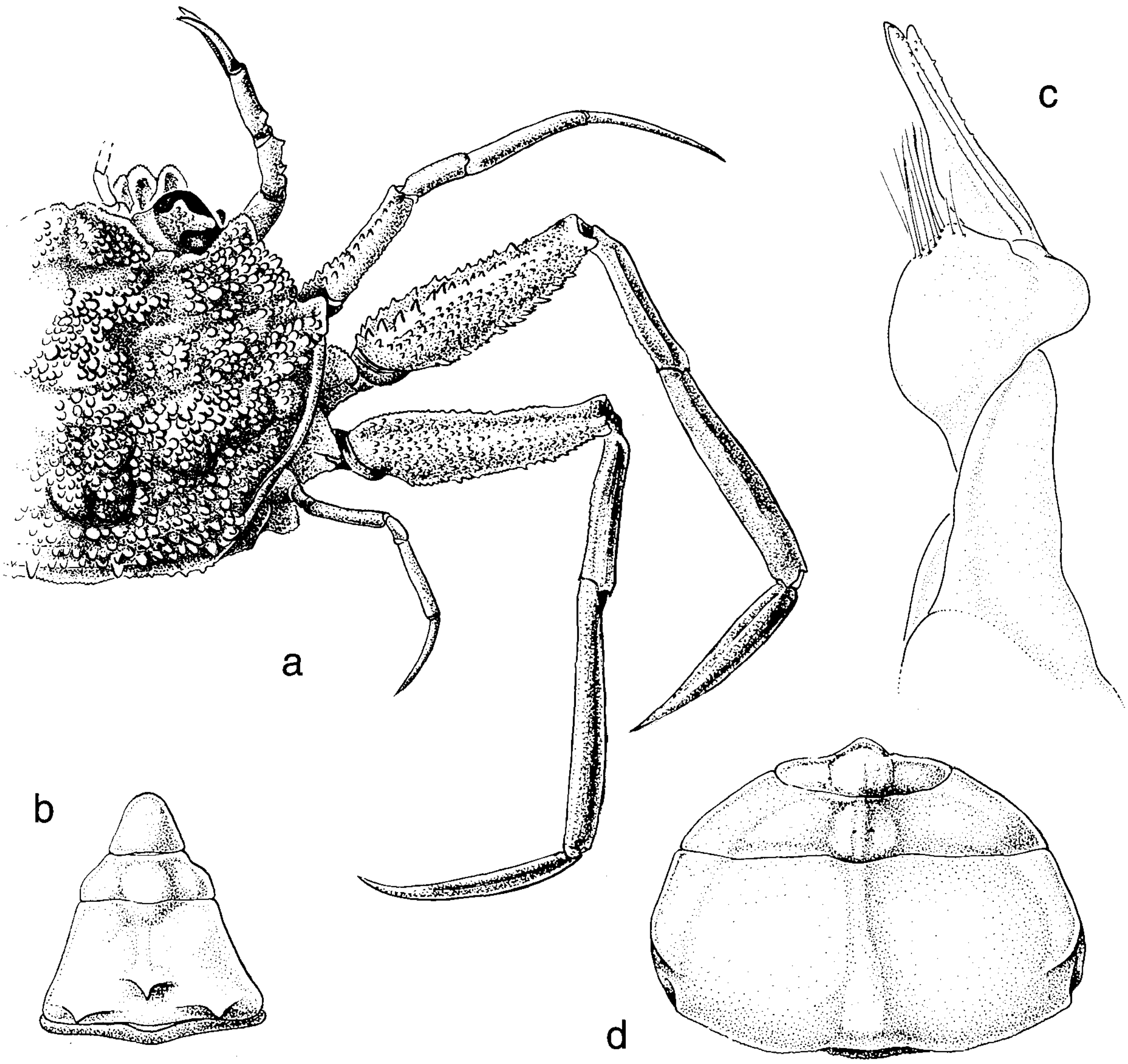

FIG. 16. — *Parapalicus ambonensis* Moosa & Serène, 1981: **a-b**, ♀ 6.3 x 8.7 mm, north of Malekula Island, Vanuatu, MUSORSTOM 8, stn CP 1086, 182-215 m (MNHN-B 26707): **a**, carapace and pereopods, dorsal surface; **b**, abdomen. — **c**, ♂ 5.2 x 7.3 mm, Grand Passage, New Caledonia, MUSORSTOM 4, stn 173, 250-290 m (MNHN-B 26706): abdomen. — **d**, ♂ 5.2 x 7.4 mm, east of Espiritu Santo Island, Vanuatu, MUSORSTOM 8, stn DW 1093, 275 m (MNHN-B 26709): left male first pleopod, ventral view.

The fifth pair of pereopods (P5) are short (0.8 CL), each merus with 3-4 small spines along the posterior border, the propodus with 4-8 spines along the posterior border, and the dactylus with 2-3 spines along the posterior border and one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.3-1.5	2.7	2.5-2.6	0.8
Merus length/CL	0.4-0.5	0.7-0.8	0.7-0.8	0.2
Dactylus length/Cl	0.4	0.6-0.7	0.6-0.7	0.2

P. ambonensis shares several features with *P. nanshaensis* Dai & Xu, 1991, a species known from only one female specimen (see below). Both species have a similar carapace shape and a cheliped merus that is armed with only two proximal tubercles. *P. nanshaensis*, however, has very characteristic blunt, closed-together teeth on the cheliped fingers (DAI & XU, 1991, fig. 28-4) and only one slight notch on each supraorbital border. The morphology of the suborbital borders, male first pleopods, and male abdomen of *P. nanshaensis* remain unknown but the holotype was not available for examination.

P. ambonensis shares with *P. armatus* sp. nov. and *P. trispiralis* sp. nov. the presence of pointed tubercles on the male abdomen. The dorsal borders of the chelipeds of these two species are armed with conspicuous tubercles (*P. armatus*) or microscopic teeth (*P. trispiralis*).

SIZE. — Maximum size among specimens examined: 6.3 x 9.7 mm (female, MNHN-B 26754); 5.5 x 7.3 mm (male, MNHN-B 26754).

DISTRIBUTION. — Known from the Andaman Sea (off Phuket island, Thailand), Banda Sea (off Kai Islands, Indonesia), Haruku Island (near Ambon, Indonesia) (MOOSA & SERÈNE, 1981), Coral Sea (Vanuatu, Chesterfield-Bellona Plateau, New Caledonia, and the Loyalty Islands), and Futuna Island, southwestern Pacific (Fig. 58). Depth: known reliably between 80 and 400 ; also collected in a trawl between 400 and 440 m.

Parapalicus armatus sp. nov.

Figs 17, 19b, 57

MATERIAL EXAMINED. — **Vanuatu**. — MUSORSTOM 8: stn CP 963, 20°20'S, 169°49'E, 400-440 m, 21.09.1994: 1 ♂ holotype 6.5 x 9.0 mm (MNHN-B 26698).

Loyalty Islands. — MUSORSTOM 6: stn DW 457, 21°00.42'S, 167°28.71'N, 353 m, 20.02.1989: 1 ♂ paratype 6.5 x 8.7 mm (MNHN-B 26699). — Stn CB 481, 21°21.85'S, 167°50.30'E, 300 m, 23.02.1989: 1 ♀ paratype 8.1 x 10.6 mm (MNHN-B 26700), 1 ♂, 2 ♀ (MNHN-B 26823).

TYPES. — *Holotype:* 1 ♂ 6.5 x 9.0 mm, MUSORSTOM 8, stn CP 963 (MNHN-B 26698).

Paratypes: 1 ♂ 6.5 x 8.7 mm, MUSORSTOM 6, stn DW 457 (MNHN-B 26699); 1 ♀ 8.1 x 10.6 mm, MUSORSTOM 6, stn CB 481 (MNHN-B 26700).

TYPE LOCALITY. — Off south coast of Aneityum (Anatom) Island, Vanuatu, 20°20'S, 169°49'E, 400-440 m.

DIAGNOSIS. — Carapace (Figs 17a, 19b) with small, triangular anterolateral tooth on each side; conspicuous tubercles along posterior border. Supraorbital borders each with three notches. Suborbital borders (Fig. 17b) each with narrow, V-shaped gap between inner and outer suborbital lobes; outer lobe rounded. Dorsal borders of cheliped propodi (Fig. 17c) each with 3-4 rows of pointed tubercles. Meri of second and third pairs of walking legs (P3-4) with tubercles along upper and lower edges. Abdomen of mature males (Fig. 17d) with two triangular tubercles on segment 3, similar one on segment 4. Male first pleopods (Figs 17e-f) with helicoidal basal parts; each distal part long, blade-like, rising from thickened portion of basal part. Abdomen of mature females with one transverse ridge along each segment 1-3 (segment 3 slightly constricted twice medially); segment 4 with short ridge at outer edges.

DESCRIPTION. — Carapace (Figs 17a, 19b) wider than long (CW/CL = 1.3-1.4); dorsal surface covered with coarse granules. Anterolateral borders of carapace each with very small triangular tooth covered with fine granules. Two small, low bosses, also covered with granules, on branchial region posterior to each tooth. Larger females with four conspicuous bosses (two large median lobes flanked by smaller one on each side) on metagastric region. Posterior border of carapace with 8-12 protuberant tubercles with rounded tips and many small tubercles with pointed or rounded tips. Episternal processes conspicuous, bordered by very small teeth, with anterior tubercle in some specimens. Posterior border of carapace with scattered plumose setae.

Frontal border of carapace divided into two small lobes divided by narrow V-shaped notch; triangular or slightly rounded tips. Borders between frontal lobes and supraorbital borders rounded, marked by slight undulation medially. Supraorbital borders each with three distinct notches. Postorbital angles short, slightly pointed. Cornea of eyes

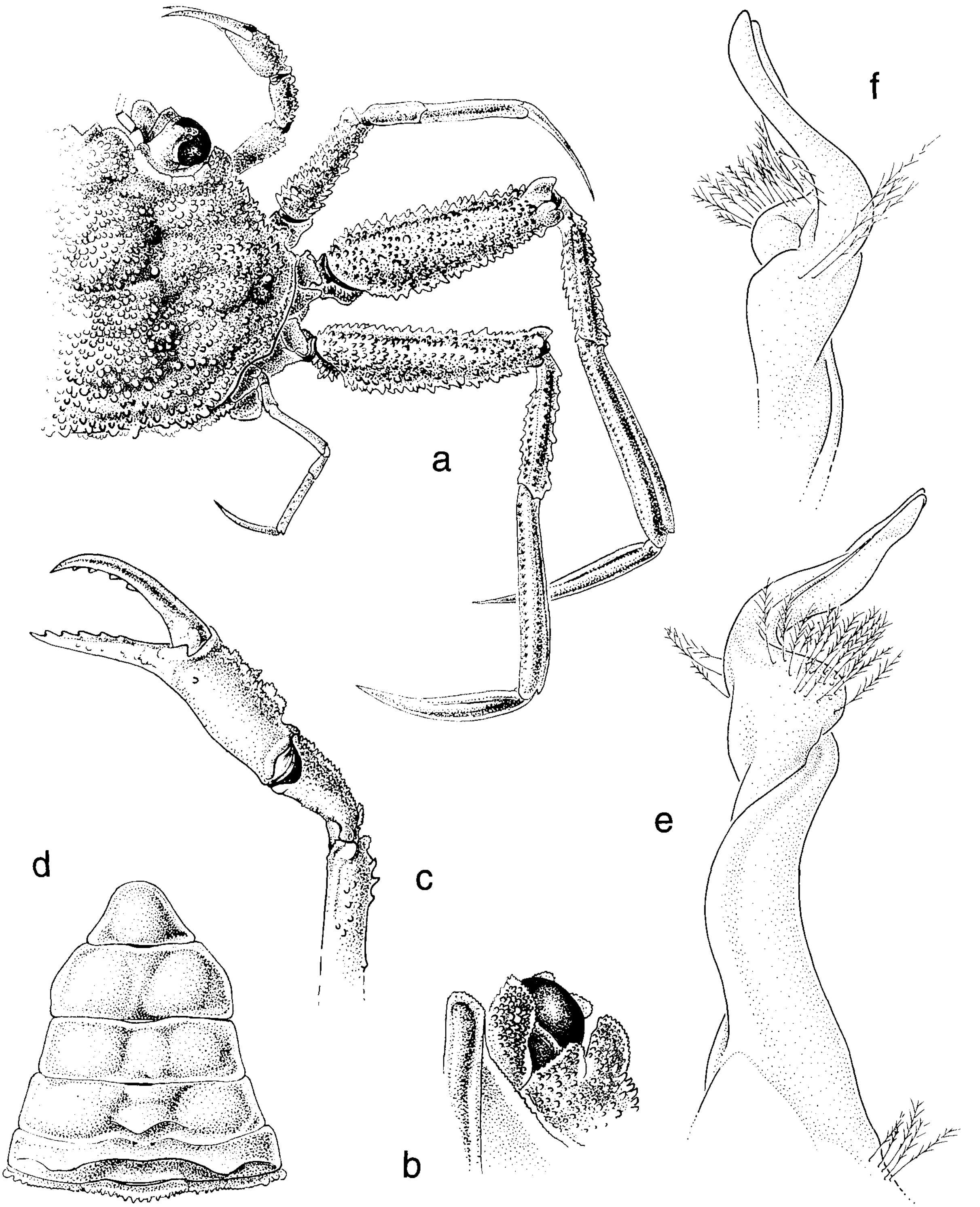

FIG. 17. — *Parapalicus armatus* sp. nov., ♂ holotype 6.5 x 9.0 mm, south of Aneityum Island, Vanuatu, MUSORSTOM 8, stn CP 963, 400-440 m (MNHN-B 26698): **a**, carapace and pereopods, dorsal surface; **b**, suborbital border; **c**, left cheliped, outer surface; **d**, abdomen; **e**, left male first pleopod, ventral view; f, left male first pleopod, distal part, lateral (inner side) view.

dorsoventrally flattened, much wider than base of short eye peduncle; each peduncle with two soft, distal tubercles (ventral largest).

Suborbital borders (Fig. 17b) each with narrow, V-shaped gap between inner and outer suborbital lobes. Outer lobe rounded, shorter than pointed inner lobe. Pterygostomial lobes project slightly ventrally, rounded (slightly pointed in some specimens), shorter than each inner suborbital lobe.

Each basal antennal segment expanded distally as rounded process; flagellum long with conspicuous, simple setae. Inner border of ischia of third maxillipeds sinuous to serrate but without defined teeth; surface coarsely granular, upper borders rounded. Meri much narrower than ischia; rounded, narrow upper borders.

Dorsal and outer borders of cheliped propodi (Fig. 17c) each with 3-4 rows of conspicuous tubercles, those of uppermost row with pointed or broadly acute tubercles (more conspicuous in males). Distal two-thirds of each finger with 4-5 triangular teeth (shorter in some specimens). Carpi short, outer borders with conspicuous, broad tubercle across distal portion and pointed tubercles throughout; meri slender, outer border with pointed tubercles.

First three pairs of walking legs (P2-4; Figs 17a, 19b) very slender, with elongate meri and filiform propodi and dactyli. Upper and lower borders of meri with small, similarly pointed tubercles (smaller on P2); distalmost tubercle on each anterior border much wider at base, higher, with rounded tip directed distally. Anterior and posterior borders of carpi of second and third walking legs (P3-4) with rounded tubercles; borders of propodi and dactyli of all walking legs (P2-4) entire (propodi of P3-4 with microscopic tubercles, proximal portion with visible tubercles, particularly P4). Each P2 with one dorsal carina each on carpus and dactylus. Each P3 with one dorsal carina on merus; two dorsal carinae on carpus; one dorsal, one ventral carina each on propodus and dactylus. Each P4 with two dorsal carinae on carpus; one dorsal and one ventral carina each on propodus and dactylus. Meri of all legs with scattered plumose setae; dorsal surface of carpi and propodi of P3-4 with rows of plumose setae; dorsal surfaces of dactyli of P3-4 each with one row of conspicuous plumose setae along anterior border.

First pair of walking legs (P2) much shorter and slender than second and third pairs (P3-4); third pair about as long as second pair. Fifth pair of pereopods (P5) short (0.8 CL), very slender; each merus with several tubercles, 3-4 spines, scattered plumose setae along posterior border; each propodus with 6-8 spines along posterior border, scattered plumose setae along anterior border; each dactylus with three spines along posterior border, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.3-1.4	2.5-2.6	2.5-2.6	0.8
Merus length/CL	0.4-0.5	0.7-0.8	0.8	0.3
Dactylus length/Cl	0.3-0.4	0.6	0.6	0.2

Abdomen of mature males (Fig. 17d) with segments 3-5 fused, two triangular tubercles on segment 3, one on 4. Male first pleopods (Figs 17e-f) with helicoidal basal parts; each distal part long, blade-like rising from thickened portion of basal part, which has plumose setae.

Abdomen of mature females with segments 3-5 fused. One transversal ridge along segments 1-2, each bordered by small, pointed tubercles; segment 3 of fused segment 3-5 with ridge slightly constricted twice medially; short ridge at each outer edge of segment 4.

DISCUSSION. — *P. armatus* can be easily distinguished from the other known members of the genus by the presence of conspicuous, pointed tubercles along the dorsal surface of the cheliped propodi, the posterior border of the carapace, and on the anterior and posterior borders of the meri of walking legs. The abundance of pointed tubercles through the body and appendages give individuals a rough appearance. It shares with *P. inanis* sp. nov. a greatly reduced anterolateral tooth on each side of the carapace; with *P. ambonensis* and *P. trispiralis* sp. nov. pointed tubercles on the male abdomen.

SIZE. — Maximum size among the six specimens examined in this study: 8.1 x 10.6 mm (female paratype, MNHN-B 26700); 6.5 x 9.0 mm (male holotype, MNHN-B 26698).

ETYMOLOGY. — From *armatus*, Latin for furnished with weapons, in reference to the diagnostic pointed tubercles along the dorsal surface of the chelipeds, meri of walking legs, and posterior border of the carapace.

DISTRIBUTION. — Known only from the Coral Sea (Vanuatu and the Loyalty Islands) (Fig. 57). Depth: known reliably between 300 and 400 m; also collected in a trawl between 400 and 440 m.

Parapalicus clinodentatus sp. nov.

Figs 18, 19c, 57

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn CP 1092, 15°10.80'S, 167°12.33'E, 314-321 m, 6.10.1994: 1 ♂, 2 ♀ (MNHN-B 26954). — Stn CP 1135, 15°40.50'S, 167°02.43'E, 282-375 m, 11.10.1994: 5 ♀ (MNHN-B 26955).

New Caledonia. BIOCAL: stn CP 105, 21°30.71'S, 166°21.72'E, 330-335 m, 8.09.1985: 1 juv. ♀ (MNHN-B 28006).

BATHUS 1: stn CP 670, 20°54'S, 165°53'E, 394-397 m, 14.03.1993: 1 ♂, 1 ♀ 9.0 x 13.1 mm (MNHN-B 26752). — Stn CP 701, 20°57.54'S, 165°35.86'E, 302-335 m, 18.03.1993: 3 ♂, 4 ♀ (MNHN-B 26956). — Stn 707, 21°42'S, 166°35'E, 347-375 m, 19.03.1993: 5 ♂, 10 ♀ (MNHN-B 27000). — Stn 708, 21°43.05'S, 166°38.57'E, 550-580 m, 19.03.1993: 1 ♀ (MNHN-B 26957). — Stn CP 710, 21°43.16'S, 166°36.35'E, 320-386 m, 19.03.1993: 1 ♂ paratype 5.9 x 8.7 mm (MNHN-B 26702), 1 ♀ paratype 8.5 mm x 12.0 mm (MNHN-B 26703), 13 ♂, 9 ♀ (MNHN-B 27001). — Stn CP 711, 21°43.00'S, 166°35.57'E, 315-327 m, 19.03.1993: 3 ♂, 2 ♀ (MNHN-B 26958).

BATHUS 2: stn CP 742, 22°33.45'S, 166°25.86'E, 340-470 m, 14.05.1993: 8 ♂, 13 ♀ (MNHN-B 26753), 1 ♀ 8.6 x 12.2 mm (MNHN-B 26705), 1 ♂ paratype 5.7 x 8.6 mm, 1 ♀ paratype 8.1 x 11.3 mm (USNM), 1 ♂ paratype 7.3 x 10.6 mm, 1 ♀ paratype 8.0 x 11.3 mm (ZRC 199.1431-1432). — Stn CP 743, 22°35.56'S, 166°26.23'E, 713-950 m, 14.05.1993: 1 ♂, 1 ♀ (MNHN-B 26959). — Stn CP 756, 22°22'S, 166°13'E, 672 m, 16.05.1993: 1 ♂ paratype 6.4 x 9.3 mm (MNHN-B 26704).

HALIPRO 1: stn CP 851, 21°43'S, 166°37'E, 314-364 m, 19.03.1994: 1 ♂ holotype 6.2 x 9.0 mm (MNHN-B 26701), 5 ♂, 5 ♀ (MNHN-B 27003). — Stn CC 856, 21°44'S, 166°37'E, 311-365 m, 20.03.1994: 1 ♀ (MNHN-B 27004). — Stn 868, 21°14'S, 165°55'E, 430-550 m, 23.03.1994: 1 ♂ (MNHN-B 27005).

BATHUS 4: stn CP 897, 20°15.93'S, 163°51.75'E, 305-350 m, 3.08.1994: 1 ♂ (MNHN-B 26960). — Stn CP 899, 20°16.68'S, 163°50.26'E, 500-600 m, 3.08.1994: 1 ♀ (MNHN-B 26961). — Stn CP 946, 20°33.81'S, 164°58.35'E, 386-430 m, 10.08.1994: 1 ♂ (MNHN-B 26962).

Fiji. MUSORSTOM 10: stn 1348, 17°30.29'S, 178°39.63'E, 353-390 m, 11.08,1998: 2 ♀ (MNHN-B 26751).

BORDAU 1: stn CP 1427, 17°16'S, 179°01'W, 364-369 m, 1.03.1999: 2 ♂, 1 ♀ (MNHN-B 27135).

TYPES. — *Holotype*: 1 ♂ 6.2 x 9.0 mm, HALIPRO 1, stn CP 851 (MNHN-B 26701).

Paratypes: 1 ♂ 5.9 x 8.7 mm, BATHUS 1, stn CP 710 (MNHN-B 26702); 1 ♀ 8.5 x 12.0 mm, BATHUS 1, stn CP 710 (MNHN-B 26703); 1 ♂ 6.4 x 9.3 mm, BATHUS 2, stn 756 (MNHN-B 26704); 1 ♀ paratype 8.6 x 12.2 mm, BATHUS 2, stn CP 742 (MNHN-B 26705); 1 ♂ paratype 5.7 x 8.6 mm, 1 ♀ paratype 8.1 x 11.3 mm, BATHUS 2, stn CP 742 (USNM); 1 ♂ paratype 7.2 x 10.6 mm, 1 ♀ paratype 8.0 x 11.3 mm, BATHUS 2, stn CP 742 (ZRC 1999.1431-1432).

TYPE LOCALITY. — Off east coast of New Caledonia, 21°43'S, 166°37'E, 314-364 m.

DIAGNOSIS. — Carapace (Figs 18a, 19c) with rounded anterolateral tooth on each side; tooth posteriorly bent at a slight angle in relation to carapace. Supraorbital borders irregular, undulating, without defined notches. Suborbital borders (Fig. 18b) each with very narrow, V-shaped gap between inner and outer suborbital lobes. Dorsal borders of cheliped propodi each with carina-like row of irregular tubercles. Abdomen of mature males (Fig. 18c) with two low tubercles on segment 3, similar one on segment 4. Male first pleopods (Fig. 18d) with helicoidal basal parts; each distal part with two curved, unequal, pointed tips that cross each other. Abdomen of mature females with one transverse ridge along each segment 1-4.

Color: Specimens that were examined only nine months after collection (MNHN-B 26751) showed that some of the tubercles on the meri and carpi of the walking legs, the meri of chelipeds, and on the dorsal surface of the carapace (mostly along the anterior border) were orange.

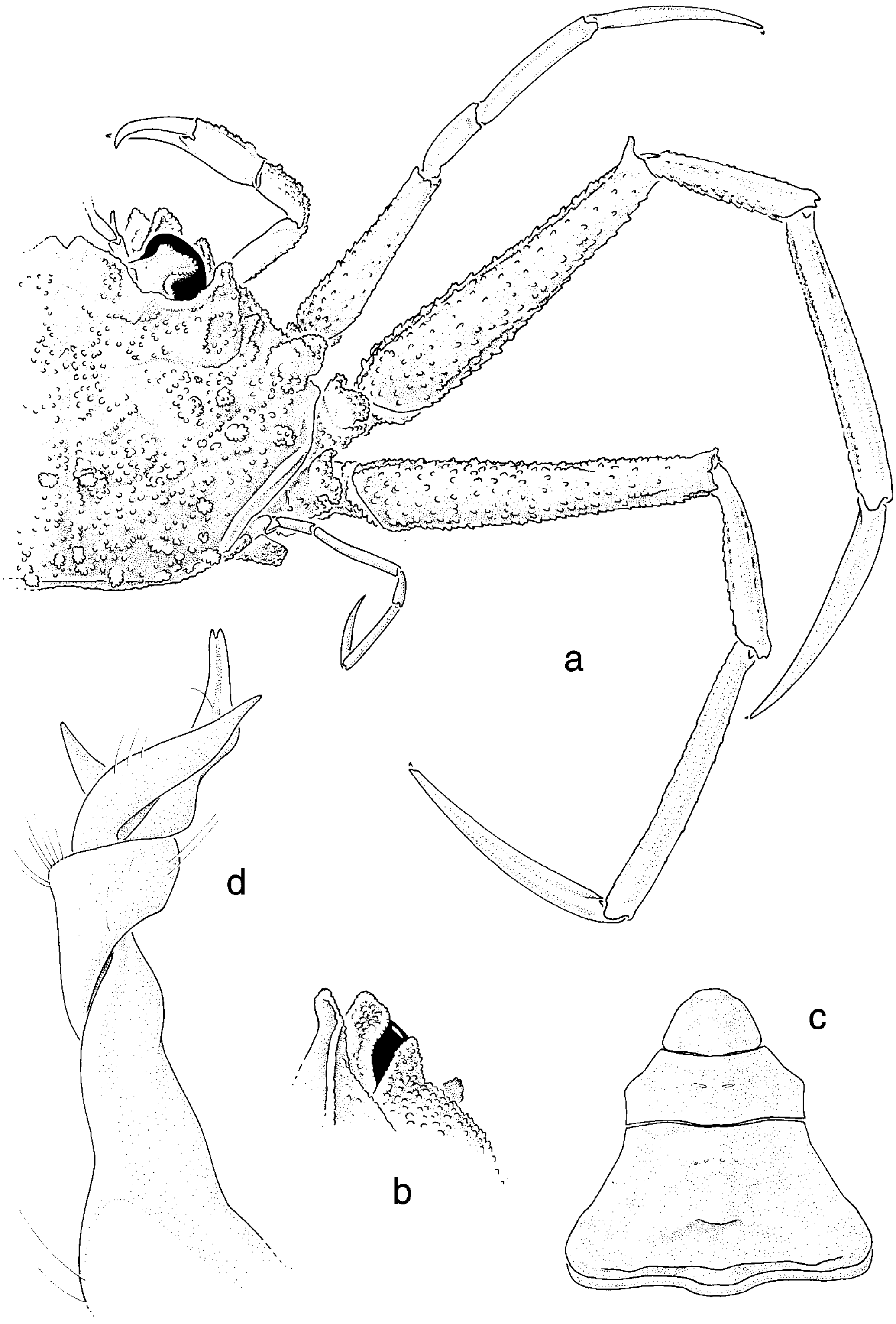

FIG. 18. — *Parapalicus clinodentatus* sp. nov., ♂ holotype 6.2 x 9.0 mm, off east coast of New Caledonia, HALIPRO 1, stn CP 851, 314-364 m (MNHN-B 26701): **a**, carapace and pereopods, dorsal surface; **b**, suborbital border; **c**, abdomen; **d**, left male first pleopod, ventral view.

DESCRIPTION. — Carapace (Figs 18a, 19c) wider than long (CW/CL = 1.4-1.5); dorsal surface covered with coarse granules. Anterolateral borders of carapace each with granular, rounded to triangular tooth bent posteriorly in relation to carapace. Two granular, rounded bosses (one high, close to carapace border plus less conspicuous one), on branchial region posterior to each tooth. Two large but low bosses on metagastric region. Slightly protuberant, granular tubercle at junction of posterolateral and posterior borders. Episternal processes oblong, with rounded tip. Larger specimens with four similar but slightly smaller, granular tubercles that protrude along posterior border. Posterior border with plumose setae.

Frontal border of carapace divided into two small lobes divided by narrow V-shaped notch; slightly rounded tips. Borders between frontal lobes and supraorbital borders slightly pointed medially separates straight anterior half and slightly raised posterior half. Supraorbital borders irregular, undulating, without well-defined notches (slight notch before postorbital angle in some specimens). Postorbital angles short, rounded (slightly pointed in some specimens). Cornea of eyes dorsoventrally flattened, much wider than base of eye peduncle; peduncles without well-defined tubercles.

Suborbital borders (Fig. 18b) each with very narrow, V-shaped gap between inner and outer suborbital lobes. Outer lobe pointed, narrow, slightly shorter than pointed inner lobe. Pterygostomial lobes project slightly ventrally, elongate, pointed, slightly shorter than each inner suborbital lobe.

Each basal antennal segment expanded distally as narrow, pointed process; flagellum long with conspicuous, simple setae. Inner border of ischia of third maxillipeds sinuous to serrate but without defined teeth; surface coarsely granular, upper borders rounded. Meri much narrower than ischia; narrow, pointed (in inner direction) upper borders.

Dorsal borders of cheliped propodi (Fig. 18a) each with carina-like row of irregular tubercles; one additional row of low tubercles along outer surface. Distal half of each finger with 4-5 triangular teeth. Carpi short, outer borders with many pointed tubercles throughout; meri slender, outer border each with 1-2 rows of low tubercles.

First three pairs of walking legs (P2-4; Figs 18a, 19c) very slender, with very elongate meri, filiform propodi and dactyli. Upper and lower borders of meri with small, similarly pointed tubercles (smaller on P2, slightly larger tubercles proximally in P3 of some specimens); distalmost tubercle on each anterior border wider at base, higher, with rounded tip slightly directed distally (particularly in P3). Anterior and posterior borders of carpi, propodi, and dactyli of all walking legs (P2-4) entire, without tubercles (propodi of P3-4 with microscopic tubercles). Each P3 with two dorsal carinae on carpus; one dorsal carina on propodus; one dorsal, one ventral (very slight) carina on dactylus. Each P4 with two dorsal carinae on carpus; one dorsal carina on propodus; one dorsal, one ventral carina each on propodus and dactylus. Meri of all legs with scattered plumose setae; dorsal surfaces of carpi and propodi of P2-4 with rows of plumose setae; dorsal surfaces of dactyli of P2-4 each with one row of conspicuous plumose setae along anterior border.

First pair of walking legs (P2) much shorter and slender than second and third pairs (P3-4); third pair about as long as second pair. Fifth pair of pereopods (P5) short (0.9 CL), very slender; each merus with microscopic tubercles, scattered plumose setae along posterior border; each propodus without setae or with scattered plumose and/or simple setae; each dactylus with 2-3 short spines along posterior border, long simple setae along anterior border, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.6-1.9	2.5-3.1	2.9-3.3	0.9
Merus length/CL	0.5-0.6	0.8-1.1	0.8-1.1	0.3
Dactylus length/Cl	0.5	0.7-0.8	0.8-0.9	0.2

Abdomen of mature males (Fig. 18c) with segments 3-5 fused, two slightly raised tubercles on segment 3 (plus low central prominence), similar one on 4. Male first pleopods (Fig. 18d) with helicoidal basal parts; each distal part with two curved, unequal, pointed tips that cross each other.

Abdomen of mature females with segments 3-5 fused. One transversal ridge along each segment 1-2, two along proximal portion of fused segment 3-5 (very low one may be present on 5).

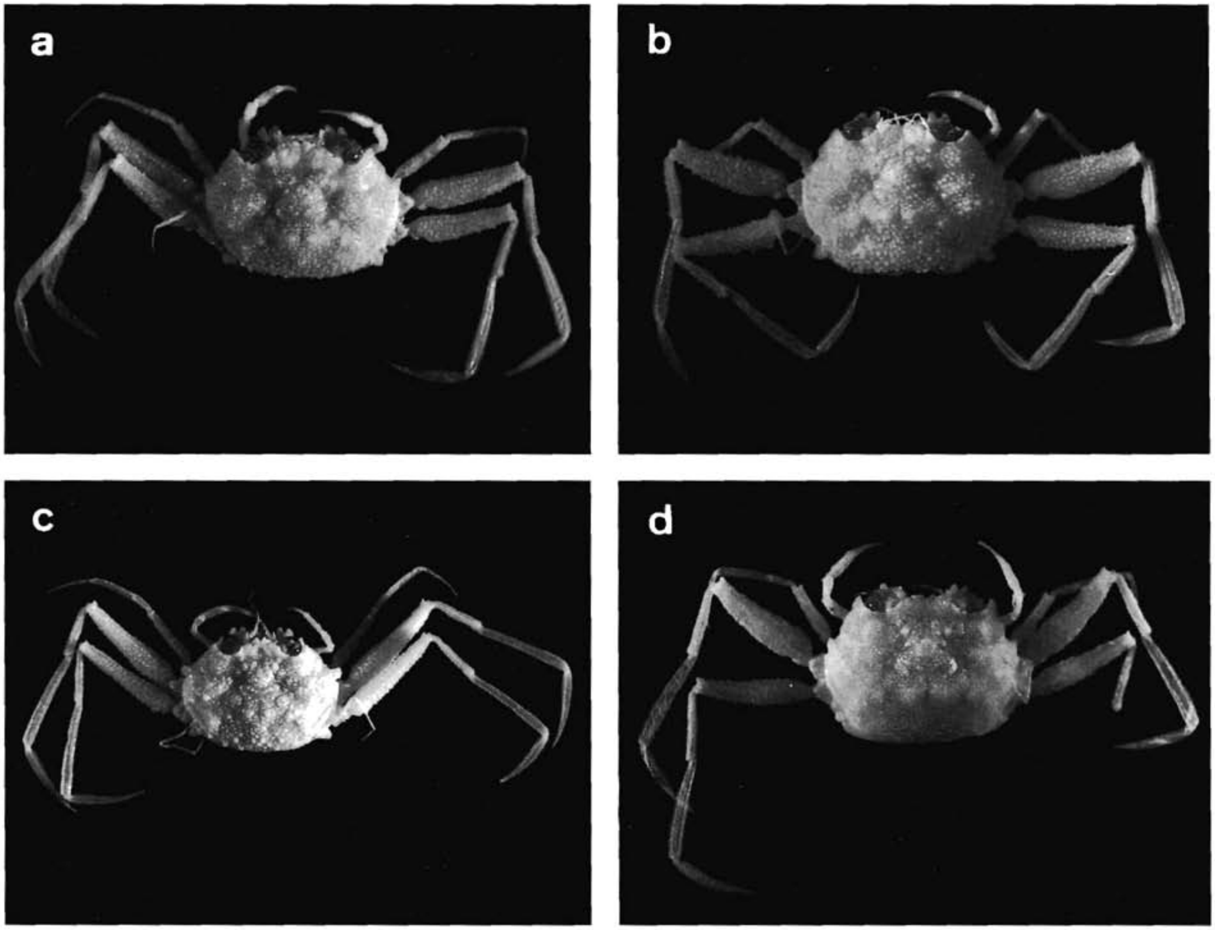

FIG. 19. — **a**, *Parapalicus ambonensis* Moosa & Serène, 1981, ♂ 5.4 x 7.6 mm, Grand Passage, north of New Caledonia, BATHUS 4, stn CP 905, 294-296 m (MNHN-B 26754): dorsal view. — **b**, *Parapalicus armatus* sp. nov.: ♀ paratype 8.1 x 10.6 mm, Loyalty Islands, MUSORSTOM 6, stn DW 481, 300 m (MNHN-B 26700): dorsal view. — **c**, *Parapalicus clinodentatus* sp. nov., ♀ 9.0 x 12.7 mm, off southeast coast of New Caledonia, BATHUS 2, stn CP 742, 340-470 m (MNHN-B 26753): dorsal view. — **d**, *Parapalicus inanis* sp. nov., ♀ paratype 4.9 x 6.2 mm, Chesterfield-Bellona Plateau, MUSORSTOM 10, stn 285, 245-255 m, (MNHN-B 26722): dorsal view.

DISCUSSION. — *P. clinodentatus* is close to *P. unidentatus* (Zarenkov, 1968) since both species share several key characters: a narrow, V-shaped gap between the inner and outer suborbital lobes, a carina-like row of irregular tubercles on the dorsal borders of the chelipeds, two salient teeth on the sides of the carapace, two curved and pointed tips that cross each other on the distal part of the male first pleopods, and relatively low tubercles on the male abdomen. *P. clinodentatus* may be readily differentiated from *P. unidentatus*, however, by having much longer walking legs (total length of P3 varied 2.9-3.3 CL in *P. unidentatus* whereas it is 2.7 CL in *P. clinodentatus*), rounded anterolateral teeth each with its posterior edge bent downward in relation to the rest of the carapace (triangular in shape and a straight continuation of the carapace in *P. unidentatus*), irregular subraorbital borders (two clear notches in *P. unidentatus*), and unequal pointed tips in the male first pleopods (equal in *P. unidentatus*).

SIZE. — Maximum size among specimens examined: 9.0 x 13.1 mm (female, MNHN-B 26752); 7.3 x 10.4 mm (male, MNHN-B 26753).

ETYMOLOGY. — From *clino*, Latin for bend or slant, and *dens*, Latin for tooth, in reference to the diagnostic position of the anterolateral tooth, which is bent in relation to the carapace.

DISTRIBUTION. — Known from the Coral Sea (Vanuatu and New Caledonia) and Fiji (Fig. 57). Depth: known reliably between 320 and 713 m; also collected in trawls between 282-375 and 713-950 m.

Parapalicus denticulatus sp. nov.

Figs 20, 21a, 57

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn CP 1077, 16°04'S, 167°06'E, 180-210 m, 5.10.1994: 2 ♂, 2 ♀ (MNHN-B 26840). — Stn CP 1117, 15°09'S, 166°53'E, 170-220 m, 9.10.1994: 1 ♀ (MNHN-B 26842). — Stn DW 1128, 16°02'S, 166°38'E, 778-811 m, 10.10.1994: 1 ♀ (MNHN-B 26841).

New Caledonia. BATHUS 1: stn 667, 20°57'S, 165°34'E, 205-212 m, 14.03.1993: 7 ♂, 9 ♀ (MNHN-B 26843), 1 ♂ 5.0 x 7.4 mm (MNHN-B 26711), 1 ♂ paratype 5.2 x 7.6 mm (MNHN-B 26712), 1 ♂ holotype 5.2 x 8.0 mm (MNHN-B 26711), 1 ♀ paratype 7.3 x 11.0 mm (MNHN-B 26713). — Stn CP 668, 20°57.21'S, 165°34.57'E, 205-219 m, 14.03.1993: 15 ♂, 9 ♀ (MNHN-B 27002), 1 ♂ (MNHN-B 26839), 1 ♂ paratype 5.0 x 7.6 mm, 1 ♀ paratype 6.8 x 10.2 mm (USNM), 1 ♂ paratype 5.1 x 7.4 mm, 1 ♀ paratype 7.3 x 10.8 mm (ZRC 1999.1433-1434). — Stn CP 669, 20°57'S, 165°35'E, 255-280 m, 14.03.1993: 4 ♂, 4 ♀ (MNHN-B 26756). — Stn DE 700, 20°57'S, 165°34'E, 160-222 m, 18.03.1993: 1 ♀ (MNHN-B 26844). — Stn CP 713, 21°45'S, 166°36'E, 250 m, 19.03.1993: 3 ♂, 7 ♀ (MNHN-B 26755).

HALIPRO 1: stn CP 863, 21°31'S, 166°20'E, 190-227 m, 22.03.1994: 2 ♂, 3 ♀ (MNHN-B 26845).

BATHUS 4: stn CP 953, 21°45'S, 166°36'E, 220-234 m, 11.08.1994: 1 ♀ 7.5 x 10.6 mm (MNHN-B 26715), 1 ♀ (MNHN-B 26846). — Stn 954, 21°44'S, 166°35'E, 255-250 m, 11.08.1994: 1 ♀ parasitized by bopyrid (MNHN-B 96847).

Loyalty Islands. MUSORSTOM 6: stn DW 410, 20°38.05'S, 167°06.65'E, 490 m, 15.02.1989: 1 ♀ (MNHN-B 26848).

TYPES. — *Holotype*: 1 ♂ 5.0 x 7.4 mm, BATHUS 1, stn CP 667 (MNHN-B 26711).

Paratypes: 1 ♂ 5.2 x 7.6 mm, BATHUS 1, stn CP 667 (MNHN-B 26712); 1 ♀ 7.3 x 11.0 mm, BATHUS 1, stn 667 (MNHN-B 26713); 1 ♂ paratype 5.2 x 8.0 mm, BATHUS 1, stn 667 (MNHN-B 26714); 1 ♀ paratype 7.5 x 10.6 mm, BATHUS 4, stn CP 953 (MNHN-B 26715); 1 ♂ 5.0 x 7.6 mm, 1 ♀ 6.8 x 10.2 mm, BATHUS 1, stn CP 668 (USNM); 1 ♂ 5.1 x 7.4 mm, 1 ♀ 7.3 x 10.8 mm, BATHUS 1, stn CP 668 (ZRC 199.1433-1434).

TYPE LOCALITY. — Off east coast of New Caledonia, 20°57.23'S, 165°34.59'E, 205-212 m.

DIAGNOSIS. — Carapace (Figs 20a, 21a) with anterolateral tooth on each side; tooth with truncate outer border and sinuous, nearly straight upper border. Supraorbital borders each with two very slight notches. Suborbital borders (Fig. 20b) each with broad, V-shaped gap between inner and outer suborbital lobes; outer lobe longer than postorbital angle. Dorsal borders of cheliped propodi (Fig. 20c) with rows of microscopic teeth; proximal tubercle on propodus with similar microscopic teeth. Abdomen of mature males (Fig. 20d) with two rounded, elongate tubercles on segment 3; similar but lower one on segment 4. Male first pleopods (Fig. 20e) with helicoidal basal parts; each distal part straight, blade-like, with trigger-like process at base. Abdomen of mature females with one transverse ridge along each segment 1-4 (slightly constricted twice medially in segment 3).

DESCRIPTION. — Carapace (Figs 20a, 21a) wider than long (CW/CL = 1.4-1.5); dorsal surface covered with coarse granules. Smooth sulcus between hepatic and branchial regions connecting with deep fissure between anterolateral tooth and large swelling (with dorsal, rounded boss) along carapace border posterior to postorbital angle. Anterolateral borders of carapace each with tooth covered with fine granules, truncate outer border, tip slightly directed anteriorly, and sinuous, nearly straight upper border. One large, elongate to rounded, granular boss close to carapace border on branchial region posterior to each anterolateral tooth. Two large, low bosses on metagastric region. Episternal processes oblong. Posterior border of carapace with 6-8 slightly protuberant tubercles, plumose setae.

Frontal border of carapace divided into two very broad lobes with straight margins sometimes marked by very slight median notch; lobes divided by narrow V-shaped notch. Borders between frontal lobes and supraorbital borders rounded, slightly raised in posterior portion. Supraorbital borders each with two very slight notches, one before postorbital angle. Postorbital angles very short (shorter than outer lobe of suborbital border), with slightly pointed tip. Cornea of eyes dorsoventrally flattened, much wider than base of short eye peduncle; peduncles without conspicuous tubercles.

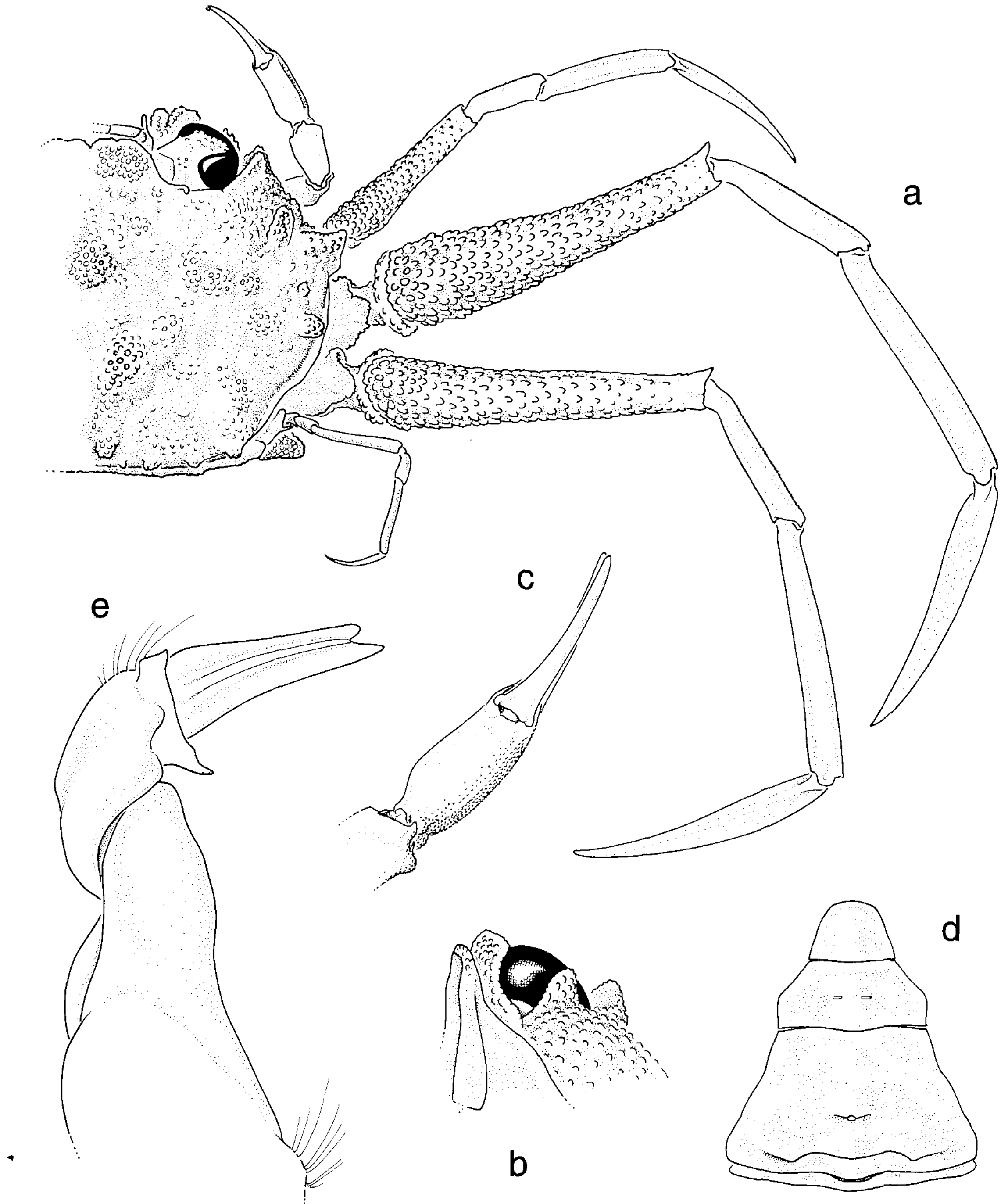

FIG. 20. — *Parapalicus denticulatus* sp. nov.: **a-d**, ♂ holotype 5.0 x 7.4 mm, off south coast of New Caledonia, BATHUS 1, stn CP 667, 205-212 m (MNHN-B 26711): **a**, carapace and pereopods, dorsal surface; **b**, suborbital border; **c**, right cheliped, upper surface; **d**, abdomen. — **e**, ♂ paratype 5.2 x 7.6 mm, off south coast of New Caledonia, BATHUS 1, stn CP 667 (MNHN-B 26712): left male first pleopod, ventral view.

Suborbital borders (Fig. 20b) each with broad, V-shaped gap between inner and outer suborbital lobes. Outer lobe pointed (obliquely directed in some specimens), shorter than pointed inner lobe. Pterygostomial lobes nearly straight, triangular, slightly shorter than each inner suborbital lobe.

Each basal antennal segment expanded distally as slightly pointed process; flagellum long with conspicuous, simple setae. Inner border of ischia of third maxillipeds sinuous to serrate but without defined teeth; surface coarsely granular, upper borders rounded. Meri much narrower than ischia; narrow, pointed (in inner direction) upper borders.

Dorsal borders of cheliped propodi (Fig. 20c) with rows of microscopic teeth; proximal portion of propodi with tubercle with denticulate margin. Distal half of each finger with 4-5 triangular teeth. Carpi short, meri slender, outer borders of both with microscopic teeth throughout.

First three pairs of walking legs (P2-4; Figs 20a, 21a) very slender, with very elongate meri, filiform propodi and dactyli. Upper and lower borders of meri with small, similarly pointed tubercles (slightly larger tubercles proximally in some specimens); distalmost tubercle on each anterior border wider at base, higher, with conspicuously pointed tip directed distally in P3-4 (similar tubercle but not conspicuously pointed in P2). Anterior and posterior borders of carpi, propodi, and dactyli of all walking legs (P2-4) entire. Each P2 with one dorsal (very slight) carina on dactylus. P3-4 each with one dorsal carina on carpus, propodus (very slight), and dactylus. Meri of all legs with scattered plumose setae; dorsal surfaces of propodi of P3-4 with rows of plumose setae; dorsal surfaces of dactyli of P2-4 each with one row of conspicuous plumose setae along anterior border.

First pair of walking legs (P2) much shorter and slender than second and third pairs (P3-4); third pair about as long as second pair. Fifth pair of pereopods (P5) short (0.8-0.9 CL), very slender; each merus with scattered plumose setae along posterior border; each propodus with smooth borders, scattered plumose setae along anterior and posterior borders; each dactylus with 1-4 short spines increasing in length distally along posterior border, long simple setae along anterior and posterior borders, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.5-1.7	2.8-2.9	2.6-2.8	0.8-0.9
Merus length/CL	0.5	0.9	0.9	0.2-0.3
Dactylus length/Cl	0.5	0.7-0.8	0.7	0.2

Abdomen of mature males (Fig. 20d) with segments 3-5 fused, two rounded, elongate tubercles on segment 3, similar but slightly lower tubercle on segment 4. Male first pleopods (Fig. 20e) with helicoidal basal parts; each distal part straight, blade-like, corneus distal part; proximal, ventrally pointed, trigger-like process.

Abdomen of mature females with segments 3-5 fused. One ridge along each segment 1-2, two along proximal portion of fused segment 3-5 (slightly constricted twice medially in segment 3).

DISCUSSION. — *P. denticulatus* is very close to *P. inermis* sp. nov. It differs from the later by the presence of numerous, very small teeth on the dorsal surface of the propodi of the chelipeds (nearly smooth in *P. inermis*), a trigger-like process at the base of a shorter and straight distal part in each male first pleopod, much lower tubercles on the male abdomen, and slightly longer second walking legs in relation to carapace length (2.8-2.9 CL against 3.0-3.5 CL in *P. inermis*). There is also a difference in size, adult *P. denticulatus* being larger than adult *P. inermis*. In *P. inermis* the average carapace length of all specimens available for measurement was 5.1 mm in males (4.1-5.3 mm, N = 22) and 6.6 mm in females (5.1-7.5 mm, N = 33) in contrast to 4.1 mm in males (3.7-4.4 mm, N = 11) and 5.7 mm in females (4.1-6.3 mm; N = 112) in *P. inermis*. Morphological differences (most significantly between the male first pleopods) and the large number of morphologically similar specimens collected in separate geographical locations indicate that *P. denticulatus* and *P. inermis* are different species and not merely populations of different age groups that belong to only one species.

There are also some similarities with *P. ambonensis*. As in *P. denticulatus*, the anterolateral teeth of *P. ambonensis* have truncate outer borders. The upper borders, however, are short and rounded (which makes the teeth look conspicuously narrow), not long and nearly straight as in *P. denticulatus*. *P. ambonensis* can be easily identified by a very short second suborbital tooth, the presence of two tubercles along the dorsal border of each cheliped propodus, and male first pleopods with a beak-like distal part (Fig. 16c).

P. denticulatus also shares with *P. unidentatus* (Zarenkov, 1968) the morphology of the dorsal surface of its carapace, which is covered (except the cervical groove and areas around the gastric portion) by granular bosses and anterolateral borders that are each armed with a triangular tooth and a conspicuous blunt boss at the branchial region posterior to the anterolateral tooth. The two species can be distinguished by the morphology of their male first pleopods (much more complex in *P. unidentatus*, with each distal part consisting of two pointed tips that cross each other; MOOSA & SERÈNE, 1981, fig. 4), the ornamentation of the cheliped propodi (carina-like row of irregular tubercles in *P. unidentatus*), and the gap between the inner and outer suborbital lobes (U-shaped in *P. denticulatus*, narrow and V-shaped in *P. unidentatus*; ZARENKOV, 1968, fig. 3B).

P. denticulatus also shares with *P. trituberculatus* (Chen, 1981) similarities in carapace shape and in the presence of microscopic teeth on the dorsal borders of the cheliped propodi. They differ from each other by the morphology of their male first pleopods (pointed distal parts that are bordered with spinules along the ventral borders in *P. trituberculatus*; Figs 28a-b), the gap between the inner and outer suborbital lobes (much broader, almost circular in *P. trituberculatus*; CHEN, 1981, pl. 2, fig. 1), and the relative length of the walking legs (shorter in *P. trituberculatus*, P3 only 2.1-2.4 CL and P4 2.3 CL).

SIZE. — Maximum size among specimens examined: 7.5 x 11.2 mm (female, MNHN-B 26755); 5.3 x 7.9 mm (male, MNHN-B 26756).

ETYMOLOGY. — From *denticulus*, the Latin diminutive of *dens*, or tooth, in reference to the diagnostic rows of microscopic teeth along the dorsal surface and anterior border of the cheliped propodi.

DISTRIBUTION. — Known only from the Coral Sea (Vanuatu, New Caledonia, and Loyalty Islands) (Fig. 57). Depth: known reliably between 210 and 778 m; also collected in trawls between 160-222 and 778-811 m.

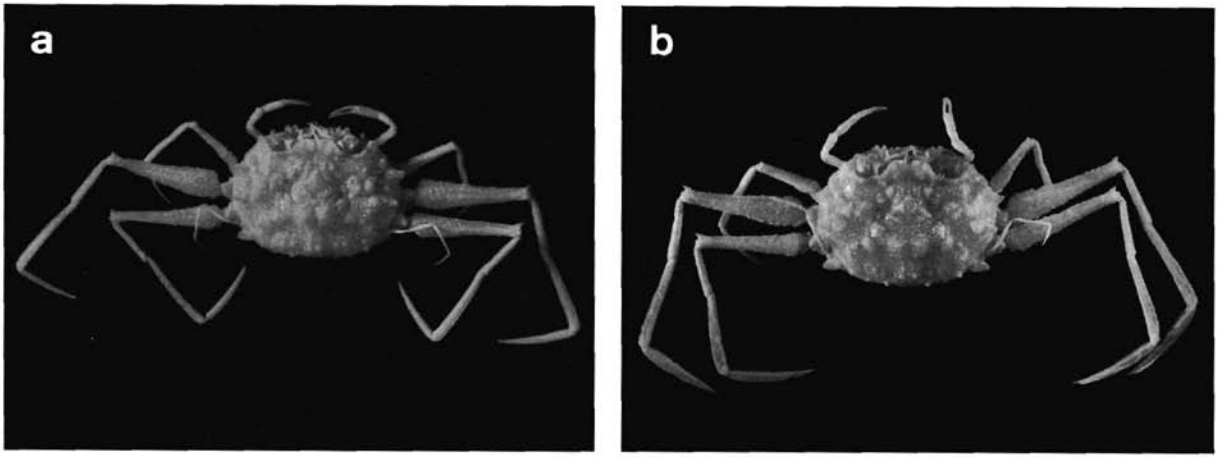

FIG. 21. — **a**, *Parapalicus denticulatus* sp. nov.: ♀ paratype 7.5 x 10.6 mm, off west coast of New Caledonia, BATHUS 4, stn CP 953, 220-234 m (MNHN-B 26715): dorsal view. — **b**, *Parapalicus inermis* sp. nov., ♀ paratype 5.3 x 7.9 mm, Fiji, MUSORSTOM 10, stn CP 1351, 292-311 m (MNHN-B 26720): dorsal view.

Parapalicus inermis sp. nov.

Figs 21b, 22, 57

MATERIAL EXAMINED. — **Fiji**. MUSORSTOM 10: stn CP 1322, 17°17.10'S, 177°47.92'E, 225-285 m, 7.08.1998: 1 ♀ (MNHN-B 26856). — Stn CP 1323, 17°16.10'S, 177°45.75'E, 143-173 m, 7.08.1998: 1 ♂ paratype 4.4 x 6.8 mm (MNHN-B 26717), 1 ♂, 31 ♀ (MNHN-B 26757), 1 ♂ paratype 3.9 x 6.6 mm, 1 ♀ paratype 5.7 x 8.3 mm (USNM). —

Stn CP 1324, 17°17.37'S, 177°47.05'E, 102-104 m, 7.08.1998: 1 ♂, 1 ♀ (MNHN-B 26858). — Stn CP 1325, 17°16.39'S, 177°49.80'E, 282-322 m, 7.08.1998: 1 ♀ (MNHN-B 26859). — Stn CP 1349, 17°31.07'S, 178°38'79'E, 244-252 m, 11.08.1998: 2 ♂, 15 ♀ (MNHN-B 26850). — Stn CP 1351, 17°31.14'S, 178°39.96'E, 292-311 m, 11.08.1998: 1 ♀ paratype 5.4 x 8.0 mm (MNHN-B 26719), 1 ♀ paratype 5.3 x 7.9 mm (MNHN-B 26720), 7 ♀ (MNHN-B 26851). — Stn CP 1355, 17°49.54'S, 178°49.39'E, 302-310 m, 12.08.1998: 1 ♂ holotype 4.2 x 6.4 mm (MNHN-B 26716), 1 ♀ paratype 5.7 x 8.4 mm (MNHN-B 26718), 4 ♀ (MNHN-B 26852). — Stn CP 1358, 17°48.49'S, 178°46.70'E, 80-120 m, 13.08.1998: 1 ♀ (MNHN-B 26857). — Stn CP 1363, 18°12.39'S, 178°33.01'E, 144-150 m, 15.08.1998: 2 ♂, 19 ♀ (MNHN-B 26849). — Stn DW 1365, 18°12.73'S, 178°32.38'E, 295-302 m, 15.08.1998: 1 ♀ (MNHN-B 26860). — Stn DW CP 1366, 18°12.36'S, 178°33.06'E, 149-168 m, 15.08.1998: 1 ♂, 6 ♀ (MNHN-B 26853). — Stn CP 1370, 18°12.32'S, 178°33.10'E, 113-123 m, 16.08.1998: 1 ♂, 12 ♀ (MNHN-B 26854). — Stn CP 1371, 18°12.36'S, 178°32.85'E, 135-151 m, 16.08.1998: 12 ♀ (MNHN-B 26855).

BORDAU 1: stn CP 1403, 16°40'S, 179°36'E, 220-224 m, 25.02.1999: 1 ♂, 4 ♀ (MNHN-B 27136). — Stn CP 1405, 16°39'S, 179°36'E, 180 m, 25.02.1999: 2 ♀ (MNHN-B 27137).

TYPES. — *Holotype*: 1 ♂ 4.2 x 6.4 mm, MUSORSTOM 10, stn CP 1355 (MNHN-B 26716).

Paratypes: 1 ♂ 4.4 x 6.8 mm, MUSORSTOM 10, stn CP 1323 (MNHN-B 26717); 1 ♀ 5.7 x 8.4 mm, MUSORSTOM 10, stn CP 1355 (MNHN-B 26718); 1 ♀ 5.4 x 8.0 mm, MUSORSTOM 10, stn CP 1351 (MNHN-B 26719); 1 ♀ 5.3 x 7.9 mm, MUSORSTOM 10, stn CP 1351 (MNHN-B 26720); 1 ♂ 3.9 x 6.6 mm, 1 ♀ 5.7 x 8.3 mm, MUSORSTOM 10, stn CP 1323 (USNM).

TYPE LOCALITY. — Off east coast of Viti Levu, Fiji, 17°49.54'S, 178°49.39'E, 302-310 m.

DIAGNOSIS. — Carapace (Figs 21b, 22a) with one anterolateral tooth on each side; tooth with truncate outer border, sinuous, nearly straight upper border. Supraorbital borders each with two very slight notches. Suborbital borders (Fig. 22b) each with broad, V- or L-shaped gap between inner and outer suborbital lobes; outer lobe longer than postorbital angle. Dorsal borders of cheliped propodi (Fig. 22c) nearly smooth, only with barely visible microscopic teeth; proximal tubercle smooth. Abdomen of mature males (Fig. 22d) with two low, elongate tubercles on segment 3; similar but slightly lower one on segment 4. Male first pleopods (Fig. 22e) with helicoidal basal parts; each distal part blade-like, corneous, proximally curved but distally widened. Abdomen of mature females with segments 3-5 fused; one transverse ridge along each segment 1-4 (slightly constricted twice medially in segment 3).

Color: A color photograph of a live specimen showed a red-brown carapace, light red-brown tubercles on the meri of the walking legs, and narrow, red-brown bands across the walking legs. Some of the color shown in the photographs remained in specimens that had been preserved in alcohol for nine months.

DESCRIPTION. — Carapace (Figs 21b, 22a) wider than long (CW/CL = 1.4-1.5); dorsal surface covered with coarse granules. Smooth sulcus between hepatic and branchial regions connecting with deep fissure between anterolateral tooth and large swelling (with dorsal, rounded boss) along carapace border posterior to postorbital angle. Anterolateral borders of carapace each with tooth covered with fine granules, truncate outer border, tip slightly directed anteriorly, and sinuous, nearly straight upper border. One large, elongate to rounded, granular boss close to carapace border on branchial region posterior to each anterolateral tooth. Two large, low bosses on metagastric region. Episternal processes oblong. Posterior border of carapace with 6-8 slightly protuberant tubercles, plumose setae.

Frontal border of carapace divided into two very broad lobes with straight margins sometimes marked by very slight median notch; lobes divided by narrow V-shaped notch. Borders between frontal lobes and supraorbital borders rounded, slightly raised in posterior portion. Supraorbital borders each with two very slight notches, one before postorbital angle. Postorbital angles very short (shorter than outer lobe of suborbital border), with slightly pointed tip. Cornea of eyes dorsoventrally flattened, much wider than base of short eye peduncle; peduncles without conspicuous tubercles.

Suborbital borders (Fig. 22b) each with broad, V-shaped gap between inner and outer suborbital lobes. Outer lobe pointed (obliquely directed in some specimens), shorter than pointed inner lobe. Pterygostomial lobes nearly straight, triangular, slightly shorter than each inner suborbital lobe.

Each basal antennal segment expanded distally as slightly pointed process; flagellum long with conspicuous, simple setae. Inner border of ischia of third maxillipeds sinuous to serrate but without defined teeth;

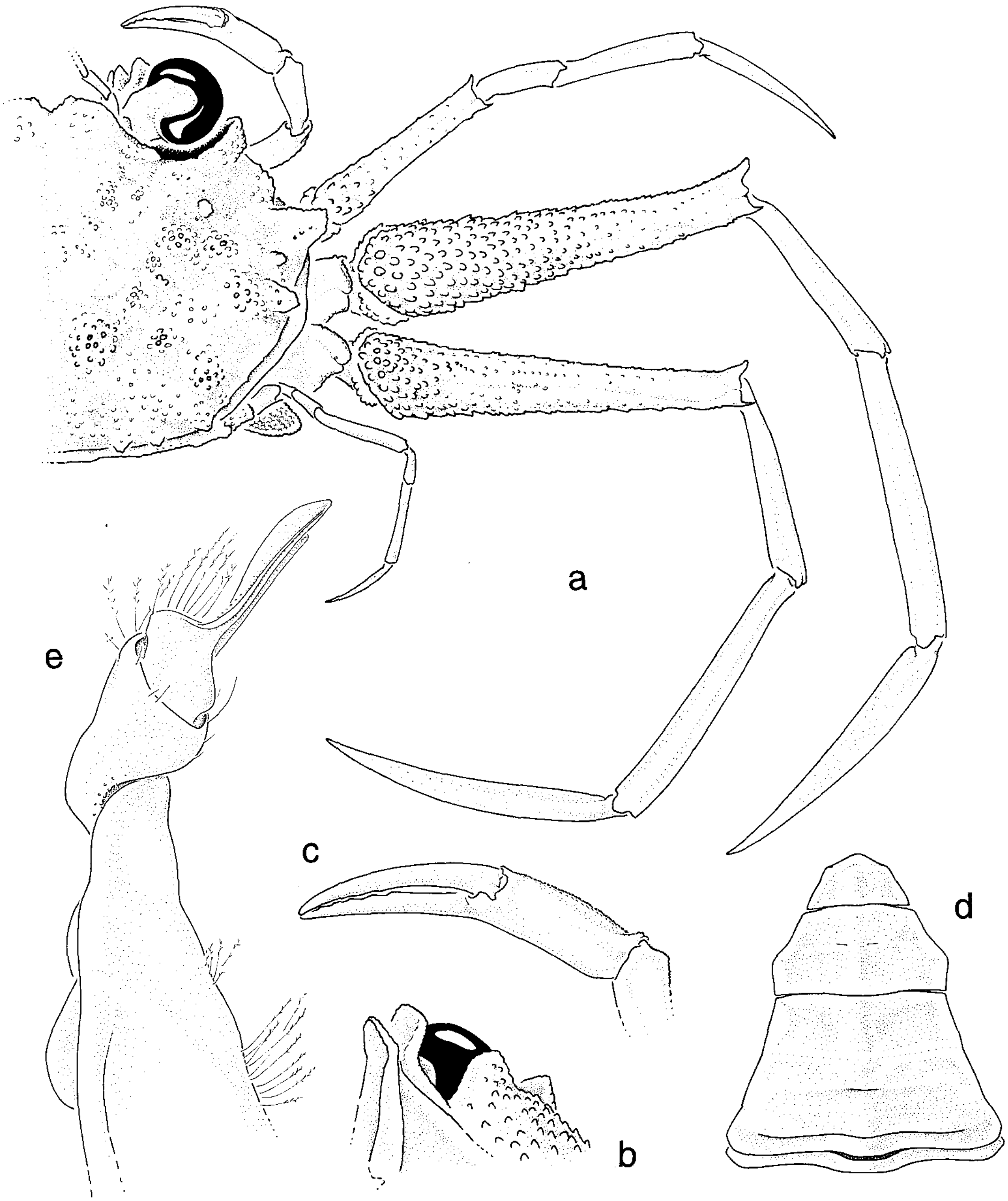

FIG. 22. — *Parapalicus inermis* sp. nov., ♂ holotype 4.2 x 6.4 mm, east of Viti Levu, Fiji, MUSORSTOM 10, stn CP 1355, 302-310 m (MNHN-B 26716): **a**, carapace and pereopods, dorsal surface; **b**, suborbital border; **c**, right cheliped, upper surface; **d**, abdomen; **e**, left male first pleopod, ventral view.

surface coarsely granular, upper borders rounded. Meri much narrower than ischia; narrow, pointed (in inner direction) upper borders.

Dorsal and outer borders of cheliped propodi (Fig. 22c) nearly smooth, only with barely visible microscopic teeth; low, rounded tubercle at proximal to each propodal-carpal joint. Distal half of each finger with 4-5 teeth (triangular in smaller females, low and rounded in larger females). Carpi short, outer borders smooth; meri slender, outer borders smooth.

First three pairs of walking legs (P2-4; Figs 21b, 22a) very slender, with elongate meri, filiform propodi and dactyli. Upper and lower borders of meri with small, similarly pointed tubercles (smaller on P2); distalmost tubercle on each anterior border much wider at base, higher, with pointed tip directed distally in P3-4 (similar tubercle but not conspicuously pointed in P2). Anterior and posterior borders of carpi, propodi, and dactyli of all walking legs (P2-4) entire. Each P2 with one dorsal (very slight) carina on dactylus. Each P3 with one dorsal carina on carpus; one dorsal (very slight) carina on propodus; one dorsal carina on dactylus. Each P4 with one dorsal carina each on carpus, propodus, and dactylus. Meri of all legs with scattered plumose setae; dorsal surfaces of propodi of P3-4 with rows of plumose setae; dorsal surfaces of dactyli of P2-4 each with one row of conspicuous plumose setae along anterior border.

First pair of walking legs (P2) much shorter and slender than second and third pairs (P3-4); third pair about as long as second pair. Fifth pair of pereopods (P5) short (0.8-0.9 CL), very slender; each merus with scattered plumose setae along posterior border; each propodus with smooth borders, long plumose setae along anterior and posterior borders; each dactylus with 1-4 spines increasing in length distally along posterior border, long, simple setae along anterior and posterior borders, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.5-1.8	3.0-3.5	2.8-3.3	0.8-0.9
Merus length/CL	0.5-0.6	0.9-1.1	0.9-1.1	0.2-0.3
Dactylus length/Cl	0.4-0.5	0.8-0.9	0.7-0.8	0.2

Abdomen of mature males (Fig. 22d) with segments 3-5 fused, two low, elongate tubercles on segment 3, similar but lower on segment 4. Male first pleopods (Fig. 22e) with helicoidal basal parts; each distal part long, blade-like, proximally curved, distally widened.

Abdomen of mature females with segments 3-5 fused. One transversal ridge along each segment 1-2, one along proximal portion of fused segment 3-5 (slightly constricted twice medially in segment 3).

DISCUSSION. — *P. inermis* is very close to *P. denticulatus* sp. nov., which is known only from the Coral Sea region (Vanuatu to Loyalty Islands), while *P. inermis* is only known from Fiji (see discussion for *P. denticulatus*). There are also some similarities with *P. ambonensis* on account of the presence of anterolateral teeth that have obtuse outer borders.

P. inermis has legs that are unusually long in relation to carapace length. The total length of the second pair of walking legs (P3) varied between 3.0-3.5 CL, the longest in any known species of *Parapalicus*.

SIZE. — Maximum size among the females examined: 6.3 x 9.4 mm (MNHN-B 26757); the largest of the males examined: 4.4 x 6.8 mm (MNHN-B 26717).

ETYMOLOGY. — From *inermis*, Latin for unarmed, in reference to the smooth appearance of the outer border of the cheliped propodi.

DISTRIBUTION. — Known only from Fiji (Fig. 57). Depth: known reliably between 104 and 302 m; also collected in trawls between 80-120 and 282-322 m.

Parapalicus elaniticus (Holthuis, 1977)

Fig. 57

Palicus elaniticus Holthuis, 1977: 185, figs 3a-f.

MATERIAL EXAMINED. — **Red Sea**. Gulf of Aqaba, off Elat, *"La-Merkhav"*, stn 8, 60-80 m, C. LEWINSOHN coll., 7.09.1966: 1 ♂ holotype of *Palicus elaniticus* Holthuis 3.5 x 4.5 mm (RMNH 30334).

Madagascar. *"Vauban"*: stn CH 52, off Majunga (northwest coast), 15°21.0'S, 46°12.5'E, 150 m, mud, A. CROSNIER coll., 8.11.1972: 1 ♀ (MNHN-B 26758).

TYPES. — *Holotype* of *Palicus elaniticus* Holthuis, 1977: 1 ♂ 3.5 x 4.5 mm, *"La-Merkhav"*, stn 8 (RMNH 30334).

TYPE LOCALITY. — Off Elat, Gulf of Aqaba, Red Sea, 60-80 m.

DIAGNOSIS. — Carapace (HOLTHUIS, 1977, fig. 3a) with triangular, anteriorly-pointed anterolateral tooth on each side. Supraorbital borders each with two slight notches, distalmost one followed by rounded, lobe-like tubercle located on proximal border of postorbital angle. Suborbital borders (HOLTHUIS, 1977, fig. 3b) each with U-shaped gap between inner and outer suborbital lobes; outer lobe much smaller than inner lobe. Dorsal border of cheliped propodi (HOLTHUIS, 1977, fig. 3d) each with two proximal tubercles. Abdomen of male holotype (HOLTHUIS, 1977, fig. 3f) with two low tubercles on segment 3, lower one on segment 4. Male first pleopods (HOLTHUIS, 1977, fig. 3g) with helicoidal basal parts; each distal part blade-like, bordered with small teeth and two wing-like proximal processes. Abdomen of only mature female examined with one transverse ridge along each segment 1-4.

DISCUSSION. — A character diagnostic of *P. elaniticus* is the rounded tubercle on the supraorbital border proximal to each postorbital angle, which gives the angle a bilobed appearance (HOLTHUIS, 1977, fig. 3a). The two specimens that were examined in this study had a notch on the middle portion of each of the supraorbital borders. The description of the species, however, mentions that the borders lack any "distinct incisions" other than the notch before the tubercle proximal to the postorbital angles (HOLTHUIS, 1977: 185). The distal half of the cheliped fingers of the female examined was armed with 3 triangular teeth, the pollex with 5. They were absent, however, in the male holotype (HOLTHUIS, 1977, fig. 3d).

The length of the walking legs was measured only in the Madagascar specimen (MNHN-B 26758): total length of second and third pair of walking legs (P3-4) was 2.1 CL (P3 merus 0.6 CL, dactylus 0.5 CL; P4 merus 0.5 CL, dactylus 0.5 CL).

SIZE. — Size of the only two specimens known to exist: 6.5 x 8.9 mm (female, MNHN-B 26758), 3.5 x 4.5 mm (male holotype, RMNH 30334).

DISTRIBUTION. — Previously known only from the Gulf of Aqaba, Red Sea (HOLTHUIS, 1977). Its distribution is now extended to the northwest coast of Madagascar (Fig. 57). Depth: known reliably between 80 and 150 m; also collected in a trawl between 60 and 80 m.

Parapalicus inanis sp. nov.

Figs 19d, 23, 57

MATERIAL EXAMINED. — **Chesterfield-Bellona Plateau**. MUSORSTOM 5: stn 280, 24°09.99'S, 159°35.75'E, 270 m, 10.10.1986: 1 ♂ holotype 3.9 x 4.7 mm (MNHN-B 6721), 1 ♀ (MNHN-B 26824). — Stn 282, 24°11.55'S, 159°32.22'E, 226-230 m, 10.10.1986: 2 ♀ (MNHN-B 26825), 1 ♀ paratype 4.7 x 6.0 mm (USNM). — Stn 285, 24°09.35'S, 159°34.04'E, 245-255 m, 10.10.1986: 1 ♀ paratype 4.9 x 6.2 mm (MNHN-B 26722).

BATHUS 2: stn DW 752, 22°22.32'S, 166°14.9'E, 330 m, 15.05.1993: 1 ♀ (MNHN-B 26826).

Loyalty Islands. MUSORSTOM 6: stn DW 462, 21°05.10'S, 167°26.85'E, 200 m, 21.02.1989: 1 ♀ paratype 4.4 x 5.8 mm (MNHN-B 26723).

TYPES. — *Holotype*: 1 ♂ 3.9 x 4.7 mm, MUSORSTOM 5, stn 280 (MNHN-B 26721).

Paratypes: 1 ♀ 4.9 x 6.2 mm, MUSORSTOM 5, stn 285 (MNHN-B 26722); 1 ♀ 4.4 x 5.8 mm, MUSORSTOM 6, stn DW 462 (MNHN-B 26723); 1 ♀ 4.7 x 6.0 mm, MUSORSTOM 5, stn 282 (USNM).

TYPE LOCALITY. — Kelso Bank, Chesterfield-Bellona Plateau, Coral Sea, 24°09.99'S, 159°35.75'E, 270 m.

DIAGNOSIS. — Carapace (Figs 19d, 23a) with small anterolateral tooth on each side; dorsal surface covered with many small granules. Frontal lobes each with slight notch. Supraorbital borders each with two slight notches. Suborbital borders (Fig. 23b) each without outer suborbital lobe, leaving very wide gap between inner suborbital lobe and postorbital angle. Dorsal borders of cheliped propodi (Fig. 23c) each with two proximal tubercles, microscopic teeth. Abdomen of mature males with two rounded tubercles on segment 3, very low one on segment 4. Male first pleopods (Figs 23d-e) with sinuous basal parts; each distal part curved, corneous apex with spinules. Abdomen of mature females (Fig. 23f) with segments 3-5 fused; straight or twice-constricted transverse ridge on segment 3, segment 4 smooth or with short ridge at each outer edge.

DESCRIPTION. — Carapace (Figs 19d, 23a) wider than long (CW/CL = 1.2-1.3); dorsal surface covered with small granules. Anterolateral borders of carapace each with very small triangular tooth covered with fine granules. Two bosses (more conspicuous in larger specimens) on metagastric region. Large granules on branchial region and along posterior border (number and distribution varies among specimens). Episternal processes small, rounded (more protuberant in larger specimens). Posterior border of carapace with very few plumose setae in some specimens.

Frontal border of carapace divided into two small lobes divided by narrow V-shaped notch; each rounded lobe divided into two very low lobes by slight notch. Borders between frontal lobes and supraorbital borders rounded. Supraorbital borders each with two very slight notches (larger specimens with irregular borders without clear notches). Postorbital angles short, slightly pointed. Cornea of eyes dorsoventrally flattened, slightly wider than base of eye peduncle; each peduncle with two slightly granular, distal tubercles (ventral the largest).

Suborbital borders (Fig. 23b) each without outer suborbital lobe, leaving very wide gap between inner suborbital lobe and postorbital angle. Pterygostomial lobes straight, broad, rounded, only slightly shorter than each inner suborbital lobe.

Each basal antennal segment expanded distally as rounded process; flagellum long with conspicuous, simple setae. Inner border of ischia of third maxillipeds sinuous to serrate but without defined teeth; surface finely granular, upper borders rounded. Meri much narrower than ischium; rounded, broad upper borders.

Dorsal borders of cheliped propodi (Fig. 23c) each with two proximal tubercles and microscopic teeth. Distal two-thirds of each finger with 3-4 short teeth. Carpi short, outer borders with few, mostly microscopic tubercles; meri slender, outer borders with scattered, low tubercles.

First three pairs of walking legs (P2-4; Figs 19d, 23a) very slender, with elongate meri, filiform propodi and dactyli. Upper and lower borders of meri with similar, slightly pointed tubercles (smaller along anterior border of P2); distalmost tubercle on each anterior border much wider at base, higher, rounded tip directed distally. Anterior and posterior borders of carpi, propodi, and dactyli of all walking legs (P2-4) entire, without tubercles. Each P2 with one dorsal carina on carpus. P3-4 each with one dorsal carina on carpus, propodus (very slight), and dactylus. Dorsal surfaces of meri of all legs and carpi and propodi of P3-4 with scattered plumose setae; dorsal surfaces of dactyli of P3-4 each with one row of conspicuous plumose setae along anterior border.

First pair of walking legs (P2) much shorter and slender than second and third pairs (P3-4); third pair about as long as second pair. Fifth pair of pereopods (P5) short (0.9 CL), very slender; each merus with 3 spines; each propodus with 2-4 spines along posterior border, scattered plumose setae along anterior border; each dactylus smooth, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.3-1.4	2.4-2.5	2.1-2.3	0.9
Merus length/CL	0.4	0.7-0.8	0.6-0.7	0.2-0.3
Dactylus length/Cl	0.4	0.6	0.5-0.6	0.2

Abdomen of only mature male examined (holotype) with segments 3-5 fused, two conspicuous, rounded to elongate tubercles on segment 3, one very low tubercle on segment 4. Male first pleopods (Figs 23d-e) with sinuous basal parts; each distal part with corneous apex, tip with spinules.

Abdomen of mature females (Fig. 23f) with segments 3-5 fused. One ridge along each segment 1-2; segment 3 of fused segment 3-5 with ridge straight or slightly constricted twice medially; segment 4 smooth or with very low, short ridge at each outer edge.

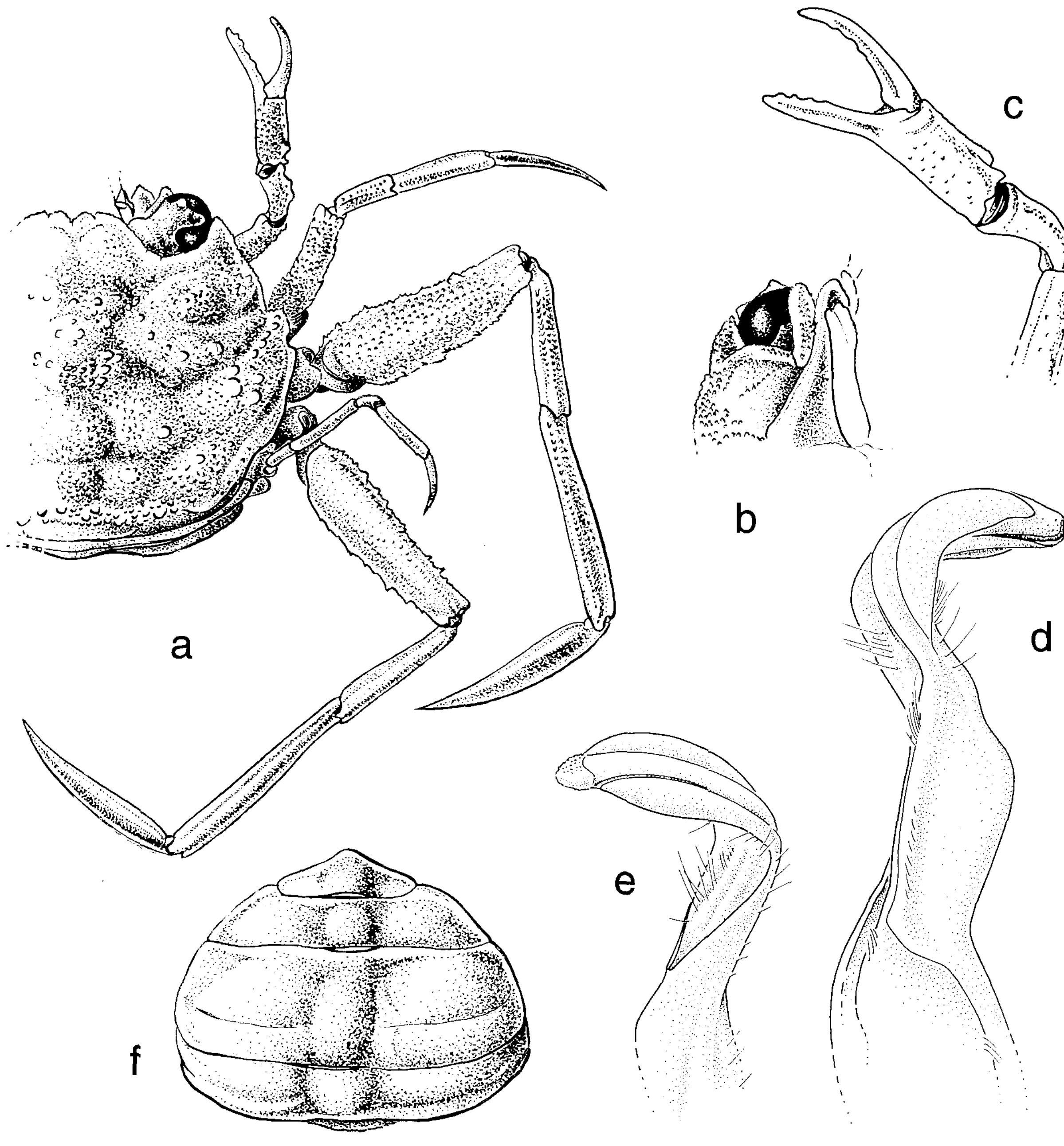

FIG. 23. — *Parapalicus inanis* sp. nov.: **a-c, f**, ♀ paratype 4.4 x 5.8 mm, Loyalty Islands, MUSORSTOM 6, stn DW 462, 200 m (MNHN-B 26723): **a**, carapace and pereopods, dorsal surface; **b**, suborbital border; **c**, left cheliped, outer surface; **f**, abdomen. — **d-e**, ♂ holotype 3.9 x 4.7 mm, Kelso Bank, Chesterfield-Bellona Plateau, Coral Sea, MUSORSTOM 5, stn 280, 270 m (MNHN-B 26721): **d**, left male first pleopod, ventral view; **e**, left male first pleopod, distal part, dorsal view;

DISCUSSION. — *P. inanis* is unique among the known species of the genus in the absence of an outer suborbital lobe. Like in *P. armatus* sp. nov., the anterolateral teeth are unusually small. It shares with *P. nanshaensis* Chen, 1981 a cheliped merus that is armed with two basal tubercles.

All of the seven specimens that were examined in this study were unusually small for *Parapalicus*, the largest specimen being only 4.9 x 6.2 mm (MNHN-B 26722).

SIZE. — Maximum size among the six females examined: 4.9 x 6.2 mm (MNHN-B 26722); the only male examined (MNHN-B 26721): 3.9 x 4.7 mm.

ETYMOLOGY. — From *inanis*, Latin for empty, in reference to the empty appearance of the suborbital region due to the absence of the outer suborbital lobe.

DISTRIBUTION. — Known only from the Coral Sea (New Caledonia and the Loyalty Islands) (Fig. 57). Depth: 200-330 m.

Parapalicus microphthalmus sp. nov.

Figs 24, 26a, 57

MATERIAL EXAMINED. — **Madagascar**. *"Vauban"*: stn CH 52, off Majunga (northwest coast), 15°21.0'S, 46°12.5'E, 150 m, A. CROSNIER coll., 8.11.1972: 1 ♂ paratype 7.3 x 11.4 mm (MNHN-B 26725), 1 ♂ paratype 5.9 x 9.6 mm (MNHN-B 26726), 1 ♀ holotype 7.8 x 11.2 mm (MNHN-B 26724), 2 ♀ (MNHN-B 26827).

TYPES. — *Holotype*: 1 ♀ 7.8 x 11.2 mm (MNHN-B 26724).
Paratypes: 1 ♂ 7.3 x 11.4 mm (MNHN-B 26725); 1 ♂ 5.9 x 9.6 mm (MNHN-B 26726).
TYPE LOCALITY. — Off northwest coast of Madagascar, 15°21.0'S, 46°12.5'E, 150 m.

DIAGNOSIS. — Carapace (Figs 24a, 26a) with conspicuous, triangular anterolateral tooth on each side. Supraorbital borders sinuous, each with two notches. Cornea and eye peduncle small; peduncles with many pointed granules. Suborbital borders (Fig. 24b) each with wide, U-shaped gap between inner and outer, dentiform, suborbital lobes. Dorsal border of cheliped propodi each with very low carina bordered with microscopic teeth. Abdomen of mature males (Fig. 24c) with two low, elongate tubercles on segment 3, triangular one on segment 4. Male first pleopods (Figs 24d-e) with helicoidal basal parts; each distal part with helicoidal, keel-like process, curved, corneous apex. Abdomen of mature females with one transverse ridge along each segment 1-4.

DESCRIPTION. — Carapace (Figs 24a, 26a) wider than long (CW/CL = 1.4-1.6); dorsal surface covered with very coarse granules. Anterolateral borders of carapace each with conspicuous triangular tooth covered with granules. Two bosses, also covered with granules, on branchial region posterior to each tooth; larger, more pointed of the two bosses closer to border of carapace, giving carapace appearance of having two anterolateral teeth. Four conspicuous bosses (two large median bosses flanked by smaller one on each side) on metagastric region. Episternal processes triangular, with conspicuous granules. Posterior border of carapace with several rounded tubercles (6 protuberant tubercles in males), scattered plumose setae.

Frontal border of carapace divided into two small lobes divided by wide U-shaped notch; triangular tips. Borders between frontal lobes and supraorbital borders rounded. Supraorbital borders sinuous, each with two notches. Postorbital angles short, slightly pointed. Cornea of eyes small, dorsoventrally flattened, wider than base of eye peduncle; peduncles with many small, pointed granules.

Suborbital borders (Fig. 24b) each with wide, U-shaped gap between inner and outer suborbital lobes. Outer lobe narrow, pointed, shorter than similarly pointed (projected outwards when seen dorsally) inner lobe. Pterygostomial lobes projecting slightly ventrally, pointed, equal in length to each inner suborbital lobe.

Each basal antennal segment expanded distally as elongate, granular process; flagellum long with conspicuous, simple setae. Inner border of ischia of third maxillipeds slightly sinuous; surface coarsely granular, upper borders slightly pointed. Meri much narrower than ischium; pointed, granular upper borders.

Dorsal and outer borders of cheliped propodi (Fig. 24a) each with very low, unarmed (only barely visible microscopic teeth) carina, low proximal tubercle. Distal half to two-thirds of each finger with 3-7 short teeth. Carpi short, outer borders with broad tubercle across distal portion, pointed tubercles throughout; meri slender, outer borders with small distal tubercles.

First three pairs of walking legs (P2-4; Figs 24a, 26a) very slender, with elongate meri, filiform propodi and dactyli. Upper and lower borders of meri with small, similarly pointed tubercles; distalmost tubercle on each anterior border much wider at base, higher, pointed tip directed distally. Anterior and posterior borders of carpi, propodi, and dactyli of all walking legs (P2-4) entire, without tubercles (carpi and propodi of P3-4 with microscopic tubercles). P3-4 each with one dorsal carina each on carpus and propodus, one dorsal one ventral (very slight) carina on dactylus. Meri of all legs with numerous plumose setae; dorsal surfaces of carpi and propodi of P3-4 with rows of plumose setae; dorsal surface of dactyli of all legs each with one row of conspicuous plumose setae along anterior border.

First pair of walking legs (P2) much shorter and slender than second and third pairs (P3-4); third pair about as long as second pair. Fifth pair of pereopods (P5) short (0.8-0.9 CL), very slender; each merus with row of very low tubercles, conspicuous plumose setae along posterior border; each propodus with conspicuous plumose setae along posterior border; each dactylus with one spine on posterior border, plumose setae along anterior border, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.5-1.7	2.5-2.8	2.4-2.7	0.8-0.9
Merus length/CL	0.5-0.6	0.8-0.9	0.8-0.9	0.2-0.3
Dactylus length/Cl	0.5	0.7	0.7	0.2

Abdomen of mature males (Fig. 24c) with segments 3-5 fused, two very low tubercles (plus central prominence) on segment 3, salient, triangular one on 4. Male first pleopods (Figs 24d-e) with helicoidal distal parts, helicoidal, keel-like process along its length; each distal part curved, corneous (flexible but rigid) apex with sperm channel.

Abdomen of mature females with segments 3-5 fused. One ridge along each segment 1-2, two along proximal portion of fused segments 3-5 (most proximal one bordered by microscopic, blunt tubercles).

DISCUSSION. — The male first pleopods of *P. microphthalmus* are one of the most complex among the Indo-west Pacific species of palicids. Their general morphology is closest to that of *P. trispiralis* sp. nov., known only from the South China Sea and the Coral Sea.

The retina and the peduncle of the eyes are reduced in size in comparison to those of the other congeners. The orbits, however, remain wide and deep.

SIZE. — Maximum size among specimens examined: 7.8 x 12.0 mm (female, MNHN-B 26724); 7.3 x 11.4 mm (male paratype MNHN-B 26725).

ETYMOLOGY. — From *mikros*, Greek for small, and *ophthalmos*, Greek for eye, in reference to the diagnostic small eyes.

DISTRIBUTION. — Only known from off the northwest coast of Madagascar (Fig. 57). This and *P. elaniticus* are the only two species of *Parapalicus* known from the Indian Ocean. Both are known from very few specimens. Depth: 150 m.

Parapalicus nanshaensis Dai & Xu, 1991

Parapalicus nanshaensis Dai & Xu, 1991: 38, 46 [English], fig. 28.

TYPES. — *Holotype*: 1 ♀ 6.5 x 8.2 mm (DAI & XU, 1991), 7.05.1986 (Academia Sinica, Beijing).

TYPE LOCALITY. — West of Nansha (= Spratly) Islands, South China Sea, 07°02'N, 108°52'E, soft muddy bottom, 138 m.

DIAGNOSIS (after DAI & XU, 1991). — Carapace (DAI & XU, 1991, fig. 28-1) with triangular anterolateral tooth on each side. Supraorbital borders sinuous, each with one notch. Suborbital borders unknown. Dorsal border

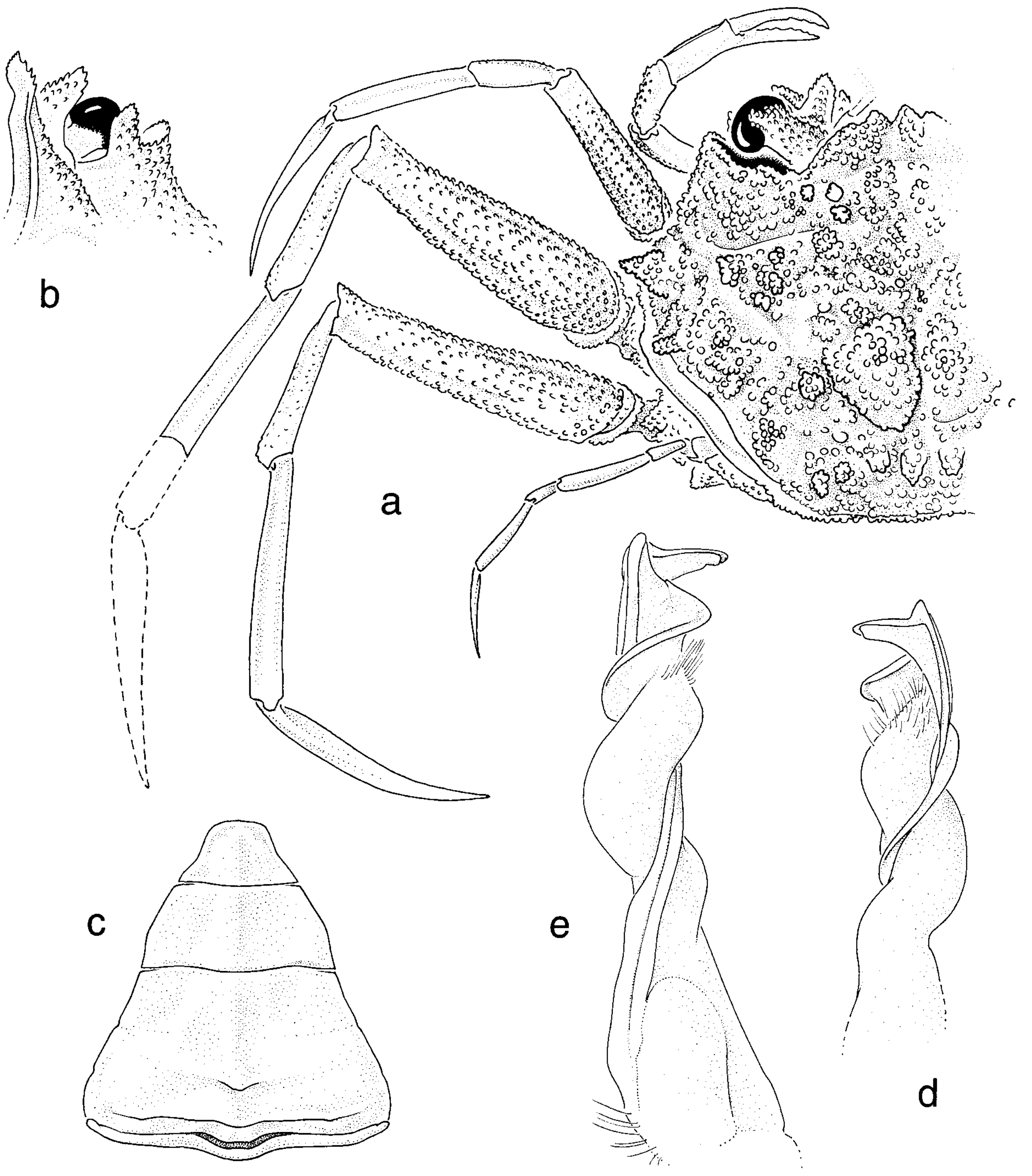

FIG. 24. — *Parapalicus microphthalmus* sp. nov.: **a-b**, ♀ holotype 7.8 x 11.2 mm, off northwest coast of Madagascar, 150 m (MNHN-B 26724): a, carapace and pereopods, dorsal surface; b, suborbital border. — **c-e**, paratype, 7.3 x 11.4 mm, off northwestern coast of Madagascar, 150 m (MNHN-B 26725); **c**, abdomen; **d**, left male first pleopod, lateral (inner side) view; **e**, left male first pleopod, ventral view.

of cheliped propodi (DAI & ZU, 1991, fig. 28-4) each with two low proximal tubercles; distal third of each finger with 3-4 short, closed-together teeth. Males unknown.

DISCUSSION. — *P. nanshaensis* was described from one female specimen. The description and the figures that accompany it did not give details of the morphology of the suborbital borders of the carapace that are needed for its proper comparison with other species. The holotype was not available for examination. No male specimens are known.

The chelipeds were described as smooth (DAI & XU, 1991: 46) but the dorsal border of each cheliped propodus is armed with two basal tubercles (DAI & XU, 1991, fig. 28-4). This is a characteristic shared with *P. ambonensis* (Fig. 16a), *P. elaniticus* (HOLTHUIS, 1977, fig. 3d), and *P. inanis* sp. nov. (Fig. 23c). *P. nanshaensis* can be clearly differentiated from *P. elaniticus*, which has supraorbital borders each with two notches and a rounded, lobe-like tubercle before the postorbital angle (HOLTHUIS, 1977, fig. 3a), and from *P. inanis*, which has a very small anterolateral tooth on each side of the carapace and notched frontal lobes. The carapace is similar to that of *P. ambonensis* and *P. trispiralis* sp. nov. (both having triangular anterolateral teeth that are pointed in an anterior direction; see Figs 16a, 27a) but the teeth on each finger of the chelipeds of *P. nanshaensis* are very different: triangular, blunt teeth that are closed together at the distal portion of each finger (DAI & XU, 1991, fig. 28-4), a character unique to the genus. Furthermore, each supraorbital border has only one slight notch in *P. nanshaensis*, but three in *P. ambonensis* (Fig. 16a).

SIZE. — Size of the female holotype: 6.5 x 8.2 mm (DAI & XU, 1991).

DISTRIBUTION. — Known only from near the Nansha (= Spratly) Islands in the South China Sea (DAI & XU, 1991). Depth: 138 m.

Parapalicus piruensis Moosa & Serène, 1981

Figs 25, 26b, 58

Parapalicus piruensis Moosa & Serène, 1981: 34, figs 2b, 3b, pl. 1, fig. C.

MATERIAL EXAMINED. — **Indonesia**. *Ceram*. MARIEL KING MEMORIAL EXPEDITION: stn CP I/1, Piru Bay, off Cape Tutuhuhur, 03°15'S, 128°08'E, 59-64 m, 1.06.1970: 1 ♀ holotype 4.7 x 6.3 mm (RDC CB2730).

Kai Islands. KARUBAR: stn DW 22, 05°22'S, 133°01'E, 85-124 m, 25.10.1991: 1 juv. ♂ (MNHN-B 26835).

New Caledonia. MUSORSTOM 4: Stn 203, 22°35.8'S, 167°04.8'E, 105-110 m, 27.09.1985: 1 juv. ♀ (MNHN-B 26836).

EXPÉDITION MONTROUZIER: Touho, 55-60 m, 7.09.1993: 1 ♀ (MNHN-B 26837); 55 m: 1 ♀ (MNHN-B 26838). — Koumac Channel, 49-63 m, 7.10.1993: 2 ♂ (MNHN-B 26760), 1 ♂ CL 3.6 mm (MNHN-B 26761).

Fiji. MUSORSTOM 10: stn CP 1358, 17°48.49'S, 178°46.70'E, 80-120 m, 13.08.1998: 2 ♂, 8 ♀, 1 juv. ♀ (MNHN-B 26759).

TYPES. — *Holotype*: 1 ♀ 4.7 x 6.3 mm, MARIEL KING MEMORIAL EXPEDITION, stn CP I/1 (RDC CB2730).

Paratype: 1 ♀ 3.2 x 4.2 mm (MOOSA & SERÈNE, 1981), Coronado Bay, Mindanao, Philippine Islands, sand and mud, 46-128 m, 10.11.1964 (RDC CB2728).

TYPE LOCALITY. — Off Cape Tutuhuhur, Piru Bay, Ceram, Indonesia, 03°15'S, 128°08'E, 59-64 m.

DIAGNOSIS. — Carapace (Fig. 26b; MOOSA & SERÈNE, 1981, fig. 2b) with small, triangular, anteriorly pointed anterolateral tooth on each side; dorsal surface covered with very small granules. Supraorbital borders sinuous, each with two notches. Suborbital borders each with wide, V-shaped gap between inner and outer suborbital lobes; outer lobe much smaller than inner lobe. Cheliped propodi smooth. Abdomen of mature males (Fig. 25a) with three very low, elongate tubercles on segment 3. Male first pleopods (Figs 25b-d) with sinuous basal parts; each distal part with two blunt, slightly curved tips. Abdomen of mature females with segments 3-5 fused; one very low transverse ridge on segment 3 (constricted twice medially); low ridge at each outer edge of segment 4.

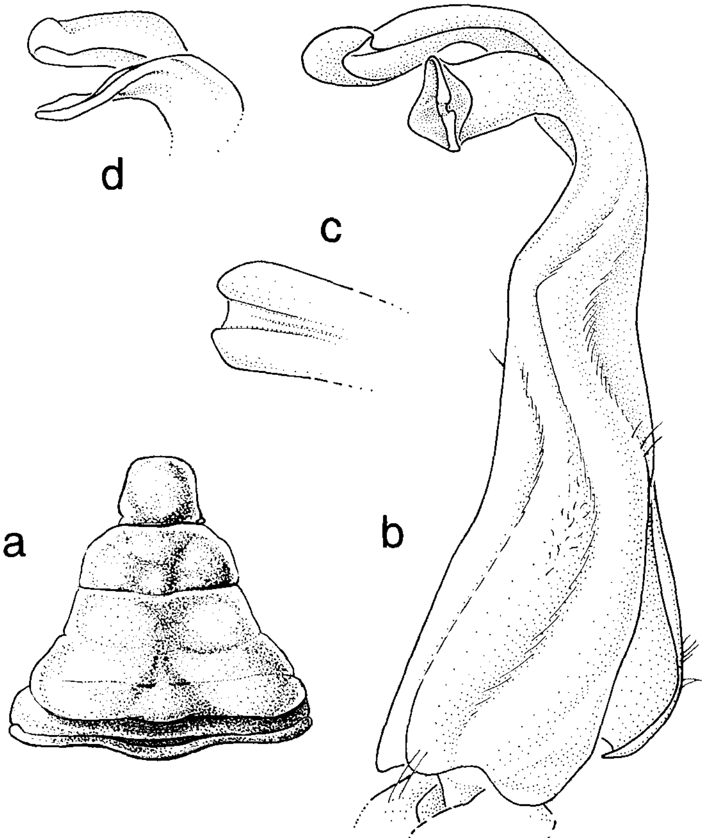

FIG. 25. — *Parapalicus piruensis* Moosa & Serène, 1981, ♂ CL 3.6 mm, Koumac Channel, New Caledonia, EXPÉDITION MONTROUZIER, 49-63 m (MNHN-B 26721): **a**, abdomen; **b**, left male first pleopod, lateral (inner side) view; **c**, apex, dorsal tip; **d**, apex.

Color: Specimens from Fiji that had been preserved for nine months after collection had irregular brown patches across the dorsal surface of the carapace and broad, vertical bands of the same color across the walking legs.

DISCUSSION. — The specimens that were examined in this study agree in most respects with the description of MOOSA & SERÈNE (1981), which was based on only two female specimens. It was short but it included relatively good (but incomplete) figures and a very poor photograph.

P. piruensis is characterized by a carapace that is only covered with small granules (Fig. 26b), short and acute anterolateral teeth that are anteriorly pointed, a very small outer suborbital lobe, and an almost smooth male abdomen (Fig. 25a). The total length of the second pair of walking legs (P3) of the specimens examined varied between 1.9-2.0 CL (merus 0.6-0.7 CL, dactylus 0.6 CL); total length of P4 2.0-2.1 CL (merus 0.6 CL, dactylus 0.6 CL).

This is the first time male specimens of *P. piruensis* have been examined and the male first pleopods described and illustrated (Figs 25b-d). The basal part is sinuous, not helicoidal as in most species of *Parapalicus*. As in *P. inanis* sp. nov. (Figs 23d-e), this appears to be the consequence of the short length of the pleopods.

SIZE. — Maximum size among the females examined: 6.7 x 7.4 mm (MNHN-B 26759); the largest of the males examined: 3.8 x 4.5 mm (MNHN-B 26760).

DISTRIBUTION. — MOOSA & SERÈNE (1981) recorded this species from the Sulu Sea (Mindanao, Philippine Islands) and Ceram Sea (Ceram, Indonesia). Its range (Fig. 58) is now extended to the Banda Sea (Kai Islands, Indonesia), Coral Sea (New Caledonia), and Fiji. Depth: known reliably between 55 and 105 m, collected too in trawls between 49-63 and 85-124 m.

Parapalicus trispiralis sp. nov.

Figs 27, 58

MATERIAL EXAMINED. — **Philippine Islands**. MUSORSTOM 1: stn 63, 14°00.8'N, 120°15.8'E, 191-195 m, 27.03.1975: 1 ♂ holotype 5.8 x 8.1 mm (MNHN-B 26727).

Loyalty Islands. MUSORSTOM 6: stn CP 419, 20°41.65'S, 167°03.70'E, 283 m, 16.02.1989: 1 ♀ paratype 7.3 x 9.5 mm (MNHN-B 26728).

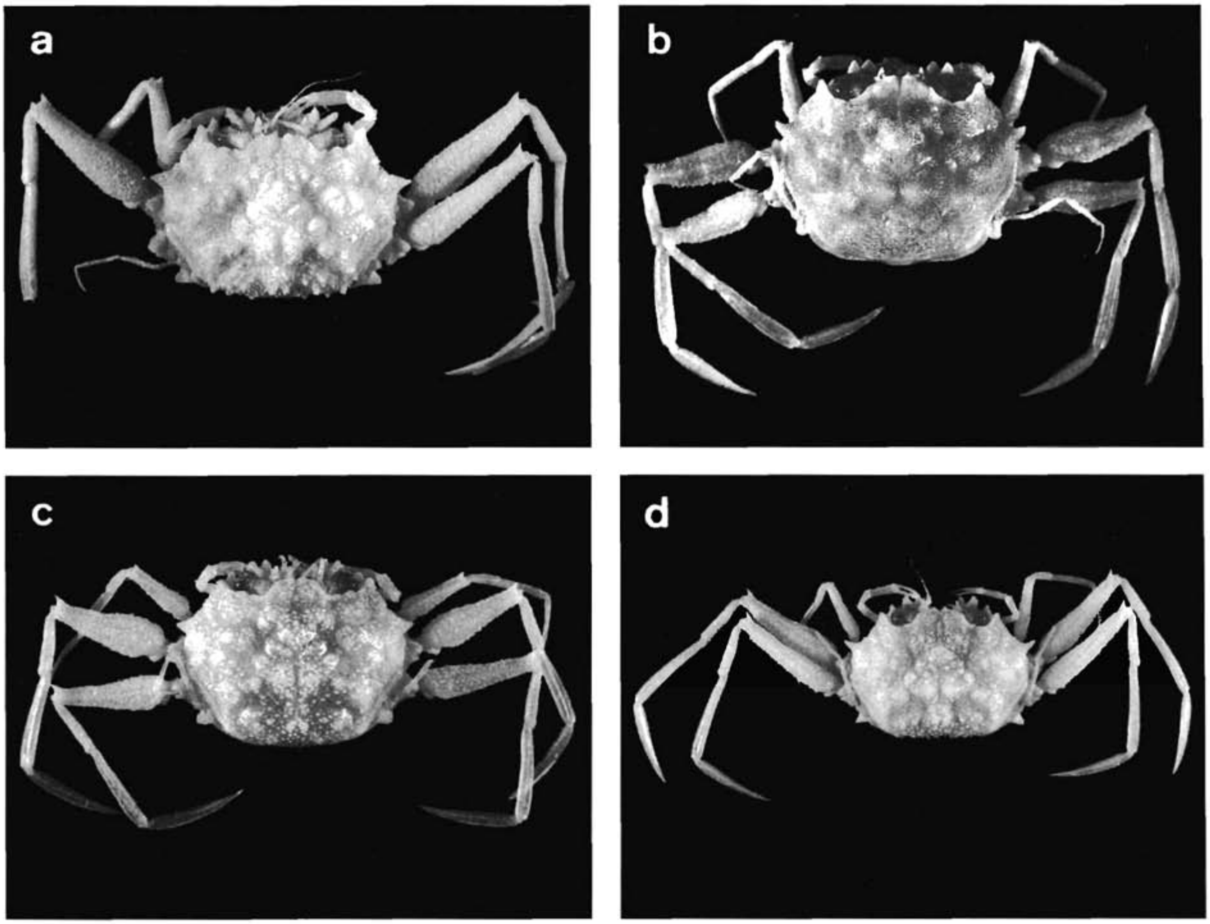

FIG. 26. — **a**, *Parapalicus microphthalmus* sp. nov., ♂ paratype 7.3 x 11.4 mm, off northwest coast of Madagascar, 150 m, A. CROSNIER coll. (MNHN-B 26725): dorsal view. — **b**, *Parapalicus piruensis* Moosa & Serène, 1981, ♀ 5.4 x 7.3 mm, Fiji, MUSORSTOM 10, stn CP 1358, 80-120 m (MNHN-B 26759): dorsal view. — **c**, *Parapalicus trituberculatus* (Chen, 1981): ♀ paratype 6.8 x 9.7 mm, South China Sea, stn 6028, 78 m (ZRC): dorsal view. — **d**, *Parapalicus unidentatus* (Zarenkov, 1968): ♀ 7.6 x 10.9 mm, South China Sea off the Philippine Islands, MUSORSTOM 3, stn CP 101, 194-196 m (MNHN-B 26998): dorsal view.

TYPES. — *Holotype*: 1 ♂ 5.8 x 8.1 mm, MUSORSTOM 1, stn 63 (MNHN-B 26727). *Paratype*: 1 ♀ 7.3 x 9.5 mm, MUSORSTOM 6, stn CP 419 (MNHN-B 26728).

TYPE LOCALITY. — Off Luzon Island, Philippine Islands, 14°00.8'N, 120°15.8'E, 191-195 m.

DIAGNOSIS. — Carapace (Fig. 27a) with small, triangular anterolateral tooth on each side. Wide notch between two frontal lobes. Supraorbital borders each with three notches forming two small lobes. Suborbital borders (Fig. 27b) each with wide, V-shaped to nearly L-shaped gap between inner and outer suborbital lobes; outer lobe much smaller than inner lobe. Dorsal borders of cheliped propodi with microscopic teeth. Abdomen of mature males (Fig. 27d) with two conspicuous, triangular tubercles on segment 3, similar, larger one on segment 4. Male first pleopods (Figs 27e-f) with three coils when seen ventrally: helicoidal basal part, twice-helicoidal, tusk-shaped distal part. Abdomen of mature females with one transverse ridge along segment 3 (constricted medially); short ridge at each outer edge of segment 4.

DESCRIPTION. — Carapace (Fig. 27a) wider than long (CW/CL = 1.3-1.4); dorsal surface covered with small granules. Anterolateral borders of carapace each with small triangular, anteriorly-pointed tooth covered with fine granules. Two small bosses, also covered with granules, on branchial region along border of carapace posterior to each tooth. Two conspicuous bosses on metagastric region. Episternal processes triangular. Posterior border of carapace with six slightly protuberant tubercles (more pronounced in female paratype) with rounded tips, few plumose setae.

Frontal border of carapace divided into two small lobes with triangular or slightly rounded tips, divided by wide V-shaped notch. Borders between frontal lobes and supraorbital borders rounded. Supraorbital borders each with

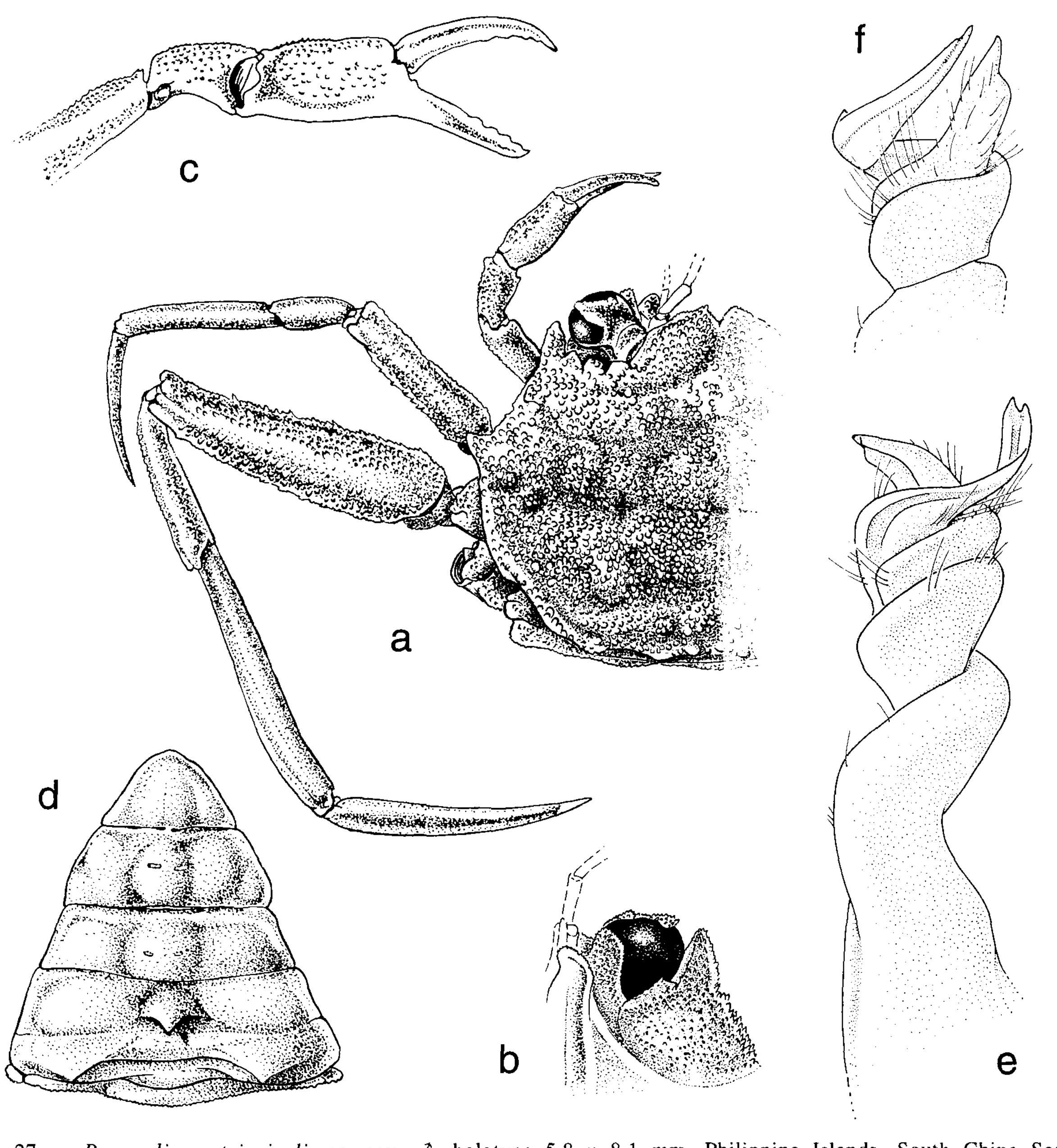

FIG. 27. — *Parapalicus trispiralis* sp. nov., ♂ holotype 5.8 x 8.1 mm, Philippine Islands, South China Sea, MUSORSTOM 1, stn 63, 191-195 m (MNHN-B 26727): **a**, carapace and pereopods, dorsal surface; **b**, suborbital border; **c**, right cheliped, outer surface; **d**, abdomen; **e**, left male first pleopod, ventral view; **f**, left male first pleopod, distal part, dorsal view.

three conspicuous notches, forming two small lobes. Postorbital angles short, pointed. Cornea of eyes dorsoventrally flattened, much wider than base of eye peduncle; each peduncle with two soft, low, distal tubercles.

Suborbital borders (Fig. 27b) each with wide, V-shaped to nearly L-shaped gap between inner and outer suborbital lobes. Outer lobe much smaller than pointed inner lobe. Pterygostomial lobes project slightly ventrally, rounded, shorter than each inner suborbital lobe.

Each basal antennal segment expanded distally as small, slightly pointed process; flagellum long, with conspicuous, simple setae. Inner border of ischia of third maxillipeds sinuous; surface with small granules, upper borders rounded. Meri much narrower than ischia; rounded, narrow upper border.

Dorsal borders of cheliped propodi with row of microscopic teeth (more conspicuous in female paratype). Distal third of each finger with 4-5 short, rounded teeth. Carpi short, outer borders each with low, broad tubercle across distal portion, small, pointed tubercles throughout; meri slender, outer borders with small, pointed tubercles.

First three pairs of walking legs (P2-4; Fig. 27a) very slender, with elongate meri, filiform propodi and dactyli. Upper and lower borders of meri with similar, low tubercles; distalmost tubercle on each anterior border much wider at base, with rounded tip directed distally. Anterior and posterior borders of carpi, propodi, and dactyli of all walking legs (P2-4) entire, without tubercles (propodi of P3-4 with microscopic tubercles). Each P2 with one dorsal carina on dactylus. Each P3 with one dorsal carina each on carpus, propodus, and dactylus. Each P4 with one dorsal carina on carpus and propodus; one ventral (very low) carina on propodus; dactylus unknown. Meri of all legs with scattered plumose setae; dorsal surfaces of carpi and propodi of P3-4 with rows of plumose setae; dorsal surface of dactyli of P2-3 each with one row of conspicuous plumose setae along anterior border; dactylus of P4 unknown.

First pair of walking legs (P2) much shorter and slender than second and third pairs (P3-4); third pair about as long as second pair. Fifth pair of pereopods (P5) short (0.8 CL), very slender; each merus with row of low tubercles, some provided with spine on posterior border, scattered plumose setae along anterior border; each propodus with two proximal spines on posterior border, scattered plumose setae along anterior border; dactylus with two spines on posterior border, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.5-1.6	2.8	-	0.8
Merus length/CL	0.4-0.5	0.8	0.8	0.2
Dactylus length/Cl	0.5	0.7	-	0.2

Abdomen of mature males (Fig. 27d) with segments 3-5 fused, two conspicuous, triangular tubercles on segment 3, similar but more salient one on segment 4. Male first pleopods (Figs 27e-f) with three coils when seen ventrally (helicoidal basal part, twice-helicoidal distal part with tusk-shaped tip); corneous, flexible apex with opening of sperm channel.

Abdomen of mature females with segments 3-5 fused. One ridge along each segment 1-2, one along proximal portion of fused segment 3-5 (ridge very slightly constricted twice medially); short ridge at each outer edge of segment 4.

DISCUSSION. — The description of *P. trispiralis* is based on only two specimens. Each of the measurements of the length of the walking legs was based on only one specimen, except for the second pair of legs (P2).

This species is close to *P. ambonensis* in that both species show conspicuous, triangular tubercles on the male abdomen. Characteristic of *P. trispiralis* is the presence of more conspicuous frontal lobes (formed by a wide median sulcus) and very small but clearly demarcated supraorbital lobes. Both of these features are characteristics of *Pseudopalicus* species. Nevertheless, the species clearly belongs to *Parapalicus* because of its helicoidal male first pleopods and the morphology of the carapace (only one anterolateral tooth), suborbital borders (tooth-like suborbital lobes), chelipeds (very slender and equal), walking legs (slender and long, smooth carpi, filiform propodi and dactyli; tubercles along borders of meri equal in size and shape), and shape of the male abdomen (triangular).

SIZE. — Size of the female paratype: 7.3 x 9.5 mm (MNHN-B 26728); male holotype: 5.8 x 8.1 mm (MNHN-B 26727).

ETYMOLOGY. — From *tres*, Latin for three, and *spiralis*, Latin for coil, in reference to the diagnostic arrangement of three coils or turns of the male first pleopods when seen ventrally.

DISTRIBUTION. — Known only from the South China Sea (off Luzon Island, Philippine Islands) and the Coral Sea (Loyalty Islands) (Fig. 58). Depth: 195-283 m.

Parapalicus trituberculatus (Chen, 1981)

Figs 26c, 28, 58

Palicus trituberculatus Chen, 1981: 465, pls 1, 2. — DAI *et al.*, 1986: 413, pl. 57, fig. 6.
Parapalicus marielae Moosa & Serène, 1981: 27, fig. 1, pl. 1, fig. A.
Palicus bidentatus Sakai, 1983: 630, fig. 3g-j.
Parapalicus trituberculatus - DAI & YANG, 1991: 450, pl. 57, fig. 6.

MATERIAL EXAMINED. — **South China Sea**. *"Albatross"*: stn 5302, southeast of Hong Kong, 21°42'N, 114°50'E, 69 m, mud, 9.08.1909: 1 ♀ holotype of *Palicus bidentatus* Sakai, 1983 CW 9.2 mm (USNM 195065).

Stn 6028, 22°00'N, 115°30'E, 78 m, soft mud, 14.04.1960: 2 ♂ paratypes 5.1 x 7.3 mm, 5.2 x 7.5 mm, 1 ♀ paratype 6.9 x 10.0 mm (ASIO); 2 ♂ paratypes 4.8 x 7.0 mm, 5.4 x 7.5 mm, 1 ♀ paratype 6.8 x 9.7 mm (ZRC 1999.1435-1437).

China. *Hainan Island.* 26.12.1955: 1 ♀ (ASIZB).

Viet Nam. *"Orlik"*: stn 206, Gulf of Tonkin, unknown depth, N.A. ZARENKOV coll., 12.07.1960: 1 ♂ 5.2 x 7.7 mm, 2 ♀ (MNHN-B 26807).

Philippine Islands. MUSORSTOM 1: stn 72, 14°11.8'N, 120°28.7'E, 127-122 m, 28.03.1976: 2 ♂ (MNHN-B 26808).

Indonesia. *Aru Islands.* MARIEL KING MEMORIAL EXPEDITION: stn AW 1/H 11-12, Wokam, west coast of Wasir Island, 05°30'S, 134°12'E, 73-91 m, 15.06.1970: 1 ♀ holotype of *Parapalicus marielae* Moosa & Serène, 1981, 5.0 x 7.1 mm (RDC CB2710).

TYPES. — *Holotype* of *Palicus trituberculatus* Chen, 1981: 1 ♂, South China Sea off China, 8.04.1960 (Institute of Oceanology, Academia Sinica, Qingdao, China; S209B-14).

Allotype of *Palicus trituberculatus* Chen, 1981: 1 ♀, South China Sea off China, 21°30'N, 115°30'E, 115 m, 13.04.1960 (Institute of Oceanology, Academia Sinica, Qingdao, China; S219B-23).

Paratypes of *Palicus trituberculatus* Chen, 1981: 1 ♂, 1 ♀, South China Sea off China, 21°00'N, 114°30'E, 83 m, 10.12.1959 (ASIO S143B-13); 2 ♂ paratypes 5.1 x 7.3 mm, 5.2 x 7.5 mm, 1 ♀ paratype 6.9 x 10.0 mm (ASIO); 2 ♂ paratypes 4.8 x 7.0 mm, 5.4 x 7.5 mm, 1 ♀ paratype 6.8 x 9.7 mm (ZRC 1999.1435-1437).

Holotype of *Parapalicus marielae* Moosa & Serène, 1981: 1 ♂ 5.0 x 7.1 mm, MARIEL KING MEMORIAL EXPEDITION, stn AW 1/H 11-12 (RDC CB2710).

Paratype of *Parapalicus marielae* Moosa & Serène, 1981: 1 ♀ 6.7 x 9.0 mm (MOOSA & SERÈNE, 1981). Same data as holotype (RDC CB2711).

Holotype of *Palicus bidentatus* Sakai, 1983: 1 ♀ CW 9.2 mm, *"Albatross"* Philippine Expedition, stn 5302 (USNM 195065).

TYPE LOCALITY. — South China Sea off China, 21°00'N, 114°30'E, 82 m.

DIAGNOSIS. — Carapace (Fig. 26c; CHEN, 1981, pl. 1) with triangular anterolateral tooth on each side. Supraorbital borders each with two slight notches. Suborbital borders (CHEN, 1981, pl. 2, fig. 1) each with very broad, almost circular gap between inner and outer suborbital lobes. Eye peduncles with numerous, small tubercles. Cheliped propodi (CHEN, 1981, pl. 2, fig. 2) with minute teeth. Abdomen of mature males (CHEN, 1981, pl. 2, fig. 4) with two slightly raised tubercles on segment 3, similar one on segment 4. Male first pleopods (Figs 28a-b; CHEN, 1981, pl. 2, figs 5-8; MOOSA & SERÈNE, 1981, fig. 1) with helicoidal basal parts; each distal part straight, pointed, bordered with minute teeth. Abdomen of mature females with one transverse ridge along each segment 1-4.

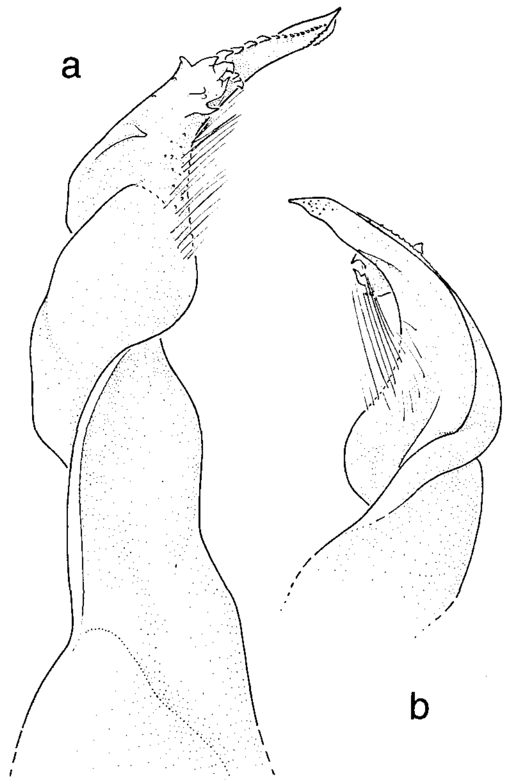

FIG. 28. — *Parapalicus trituberculatus* (Chen, 1981), ♂ 5.2 x 7.7 mm, Gulf of Tonkin, Viet Nam, unknown depth (MNHN-B 26807): **a**, left male first pleopod, ventral view; **b**, left male first pleopod, distal part, dorsal view.

DISCUSSION. — *P. trituberculatus* is similar to *P. clinodentatus* sp. nov. and *P. unidentatus* (Zarenkov, 1968) in the morphology of the dorsal surface of their carapaces, which are covered by granular bosses and have a triangular tooth and a blunt boss posterior to the anterolateral tooth. These two species can be differentiated from *P. trituberculatus* by the morphology of their male first pleopods (more complex in *P. clinodentatus* and *P. unidentatus*), the ornamentation of the cheliped propodi (a carina-like ornamentation present in *P. clinodentatus* and *P. unidentatus*), and the gaps between the inner and outer suborbital lobes (narrow and V-shaped in *P. clinodentatus* and *P. unidentatus*). *P. trituberculatus* also shares several characteristics with *P. denticulatus* sp. nov. (see contrast between the two species in the description of *P. denticulatus*).

The specimens that were examined agree with the paratypes that were available and the excellent figures given in its description (CHEN, 1981). The large boss posterior to the triangular tooth is referred to in the description as a tooth, hence the presence of "two teeth near the middle". The gap between the inner and outer suborbital lobes is described as V-shaped but it was wide and U-shaped in all specimens examined in this study as well as in the figure given in the original description (CHEN, 1981, pl. 2, fig. 1). The total length of the second pair of walking legs (P3) in the specimens that were measured varied between 2.1-2.4 CL (merus 0.6-0.7 CL, dactylus 0.6-0.7 CL); total length of P4 2.3 CL (merus 0.7 CL, dactylus 0.7 CL).

A comparison between the holotype of *Parapalicus marielae* Moosa & Serène, 1981 (RDC CB2710) and six paratypes of *Palicus trituberculatus* Chen, 1981 (ASIO; ZRC 1999.1435-1437) has clearly shown that they belong to the same species. The descriptions of both species were published in the same year but only that of CHEN (1981) gives an exact date: September 1981. Since the exact publication date of MOOSA & SERÈNE (1981) could not be determined, 31 December 1981 is adopted as its date of publication (International Code of Nomenclature, fourth edition, 1999, Article 21.3.2). It is then concluded that description of CHEN (1981) was published first and therefore the species should be referred to as *Parapalicus trituberculatus* (Chen, 1981). *P. marielae* is known from only two specimens. The description mentioned the presence of a "tooth" on the branchial region (MOOSA & SERÈNE, 1981: 29). This is undoubtedly a reference to the outermost of the one or two pairs of granular bosses present in that region of the carapace in many species of *Parapalicus*.

The examination of the holotype of *Palicus bidentatus* Sakai, 1983 has shown that it is identical to *P. trituberculatus*. SAKAI (1983) based his diagnosis on a flattened specimen without realizing it. Although the anterolateral teeth of the holotype are bent upward (and hence SAKAI's drawing showing two conspicuous "obtuse processes" with rounded tips representing the anterolateral tooth and the blunt boss posterior to it), the edge of the front folded over the carapace, and with only three walking legs and one cheliped remaining, all characters clearly agree with those of *P. trituberculatus*. The notches on the supraorbital border were incorrectly shown as forming three conspicuous lobes ("3 dorsal ... teeth") and the frontal lobes as having four, not two, lobes (SAKAI, 1983: 630, fig. 3g). Although some specimens of *P. trituberculatus* have slight notches on the frontal lobes, it was difficult to verify the morphology of the folded frontal lobes in the holotype of *P. bidentatus*. In addition, SAKAI's specimen was collected southeast of Hong Kong, not far from the type locality of *P. trituberculatus*.

SIZE. — Maximum size among specimens examined: 6.9 x 10.0 mm (female paratype, ASIO); 5.4 x 7.5 mm (male paratype, ZRC 1999.1435-1437).

DISTRIBUTION. — Known from the Gulf of Tonkin (off Viet Nam), in various locations of the South China Sea from off south China to the Philippine Islands (CHEN, 1981; SAKAI, 1983, as *Palicus bidentatus*), and the Arafura Sea (off Aru Islands), Indonesia (MOOSA & SERÈNE, 1981, as *Parapalicus marielae*) (Fig. 58). Depth: 69-122 m.

Parapalicus unidentatus (Zarenkov, 1968)

Figs 26d, 58

Palicus unidentatus Zarenkov, 1968: 763, figs 3A-Г.
Parapalicus unidentatus - MOOSA & SERÈNE, 1981: 32, fig. 4, pl. 1, fig. B.

MATERIAL EXAMINED. — **South China Sea**. *"Orlik"*: stn 211, off northern coast of Hainan, 60-180 m, 13.07.1960: 1 ♂, holotype (ZMMU Ma 5444). — Stn 203: *ibidem*, 60 m, 11.07.1960: 1 ♀, paratype (ZMMU Ma 5245).

Philippine Islands. MUSORSTOM 1: stn 14, 14°00.2'N, 120°17.2'E, 190 m, 20.03.1976: 1 ♂ (MNHN-B 27033). — Stn 20, 13°59.2'N, 120°20.3'E, 208-222 m, 21.03.1976: 1 ♀ (MNHN-B 27046). — Stn 24, 14°00.0'N, 120°18.0'E, 189-209 m, 22.03.1976: 3 ♀ (MNHN-B 27047). — Stn 26, 14°00.9'N, 120°16.8'E, 189 m, 22.03.1976: 1 ♂, 6 ♀ (MNHN-B 27048). — Stn 27, 13°59.8'N, 120°18.6'E, 192-188 m, 22.03.1976: 3 ♀ (MNHN-B 27049). — Stn 30, 14°01.3'N, 120°18.7'E, 186-177 m, 22.03.1976: 3 ♂, 1 ♀ (MNHN-B 27050). — Stn 31, 14°00.0'N, 120°16.0'E, 187-195 m, 22.03.1976: 3 ♀ (MNHN-B 27051). — Stn 32, 14°02.2'N, 120°17.7'E, 193-184 m, 23.03.1976: 3 ♀ (MNHN-B 27052). — Stn 35, 13°59.0'N, 120°18.5'E, 186-187 m, 23.03.1976: 1 ♀ (MNHN-B 27053). — Stn 55, 13°55.0'N, 120°12.5'E, 200-194 m, 26.03.1976: 1 ♀ (MNHN-B 27054). — Stn 56, 13°53.1'N, 120°08.9'E, 134-139 m, 26.03.1976: 1 ♂ 7.2 x 10.3 mm (MNHN-B 26763), 5 ♀ (MNHN-B 26762), 1 ♂ (MNHN-B 27055). — Stn 61, 14°02.2'N, 120°18.1'E, 202-184 m, 27.03.1976: 1 ♀ (MNHN-B 27056). — Stn 63, 14°00.8'N, 120°15.8'E, 191-195 m, 27.03.1976: 1 ♂, 2 ♀ (MNHN-B 27034). — Stn 64, 14°00.5'N, 120°16.3'E, 194-195 m, 27.03.1976: 1 ♂ (MNHN-B 27035). — Stn 71, 14°09.3'N, 120°26.2'E, 174-204 m, 28.03.1976: 6 ♀ (MNHN-B 27036).

MUSORSTOM 2: stn CP 1, 14°00'N, 120°19'E, 188-198 m, 20.11.1980: 1 ♀ (MNHN-B 27057). — Stn CP 2, 14°01'N, 120°17'E, 184-186 m, 20.11.1980: 1 ♀ (MNHN-B 27058). — Stn CP 10, 14°00'N, 120°18'E, 188-195 m, 21.11.1980: 3 ♀ (MNHN-B 27059). — Stn CP 11, 14°00'N, 120°19'E, 194-196 m, 21.11.1980: 3 ♀ (MNHN-B 27060). — Stn CP 12, 14°01'N, 120°20'E, 197-210 m, 21.11.1980: 1 ♀ (MNHN-B 27061). — Stn CP 18, 14°00'N, 120°18'E, 188-195 m, 22.11.1980: 4 ♂, 11 ♀ (MNHN-B 27037). — Stn CP 19, 14°00'N, 120°16'E, 189-192 m, 22.11.1980: 1 ♀ (MNHN-B 27062). — Stn CP 20, 14°00'N, 120°18'E, 185-192 m, 22.11.1980: 2 ♂, 7 ♀ (MNHN-B 27038). — Stn CP 21, 14°00'N, 120°17'E, 191-192 m, 22.11.1980: 2 ♀ (MNHN-B 27062). — Stn CP 51, 14°00'N, 120°17'E, 170-187 m, 27.11.1980: 1 ♀ (MNHN-B 27063). — Stn CP 62, 14°00'N, 120°17'E, 186-189 m, 29.11.1980: 2 ♀ (MNHN-B 27064). — Stn CP 64, 14°01'N, 120°19'E, 191-195 m, 29.11.1980: 6 ♀ (MNHN-B 27065). — Stn CP 67, 14°01'N, 120°19'E, 193-199 m, 29.11.1980: 1 ♂, 6 ♀ (MNHN-B 27039). — Stn CP 68, 14°01'N, 120°18'E, 195-199 m, 29.11.1980: 1 ♂, 7 ♀ (MNHN-B 27040). — Stn CP 71, 14°00'N, 120°18'E, 189-197 m, 30.11.1980: 1 ♀ (MNHN-B 27066). — Stn CP 72, 14°00'N, 120°18'E, 182-197 m, 30.11.1980: 2 ♂, 3 ♀ (MNHN-B 27041).

MUSORSTOM 3: stn CP 86, 14°00'N, 120°18'E, 187-192 m, 31.06.1985: 1 ♂ (MNHN-B 27042). — Stn CP 87, 14°00'N, 120°19'E, 191-197 m, 31.06.1985, 2 ♂, 19 ♀ (MNHN-B 27043). — Stn CP 88, 14°01'N, 120°17'E, 183-187 m, 31.05.1985, 1 ♂, 2 ♀ (MNHN-B 27067). — Stn CP 92, 14°03'N, 120°12'E, 224 m, 31.05.1985: 2 ♀ (MNHN-B 27068). — Stn CP 96, 14°00'N, 120°18'E, 190-194 m, 1.06.1985: 3 ♀ (MNHN-B 27069). — Stn CP 97, 14°00'N, 120°18'E, 189-194 m, 1.06.1985: 1 ♂, 2 ♀ (MNHN-B 27044). — Stn CP 100, 14°00'N, 120°18'E, 189-199 m, 1.06.1985, 14 ♀ (MNHN-B 27070). — Stn CP 101, 14°00'N, 120°19'E, 194-196 m, 1.06.1985: 9 ♀ (MNHN-B 26998). — Stn CP 103, 14°00'N, 120°18'E, 193-200 m, 1.06.1985: 1 ♀ (MNHN-B 27071). — Stn CP 108, 14°01'N, 120°18'E, 188-195 m, 2.06.1985: 1 ♂, 8 ♀ (MNHN-B 27045). — Stn CP 109, 14°00'N, 120°18'E, 190-198 m, 2.06.1985: 2 ♀ (MNHN-B 27072). — Stn CP 111, 14°00'N, 120°18'E, 193-205 m, 2.06.1985: 2 ♀ (MNHN-B 27073). — Stn CP 112, 14°00'N, 120°18'E, 187-199 m, 2.06.1985: 3 ♀ (MNHN-B 27074).

Semirara Islands. MUSORSTOM 3: stn CP 120, 12°06'N, 121°15'E, 219-220 m, 3.06.1985: 18 ♀ (MNHN-B 27075). — Stn CP 121, 12°08'N, 121°18'E, 73-84 m, 3.06.1985: 1 ♀ (MNHN-B 27076).

Indonesia. *Strait of Makassar*. CORINDON: stn CH 267, 01°56'S, 119°17'E, 134-186 m, 7.11.1980: 4 ♂, 1 ♀ (MNHN-B 27032).

Tanimbar Islands. KARUBAR: stn CP 65, 09°14'S, 132°27'E, 176-174 m, 1.11.1991: 2 ♀ (MNHN-B 27077).

TYPES. — *Holotype*: 1 ♂ CL 6.0 mm, *"Orlik"*, stn 213 (ZMMU Ma 5444). *Paratype*: 1 ♀ CL 7.2 mm, *"Orlik"*, stn 203 (ZMMU Ma 5245).

TYPE LOCALITY. — Off northeast coast of Hainan Island, China, South China Sea, 60-180 m.

DIAGNOSIS. — Carapace (Fig. 26d; ZARENKOV, 1968, fig. 3A) with triangular anterolateral tooth on each side. Supraorbital borders each with two notches. Suborbital border (ZARENKOV, 1968, fig. 3B) each with narrow, V-shaped gap between inner and outer suborbital lobes. Cheliped propodi with carina-like row of irregular tubercles; two additional rows of low tubercles along outer surface below. Abdomen of mature males (ZARENKOV, 1968, fig. 3Б) with two slightly raised tubercles on segment 3, similar one on segment 4. Male first pleopods (ZARENKOV, 1968, fig. 3Г; MOOSA & SERÈNE, 1981, fig. 4) with helicoidal basal parts; each distal part with two equal, pointed tips that cross each other. Abdomen of mature females with one transverse ridge along segments 1-4.

DISCUSSION. — The chelipeds were described by ZARENKOV (1968: 763) as having "two long rows... of granules". When observed from the inner side, however, the dorsal row was in the shape of a carina-like row of irregular tubercles. The abdomen of all but one of the mature males that were examined in this study followed the figure of ZARENKOV (1968, fig. 3Б). In the largest male (MNHN-B 26763), however, the tubercles are pointed. The morphology of their male first pleopods agrees in general terms with the schematic figure of ZARENKOV (1968, fig. 3Г) and with the holotype. It agrees more closely with the more detailed figure of MOOSA & SERÈNE (1981, fig. 4) except that the two tusk-shaped tips as well as the corneous apex are shorter in their figure than in most of the many specimens that were examined. In some specimens the tips were slightly curved distally.

The material that was examined also agrees with the diagnosis of MOOSA & SERÈNE (1981: 32), who also studied some of the MUSORSTOM 1 material from the Philippine Islands examined during this investigation. One exception is their statement that there is only one "shallow excavation" on the supraorbital borders. The male abdomen is described as having two "lobes" on segment 3 but a "triangular lobe" on segment 4. They only examined two males, however.

The total length of the second pair of walking legs (P3) in the measured specimens was 2.7 CL (merus 0.8-0.9 CL, dactylus 0.7 CL); total length of P4 2.7-2.8 CL (merus 0.9 CL, dactylus 0.7 CL).

P. unidentatus may be confused with *P. denticulatus* sp. nov. and *P. trituberculatus* sp. nov. because in the three species the dorsal surfaces of the carapace are covered by granular bosses and have a triangular anterolateral tooth with a blunt boss posterior to it. *P. unidentatus* may be separated from *P. denticulatus* by the morphology of its male first pleopods (much simpler in *P. denticulatus*, which has a single blade-like distal part; Fig. 20e), the ornamentation of the cheliped propodi (microscopic teeth in *P. denticulatus*; Fig. 20c), and the gap between the inner and outer suborbital lobes (broad and U-shaped in *P. denticulatus*; Fig. 20b). *P. unidentatus* can be separated from *P. trituberculatus* also by the morphology of its male first pleopods (only a blade-like distal part bordered by minute teeth in *P. trituberculatus*; Fig. 28a-b), the ornamentation of the cheliped propodi (microscopic teeth in *P. trituberculatus*) and the gaps between the inner and outer suborbital lobes (very broad and U-shaped in *P. trituberculatus*; CHEN, 1981, pl. 2, fig. 1).

SIZE. — Maximum size among specimens examined: 9.7 x 12.5 mm (female, MNHN-B 26762); 7.2 x 10.3 mm (male, MNHN-B 26763).

DISTRIBUTION. — Recorded from several locations in the South China Sea (ZARENKOV, 1968; MOOSA & SERÈNE, 1981). Its distribution is now extended to the Strait of Makassar and Arafura Sea (off Tanimbar Islands) in Indonesia (Fig. 58). Depth: known reliably between 84 and 220 m; also collected in trawl between 73-84 m.

Genus ***MIROPALICUS*** nov.

TYPE SPECIES. — *Palicus vietnamensis* Zarenkov, 1968. Gender: masculine.

DIAGNOSIS. — Frontal border of carapace divided into two small lobes. Anterolateral borders each with several rounded teeth. Dorsal surface of carapace with small granules and granular bosses. Eyes dorsoventrally flattened, much wider than peduncle; peduncle with small, soft tubercles. Supraorbital borders each with two very short lobes. Suborbital borders each limited by conspicuous, rounded pterygostomial lobe (inner suborbital lobe much reduced, compressed on inner edge of border by pterygostomial lobe), short outer lobe. Each basal antennal segment rectangular, slender, without distal expansion. Epistome narrow (not expanded dorsoventrally), vertically inclined; two median teeth. Chelipeds increasingly unequal with increasing body size (particularly in males), smallest typically more slender in females. First three pairs of walking legs (P2-4) very slender, with elongate meri, filiform (long and very narrow) carpi, propodi, and dactyli. First pair (P2) much shorter than second pair (P3), but second pair only slightly longer than third pair (P4). Borders of meri of P2-4 with nearly equal tubercles. Distal, posterior borders of propodus and proximal, posterior borders of dactylus of P4 with short spines. Fifth pair of pereopods (P5) reduced (0.8-0.9 CL), very slender. Abdomen of mature males elongate (sides almost parallel to each other), with all segments free, one transverse ridge each along some segments. Male first pleopods long, slender; basal parts straight; each distal part thick, uniramous. Abdomen of mature females with all segments free, one transverse ridge along each segment 1-4.

DESCRIPTION. — Carapace transversely subovate, much broader than long, covered with conspicuous granules, some which are grouped into bosses. Confluence of branchial and mesogastric regions depressed, smooth. Sulcus between hepatic and branchial regions. Anterolateral borders of carapace rounded, with rounded teeth and bosses. Thoracic sternite 7 with reduced process (episternal process) at each outer edge and posterior to insertion of fifth pair of pereopods (P5), visible dorsally as narrow, rounded process.

Frontal border divided into two small lobes. Supraorbital borders each with two very short lobes. Postorbital angles long with rounded tips. Cornea of eyes dorsoventrally flattened, much wider than base of eye peduncle (reniform); peduncle with soft tubercles. Orbits deep, wide.

Suborbital borders very wide, each limited by conspicuous, ventrally projecting, rounded pterygostomial lobe on inner edge (inner suborbital lobe reduced, compressed by pterygostomial lobe), rounded, short outer lobe.

Each basal antennal segment rectangular, slender; flagellum long with conspicuous setae. Epistome narrow, not expanded dorsoventrally, vertically inclined. Border of epistome with two median teeth plus two triangular outer processes connecting distally with pterygostomial lobe. Meri of third maxillipeds narrower than ischia.

Chelipeds increasingly unequal with increasing size (particularly in males), smallest more slender in females. Fingers of larger cheliped with cutting edge or teeth; those of smaller cheliped with teeth, pollex becoming flatter with increasing size. Dorsal and outer borders of cheliped propodi with conspicuous tubercles. First three pairs of walking legs (P2-4) very slender, with elongate meri, filiform (long and very narrow) carpi, propodi, and dactyli. Upper and lower borders of meri with equal or nearly equal tubercles; carpi entire, without teeth; row of spines along posterior borders of propodi and dactyli of third pair of walking legs (P4). First pair of walking legs (P2) much shorter, slender than second pair (P3); third pair (P4) much shorter than second pair but only slightly shorter than first pair. Last two pairs of walking legs (P3-4) each with slightly broadened coxae, having slightly flattened, thick-edged anterior and posterior borders. Fifth pairs of pereopods (P5) reduced (0.8-0.9 CL), very slender; basis-ischia slender, smooth; many short spines along posterior border of dactyli, some on propodi.

Abdomen of mature males elongate, with both sides almost parallel to each other, with all segments free, segments 1-2 dorsoventrally compressed, one transverse ridge each along some segments. Male first pleopods long, slender; basal parts straight; each distal part uniramous. Second male pleopods short, thin, slightly curved; distal segment with blunt tip.

Abdomen of mature females broad, rounded, with all segments free, one transverse ridge along each segment 1-4. Abdomen of immature females triangular (but broader than in males), segments 1-2 dorsoventrally compressed, segments 3-6 fused, transverse ridge along each segment 1-4.

SPECIES INCLUDED. — Only one species is so far known, *M. vietnamensis* (Zarenkov, 1968).

SEXUAL DIMORPHISM. — Females attain a larger size than males. The chelipeds are unequal in size in both sexes but the difference is more apparent in males. The smallest cheliped is usually more slender in females. There is no evidence of differences in the length or shape of the walking legs or fifth pair of pereopods.

DISCUSSION. — The genus is erected for one species that has unique characteristics while sharing some with *Pseudopalicus* and others with *Parapalicus* (see Table 1).

ZARENKOV (1968: 763) commented on the unusual length of the second pair of walking legs (P3) of his new species, *Palicus vietnamensis* Zarenkov, 1968. He pointed out that this character was mostly present in the American species of palicids but that there were differences in the respective suborbital borders, a reference to the very broad suborbital border of the new species. It was placed, like most other species of palicids known at that time, in *Palicus* Philippi, 1838. MOOSA and SERÈNE (1981) provisionally included the species in their new genus, *Parapalicus*. They did not examine any specimens, but commented that the narrow abdomen of the males was very different from the triangular abdomen of *Parapalicus*, which "probably be restricted to species with broad abdomen only" (MOOSA & SERÈNE, 1981: 26).

Characters that *Miropalicus* shares with *Parapalicus* are the morphology of the legs (long and filiform, with equal or nearly equal tubercles along the borders of the meri, smooth borders of the carpi, propodi, and dactyli, and very slender P5, with smooth, slender basis-ischia), granular carapace, frontal border with two lobes, elongate cheliped fingers, and dorsoventrally flattened eyes that are much wider than the peduncle (reniform eyes). Characteristic of *Pseudopalicus* are the narrow shape of the male abdomen, a female abdomen with all segments free and transverse ridges along segments 1-4, general shape of the carapace (more quadrate than oval, long and conspicuous postorbital angles), greatly reduced episternal processes, unequal chelipeds, narrow and elongate epistome provided with teeth, and slender basal antennal segments.

Unique characters of *Miropalicus* are the presence of a third pair of walking legs (P4) that is only slightly longer than the first pair (P2) (markedly longer than P2 in *Pseudopalicus* and *Parapalicus*), spines along the posterior border of both propodi and dactyli of P4, male first pleopods with straight basal parts and thick distal parts each with a nearly square tip, and a seemingly enlarged orbit with hardly any lobes or teeth along both supraorbital and suborbital borders, the reduced inner suborbital lobe being dwarfed by the very large pterygostomial lobe. The coxae of P2-4, slightly expanded into thick anterior and posterior edges, are somewhat intermediate between those of *Pseudopalicus* (thin, expanded edges) and *Parapalicus* (smooth, rounded edges).

ZARENKOV (1968: 765) allied *M. vietnamensis* (together with *Palicus hatusimaensis* Sakai, 1963) with RATHBUN's group 2 of the western Atlantic species of *Palicus* (RATHBUN, 1918: 184) on account of its very long walking legs. This group consists of five species: *P. acutifrons* (A. Milne Edwards, 1880), *P. cursor* (A. Milne Edwards, 1880), *P. floridanus* (Rathbun, 1918), *P. gracilis* (Smith, 1883), and *P. gracilipes* (A. Milne Edwards, 1880). Indeed, *M. vietnamensis* has striking superficial similarities with *P. cursor*. Both species have very long walking legs, the third walking legs (P4) are conspicuously shorter than the second (P3), and there are three anterolateral teeth. *P. cursor*, however, has a triangular male abdomen with at least one conspicuous tubercle, and the carapace has four anterior lobes, a large, triangular outer suborbital tooth, and well-developed supraorbital lobes. There are also superficial similarities with *P. gracilipes* (A. Milne Edwards, 1880), but as in *P. cursor*, this species has a triangular male abdomen with three tubercles similar to that of *Parapalicus*. Thus, similarities with RATHBUN's group 2 are only superficial and none of these five species conform with the characters used in the definition of *Miropalicus*.

ETYMOLOGY. — From *mirus*, Latin for wonderful or strange, and the generic name *Palicus*, in reference to the wide orbits without conspicuous lobes, which make the eyes look unusually large, and the unusually long and graceful walking legs.

Miropalicus vietnamensis (Zarenkov, 1968)

Figs 29, 30a, 59, 60f

Palicus vietnamensis Zarenkov, 1968: 762, fig. 2A-Г.
Parapalicus vietnamensis - MOOSA & SERÈNE, 1981: 26, 27 (in key).

MATERIAL EXAMINED. — **South China Sea**. *"Orlik"*, Vietnam, 300-350 m: 1 ♂, holotype (ZMMU Ma 5248).

Philippine Islands. MUSORSTOM 2: stn CP 83, 13°55'N, 120°30'E, 318-320 m, 2.12.1980: 1 ♀ (MNHN-B 27159).

Indonesia. *Tanimbar Islands*. KARUBAR: stn ED 68, 08°54'S, 132°01'E, 280-296 m, 1.11.1991: 1 ♀ (MNHN-B 27160). — Stn CP 79, 09°16'S, 131°22'E, 250-239 m, 3.11.1991: 5 ♂, 18 ♀ (MNHN-B 26765). — Stn CP 83, 09°23'S, 131°00'E, 285-297 m, 4.11.1991: 2 ♂, 7 ♀ (MNHN-B 27157). — Stn CP 84, 09°23'S, 131°09'E, 275-246 m, 4.11.1991: 3 ♂, 15 ♀ (MNHN-B 27158). — Stn CP 85, 09°22'S, 131°14'E, 245-240 m, 4.11.1991: 1 ♂ 7.8 x 9.7 mm (MNHN-B 26809).

Vanuatu. MUSORSTOM 8: stn CP 980, 19°21'S, 169°25'E, 450-433 m, 22.09.1994: 1 ♀ (MNHN-B 27161).

New Caledonia. MUSORSTOM 4: stn 236, 22°11.30'S, 167°15.00'E, 495-550 m, 2.10.1985: 1 ♂, 1 ♀ (MNHN-B 27162). — Stn 239, 22°14.80'S, 167°15.70'E, 470-475 m, 2.10.1985: 1 ♀ (MNHN-B 27163). — Stn 241, 22°09.00'S, 167°12.20'E, 470-480 m, 3.10.1985: 1 ♂, 1 ♀ (MNHN-B 27164). — Stn 243, 22°02.80'S, 167°07.70'E, 435-450 m, 3.10.1985: 1 ♀ (MNHN-B 27165).

BATHUS 1: stn CP 656, 21°13'S, 165°53'E, 452-460 m, 12.03.1993: 3 ♀ (MNHN-B 27166). — Stn CP 657, 21°14'S, 165°54'E, 490-530 m, 12.03.1993: 1 ♂, 1 ♀ (MNHN-B 27167). — Stn CP 698, 20°34'S, 164°57'E, 491-533 m, 17.03.1993: 2 ♂ (MNHN-B 27168).

BATHUS 2: stn CP 738, 23°02'S, 166°56'E, 558-647 m, 13.05.1993: 1 ♀ (MNHN-B 27169). — Stn CP 742, 22°33'S, 166°25'E, 340-470 m, 14.05.1993: 1 ♀ (MNHN-B 27170). — Stn CP 761, 22°18'S, 166°10'E, 490-500 m, 16.05.1993: 1 ♂ (MNHN-B 27171). — Stn CP 770, 22°09'S, 166°04'E, 400-402 m, 18.05.1993: 1 ♀ (MNHN-B 27172).

HALIPRO 1: stn CP 868, 21°14'S, 165°55'E, 430-550 m, 23.03.1994: 1 ♂, 1 ♀ (MNHN-B 27173). — Stn CP 869, 21°14'S, 165°55'E, 450-490 m, 23.03.1994: 2 ♂, 1 ♀ (MNHN-B 27174).

BATHUS 4: stn DW 888, 21°00'S, 164°27'E, 430-436 m, 2.08.1994: 1 ♀ (MNHN-B 27175). — Stn CP 899, 20°16'S, 163°50'E, 500-600 m, 3.08.1994: 2 ♂, 2 ♀ (MNHN-B 26995).

Loyalty Islands. MUSORSTOM 6: stn DW 410, 20°38.05'S, 167°06.65'E, 490 m, 15.02.1989: 1 ♂ (MNHN-B 27176). — Stn CP 415, 20°40.20'S, 167°03.95'E, 461 m, 15.02.1989: 1 ♂ (MNHN-B 27177). — Stn DW 428, 20°23.54'S, 166°12.57'E, 420 m, 17.02.1989: 1 ♀ 10.5 x 14.8 mm (MNHN-B 26764). — Stn CP 467, 21°05.13'S, 167°32.11'E, 575 m, 21.02.1989: 1 ♂ (MNHN-B 27178).

TYPES. — *Holotype* : 1 ♂ CL 7.2 mm, *"Orlik"*, off Viet Nam (ZMMU Ma 5248).

TYPE LOCALITY. — Off Viet Nam coast, South China Sea, 300-350 m.

DIAGNOSIS. — Carapace (Figs 29a, 30a, 60f; ZARENKOV, 1968, fig. 2A) with three rounded to slightly flattened anterolateral teeth on each side; teeth decrease in size posteriorly; 2-5 (usually four) rounded tubercles on branchial region posterior to anterolateral teeth. Supraorbital borders each with two very short lobes. Suborbital border (Fig. 29b; ZARENKOV, 1968, fig. 2B) very wide, limited by conspicuous, rounded, ventrally projecting pterygostomial lobe (inner suborbital reduced, compressed by pterygostomial lobe), small, rounded outer lobe. Dorsal and outer borders of cheliped propodi (ZARENKOV, 1968, fig. 2A) each with three rows of tubercles, more pronounced in slender chelipeds of females. Second pair of walking legs (P3) very long (3.5-4.0 CL), third pair (P4) short, only slightly longer than first pair (Figs 30a, 60f). Distal, posterior borders of propodi and proximal, posterior borders of dactyli of P4 (Fig. 29c) with short spines. Abdomen of mature males (Fig. 29d; ZARENKOV, 1968, fig. 2B) narrow, with all segments free; one complete transverse ridge along segments 1-3 and along median portion of segment 4. Male first pleopods (Figs 29e-f; ZARENKOV, 1968, fig. 2Г) with straight basal parts; each distal part thick, with elongate, dorsal process with sperm channel, two ventral tubercles, one rounded, second pointed. Abdomen of mature females with all segments distinct, one transverse ridge along each segment 1-4 (very low ridge may be present on segment 5).

Color: A male from the Loyalty Islands photographed live (Fig. 60f) had a pink carapace with irregular yellow spots. The yellow spots on the nearly transparent walking legs and chelipeds may remain in specimens preserved for several years. The cornea of the eyes is light blue in live specimens.

DISCUSSION. — *M. vietnamensis* was placed by ZARENKOV (1968) in *Palicus* but MOOSA & SERÈNE (1981) provisionally placed it in their new genus *Parapalicus* (see discussion of *Miropalicus*).

The material examined in this study agrees with the description and figures of ZARENKOV (1968). There are, however, some exceptions. The male abdomen was described as having segments 3-4 fused and crossed by two ridges (ZARENKOV, 1968, fig. 2B). This characteristic, suggestive of a juvenile specimen, was not found in any of the specimens examined in this study. ZARENKOV's specimen, one of three males he examined, was certainly not a juvenile because of its size (CL 7.1 mm), which was close to the maximum size of the males examined in this

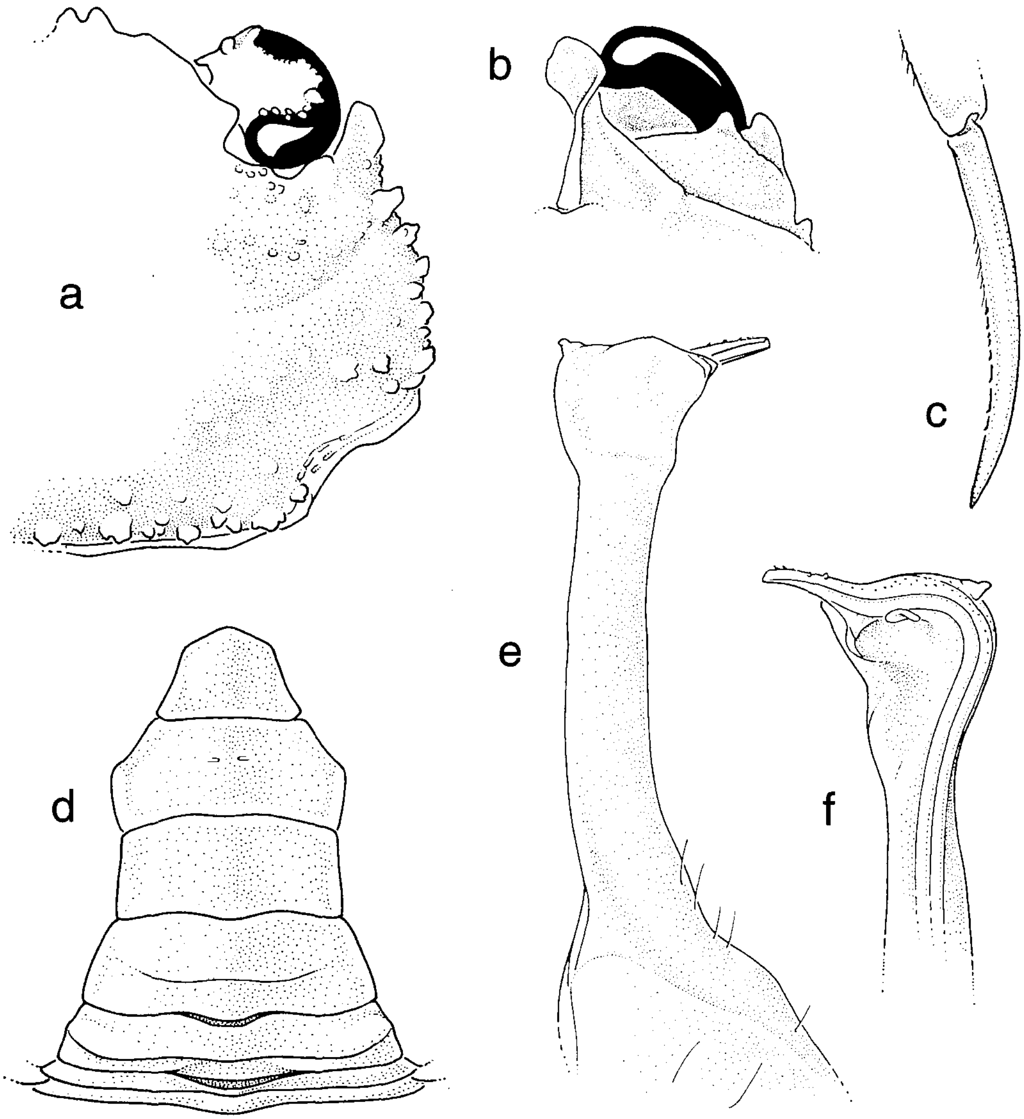

FIG. 29. — *Miropalicus vietnamensis* (Zarenkov, 1968), ♂ 7.8 x 9.9 mm, Tanimbar Islands, Arafura Sea, Indonesia, KARUBAR, stn CP 85, 245-240 m (MNHN-B 26809): **a**, carapace, dorsal view; **b**, suborbital border; **c**, dactylus, right fourth pereopod, dorsal view; **d**, abdomen; **e**, left first male pleopod, ventral view; **f**, left male first pleopod, distal part, dorsal view.

study. The examination of the male holotype (ZMMU Ma 5248) showed that contrary to ZARENKOV's drawings, the abdomen has all segments free and the first pleopods are as illustrated here (figs 29e-f).

There are rows of conspicuous plumose setae along both borders of the propodi and the anterior borders of the dactyli of P3-4. For the propodi, however, ZARENKOV (1968, fig. 2A), shows setae only along the posterior borders. No spines were indicated.

Characteristic of this species is the presence of 2-5 (usually four) high, rounded, granular bosses on the branchial region posterior to each anterolateral tooth. Although on the outer border of the branchial region, they are slightly above the border proper, and can be differentiated from the larger and often flatter anterolateral teeth. The most posterior of the bosses, the largest, is the first of typically 14 rounded bosses that cross the carapace along the branchial and cardiac regions.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.4-1.6	3.5-4.0	1.8-1.9	0.8-0.9
Merus length/CL	0.5-0.6	1.2-1.4	0.6-0.7	0.2-0.3
Dactylus length/Cl	0.4-0.5	0.7-0.8	0.5	0.2

The fifth pair of pereopods (P5) has smooth, slender basis-ischia and meri (except a few microscopic tubercles along the posterior borders of the meri), each propodus with 2-7 spines along the posterior border, and each dactylus with 9-15 long, thick spines along the posterior border and two along the distal part of the anterior border in addition to a long terminal tooth.

SIZE. — Maximum size among specimens examined: 10.5 x 14.8 mm (female, MNHN-B 26764); 7.5 x 10.0 mm (male, MNHN-B 26765).

DISTRIBUTION. — Originally known only from the South China Sea (ZARENKOV, 1968), its distribution is now extended to the South China Sea (coast of the Philippine Islands), Arafura Sea (off Tanimbar Islands, Indonesia), and Coral Sea (Vanuatu, New Caledonia, and the Loyalty Islands) (Fig. 59). Depth: known reliably between 245 and 575 m; also collected in trawl between 558 and 647 m.

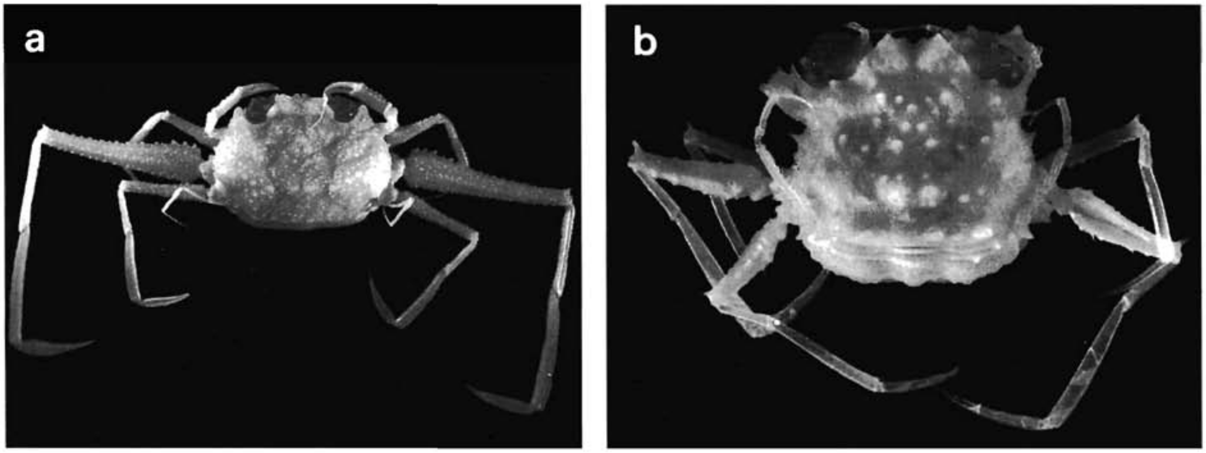

FIG. 30. — **a**, *Miropalicus vietnamensis* (Zarenkov, 1968): ♀ 10.7 x 15.5 mm, off northwest coast of New Caledonia, BATHUS 4, stn CP 899, 500-600 m (MNHN-B 26995): dorsal view. — **b**, *Paliculus kyusyuensis* (Yokoya, 1933): ♀ 3.1 x 3.5 mm, KARUBAR, stn DW 2, 209-240 m (MNHN-B 26770): dorsal view.

Genus *PALICULUS* nov.

TYPE SPECIES. — *Palicus kyusyuensis* Yokoya, 1933. Gender: masculine.

DIAGNOSIS. — Mature adults reach very small size. Frontal border of carapace divided into two small lobes. Anterolateral borders each with 1-4 pointed teeth. Dorsal surface of carapace with tubercles, few granular bosses. Eyes dorsoventrally flattened, much wider than peduncle; peduncle long with small, soft tubercles. Supraorbital borders each with 1-2 lobes. Suborbital borders broad, each limited by conspicuous pterygostomial lobe, 1-2 short lobes. Each basal antennal segment rectangular, slender, without distal expansion. Epistome narrow (not expanded dorsoventrally), vertically inclined; two median teeth. Chelipeds nearly equal but more unequal in males. First three pairs of walking legs (P2-4) very slender, with elongate meri and (with one exception) filiform (long and very narrow) carpi, propodi, and dactyli. First pair (P2) much shorter than second pair (P3), but second pair only slightly longer than third pair (P4). Borders of meri of P2-4 with nearly equal tubercles; carpi, propodi, and dactyli entire. Fifth pair of pereopods (P5) reduced (0.9 CL), very slender. Abdomen of mature males elongate (sides almost parallel to each other), with all segments free, one transverse ridge along each segment 1-3. Male first pleopods with basal parts straight; each distal part biramous. Abdomen of mature females with segments 3-5 or 4-6 fused, one transverse ridge along each segment 1-3, one along fused segments 3-6 or 4-6.

DESCRIPTION. — Very small size (females ovigerous at less than CL 3.0 mm, reaching maximum known size of CL 5.0 mm). Carapace subquadrate, tuberculate. Anterolateral borders of carapace straight, with 1-4 pointed anterolateral teeth. Confluence of branchial and mesogastric regions depressed, smooth; sulcus between hepatic and branchial regions. Thoracic sternite 7 typically with process (episternal process) at each outer edge and posterior to insertion of fifth pair of pereopods (P5), visible dorsally as rounded to narrow, pointed process (more conspicuous in males).

Frontal border divided into two small lobes that may have recessed, pointed portion creating 4-lobe appearance. Supraorbital borders each with 1-2 lobes. Postorbital angles long, pointed tips, directed outward. Cornea of eyes dorsoventrally flattened, much wider than base of eye peduncle (reniform); peduncle long with soft tubercles. Orbits deep, wide.

Suborbital borders each limited by conspicuous, ventrally inclined, rounded pterygostomial lobe on inner edge (inner suborbital lobe reduced, compressed by pterygostomial lobe) and 1-2 rounded, short outer lobes. Ridge connecting each pterygostomial lobe with pterygostomial region with triangular tooth.

Each basal antennal segment rectangular, slender or slightly expanded; flagellum long with conspicuous setae. Epistome narrow, not expanded dorsoventrally, vertically inclined. Border of epistome with no apparent teeth or two short median teeth plus two narrow outer processes connecting distally with each pterygostomial lobe. Meri of third maxillipeds as wide as ischia.

Chelipeds increasingly unequal with increasing size (particularly in males), smallest more slender in females. Fingers of larger cheliped with cutting edge or teeth; those of smaller cheliped with teeth, pollex becoming flatter with increasing size. Dorsal borders of cheliped propodi with conspicuous tubercles. First three pairs of walking legs (P2-4) very slender, with elongate meri and (with one exception) filiform (long and very narrow) carpi, propodi, and dactyli. Upper and lower borders of meri with nearly equal (can be thin, rounded) tubercles; carpi entire, without teeth; borders of dactyli entire. First pair of walking legs (P2) much shorter and slender than second pair (P3); third pair (P4) slightly shorter than second pair. Fifth pairs of pereopods (P5) reduced (0.9 CL), very slender; basis-ischia slender and smooth; spines along posterior border of meri.

Abdomen of mature males elongate, with both sides almost parallel to each other, with segments free, segments 1-2 dorsoventrally compressed, one complete transverse ridge along each segment 1-3, incomplete along segment 4. Male first pleopods long, slender; basal parts straight; each distal part biramous. Second male pleopods short, thin, slightly curved; distal segment with blunt tip.

Abdomen of mature females broad, rounded, segments 1-2 dorsoventrally compressed, segments 3-5 or 4-6 fused, one transverse ridge along each segment 1-3, proximal portion of fused segment. Abdomen of immature females triangular (but broader than in males), segments 1-2 dorsoventrally compressed, 3-6 fused, transverse ridge along each segment 1-4.

SPECIES INCLUDED. — Three species are known: *P. foliatus* sp. nov., *P. kyusyuensis* (Yokoya, 1933), and *Paliculus* sp., an undescribed species known from only one incomplete specimen.

SEXUAL DIMORPHISM. — As in other Indo-west Pacific palicids, females are larger in size than males. The chelipeds are slightly unequal in size in both sexes but the difference is more apparent in males. There is no evidence of sexual dimorphism in the relative length of pereopods.

DISCUSSION. — *Paliculus* (with the exception of *P. foliatus* sp. nov.) shares with *Parapalicus* and *Miropalicus* elongate, filiform walking legs (Fig. 30b). The tubercles on the meri of the walking legs are equal or nearly equal. Similarities between *Paliculus* and *Miropalicus* include a narrow male abdomen, enlarged pterygostomial lobes each fused to a reduced inner suborbital lobe, simple (not expanded) basal antennal segments, and a similar type of chelipeds, the largest with a thick and high propodus, particularly in males. In fact, ZARENKOV (1968: 765) placed *M. vietnamensis* together with *P. kyusyuensis* (as *Palicus hatusimaensis*) in a group of two Indo-west Pacific palicids related to group 2 of RATHBUN (1918: 184) (see discussion of *Miropalicus*). MOOSA & SERÈNE (1981: 26) provisionally placed these two species in their new genus *Parapalicus* but remarked on the differences between their narrow male abdomens and the broad abdomen of *Parapalicus*. A similar narrow male abdomen is characteristic of *Pseudopalicus* but this genus and *Paliculus* differ widely in the morphologies of the carapace, pereopods, and male first pleopods. There are also marked differences in the morphologies of the carapace and male first pleopods of *Paliculus* and *Parapalicus* (see below).

Besides a small size, *Paliculus* has several characters unique among Indo-west Pacific palicids: a subquadrate carapace with a straight or nearly straight sides and 1-4 pointed (not truncate and short as in *Rectopalicus*) anterolateral teeth on each side, and third maxillipeds where the meri is as wide as the ischia. None of these unique characters appear to be present among described species of palicids from the western Atlantic and eastern Pacific regions. The male first pleopods (Fig. 31e) do not have an helicoidal basal part (in contrast to *Parapalicus*) and the distal part is biramous but much different from any known species of *Pseudopalicus*.

ETYMOLOGY. — From the generic name *Palicus* and the diminutive suffix *-ulus* (Latin).

Key to the species of *PALICULUS*

1. Posterior border of carapace slightly pointed medially (Fig. 32a) ....
 .... ***Paliculus foliatus*** sp. nov.

— Posterior border of carapace slightly convex, not pointed medially **2**

2. Anterolateral border of carapace with two pointed, elongate teeth. Supraorbital border with one median lobe having one pointed tip. Suborbital border with one lobe ....
 .... ***Paliculus kyusyuensis*** (Yokoya, 1933)

— Anterolateral border of the carapace with one pointed, elongate tooth. Supraorbital border with one median lobe having two pointed tips. Suborbital border with two lobes ....
 .... ***Paliculus*** sp.

Paliculus kyusyuensis (Yokoya, 1933)

Figs 30b, 31, 56

Palicus kyusyuensis Yokoya, 1933: 206, 217, fig. 70. — SAKAI, 1976: 595, fig. 325b.
Cymopolia kyusyuensis - SAKAI, 1939: 609, fig. 90b; 1956: 52.
Palicus hatusimaensis Sakai, 1963: 230, fig. 7c; 1965: 185, pl. 89, fig. 3; 1976: 595, pl. 205, fig. 3. — TAKEDA & MIYAKE, 1968: 577, fig. 11; 1972: 87. — ZARENKOV, 1968: 765, fig. 3Д [as *Palicus contractus* in caption]. — TAKEDA, 1973: 55.
Parapalicus hatusimaensis - MOOSA & SERÈNE, 1981: 26.

MATERIAL EXAMINED. — **Madagascar.** *Northwest coast, off Nosy Be. "Vauban"*: dredging 2, 12°38.5'S, 48°16.5'E, 240 m, sand, A. CROSNIER coll., 11.10.1974: 1 ♀ (MNHN-B 26769).

Japan. *Sagami Bay.* 30-50 m, Manazuru Marine Laboratory staff coll., 5.08.1960: 1 ♀ holotype of *Palicus hatusimaensis* Sakai, 1963 3.3 x 4.0 mm (SMF 24697).

Kii Peninsula. "Tansei Maru": stn KT96-6, stn TB-3, off Tanabe, 33°39.06'N, 135°06.82'E, 180-187 m, 12.05.1996: 1 ♀ (CBM-ZC 4955).

Bungo Strait. Sandy bottom, T. KOMAI coll., 11.07.1994: 1 ♀ (CBM-ZC 981).

Kyushu. "Soyo Maru", stn 304, off southern Miyazaki-ken, 241 m, 12.07.1928: 1 juv. ♀ (KMNH).

Tsushima Islands. Stn 33, 34°16'N, 129°31.5'E, 105 m, sand and shells, 5.08.1968: 1 ♀ (ZLKU 13565). — Stn 35, 34°25.1'N, 129°59.3'E, 115 m, coarse sand and shells, 5.08.1968: 1 ♀ (ZLKU 12901). — Stn no. missing: 2 ♂, 2 ♀ (ZLKU 13566).

Amami Islands. "*Toyoshio-Maru*": stn 8, off Kekaroma Island, 28°04.71'N, 129°27.38'E, sledge net, 310 m, E. TSUSHIDA coll., 10.11.1994: 3 ♀ (CBM-ZC 4951).

Indonesia. *Kai Islands*. SIBOGA EXPEDITION: stn 260, 05°36.5'S, 132°55.2'E, 90 m, sand, coral and shells, 16-18.12.1899: 1 ♂ (ZMUC). — KARUBAR: stn DW 2, 05°47'S, 132°13'E, 209-240 m, 22.10.1991: 2 ♀ (MNHN-B 26770).

Tanimbar Islands. KARUBAR: stn DW 49, 08°00'S, 132°59'E, 210-206 m, 29.10.1991: 2 ♀ (MNHN-B 26771).

Chesterfield Islands. MUSORSTOM 5: stn 301, 22°06.90'S, 159°24.60'E, 487-710 m, 12.10.1986: 1 ♀ 2.8 x 3.2 mm (MNHN-B 26766).

New Caledonia. BIOCAL: stn DW 77, 22°15'S, 167°15'E, 440 m, 5.10.1985: 1 ♂ 2.7 x 3.1 mm, 1 ♀ (MNHN-B 26767); 1 ♀, 1 juv. ♀ 3.5 x 3.6 mm (MNHN-B 26768).

Wallis Island. MUSORSTOM 7: stn DW 610, 13°21'S, 176°09'W, 286 m, 26.05.1992: 1 ♀ (MNHN-B 26772).

TYPES. — *Holotype* of *Palicus kyusyuensis* Yokoya, 1933: 1 ♀, south of Koshiki Islands, Japan, stn 423, 243 m, 15.07.1929 (deposit unknown, possibly lost).

Holotype of *Palicus hatusimaensis* Sakai, 1963: 1 ♀ 3.3 x 4.0 mm, Sagami Bay, Japan (SMF 24697).

TYPE LOCALITY. — South of Koshiki Islands, southwest of Kyushu, Japan, 243 m.

DIAGNOSIS. — Carapace (Figs 30b, 31a; YOKOYA, 1933, fig. 30; SAKAI, 1963, fig. 7c; 1976, pl. 205, fig. 3; SAKAI's references as *Palicus hatusimaensis*) with two narrow, pointed anterolateral teeth (2-3 very small teeth may be present posterior to anterolateral teeth) on each side. Dorsal surface of carapace with small, rounded tubercles (less common in smaller individuals); two raised, granular bosses on metagastric region; four salient tubercles along posterior border. Supraorbital borders each with one short, rounded or pointed, median lobe. Postorbital angle long, pointed outward. Suborbital border (Fig. 31b; ZARENKOV, 1968, fig. 3Д, as *Palicus contractus* in caption; TAKEDA & MIYAKE, 1968, fig. 11a, as *P. hatusimaensis*) each limited by conspicuous, ventrally projecting pterygostomial lobe and broad, rounded outer lobe. One pointed or rounded tooth on each ridge connecting pterygostomial lobe with pterygostomial region of carapace (Fig. 31b); conspicuous, sharp tooth on pterygostomial region anterior to insertion of cheliped. Dorsal and outer borders of cheliped propodi each with 2-3 rounded tubercles (SAKAI, 1963, fig. 7c, as *P. hatusimaensis*). Abdomen of mature males narrow, with all segments free; one complete transverse ridge along segments 1-3 (only along central portion of segment 4). Male first pleopods (Fig. 31e; TAKEDA & MIYAKE, 1968, fig. 11b-c, as *P. hatusimaensis*) with straight basal parts; each distal part with elongate dorsal process topped by toothed structure and much shorter ventral process with rounded tips. Abdomen of mature females with segments 4-6 fused, one transverse ridge along each segment 1-3 and proximal portion of fused segment 4-6; ridges with lobed edges, particularly that along segment 3.

DISCUSSION. — *Palicus kyusyuensis* was described from one female specimen from southern Japan (3.2 x 4.3 mm; YOKOYA, 1933: 206). The holotype, which like other specimens examined by Y. YOKOYA should have been deposited at the Zoological Laboratory, Kyushu University, Fukuoka but eventually transferred to the Kitakyushu Museum of Natural History, Kitakyushu, appears to be lost. The original specimen lacked both chelipeds and had only one P2 and one P5.

P. hatusimaensis Sakai, 1963 was described from one female from central Japan (SAKAI, 1963: 230) (the holotype was erroneously referred to as a male in the measurements given by SAKAI). SAKAI unfortunately failed to compare his new species with *P. kyusyuensis*. The examination of SAKAI's holotype (3.3 x 4.0 mm; SMF 24697) plus additional material from Japan and other Indo-west Pacific locations failed to show that *P. hatusimaensis* is different from *P. kyusyuensis*.

One difference, however, is that while the frontal border of the carapace of both *P. kyusyuensis* and *P. hatusimaensis* was described as being bilobed, each lobe of *P. hatusimaensis* is recessed ventrally and topped by a sharp denticle (SAKAI, 1963, fig. 7c), giving the front a 4-lobe appearance. The morphology of the frontal border was found to vary widely. Of the 20 specimens with complete anterior borders that were examined in this study, 12 agreed with the holotype of *P. hatusimaensis* in having a bilobed border with four separate tips and two had four tips in patterns different from that of *P. hatusimaensis* (two broad, straight lobes each with only one pointed tip on the inner or outer border). One female from Kyushu, southern Japan (3.8 x 4.1 mm; KMNH), one female from the Amami Islands, southern Japan (3.0 x 3.5 mm; CBM-ZC 4951), and one juvenile female from New Caledonia (3.5 x 3.6 mm; MNHN-B 26768) clearly had two lobes each with a pointed tip at the apex identical to those shown in YOKOYA's figure (YOKOYA, 1933, fig. 70). One female from the Chesterfield Islands (2.8 x 3.2 mm; MNHN-B 26766) had a bilobed front, each lobe triangular but without the pointed tip shown in YOKOYA's figure, and another female from the Tsushima Islands, Japan with a single left lobe and a right lobe with two tips (3.4 x 3.8 mm; ZLKU 13565). Finally, one male from the Tsushima Islands (2.4 x 2.6 mm; ZLKU 13566) had a straight front without lobes.

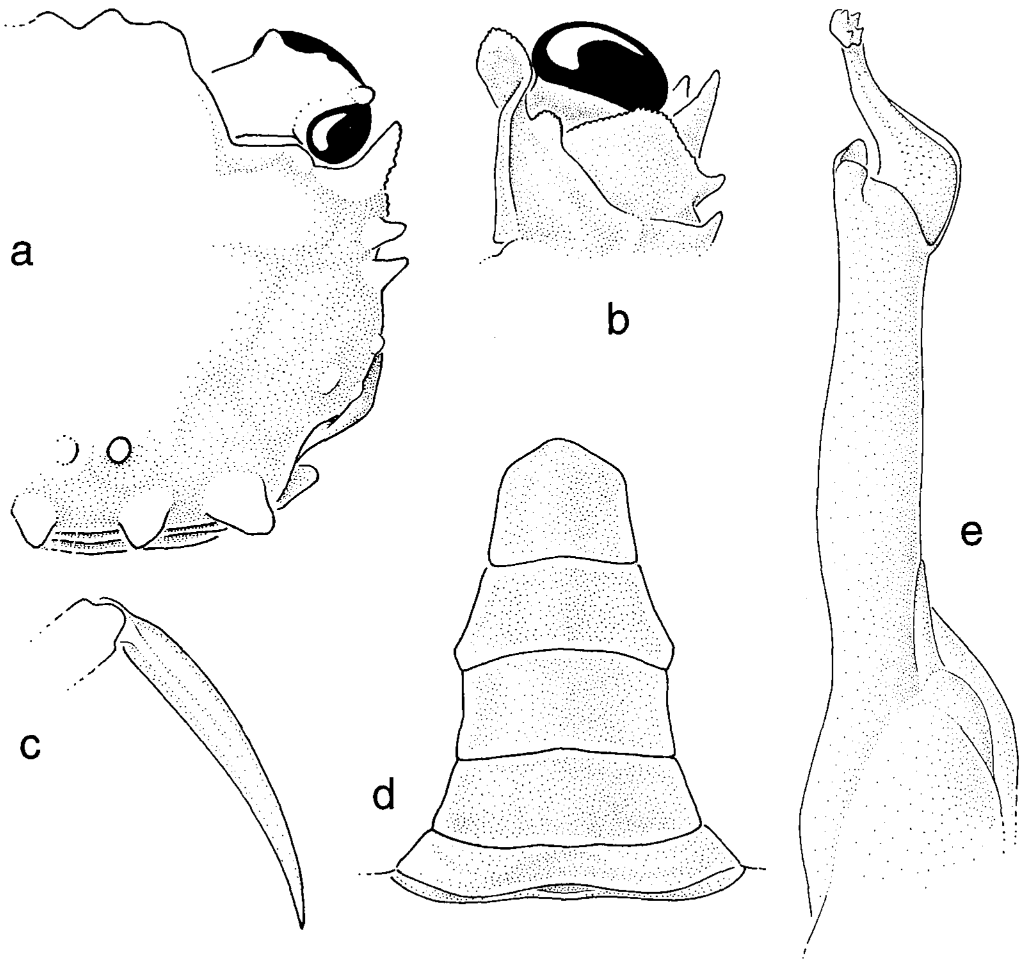

FIG. 31. — *Paliculus kyusyuensis* (Yokoya, 1933), ♂ 2.4 x 2.6 mm, off south coast of New Caledonia, BIOCAL, stn DW 77, 440 m (MNHN-B 26767): **a**, carapace, dorsal view; **b**, suborbital border; **c**, dactylus, right fourth pereopod, dorsal view; **d**, abdomen; **e**, right male first pleopod, ventral view.

There are nevertheless two other differences between YOKOYA's and SAKAI's species. YOKOYA did not mention in his description nor showed in the accompanying figure two characteristics of the species: two raised bosses on the metagastric region of the carapace and four salient tubercles along the posterior border of the carapace. It is assumed that they were overlooked by YOKOYA. His drawings have been known not to be always accurate (see KOMAI, 1996).

SAKAI's description of *P. hatusimaensis* describes "four or five teeth" along each anterolateral border (SAKAI, 1963: 230) but included in this number are the postorbital angle and "two or three tiny teeth" posterior to the two longer anterolateral teeth that are always present. His description therefore should have been five or six but including small teeth posterior to the second anterolateral tooth.

The outer suborbital lobe is shown in a figure given by TAKEDA & MIYAKE (1968, fig. 11a, as *Palicus hatusimaensis*) as a narrow lobe. In all of the specimens that were examined in this study it was broad and rounded like that shown by ZARENKOV (1968, fig. 3Д). Furthermore, TAKEDA & MIYAKE's figure does not show the characteristic pointed teeth on the anterior edge of the ridge that connects the pterygostomial lobe with the pterygostomial region of the carapace. Two teeth are shown in ZARENKOV's figure. Another disagreement between the material examined in this study and TAKEDA & MIYAKE's figures involves the left male first pleopod (TAKEDA & MIYAKE, 1968, figs 11c-d). It was shown as having a single distal part with a "transparent, twisted beak at the tip". The right first pleopod of a male from New Caledonia (2.7 x 3.1 mm; MNHN-B 26767) that is shown in Fig. 31e and those of a male from an unknown location in Japan (2.8 x 3.2 mm; ZLKU 13566) had a biramous distal part that consisted of an elongate dorsal process that ended in a toothed structure and a shorter ventral process with rounded tips. TAKEDA & MIYAKE's specimens were collected in the East China Sea east and southeast of Kyushu, Japan. It was almost identical in size to the New Caledonia and Japan specimens, 2.7 x 3.2 mm. Either these specimens were incorrectly drawn or they may represent a different species .

Even in the absence of YOKOYA's specimen, there is sufficient evidence to consider *Palicus hatusimaensis* Sakai a subjective junior synonym of *Palicus kyusyuensis* Yokoya.

P. kyusyuensis, which is rarely collected due to the small size and fragility of individuals, shows a much wider geographic distribution than originally recorded. It ranges from Madagascar to Japan and Wallis Island in the southwestern Pacific (Fig. 56). It is most probably found across the Indian Ocean.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.4-1.5	2.1-2.2	1.8-1.9	0.9
Merus length/CL	0.5-0.6	0.6-0.7	0.5	0.3
Dactylus length/Cl	0.4	0.5-0.6	0.5	0.2

SIZE. — Maximum size among specimens examined: 3.6 x 4.4 mm (female, CBM-ZC 4955); 2.7 x 3.1 mm (male, MNHN-B 26767).

DISTRIBUTION. — Japan (YOKOYA, 1933; SAKAI, 1963, 1965, 1976; TAKEDA & MIYAKE, 1968, 1972; some records as *P. hatusimaensis*), South China Sea (ZARENKOV, 1968, as *P. hatusimaensis*), and now also known from Madagascar, Sunda and Banda seas (Indonesia), Coral Sea (Chesterfield Islands and New Caledonia), and Wallis Island, southwestern Pacific (Fig. 56). Depth: known reliably between 50 and 487 m; also collected in trawls between 30-50 and 487-710 m.

Paliculus foliatus sp. nov.

Figs 32

MATERIAL EXAMINED. — **New Caledonia**. EXPÉDITION MONTROUZIER: Touho, unknown depth (less than 50 m), 09.1993: 1 ♀ holotype 5.0 x 5.0 mm (MNHN-B 26729).

TYPE. — *Holotype:* 1 ♀ 5.0 x 5.0 mm (MNHN-B 26729).

TYPE LOCALITY. — Touho, northeastern coast of New Caledonia, unknown depth.

DIAGNOSIS. — Carapace (Fig. 32a) subquadrate, with four narrow, pointed anterolateral teeth on each side. Dorsal surface of carapace with small, rounded tubercles; conspicuously depressed area along confluence of branchial and mesogastric regions; two raised, granular bosses on metagastric region; posterior border medially pointed, with four salient tubercles. Supraorbital borders each with one pointed median lobe. Postorbital angle long, pointed outward. Suborbital borders (Fig. 32b) each limited by conspicuous, ventrally projecting pterygostomial lobe and broad, rounded outer lobe. One blunt tooth on each ridge connecting pterygostomial lobe with pterygostomial region of carapace; pointed tooth on pterygostomial region anterior to insertion of cheliped.

Dorsal borders of cheliped propodi each with one conspicuous, rounded tubercle. Borders of meri and carpi of second to fourth walking legs (P2-4; Fig. 32c) with thin, rounded tubercles. Abdomen of mature females with segments 3-5 fused, one transverse ridge along segment 1; ridge with lobed edges. Males unknown.

DESCRIPTION. — Carapace (Fig. 32a) subquadrate, as wide as long (CW/CL = 1.0 in single specimen known); dorsal surface much depressed, with few large granules, two raised, granular bosses on metagastric region. Confluence of branchial and mesogastric regions conspicuously depressed, granular. Anterolateral borders of carapace each with four narrow, pointed anterolateral teeth. Posterior border pointed, with one salient, rounded tubercle at junction with each posterolateral side, two similar but smaller tubercles on median pointed tip.

Frontal border of carapace divided into two narrow, widely separated lobes. Borders between frontal lobes and supraorbital borders slightly folded upward medially, ending in sharp angle forming L- shaped fissure before supraorbital border. Supraorbital borders each with one pointed median lobe. Postorbital angles long (extend beyond dorsal border of retracted eye), pointed outward. Cornea of eyes dorsoventrally flattened, wider than base of long eye peduncle; each peduncle with several conspicuous, elongate, granular tubercles.

Suborbital borders (Fig. 32b) each limited by conspicuous, ventrally inclined, broad pterygostomial lobe on inner edge (inner suborbital lobe reduced, compressed by pterygostomial lobe) and one rounded, short outer lobe. Ridge connecting each pterygostomial lobe with pterygostomial region with blunt tooth. Pointed tooth on pterygostomial region anterior to insertion of cheliped.

Each basal antennal segment slightly expanded outward; three rounded tubercles along expanded margin; flagellum long, with very long, simple setae. Epistome narrow, vertically inclined, with no apparent teeth. Inner border of ischia of third maxillipeds straight; surface granular, upper borders rounded. Meri much narrower than ischia; two large tubercles, broad, serrated upper borders.

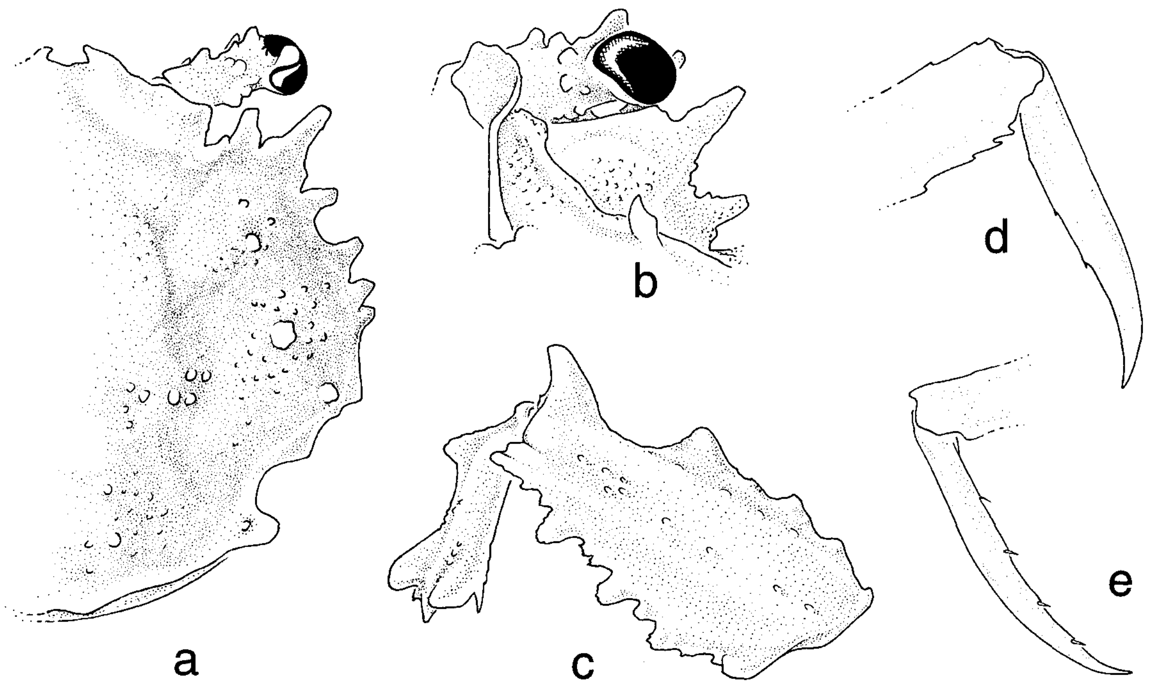

FIG. 32. — *Paliculus foliatus* sp. nov., ♀ holotype 5.0 x 5.0 mm, Touho, northeast coast of New Caledonia, EXPÉDITION MONTROUZIER, unknown depth (MNHN-B 26729): **a**, carapace, dorsal view; **b**, suborbital border; **c**, merus, left third pereopod, dorsal view; **d**, dactylus, right fourth pereopod, dorsal view; **e**, dactylus, left fifth pereopod, dorsal view.

Dorsal and outer borders of propodus of largest cheliped with one conspicuous, rounded, anteriorly inclined tubercle; smallest cheliped with one large, anteriorly inclined tubercle and two smaller, rounded tubercles on proximal and distal borders. Fingers of both chelipeds with cutting edges. Outer borders of carpi and meri with conspicuous, elongate, rounded tubercles.

Walking legs (P2-4) slender but with flattened, non-filiform propodi. Upper and lower borders of meri (Fig. 32c) with thin, rounded tubercles; distalmost tubercle on each anterior border much wider at base, much higher; similar thin, rounded tubercles on anterior borders of propodi. Anterior and posterior borders of propodi with short teeth (most topped by small spine on posterior border); posterior border of dactyli with 1-2 teeth (Fig. 32d). P3-4 with one dorsal, one ventral carina each (all very slight) on carpi, propodi, and dactyli. Meri of all walking legs with long plumose setae; dorsal surfaces of propodi of P3-4 each with one row of conspicuous plumose setae each along anterior and posterior borders, dactyli with one similar row along anterior borders.

First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair slightly shorter than second. Fifth pair of pereopods (P5) short (0.7 CL); each merus slender, low tubercles along posterior border; each propodus with four low tubercles, three of which topped by short spine; each dactylus (Fig. 32e) with four short, thin spines along posterior border, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.0	1.3	1.2	0.7
Merus length/CL	0.4	0.4	0.4	0.2
Dactylus length/Cl	0.2	0.3	0.3	0.2

Abdomen of mature females with segments 3-5 fused, one transverse ridge with lobed edges along segment 1. Male first pleopods and abdomen of males and immature females unknown.

DISCUSSION. — This species is described from only one small, ovigerous female. Its has a unique, depressed, leaf-like carapace with pointed posterior border and thin, broad tubercles along the borders of the walking legs (P2-P4). It shares more characters with *Paliculus*, specifically with *P. kyusyuensis*, than with any other genus. It shares with *P. kyusyuensis* the morphologies of the supraorbital border (only one median lobe), suborbital border (one broad, short lobe, inner lobe reduced and compressed by pterygostomial lobe), pterygostomial region (blunt tooth on ridge connecting the pterygostomial lobe with the pterygostomial region, pointed tooth on pterygostomial region anterior to insertion of cheliped; Fig. 32b), female abdomen (fusion of some of the segments, lobed transverse ridge), narrow and pointed anterolateral teeth, salient tubercles along posterior border, long and outwardly pointed postorbital angle, and narrow epistome. Yet, there are very strong differences between the walking legs of both species (very long and fililform in *P. kyusyuensis*) and body size (smaller in *P. kyusyuensis*). There are also differences in the basal antennal segments (rectangular without outward expansion in *P. kyusyuensis*) and maxillipeds (much longer exopod and merus, narrower anterior border in *P. kyusyuensis*).

Some of the outstanding differences between the two species may be accounted to different habitats. *P. kyusyuensis* is an inhabitant of soft sediments in moderate depths. The habitat of *P. foliatus* remains unknown but its unique shape and shorter walking legs suggest that it lives cryptically on a hard substrate.

SIZE. — Size of female holotype: 5.0 x 5.0 mm (MNHN-B 26729).

ETYMOLOGY. — From *phyllon*, Greek for leaf, in reference to the leaf-like shape of the sides of the carapace and tubercles along the walking legs.

DISTRIBUTION. — Known only from New Caledonia. Depth: unknown but probably shallow water.

Paliculus sp.

Fig. 33

MATERIAL EXAMINED. — **Philippine Islands**. MUSORSTOM 3: stn DR 117, 12°31'N, 120°39'E, 92-97 m, 3.06.1985: 1 ♀ 2.3 x 2.4 mm (MNHN-B 26730).

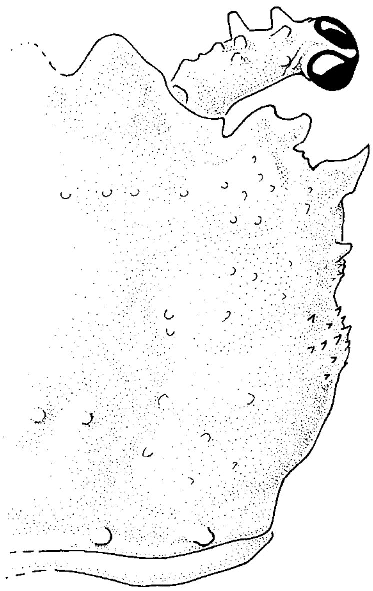

FIG. 33. — *Paliculus* sp.: ♀ 2.3 x 2.4 mm, Mindoro Strait, Philippine Islands, MUSORSTOM 3, stn DR 117, 92-97 m (MNHN-B 26730): carapace, dorsal view.

DIAGNOSIS. — Carapace (Fig. 33) subquadrate with one small, pointed anterolateral tooth on each side (4-5 very small pointed tubercles present posterior to anterolateral tooth). Dorsal surface of carapace with scattered, small, rounded tubercles; two slightly raised, granular bosses on metagastric region; four tubercles along posterior border. Supraorbital borders each with one conspicuous, bilobed median lobe. Postorbital angles long and pointed outward. Suborbital border each limited by conspicuous, ventrally projecting pterygostomial lobe and two broad, rounded lobes. One tooth on each ridge connecting pterygostomial lobe with pterygostomial region of carapace. Abdomen of mature females with segments 3-6 fused and one transverse ridge along each segment 1-3 and proximal portion of fused segments 3-6. Males unknown.

DISCUSSION. — One very small, ovigerous female from the Mindoro Strait, Philippine Islands (2.3 x 2.4 mm; MNHN-B 26730) shares many characters with *P. kyusyuensis*. The specimen, however, lacks all appendages.

As in *P. kyusyuensis*, the carapace is subquadrate with few tubercles (less tubercles that are less pronounced than in *P. kyusyuensis*) and one pointed anterolateral tooth on each side (shorter that the two in *P. kyusyuensis*), the postorbital angles are thin, curved, and pointed outward, each supraorbital border has one median lobe (but bilobed and larger than in *P. kyusyuensis*), the suborbital borders are limited by a conspicuous pterygostomial lobe and each has two lobes (only one in *P. kyusyuensis*), there is one tooth on the ridge that connects each pterygostomial lobe with the pterygostomial region of the carapace, and one tooth on the pterygostomial region (all more conspicuous and salient in *P. kyusyuensis*). The episternal processes are narrow, pointed, and smaller than in *P. kyusyuensis*.

Although the species appears to be new, it is not being described as such because of the lack of information on the morphology and relative size of the walking legs. It is placed in *Paliculus* due to its close proximity to *P. kyusyuensis*, at least as far as the morphology of the carapace is concerned.

The only specimen known is the smallest ovigerous female recorded (2.3 x 2.4 mm) for any of the species of palicids that was examined in this study.

DISTRIBUTION. — Known only from the Philippine Islands. Depth: 92-97 m.

Genus *RECTOPALICUS* nov.

TYPE SPECIES. — *Rectopalicus woodmasoni* (Alcock, 1900). Gender: masculine.

DIAGNOSIS. — Frontal border of carapace divided into four pointed or two broad lobes. Carapace subquadrate or subpyriform, border posterior to postorbital angle nearly straight; truncate anterolateral teeth. Dorsal surface of carapace with tuberculate bosses or rounded tubercles. Eyes dorsoventrally flattened, wider than peduncle; peduncles with many granular tubercles. Supraorbital borders each with two rectangular or rounded lobes. Suborbital borders each with two short lobes. Each basal antennal segment rectangular, without distal expansion. Epistome vertically inclined or expanded dorsoventrally; two triangular median teeth. Chelipeds nearly equal or unequal in both sexes. First three pairs of walking legs (P2-4) with flattened (not filiform) carpi, propodi, and dactyli. First pair (P2) much shorter than second pair and third pairs (P3-4), third pair as long as second pair. Borders of meri and carpi of P2-4 with nearly equal rounded tubercles; posterior borders of propodi and dactyli with short spines. Fifth pair of pereopods (P5) reduced (0.5-0.8 CL), thick or slender. Abdomen of mature males, elongate (sides almost parallel to each other), with all segments free, one transverse ridge along each segment 1-4 (may be incomplete in segment 4). Male first pleopods with sinuous basal parts; each distal part uniramous, laterally flattened, dissimilar dorsal and ventral tips that may have teeth. Abdomen of mature females with all segments free, one transverse ridge along each segment 1-4.

DESCRIPTION. — Carapace subquadrate or subpyriform; dorsal surface covered with granules or rounded tubercles, some grouped into bosses. Confluence of branchial and mesogastric regions depressed. Sulcus between hepatic and branchial regions apparent. Anterolateral borders of carapace nearly straight, with short, truncate teeth, or straight along anterior portion and conspicuously rounded posteriorly with short, truncate teeth. Thoracic sternite 7 with much reduced process (episternal process) at each outer edge and posterior to insertion of fifth pair of pereopods (P5), visible dorsally as rounded process.

Frontal border of carapace divided into four pointed or two broad lobes. Supraorbital borders each with two rectangular or rounded lobes. Postorbital angles short or long and pointed. Cornea of eyes dorsoventrally flattened, wider than base of eye peduncle; each peduncle with many granular tubercles. Orbits deep and wide.

Suborbital borders each with short inner and outer lobes. Pterygostomial lobe at each anterolateral angle of buccal frame straight, with broad, rounded or straight border.

Each basal antennal segment thick, rectangular, and covered with tubercles; flagellum short with few long plumose setae. Epistome vertically inclined or broad and expanded dorsoventrally. Border of epistome with two large, triangular median teeth plus two similar outer processes fusing distally with each pterygostomial lobe. Meri of third maxillipeds narrower than ischia.

Chelipeds nearly equal or unequal in both sexes. Fingers slender, with broadly rounded teeth. First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair about same long as second. First three pairs of walking legs (P2-4) with flattened (not filiform) carpi, propodi, and dactyli; anterior (dorsal) and posterior (ventral) borders of meri with nearly equal tubercles; anterior border of carpi with rounded or slightly pointed tubercles; posterior borders of propodi and dactyli with spines or small teeth tipped by a spine. Last two pairs of walking legs (P3-4) each with broad coxae, having flattened, thick edged anterior and posterior borders. Fifth pair of pereopods (P5) reduced (0.5-.08 CL), thick or slender; basis-ischia and meri with small tubercles; spines along posterior border of dactyli.

Abdomen of mature males elongate, with both sides almost parallel to each other, with all segments free, segments 1-2 dorsoventrally compressed, one transverse ridge along each segment 1-3 or 1-4 (incomplete in segment 4). Male first pleopods with sinuous basal parts; each distal part biramous or uniramous, thick, laterally flattened and with dissimilar dorsal and ventral tips; teeth may be present. Second male pleopods short, thin, slightly curved; distal segment with blunt tip.

Abdomen of mature females broad and rounded, with all segments free, segments 1-2 dorsoventrally compressed, one transverse ridge along each segment 1-4. Abdomen of immature females, when known, triangular (but broader than in males), segments 1-2 dorsoventrally compressed, 4-6 fused, transverse ridge along segments 1-4.

SPECIES INCLUDED. — Three species are known: *R. amphiceros* sp. nov., *R. ampullatus* sp. nov., and *R. woodmasoni* (Alcock, 1900).

SEXUAL DIMORPHISM. — Males are smaller than females as in other palicids. Only one specimen of each sex were examined in *R. amphiceros* and *R. ampullatus*; more specimens of *R. woodmasoni* were available for examination but only three were males. The cheliped propodus of the largest cheliped is thicker in the males of *R. amphiceros* and *R. woodmasoni*, while they are only slightly thicker in the male of *R. ampullatus*.

DISCUSSION. — *Rectopalicus* comprises three species that share conspicuously nearly straight lateral borders, short and truncate anterolateral teeth, and spines on the propodi of the walking legs. There are also some similarities in the male first pleopods. Two of the species, *R. amphiceros* and *R. woodmasoni*, are very similar in most characters except in their male first pleopods, clearly uniramous in *R. amphiceros* but seemingly biramous in *R. woodmasoni*. *R. ampullatus*, however, shows differences that are perhaps the result of drastic modifications to its general body plan, its uniquely subpyriform carapace that is straight anteriorly but rounded posteriorly (Figs 36a, 37a). The epistome is broader than that of *R. woodmasoni* (but not so much than in *R. amphiceros*, which is slightly expanded dorsoventrally and as such it may be considered intermediate between *R. ampullatus* and *R. woodmasoni*), the walking legs (P2-P4) are shorter, last pair of pereopods (P5) more slender and shorter, and the body is covered by rounded tubercles. Its male first pleopods, however, are uniramous and very similar to those of *R. amphiceros*.

There are some similarities between *Rectopalicus* and *Exopalicus* new genus, which has a very different body plan, with a carapace that is conspicuously convex and very short walking legs (Fig. 37d). Both genera share spines along the propodi of the walking legs and (with the exception of *R. woodmasoni*) a uniramous, angular male first pleopod. The similarities between *Exopalicus* and *R. ampullatus*, in particular, are more marked: short walking legs, slender and short P5, and body covered with rounded tubercles. Their respective body plans, however, are unique and very different from each other, in addition to differences in the epistome and third maxillipeds. The collection of additional specimens and perhaps new species may clarify the position of both genera within the Palicidae.

The nearly straight lateral borders and truncate anterolateral teeth of *Rectopalicus* are not shared with any known species of western Atlantic or eastern Pacific palicids.

ETYMOLOGY. — From *rectus*, Latin for straight, and the generic name *Palicus*, in reference to the diagnostic, nearly straight lateral borders of the carapace.

Key to the species of *RECTOPALICUS*

1. Carapace with anterolateral borders straight anteriorly but rounded posteriorly (Figs 36a, 37a). Abdomen of males and females covered with low, rounded tubercles (Fig. 36e) .... ***Rectopalicus ampullatus*** sp. nov.
— Carapace with nearly straight lateral borders. Abdomen of males and females not covered by conspicuous tubercles **2**

2. Postorbital angles conspicuously pointed outward (Figs 35a-b). Spines but no teeth along the posterior border of dactyli of walking legs (P2-4; Fig. 35c). Male first pleopods uniramous (Figs 35d-e) .... ***Rectopalicus amphiceros*** sp. nov.
— Postorbital angles not conspicuously pointed outward (Figs 8c, 37c). Teeth (which may be topped by a spine) along posterior border of dactyli of walking legs (P2-4). Male first pleopods with two lobes (Figs 34a-b) ..... ***Rectopalicus woodmasoni*** (Alcock, 1900)

Rectopalicus woodmasoni (Alcock, 1900)

Figs 8c, 34, 37c, 53

Palicus Wood-Masoni Alcock, 1900: 795. — ALCOCK & MCARDLE, 1903: pl. 67, fig. 3.
Palicus microfrons Sakai, 1963: 228, fig. 7b; 1965: 184, pl. 89, fig. 2; 1976: 594, fig. 325a, pl. 205, fig. 4.
Pseudopalicus woodmasoni - MOOSA & SERÈNE, 1981: 35 (in key).
Palicoides microfrons - TAKEDA, 1982b: 17, fig. 2.

MATERIAL EXAMINED. — **Japan**. *Kii Peninsula.* Shionomisaki, 33°26.13'N, 135°40.64'E, 160 m, S. NAGAI coll., 16.01.1997: 1 ♀ (CBM-ZC 3603); 100 m, S. YAMAGUCHI coll., 22.09.1978: 2 ♀ (CBM-ZC 4262).

Ryukyu Islands. "Toyoshio-Maru": stn 8, Amami Islands, off Kekaroma Island, 28°04.71'N, 129°27.38'E, 310 m, K. TSUSHIDA coll., , 10.11.1994: 1 juv. ♀ (CBM-ZC 4951).

Philippine Islands. MUSORSTOM 1: stn 57, 13°53.1'N, 120°13.2'E, 107-96 m, 26.03.1976: 1 ♀ (MNHN-B 26778).

Thailand *(Andaman Sea coast)*. Stn H38/D, off Phuket island, 9.05.1996: 1 ♂ CL 5.1 mm (PMBC).

Indonesia. *Kai Islands.* KARUBAR: stn DW 22, 05°22'S, 133°01'E, 124-85 m, 25.10.1991: 1 ♀ (MNHN-B 26773).

New Caledonia. *"Kandjar"*, dredgings between 22°40'-22°50'S and 167°10'-167°30'E, 200-350 m, P. TIRARD coll., 7-10.10.1986: 1 ♀ (MNHN-B 26780).

SMIB 5: stn DW 95, 22°59.7'S, 168°19.8'E, 200 m, 14.09.1989: 1 juv. ♂ 5.4 x 5.7 mm (MNHN-B 26775).

BATHUS 2: stn DW 723, 22°50.21'S, 167°26.84'E, 430-433 m, 11.05.1993: 1 ♂ 7.2 x 7.6 mm (MNHN-B 26777). — Stn DW 728, 22°47.11'S, 167°28.11'E, 241-245 m, 12.05.1993: 1 ♀ 9.4 x 10.3 mm (MNHN-B 26774), 1 ♀ (MNHN-B 26781).

BATHUS 3: stn DW 836, 23°02'S, 166°59'E, 295-306 m, rocks and gravel, 30.11.1993: 1 juv. ♂ 5.5 x 5.6 mm, 1 ♀ (MNHN-B 26776).

Vanuatu. MUSORSTOM 8: stn CP 1131, 15°38.41'S, 167°03.52'E, 140-175 m, 11.10.1994: 1 juv. ♀ (MNHN-B 26779).

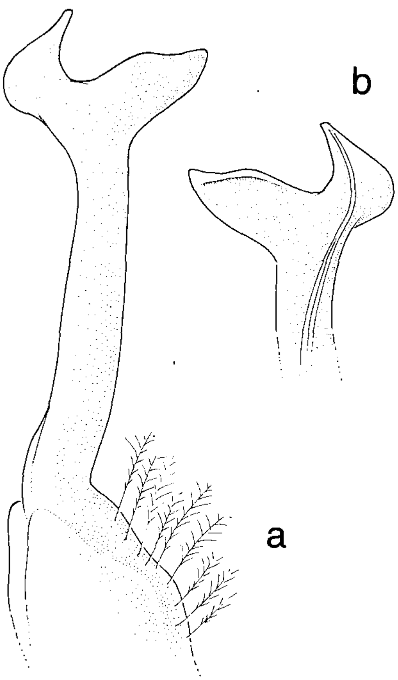

FIG. 34. — *Rectopalicus woodmasoni* (Alcock, 1900), ♂ 7.2 x 7.6 mm, off south coast of New Caledonia, BATHUS 2, stn DW 723, 430-433 m (MNHN-B 26777): **a**, left male first pleopod, ventral view; **b**, left male first pleopod, distal part, dorsal view.

TYPES. — *Holotype* of *Palicus woodmasoni* Alcock, 1900: 1 ♂ 9 x 11 mm (ALCOCK, 1900), Andaman Islands. Deposit unknown: Zoological Survey of India, Calcutta ?

Holotype of *Palicus microfrons* Sakai, 1963: 1 ♀ 8.0 x 9 mm (SAKAI, 1963), Misaki, Sagami Bay, Japan, 85 m, EMPEROR OF JAPAN coll. (Showa Memorial Institute, National Science Museum, Tsukuba).

TYPE LOCALITY. — Andaman Islands, India.

DIAGNOSIS. — Carapace (Figs 8c, 37c; ALCOCK & MCARDLE, 1903, pl. 67, fig. 3; SAKAI, 1963, fig. 7b; 1976, fig. 325a, pl. 205, fig. 4) subquadrate, typically with four truncate anterolateral teeth on each side; teeth decrease posteriorly in size. Dorsal surface of carapace covered by large granules and several granular bosses; posterior border with six elongate tubercles (continuous in small specimens). Supraorbital borders each with two rounded lobes, outer lobe slightly narrower than inner lobe. Suborbital border obliquely directed, with rectangular inner lobe and broad, proximally rounded outer lobe. Dorsal borders of cheliped propodi with several rounded or elongate tubercles. Dactyli of walking legs (P2-4) with small teeth along posterior border (2-3 in P4; Fig. 8c). Abdomen of mature males with all segments free, one complete transverse ridge along each segment 1-4 (ridge along segment 4 may be incomplete). Male first pleopods (Figs 34a-b; TAKEDA, 1982b, fig. 2A) with straight basal parts; each distal part with two lateral processes, inner one narrower. Abdomen of mature females with all segments free and one complete transverse ridge along each segment 1-4 (low ridge may be present along segment 5).

DISCUSSION. — *R. woodmasoni* was described as *Palicus woodmasoni* from a single male specimen collected in the Andaman Islands (ALCOCK, 1900). It is not know if the holotype is still extant. The description and excellent figure (ALCOCK & MCARDLE, 1903, pl. 67, fig. 3; reproduced here as Fig. 8c) plus additional material from the western Pacific Ocean and the Andaman Sea not far from the type locality, however, permit its characterization as a species of *Rectopalicus*.

Diagnostic characters other than those given in the diagnosis are a border between the anterior lobes and each supraorbital margin that is folded upward and slightly pointed anteriorly. Each basal antennal segment is rectangular but thick and slightly expanded along the outer border, and a row of low, rounded tubercles along its ventral surface. Each eye peduncle has a conspicuous, triangular tubercle on its anterior border, and a much lower tubercle at the outer end of the tubercle. The pterygostomial lobes project ventrally, forming a flat, triangular structure posterior to each inner suborbital lobe. The epistome is vertically inclined, with two short, slightly pointed median teeth flanked on each side by a large triangular outer process and a thin, rounded margin before each pterygostomial lobe. The third pair of walking legs (P4; Fig. 37c) has short meri (0.4 CL), each armed with one row of a few, elongate teeth along the upper border and one broad and slightly pointed distal tooth. Each dactylus is slender (0.3 CL) and its posterior border is armed with 2-3 small spines or teeth (see below). The fifth pair of pereopods (P5) is thick and short (0.7 CL). The meri are slender and tuberculate, with conspicuous, rounded and triangular tubercles (small specimens have larger tubercles, each with a short spine), plus a few short spines and plumose setae along the posterior border; each propodus with tubercles and 4-7 spines; each dactylus with 1-2 thick spines along posterior border, microscopic teeth, 1-2 short distal spines along anterior border, and one terminal pointed tooth.

Two female specimens (MNHN-B 26774, Fig. 37c; MNHN-B 26773) had a frontal border with only three lobes, the median one being entire without a sulcus.

Palicus microfrons Sakai, 1963, which was described from one female from Japan, has a subquadrate carapace with straight lateral borders and truncate anterolateral teeth as in *R. woodmasoni*. SAKAI (1963: 230) mentioned that his new species was "closely related" to *Palicus woodmasoni* but that they differed in the "shape and arrangement of the frontal and lateral teeth " and of "features of the granules and tubercles of the dorsal surface of the carapace". These differences were most certainly based only on the examination of ALCOCK's description and figure (ALCOCK & MCARDLE, 1903, pl. 67, fig. 3; reproduced as Fig. 8c) and not by the examination of the holotype that is presumably in Calcutta. ALCOCK mentioned that there were three anterolateral teeth in his species. The figures of SAKAI (1963, fig. 7b; 1976, fig. 325a, pl. 205, fig. 4), however, show four teeth, while those of TAKEDA (1982b, figs 2B-C, as *Palicoides microfrons*) show five.

All specimens examined in this study had four anterolateral teeth. Tubercles along the edge beyond the last tooth may be easily interpreted as small teeth. In a female specimen from Japan (CBM-ZC 4226) one such tubercle appeared on the right side but none on the left. In small specimens the separation between the teeth becomes less well defined. The number of teeth along the anterolateral borders of palicids has always been a matter of interpretation since the postorbital angles are considered as teeth by some and small, tubercle-like teeth may not.

The anterolateral borders of the carapace of *P. microfrons* carapace were described by SAKAI (1963, 228, fig. 7b; 1976, pl. 205, fig. 4) as being "almost straight and slightly divergent backwards". All specimens examined during this study (which included four from Japan) had carapaces that were straight but clearly divergent on a posterior direction, as noticed by TAKEDA (1982b, figs 2B-C, as *Palicoides microfrons*) and shown in a figure by SAKAI (1976, fig. 325a).

The only significant difference between *P. woodmasoni* and *P. microfrons* is in the fact that no mention was made in ALCOCK's description of *P. woodmasoni* of the presence of spines or teeth on the dactyli of the walking legs. Small teeth were shown in his figure (ALCOCK & MCARDLE, 1903, pl. 67, fig. 3; reproduced as Fig. 8c). SAKAI (1963: 230) described "minute spinules" on the dactyli of *P. microfrons*, as shown in his first figures (SAKAI, 1963, fig. 7b; 1976, pl. 205, fig. 4), but were absent in another (SAKAI, 1976, fig. 325a). Either the presence of small spines in the holotype was overlooked by ALCOCK or the dactyli actually had no spines, a situation that has been observed in at least some of the legs of some of the specimens that were examined.

The presence of spines or teeth (if any) on the dactyli of the walking legs is a variable character. Most specimens examined in this study had either teeth or spines. The larger specimens tend to have teeth and the smaller spines but this varies. For example, the largest specimen examined, a female from Japan (9.7 x 10.3 mm; CBM-ZC 4262), had spines on the dactyli of P2-4 of the right side and P2 on the left side but no spines or teeth on the P3-4 of the left side (only half of the dactylus of P4 remained); a smaller female from the same locality (8.6 x 9.1 mm; CBM-ZC 4262) with four walking legs had smooth dactyli in three legs but a spine on the P2; a small female from Japan (6.7 x 7.5 mm; CBM-ZC 3603) with three legs had teeth topped by a spine on a P2, a very short tooth on a P3, and a short tooth topped by a spine on a P4; a large female from New Caledonia (9.4 x 10.3 mm; MNHN-B 26774) had teeth topped by spines, lacking a spine, or only single spines in the four legs that remained.

Only one specimen from the Andaman Sea near the type locality was examined. Although the male specimen (CL 5.1 mm; PMBC) was incomplete, the dorsal surface of the carapace, suborbital region, and abdomen agree with the Japanese and western Pacific specimens that were examined in this study. The legs and first pleopods, which would have provided the key pieces of evidence for the probable separation between the two species, were unfortunately missing.

MOOSA & SERÈNE (1981: 35) did not examine any specimens but included *Palicus woodmasoni* in their new genus, *Pseudopalicus*, but strangely enough without mentioning *Palicus microfrons*. No mention of their synonymy was made, however. There is nevertheless enough evidence to consider *Palicus microfrons* Sakai a junior subjective synonym of *Palicus woodmasoni* Alcock, now included in the new genus *Rectopalicus*.

There are also close similarities between *R. woodmasoni* and *R. amphiceros* sp. nov., a species being described from only two specimens from New Caledonia. *R. amphiceros*, however, has postorbital angles that are conspicuously pointed outward and there are no teeth on the dactyli of the walking legs, among other characters (see description of *R. amphiceros* below).

TAKEDA (1982b) placed *Palicus microfrons* Sakai in *Palicoides* Moosa & Serène, 1981 based on the presence of a "subterminal process" on the male first pleopods. Indeed, the subquadrate shape of the carapace, the presence of truncate anterolateral teeth, and the relatively thicker P5 of *R. woodmasoni* are characteristics of *Palicoides*. The two lateral processes of the pleopods (Figs 34a-b; TAKEDA, 1982b, fig. 2A) nevertheless do not bear a close resemblance to those of *Palicoides longimanus* (Miyake, 1936) (Fig. 43a) or of *P. whitei* (Miers, 1884) (Figs 43b-d), the later characterized by a very conspicuous, arched, and spinous process. The pleopod illustrated by TAKEDA had a longer inner process than that illustrated here (Fig. 43a) and the process showed a row of setae. The difference in the size of both specimens is small (Japanese specimen of TAKEDA: 6.2 x 6.5 mm; specimen illustrated in Figs 34a-b: 7.2 x 7.6 mm, MNHN-B 26777) but it may explain the differences observed. The male first pleopods of two juvenile males (5.4 x 5.7 mm, MNHN-B 26775; 5.5 x 5.6 mm, MNHN-B 26776) were very thin and unspecialized into any defined structures. The male first pleopods of *R. woodmasoni* are somewhat closer to those of *R. amphiceros* sp. nov. (Figs 35d-e), and *R. ampullatus* sp. nov. (Figs 36f-g) in their general shapes.

In addition to the differences in the male first pleopods, other characters support the placement of *Palicus microfrons* in *Rectopalicus*, not in *Palicoides*: 1) four lobes (inner pair rounded, narrow, and short; outer pair very broad, rounded, and typically as high as first pair) on anterior border (only two in *Palicoides*), 2) segments 2-3 of the antennae are relatively narrow and there are conspicuous setae on the flagellum (segments 2-3 very wide and provided with long setae, few setae on flagellum in *Palicoides*), 3) cornea of eyes is dorsoventrally flattened, clearly wider than peduncle, and there is one large distal tubercle on each peduncle (spherical, almost as wide as peduncle and conspicuous crescent-shaped process on peduncle in *Palicoides*), 4) each supraorbital border has two lobes (only one lobe in *Palicoides*), 5) presence of four anterolateral teeth on each side of the carapace (only two in *Palicoides*), 6) chelipeds are relatively short (much longer and slender in *Palicoides*), 7) meri of walking legs (P2-4) have conspicuous tubercles on the upper and lower borders (microscopic tubercles in *Palicoides*), 8) abdomen of mature females has all segments free (segments 5-6 fused in *Palicoides*), and 9) epistome with median teeth and outer process (smooth in *Palicoides*).

SIZE. — Maximum size among specimens examined: 9.7 x 10.3 mm (female, CBM-ZC 4262); 7.2 x 7.6 mm (male, MNHN-B 26777).

DISTRIBUTION. — Andaman Islands (ALCOCK, 1900) and Japan (SAKAI, 1963, 1976; TAKEDA, 1982b; as *P. microfrons*) and now recorded from the Andaman Sea coast of Thailand, Banda Sea (Indonesia), and Coral Sea (Vanuatu and New Caledonia) (Fig. 53). Depth: known reliably between 107 and 430 m; also collected in a trawl between 85 and 124 m.

Rectopalicus amphiceros sp. nov.

Figs 35

MATERIAL EXAMINED. — **New Caledonia**. MUSORSTOM 4: stn DW 203, 22°35.8'S, 167°04.8'E, 105-110 m, 27.09.1985: 1 ♂ holotype 4.6 x 4.8 mm (MNHN-B 26731). — Stn DW 204, 22°37.0'S, 167°05.7'E, 120 m, 27.09.1985: 1 juv. ♀ paratype 4.1 x 4.5 mm (MNHN-B 26732).

TYPES. — *Holotype*: 1 ♂ 4.6 x 4.8 mm, MUSORSTOM 4, stn DW 203 (MNHN-B 26731).
Paratype: 1 juv. ♀ 4.1 x 4.5 mm, MUSORSTOM 4, stn DW 204 (MNHN-B 26732).

TYPE LOCALITY. — Off south coast of New Caledonia, 22°35.8'S, 167°04.8'E, 105-110 m.

DIAGNOSIS. — Carapace (Fig. 35a) subquadrate, with four short, rounded anterolateral teeth on each nearly straight side; teeth slightly decrease posteriorly in size. Dorsal surface of carapace with large granules and several granular bosses; posterior border with four very elongate tubercles. Supraorbital borders each with two rounded lobes. Postorbital angles very long, narrow, pointed outward so they extend only to about half of dorsal border of retracted eye. Suborbital borders (Fig. 35b) obliquely directed, each with rectangular inner lobe and broad, proximally rounded, outer lobe. Dorsal borders of cheliped propodi with several rounded or elongate tubercles. Dactyli of walking legs (P2-4) with thick spines along posterior border (two spines on P4; Fig. 35c). Abdomen of males with all segments free and one complete transverse ridge along each segment 1-3, incomplete ridge along segment 4. Male first pleopods (Figs 35d-e) with straight basal parts armed with teeth and one dorsal tubercle; each distal part with two broad lateral processes, inner one narrower. Abdomen of mature females unknown.

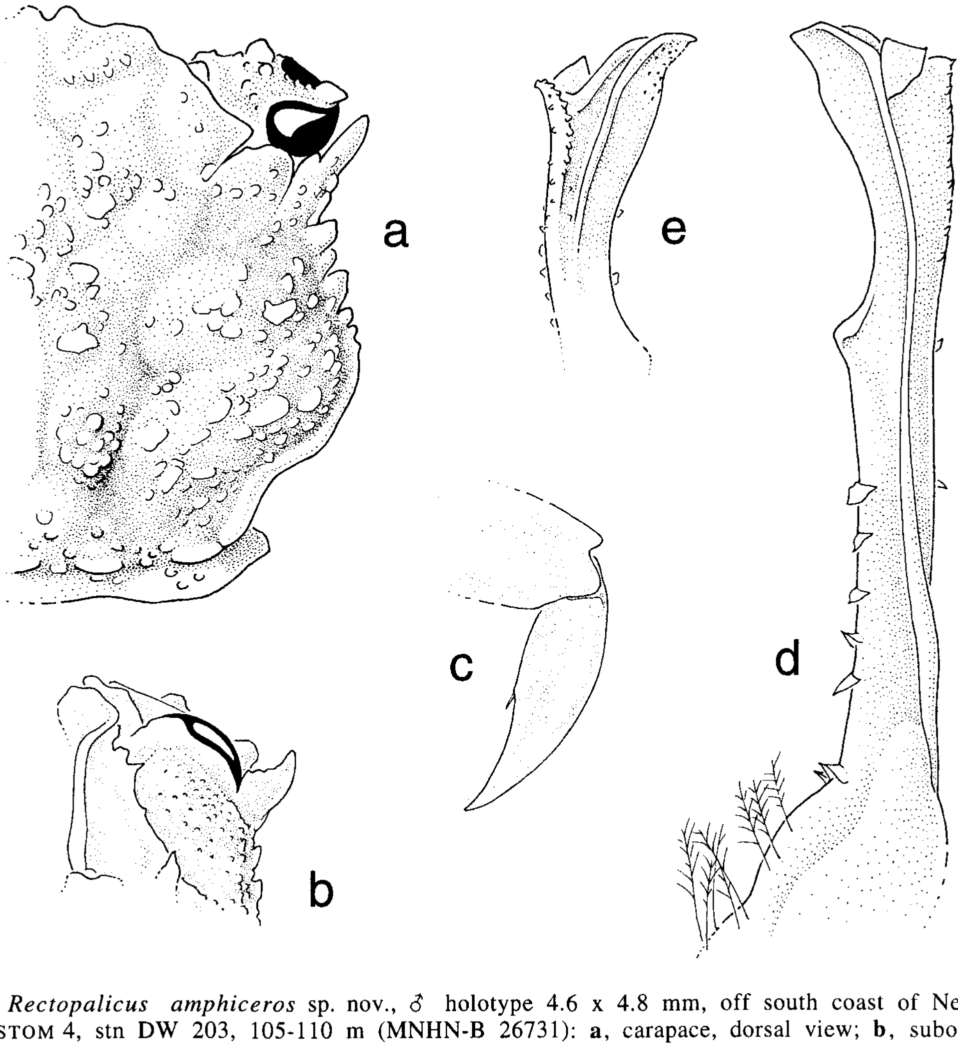

FIG. 35. — *Rectopalicus amphiceros* sp. nov., ♂ holotype 4.6 x 4.8 mm, off south coast of New Caledonia, MUSORSTOM 4, stn DW 203, 105-110 m (MNHN-B 26731): **a**, carapace, dorsal view; **b**, suborbital border; **c**, dactylus, right fourth pereopod, dorsal view; **d**, left male first pleopod, lateral (inner side) view; **e**, left male first pleopod, distal part, lateral (outer side) view.

DESCRIPTION. — Carapace (Fig. 35a) subquadrate, only slightly wider than long (CW/CL = 1.0); dorsal surface of covered by large granules and several granular bosses (several small, rounded bosses on branchial and gastric regions, one row across lower third of carapace). Anterolateral borders of carapace nearly straight, each with four short, rounded teeth decreasing posteriorly in size. Posterior border with four elongate tubercles and scattered plumose setae.

Frontal border of carapace divided into four lobes, inner pair rounded, narrow and short, outer pair very broad, rounded, shorter than first pair. Borders between frontal lobes and supraorbital borders folded upward, with almost straight margin ending in sharp angle forming V-shaped fissure before supraorbital border. Supraorbital borders each with two rounded lobes, outer lobe slightly narrower than inner lobe. Postorbital angles long, slender, and pointed outward, so they only extend to about half of dorsal border of retracted eye. Cornea of eyes dorsoventrally flattened, wider than base of eye peduncle; each peduncle with one large distal tubercle.

Suborbital borders (Fig. 35b) obliquely directed, each with rectangular inner lobe, broad, proximally rounded, outer lobe. Pterygostomial lobes short, straight, with rounded borders. Ridge connecting each pterygostomial lobe with pterygostomial region with row of pointed teeth. Pointed tooth on pterygostomial regions anterior to insertion of chelipeds.

Each basal antennal segment slender and rectangular (row of rounded tubercles along ventral surface); flagellum long, with very few, simple setae. Epistome slightly expanded dorsoventrally, with two triangular median teeth, each flanked by triangular, narrow, pointed outer process and thin, rounded margin before pterygostomial lobe. Inner border of ischia of third maxillipeds straight; surface granular, upper borders rounded to slightly pointed. Meri narrower than ischia; oblong upper borders.

Dorsal borders of cheliped propodi each with 3-4 rows of rounded and pointed tubercles. Fingers with 3-4 broadly rounded teeth. Carpi short, outer border with pointed tubercles; meri slender, with rounded tubercles.

First three pairs of walking legs (P2-4) of holotype slender but flattened. Upper and lower borders of meri with rounded, proximal tubercles; distalmost tubercle on each anterior border much wider at base, much higher, slender, pointed or rounded, directed distally. Carpi of walking legs (P2-4) elongate; posterior borders of propodi and dactyli with small spines (Fig. 35c). Each P2 with one dorsal carina, 2-4 spines along posterior border of propodus; one minute spine along posterior border of dactylus. P3-4 each with one dorsal, one ventral carina on carpus, propodus, and dactylus; 1-3 spines along posterior border of propodus. Meri of all walking legs with scattered plumose setae; dorsal surfaces of propodi and dactyli of P3-4 each with one row of conspicuous plumose setae along anterior and posterior borders.

First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); fourth pair slightly longer than third. Fifth pair of pereopods (P5) short (0.8 CL); each merus very slender, with plumose setae along posterior border; each propodus and dactylus with many long simple and plumose setae along both borders; each dactylus with one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.0	1.3	1.4	0.8
Merus length/CL	0.3	0.4	0.4	0.3
Dactylus length/Cl	0.3	0.3	0.3	0.2

Abdomen of males with all segments free. One complete transverse ridge along each segment 1-3 (low, incomplete ridge along most of segment 4). Male first pleopods (Figs 35d-e) with sinuous basal parts, borders with teeth and one tubercle on each dorsal side; each distal part laterally flattened, with one pointed dorsal edge and one straight ventral edge bordered by minute teeth. Abdomen of mature females unknown.

DISCUSSION. — *P. amphiceros* is described from only one complete specimen, the male holotype. The paratype, a juvenile female, had only two walking legs. Notwithstanding the scarcity of material and its very close proximity to *R. woodmasoni*, it is described as a separate species on account of the unique male first pleopods and the outward orientation of its postorbital angles. It can be separated from *R. woodmasoni* by these two characters and the presence of shorter and slightly rounded anterolateral teeth (conspicuously truncate in *R. woodmasoni*), four tubercles along the posterior border of the carapace (six in *R. woodmasoni*), and by having spines along the posterior border of the dactyli of the walking legs (teeth that may be topped with spines in *R. woodmasoni*). Some of these characters, however, may be present only in small specimens, the only type of specimens thus far known.

The unique male first pleopods are laterally flattened like those of *R. ampullatus* but they are much more complex. Each basal part has thick teeth and one large dorsal tubercle vary similar to that of *Pseudopalicus undulatus* (Figs 14d-e). There are also similarities in their general shape with the male first pleopods of *Exopalicus maculatus* (Edmondson, 1930) (Fig. 38d). It lacks, however, the large lateral teeth of *E. maculatus*.

SIZE. — Size of the only two specimens known to exist: 4.1 x 4.5 mm (female paratype, MNHN-B 26732); 4.6 x 4.8 mm (male holotype, MNHN-B 26731).

ETYMOLOGY. — From the Latinized word for *amphikeros*, Greek for having two horns, in reference to the characteristic postorbital angles, which are pointed in an outward direction as in the horns of cattle.

DISTRIBUTION. — Known only from the Coral Sea (New Caledonia). Depth: 110-120 m.

Rectopalicus ampullatus sp. nov.

Figs 36, 37a-b, 61a

MATERIAL EXAMINED. — **Loyalty Islands**. MUSORSTOM 6: stn DW 462, 21°05.10'S, 167°26.85'E, 200 m, 21.02.1989: 1 ♂ holotype 6.2 x 6.3 mm (MNHN-B 26782).
Futuna Island. MUSORSTOM 7: stn DW 513, 14°13'S, 178°11'W, 260-300 m, 12.05.1992: 1 ♀ paratype 7.9 x 8.7 mm (MNHN-B 26783).

TYPES. — *Holotype*: 1 ♂ 6.2 x 6.3 mm, MUSORSTOM 6, stn DW 462 (MNHN-B 26782).
Paratype: 1 ♀ 7.9 x 8.7 mm, MUSORSTOM 7, stn DW 513 (MNHN-B 26783).

TYPE LOCALITY. — Loyalty Islands, 21°05.10'S, 167°26.85'E, 200 m.

DIAGNOSIS. — Carapace (Figs 36a, 37a, 61a) subpyriform, with anterolateral borders anteriorly straight, posteriorly rounded; rounded portion with four short, truncate teeth on each side. Dorsal surface of carapace with many rounded tubercles and tuberculate bosses. Supraorbital borders each with two very short lobes. Suborbital borders (Fig. 36c) each with short, irregular inner and outer lobes. Dorsal borders of cheliped propodi with rounded tubercles. Dactyli of walking legs (P2-4) with teeth along posterior border (two teeth in P4; Fig. 36d). Abdomen of males (Fig. 36e) with all segments free, one complete transverse ridge along each segment 1-3 (incomplete ridge along each median portion of segment 4). Male first pleopods (Figs 36f-g) with sinuous basal parts; each distal part laterally flattened with irregular dorsal tip. Abdomen of mature females with all segments free, one complete transverse ridge along each segment 1-4 (low ridge along segment 5).

Color: The carapace of the live holotype, a male (Fig. 61a), was yellow-brown with a few symmetric, white streaks. The meri and carpi of the second and third walking legs (P3-4) were of the same color, the remaining portions white. A red-brown band crossed the propodi of the second walking legs (P2).

DESCRIPTION. — Carapace (Figs 36a, 37a, 61a) subpyriform, only slightly wider than long (CW/CL = 1.0-1.1); dorsal surface covered with many rounded tubercles and tuberculate bosses, most conspicuous of which are on branchial and metagastric regions. Carapace straight along anterior portion, broad posteriorly; broad portion with four short, truncate teeth on each side (teeth, particularly first two, may be divided into separate teeth or tubercles). Episternal processes reduced (short), granular, rounded. Posterior border with many rounded tubercles, no setae.

Frontal border of carapace divided into two broadly rounded, short lobes. Borders between frontal lobes and supraorbital borders as three successive curved or straight, slightly folded-upward portions separated from each other by pointed tips (first two pointed tips together with pointed lobes gives carapace a four-lobed appearance). Supraorbital borders each with two very short, straight lobes. Postorbital angles short (not extending to dorsal border of retracted eye) with slightly pointed tips. Cornea of eyes dorsoventrally flattened, wider than base of eye peduncle; each peduncle with many granular tubercles (most dorsal, distal tubercles the two most conspicuous).

Anterior portion of body between frontal lobes of carapace and posterior border of meri of third maxillipeds (Figs 36b, 37b) nearly flat; epistome, pterygostomial lobe, and suborbital border fused together. Suborbital borders

(Fig. 36c) each with short inner and outer lobes, both with irregular, tuberculate borders. Pterygostomial lobe at each anterolateral angle of buccal frame short, straight, with rectangular anterior border (broad, flat, irregular border when seen anteriorly).

Each basal antennal segment thick, rectangular, covered with thick tubercles; flagellum short with few long plumose setae. Epistome broad, expanded dorsoventrally, straight except concavity along median portion. Border of epistome with two large, triangular median teeth plus two similar outer processes fusing distally with each pterygostomial lobe. Inner border of ischia of third maxillipeds broadly triangular; surface with rounded tubercles, upper borders straight with oblong tip. Meri as wide as ischia; straight-edged, triangular upper borders.

Chelipeds nearly equal in both sexes. Dorsal and outer borders of cheliped propodi with rows of small, rounded tubercles. Fingers with very short, rounded teeth. Carpi short, outer borders with low, rounded tubercles; meri slender, outer borders with low, rounded tubercles.

First three pairs of walking legs (P2-4; Figs 37a-b) slender but flattened. Anterior (dorsal) and posterior (ventral) borders and dorsal and ventral surfaces of meri with nearly equal, rounded tubercles. Anterior borders of carpi with rounded tubercles; posterior borders of propodi with minute, pointed tubercles, spines on P2. Posterior borders of dactyli with teeth capped with a spine. Each P2 with one dorsal, one ventral row of tubercles on carpus; one dorsal carina, two ventral rows of tubercles, 2-3 short spines on propodus; one dorsal, one ventral carinae, 2-3 teeth on posterior border of dactylus. Each P3 with one ventral row of tubercles on carpus; one dorsal row of tubercles, one carina, two ventral rows of tubercles on propodus; one dorsal, one ventral carinae, 2-3 teeth on posterior border of dactylus. Each P4 with two dorsal, one ventral rows of tubercles on carpus; one dorsal, two ventral carinae on propodus; one dorsal, one ventral carinae, two teeth on posterior border of dactylus (Fig. 36d). Meri of all walking legs with very few, scattered plumose setae; dorsal surfaces of propodi and dactyli of P3-4 with one row of conspicuous plumose setae along anterior and posterior borders (setae along posterior borders of dactyli particularly longer).

First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair about same size as second. Fifth pair of pereopods (P5) very short (0.5 CL); each merus slender, tuberculate surface; each propodus with low tubercles; each dactylus with three short, thin spines along posterior border, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	0.7	1.0-1.1	1.0-1.1	0.5
Merus length/CL	0.2	0.3	0.3	0.1
Dactylus length/Cl	0.2	0.3	0.3	0.1

Abdomen of males (Fig. 36e) with all segments free, covered with rounded tubercles. One complete transverse ridge along each segment 1-3; ridges bordered by conspicuous, rounded tubercles. Male first pleopods (Figs 36f-g) with sinuous basal parts; each distal part laterally flattened; ventral tip rounded, dorsal tip with blunt, pointed processes.

Abdomen of mature females broad, rounded, covered with rounded tubercles, with all segments free, one transverse ridge along each segment 1-4 (very slight along segment 5). Abdomen of immature females unknown.

DISCUSSION. — The unique shape of the carapace of *P. ampullatus* parallels a remarkable shortening and flattening of the anterior part of the body. Several morphological changes have taken place as part of this readjustment. The epistome has expanded dorsoventrally (Fig. 36b). Each pterygostomial lobe is short and straight but it has been laterally expanded to fuse with the edges of the epistome. As a result, the inner portion of the suborbital margin is thicker and makes contact with the laterally expanded pterygostomial lobe. The third maxillipeds, which form the ventral boundary between the flat anterior portion and the rest of the body, are folded so that each merus is bent nearly 90° in relation to the straight ischium.

The unique shape and coarse tuberculation of *R. ampullatus* is most probably correlated with a particular habitat that may be unique among palicids. Perhaps it burrows in coarse sediments while leaving the flattened anterior portion of the body above the bottom. Short but dorsoventrally flattened walking legs may be involved in digging. It may also be involved in swimming short distances, as in the case of *Exopalicus maculatus* (Edmondson, 1930) (see below).

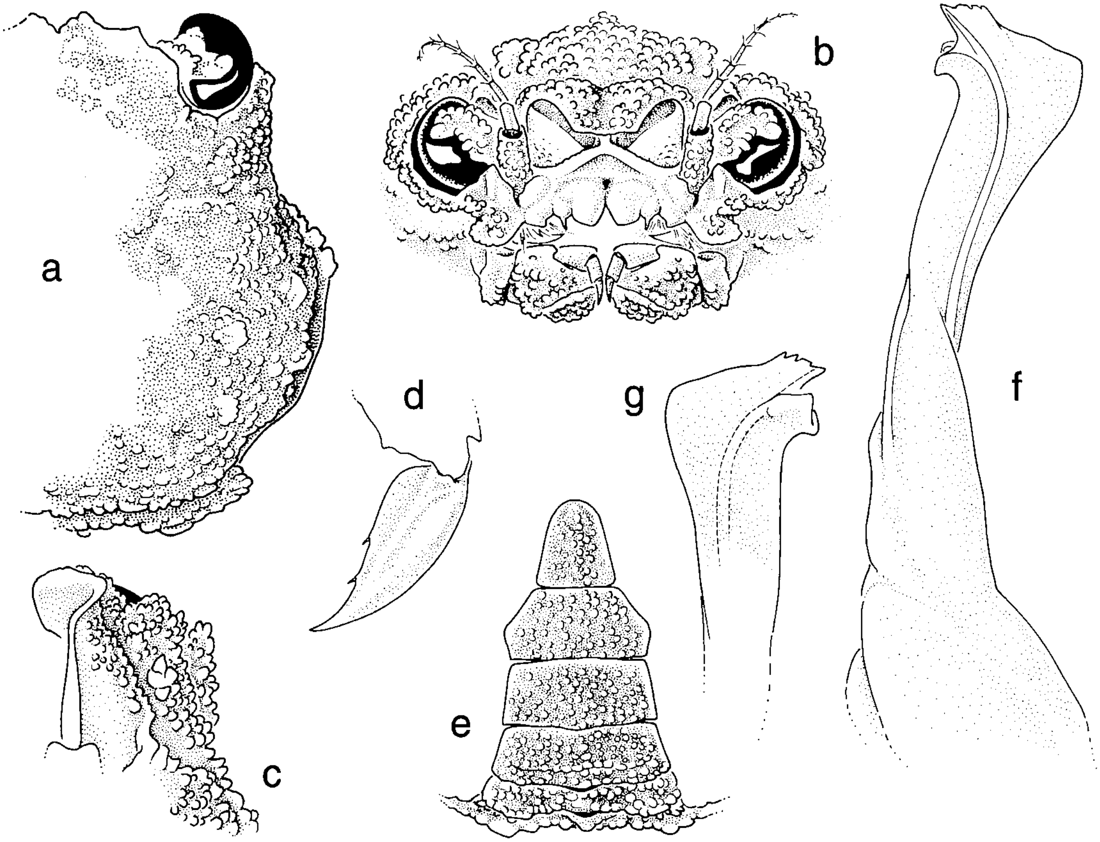

FIG. 36. — *Rectopalicus ampullatus* sp. nov., ♂ holotype 6.2 x 6.3 mm, Loyalty Islands, MUSORSTOM 6, stn DW 462, 200 m (MNHN-B 26782): **a**, carapace, dorsal view; **b**, carapace, anterior portion; **c**, suborbital border; **d**, dactylus, right fourth pereopod, dorsal view; **e**, abdomen; **f**, left male first pleopod, lateral (inner side) view; **g**, left male first pleopod, distal part, lateral (outer side) view.

SIZE. — Maximum size among specimens examined: 7.9 x 8.7 mm (female paratype; MNHN-B 26783); 6.2 x 6.3 mm (male holotype; MNHN-B 26782).

ETYMOLOGY. — From *ampulla*, Latin for bottle or flask, in reference to the unique flask-shape of the body: narrow anteriorly, wider and rounded posteriorly.

DISTRIBUTION. — Loyalty Islands and Futuna Island, southwestern Pacific Ocean. Depth: known reliably between 200 and 260 m, collected too in a trawl between 260-300 m.

Genus *EXOPALICUS* nov.

TYPE SPECIES. — *Palicus maculatus* Edmondson, 1930 by monotypy. Gender: masculine.

DIAGNOSIS. — Frontal border of carapace divided into two rounded, short lobes. Carapace hexagonal. Three triangular anterolateral teeth. Dorsal surface of carapace convex, covered with rounded tubercles and tuberculate bosses. Eyes dorsoventrally flattened, wider than peduncle; peduncles with many granular tubercles. Supraorbital borders each with one short, rectangular lobe. Suborbital borders each with two short lobes. Each basal antennal segment rectangular, without distal expansion. Epistome slightly expanded dorsoventrally; two triangular median teeth. Chelipeds unequal in both sexes. First three pairs of walking legs (P2-4) with flattened (not filiform) carpi, propodi, and dactyli. First pair (P2) much shorter than second pair and third pairs (P3-4), third pair as long as second pair. Borders of meri and carpi of P2-4 with nearly equal rounded tubercles; posterior border of propodi and dactyli with short spines. Fifth pair of pereopods (P5) reduced (0.5 CL), thick. Abdomen of mature males, elongate (sides almost parallel to each other), all segments free, one transverse ridge along each segment 1-4 (may be incomplete in segment 5). Male first pleopods with sinuous basal parts; each distal part uniramous, laterally flattened, dissimilar dorsal and ventral tips with teeth. Abdomen of mature females with all segments free, one transverse ridge along each segment 1-3 (may be low in segment 4).

DESCRIPTION. — Carapace hexagonal; dorsal surface conspicuously convex and covered with rounded tubercles, some grouped into bosses. Confluence of branchial and mesogastric regions depressed. Sulcus between hepatic and branchial regions apparent. Anterolateral borders of carapace with three broad, triangular teeth. Thoracic sternite 7 with process (episternal process) at each outer edge and posterior to insertion of fifth pair of pereopods (P5), visible dorsally as oblong process.

Frontal border of carapace divided into two broad lobes. Supraorbital borders each with one short, rectangular lobe formed by two very shallow notches. Postorbital angles very short and triangular. Cornea of eyes dorsoventrally flattened, wider than base of eye peduncle; each peduncle very short, with many granular tubercles. Orbits deep, wide.

Suborbital borders each with broadly rounded, short inner and outer lobes. Pterygostomial lobe at each anterolateral angle of buccal frame with slight vertical inclination and broad, rounded to slightly pointed border.

Each basal antennal segment short, rectangular; flagellum short with few long plumose setae. Epistome broad, slightly expanded dorsoventrally. Border of epistome with two large, triangular median teeth plus two pointed outer processes fusing distally with each pterygostomial lobe. Meri of third maxillipeds narrower than ischia.

Chelipeds unequal in both sexes. Fingers thick (very short in largest cheliped), with cutting edge and no teeth. Inner surfaces of propodi of males with thick clump of plumose setae. First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair about same long as second. First three pairs of walking legs (P2-4) with flattened (not filiform) carpi, propodi, and dactyli; anterior (dorsal) and posterior (ventral) borders and dorsal and ventral surfaces of meri with nearly equal, rounded tubercles; anterior border of carpi with rounded or slightly pointed tubercles; posterior borders of propodi and dactyli with thick spines or (on dactyli) small teeth tipped by a similar spine. Last two pairs of walking legs (P3-4) each with broad coxae, having flattened, thick edged anterior and posterior borders. Fifth pair of pereopods (P5) much reduced (0.5 CL), thick; basis-ischia and meri with small tubercles; spines along posterior border of dactyli.

Abdomen of mature males elongate, with both sides almost parallel to each other, with all segments free, segments 1-2 dorsoventrally compressed, one transverse ridge along each segment 1-4 (incomplete in segment 5). Male first pleopods (Fig. 38d) with sinuous basal parts; each distal part uniramous, thick, laterally flattened, with dissimilar dorsal and ventral tips with teeth. Second male pleopods short, thin, slightly curved; distal segment with blunt tip.

Abdomen of mature females broad and rounded, with all segments free, segments 1-2 dorsoventrally compressed, one transverse ridge along each segment 1-3 (may be low in segment 4).

SPECIES INCLUDED. — Only one species is known, *Exopalicus maculatus* (Edmondson, 1930).

SEXUAL DIMORPHISM. — Males are smaller than females as in other palicids. The chelipeds are unequal in both sexes. There is a thick clump of plumose setae on the inner surfaces of the cheliped propodi in males, as in five other species of Indo-west Pacific palicids (see "Sexual Dimorphism and Mating Behavior").

DISCUSSION. — *Exopalicus* shares with *Rectopalicus* the presence of short walking legs with spines along the posterior border of the propodi. There are also some similarities in the epistome (slightly expanded dorsoventrally as in *R. amphiceros*), male first pleopods (laterally flattened with spines, as in *R. amphiceros*; Figs 35d-e), and conspicuous rounded tubercles on the carapace and appendages as in *R. ampullatus*. Nevertheless, the hexagonal, dorsally convex (almost rounded) shape of its carapace, large and triangular anterolateral teeth, and complex male first pleopods with terminal and lateral teeth of different sizes and shapes set it apart from the subquadrate or pyriform carapace and body plan of *Rectopalicus* and its simpler male first pleopod. Other characteristic features of *Exopalicus* are the very short eye peduncles and postorbital angles (perhaps as a result of the rounding of the carapace), more conspicuous episternal process, and the presence of only one very short lobe on each supraorbital border.

The walking legs and fifth pair of pereopods are shorter in relation to carapace size in *Exopalicus* than in other Indo-west Pacific palicids. The shortening of the walking legs may be an adaptation to living in hard substrate habitats, such as coral, where swimming is very much limited.

No known species of western Atlantic or eastern Pacific palicids resembles the general body plan of *Exopalicus*.

ETYMOLOGY. — From *ex*, Latin for out of, and the generic name *Palicus*, in reference to the unique triangular outline of the conspicuously convex carapace, which sets it apart from other genera of palicids.

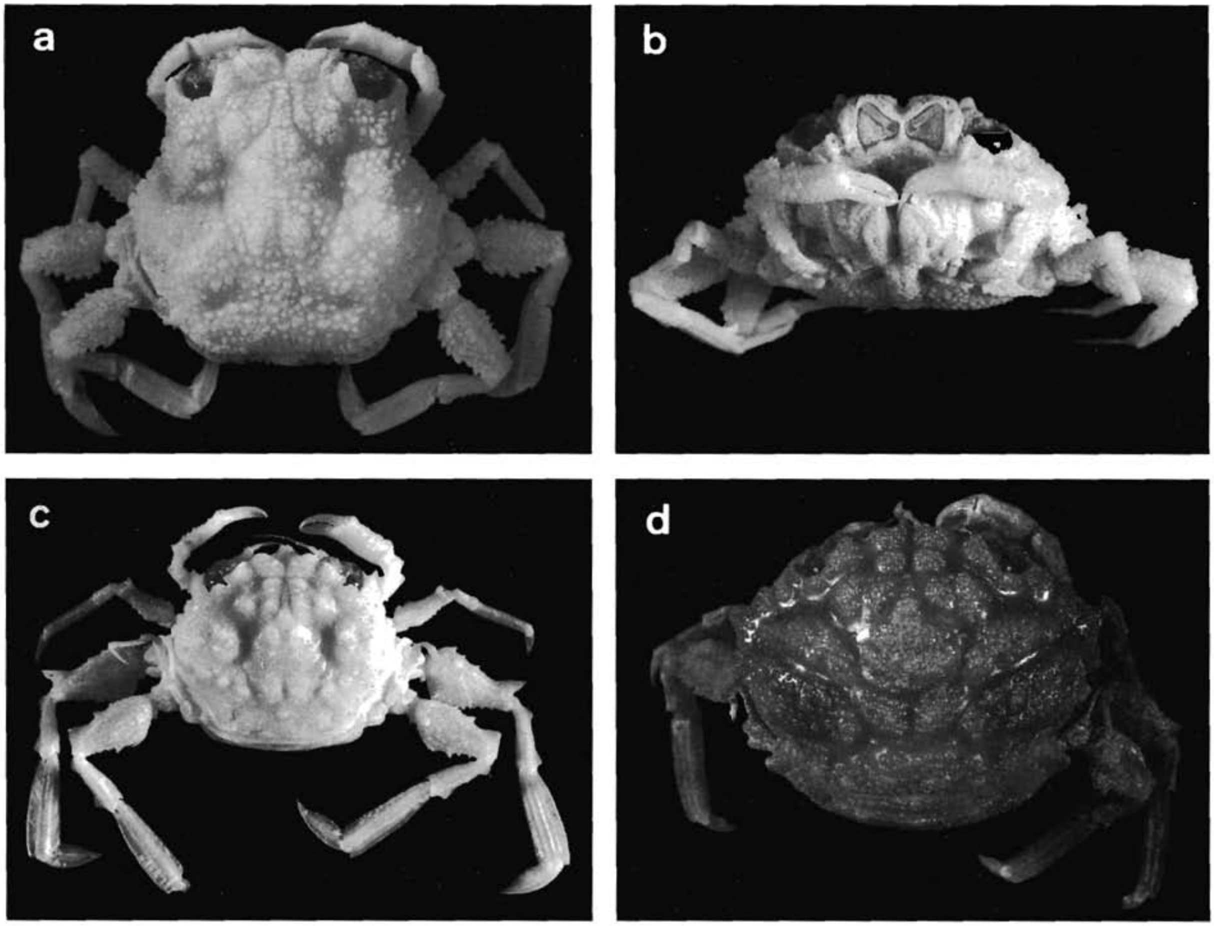

FIG. 37. — **a-b**, *Rectopalicus ampullatus* sp. nov., ♂ holotype 6.2 x 6.3 mm, Loyalty Islands, MUSORSTOM 6, stn DW 462, 200 m (MNHN-B 26782): **a**, dorsal view; **b**, anterior view of carapace. — **c**, *Rectopalicus woodmasoni* (Alcock, 1900), ♀ 9.4 X 10.3 mm, off southwest coast of New Caledonia, BATHUS 2, stn CP 728, 241-245 m (MNHN-B 26774): dorsal view. — **d**, *Exopalicus maculatus* (Edmondson, 1930), ♀ 9.5 x 13.1 mm, Oahu, Hawaiian Islands, J. HOOVER & D. DICKEY coll., 3-4 m (MNHN-B 26784): dorsal view.

Exopalicus maculatus (Edmondson, 1930)

Figs 37d, 38, 56, 61b

Palicus tuberculatus Edmondson, 1925: 57, figs 8e-g, pl. 4, figs A-G; 1933: 268; 1946: 310.
Palicus maculatus Edmondson, 1930: 15, figs 6a-g, pl. 1, fig. C; 1933: 268, fig. 158c; 1946: 310, fig. 184c.
Cymopolia medipacifica Edmondson, 1962: 9, figs 4a-c.
Cymopolia maculata - EDMONDSON, 1962: 11, figs 4d-e.
Pseudopalicus sp. - HOOVER, 1998: 287, unnumb. fig.

MATERIAL EXAMINED. — **La Réunion**. Cap Houssaye, night diving, on *Millepora* coral, 15 m, J. BENETEAU coll., 10.1973: 1 ♂ 5.5 x 7.2 mm, 1 ♀ 5.6 x 6.8 mm (MNHN-B 26785).

Marshall Islands. *Enewetak Atoll*. Parry Island, lagoon, 3-5 m, J.S. GARTH coll., 22.07.1957: 1 ♂, 1 ♀ (LACM).

Hawaiian Islands. *Oahu*. Waikiki, OSTERGAARD coll., 11.1922: 1 ♂, 1 ♀ (BPBM 932). — Waikiki, 1923: 1 ♀ (BPBM 3266). — Waikiki, 30.03.1930: 1 ♂ holotype of *Palicus maculatus* Edmondson, 1930, 5.6 x 7.2 mm (BPBM 3337). — Honolulu, Ala Moana Beach Park, Magic Island Boat Channel, rock wall, night diving, 5 m, J. HOOVER coll., 7.10.1997: 1 ♀ (QM W24746); rock wall, night diving, 3-4 m, J. HOOVER & D. DICKEY coll., 17.06.1999: 1 ♀ 9.5 x 13.1 mm (MNHN-B 26784); on boulders, night collection, 1 m, D. TAKAOKA coll., 1.08.1999: 1 ♀ 9.8 x 14.0 mm (MNHN-B 26999). — Blow Hole, 18 m, R. HOLCOM coll., 02.1996: 1 ♂ (QM W21847); 15 m, 01.1997: 2 ♂ 7.1 x 10.2 mm, 7.4 x 10.3 mm (QM W24745).

Molokai. Kaunakakai, BALL & C.H. EDMONDSON coll., 22.02.1922: 1 ♀ (BPBM 940).

TYPES. — *Holotype* of *Palicus tuberculatus* Edmondson, 1925 apparently lost: 1 ♀ 9 x 12 mm, Ocean (= Kure) Island, 28°25'N, 178°25'W, "shallow water on the reef" (EDMONDSON, 1925) (BPBM 1134).

Holotype of *Palicus maculatus* Edmondson, 1930: 1 ♂ 5.6 x 7.2 mm, Oahu, Hawaiian Islands (BPBM 3337).

TYPE LOCALITY. — Waikiki reef, Oahu, Hawaiian Islands, shallow water.

DIAGNOSIS. — Carapace (Figs 37d, 38a) with three triangular, broadly pointed anterolateral teeth on each side; large tubercle posterior to postorbital angle, several small, rounded tubercles between the anterolateral teeth. Dorsal surface of carapace convex, with many rounded tubercles and tuberculate bosses. Supraorbital borders each with two shallow notches resulting in one very short lobe. Suborbital borders (Fig. 38b) each with very broad, short inner and outer lobes. Dorsal borders of cheliped propodi with rounded tubercles. Dactyli of walking legs (P2-4) with thick spines along posterior borders (one tooth in P4; Fig. 38c). Abdomen of mature males with all segments free, one complete transverse ridge along each segment 1-4, incomplete ridge along median portion of segment 5. Male first pleopods (Fig. 38d) with sinuous basal parts; each distal part with one flattened process with teeth. Abdomen of mature females with all segments free, one complete transverse ridge along each segment 1-3 (low ridge along segment 4).

Color: Individuals photographed live in Hawaii show a very wide range of color patterns: pink carapace with large red dots (Fig. 61b), pink with irregular white markings (HOOVER, 1998: 287, unnumbered figure), irregular bright or light orange spots, and bright red carapace and white legs. Another was described as "dull, dark grayish brown" (HOOVER, personal communication).

DISCUSSION. — This species was described as *Palicus tuberculatus* by EDMONDSON (1925). The holotype (BPBM 1134) is apparently lost, but three specimens identified by EDMONDSON as *P. tuberculatus* and mentioned by him in the description (BPBM 940, BPBM 942) agree with the actual description. One exception, however, is in the number of anterolateral teeth on each side of the carapace. EDMONDSON (1925: 57; pl. 4, figs A, E) gives its number as five but the number, shape, and relative length vary widely among the specimens examined in this study, even between the right and left side of the same individuals. For example, a male identified by EDMONDSON (BPBM 932) had four obvious teeth and tubercles on the left side but five on the right. The anterolateral teeth are perhaps more correctly given as three. Most, in not all of the teeth typically have a small, rounded tubercle on one or both sides (Figs 37d, 38a). There is also a conspicuous, rounded tubercle posterior to the postorbital angle that can be almost as large as the first tooth, particularly in small individuals.

Palicus maculatus Edmondson, 1930, which is known only from one male collected from shallow-water coralline algae in Hawaii (5.6 x 7.2 mm; BPBM 3337), is clearly a small specimen of *P. tuberculatus*.

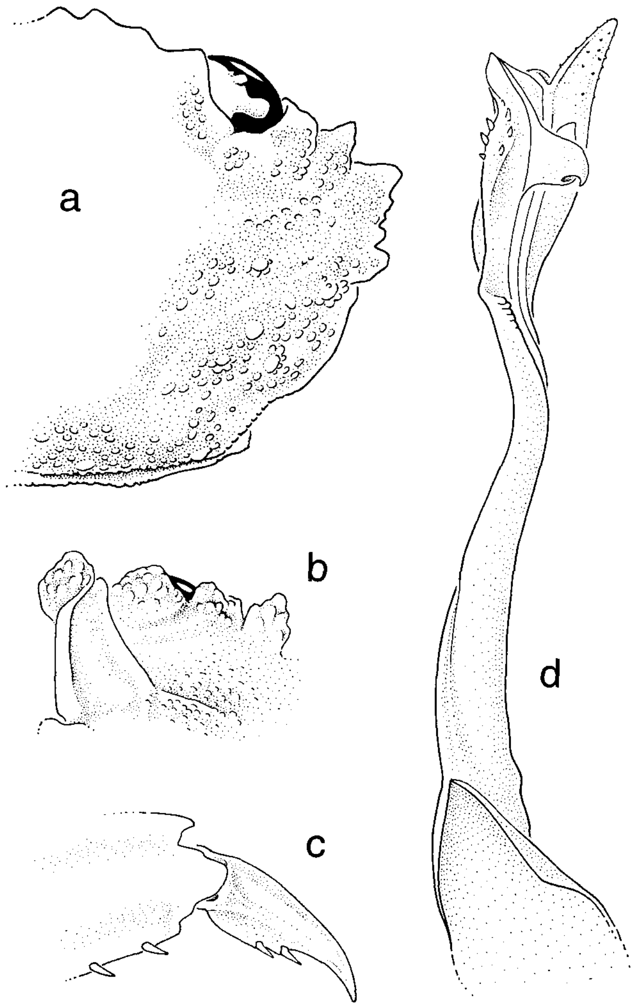

FIG. 38. — *Exopalicus maculatus* (Edmondson, 1930), ♂ 7.4 x 10.3 mm, Blow Hole, Oahu, Hawaiian Islands, 15 m (QM W24745): **a**, carapace, dorsal view; **b**, suborbital border; **c**, dactylus, right fourth pereopod, dorsal view; **d**, left male first pleopod, lateral (outer side) view.

EDMONDSON (1930: 17) distinguished *P. maculatus* from *P. tuberculatus* by having a smaller fifth anterolateral tooth ("as long as the fourth, but narrower" than *P. tuberculatus*), tubercles on the "upper and lower surfaces" less prominent, and the fingers of the chelipeds "less deflexed and the inner borders of the hands are free from hair". These characters fall within the range of morphological variation of the species. One exception, however, is the absence of the thick clump of plumose setae that characterizes males of *P. maculatus*. It is possible that the setae were absent in the holotype after almost seventy years of preservation or that perhaps this is a character absent in small males. Furthermore, EDMONDSON's figures of the holotype were incorrect. The holotype has four anterolateral teeth, the second is the largest and the last two are located on an almost straight line posterior to it. The figure, however, shows what might be interpreted as two rounded teeth anterior to a large, pointed tooth and two broad, rounded teeth posterior to it.

EDMONDSON's living specimen was described as having a "broad crimson band" across the propodi of the walking legs and chelipeds and a large crimson spot on a depression behind each eye (EDMONDSON, 1930: 15, pl. 1, fig. C). The dark band across each second pair of walking legs that is shown in EDMONDSON's photograph is similar to that shown in the holotype of *R. ampullatus* (Fig. 61a). A specimen photographed live in Hawaii (HOOVER, 1998: 287, unnumbered figure) was cryptically colored pink and with irregular white markings on the carapace and walking legs. A female (9.5 x 13.1 mm; MNHN-B 26784) that had been preserved in alcohol for 18 days showed numerous, small red dots on the dorsal surfaces of the chelipeds, meri of walking legs, and borders of the carapace.

The name of *P. tuberculatus* was subsequently changed by EDMONDSON (1962: 8) to *P. medipacificus* (Edmondson, 1962) (as *Cymopolia medipacifica*) since the name was already preoccupied by *Cymopolia tuberculata* Faxon, 1895, a western Atlantic species. *P. maculatus* Edmondson, 1930, however, takes precedence since the name was used in 1930 for a junior subjective synonym.

All pereopods of *E. maculatus* are particularly short when compared with other palicids. The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	0.9	1.1-1.2	1.1	0.5
Merus length/CL	0.3	0.3	0.3	0.1
Dactylus length/CL	0.1-0.2	0.2	0.2	0.1

There are 5-6 spines each along the posterior border of the propodi of P2-P3, and 7-8 in P4. Each dactylus of the walking legs is armed with a 1-2 teeth, each capped by a thick spine (Fig. 38c). The P5 are very short, the ischia and meri have small but conspicuous tubercles, and the posterior borders of the meri and dactyli are each armed with two and one spine respectively.

E. maculatus is known only from few locations at the extreme ends of the Indo-west Pacific region: the southwestern Indian Ocean and the north-central Pacific Ocean. Most specimens have been collected at night. It appears that individuals hide in coral and other hard substrates and emerge at night. Their nocturnal habits (see HOOVER, 1998: 287), small size, and cryptic coloration should explain their puzzling absence in collections from other Indo-west Pacific locations.

SIZE. — Maximum size among specimens examined: 8.4 x 11.1 mm (male, LACM), 9.8 x 14.0 mm (female, MNHN-B 26999).

DISTRIBUTION. — Known from the Hawaiian Islands and Kure Island (EDMONDSON, 1925, 1930, 1933, 1946, 1962; some records as *P. tuberculatus* or *Cymopolia medipacifica*) but its range now includes the Marshall Islands, and La Réunion, southwestern Indian Ocean (Fig. 56). Depth: "shallow water" (EDMONDSON, 1925, 1930) to 18 m.

Genus *NEOPALICUS* Moosa & Serène, 1981

Neopalicus Moosa & Serène, 1981: 41.

TYPE SPECIES. — *Cymopolia jukesii* White, 1847 by original designation (MOOSA & SERÈNE, 1981). Gender: masculine.

DIAGNOSIS. — Carapace subquadrate; frontal border divided into two large lobes followed by distinct notch on each side. Anterolateral borders each with two large truncate teeth (similar but shorter teeth may be posterior to first two). Dorsal surface of carapace with large, low granules in horizontal rows, very low bosses. Eyes spherical; each peduncle with one conspicuous, granular, median tubercle and two smaller, granular or soft tubercles. Supraorbital borders each with 1-2 triangular lobes. Suborbital borders with two large, triangular, dentiform lobes. Each basal antennal segment expanded into thick, flat process or two wing-like expansions. Epistome expanded dorsoventrally, forming broad, semicircular, nearly flat surface; thin carina-like process along median portion without protruding median teeth. Chelipeds equal or nearly equal in males and females, slender in females, heavier in males. First three pairs of walking legs (P2-4) with flattened (not filiform) carpi, propodi, and dactyli. First pair (P2) shorter than second and third pairs (P3-4); third pair about as long as second pair. Meri of P2-4 oval in shape, borders with thick tubercles or triangular teeth. Anterior borders of propodi of P3-4 with conspicuously wide, convex enlargement; posterior border of dactyli entire. Fifth pair of pereopods (P5) reduced (0.7-0.8 CL), thick; rows of thick spines along posterior border of propodi. Abdomen of mature males elongate (sides almost parallel to each other), all segments free, one transverse ridge along each segment. Male first pleopods long and slender; basal parts sinuous; each distal part biramous. Abdomen of mature females with all segments free, one transverse ridge along each segment.

REDESCRIPTION. — Carapace subquadrate, slightly broader than long, with large, low granules arranged in horizontal bands. Anterolateral borders straight or slightly curved, each with two truncate teeth. Confluence of branchial and mesogastric regions depressed and smooth. Conspicuous sulcus between hepatic and branchial regions. Thoracic sternite 7 with reduced process (episternal process) at each outer edge and posterior to insertion of fifth pair of pereopods (P5), visible dorsally as elongate or slightly rounded process below posterolateral border of carapace. Posterior border of carapace smooth, without protruding tubercles or plumose setae.

Frontal border divided into two rounded lobes; distinct, wide notch separates frontal lobes on each side from folded, slightly rounded border ending in sharp angle forming V-shaped fissure at supraorbital border. Supraorbital borders each with 1-2 triangular lobes. Postorbital angles relatively short (never extending above retracted eyes), pointed. Cornea of eyes spherical, almost as wide as base of peduncle; each peduncle with one conspicuous, rounded, granular, median tubercle and two smaller, granular or soft tubercles. Orbits deep.

Suborbital border with two triangular, dentiform lobes. Pterygostomial lobe at each anterolateral angle of buccal frame projects ventrally, sinuous edge.

Antennules short, thick, and transversely folded beneath front; interantennular septum narrow. Each basal antennal segment expanded into thick, dorsoventrally flattened, scale-like process or two thin, wing-like, anterior expansions. Epistome expanded dorsoventrally, forming nearly flat surface between antennular fossae and anterior border of endostome; no median teeth, only low, thin, carina-like process along median portion, flanked at same level by two outer lobes that connect with each pterygostomial lobe. Meri of third maxillipeds smaller, narrower than ischia.

Chelipeds equal or nearly equal in males and females, long, slender in females and shorter, thicker in males (very thick propodus in largest males). Fingers of chelipeds with triangular teeth (broadly rounded teeth in very large chelipeds of largest males), pollex becoming flatter with increasing size. First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair slightly shorter or as long as second. First three pairs of walking legs (P2-4) with flattened (not filiform) carpi, propodi, and dactyli. Meri slightly oval (not much more longer than wide); anterior (dorsal) and posterior (ventral) borders with thick, unequal tubercles or triangular teeth, rows of tubercles on dorsal and ventral surfaces. Elongate (but not filiform and conspicuously slender) propodi and dactyli; posterior borders entire. Last two pairs of walking legs (P3-4) each with slightly broadened coxae, having slightly flattened, thick-edged anterior and posterior borders. Anterior borders of propodi of P3-4 with conspicuously wide, convex enlargement. Fifth pair of pereopods (P5) reduced (0.7-0.9 CL), thick; basis-ischia and meri long and tuberculate; propodi with 2-3 rows of very thick spines along posterior border; dactyli thick and slightly curved.

Abdomen of mature males elongate, with both sides almost parallel to each other, with all segments free, segments 1-2 dorsoventrally compressed, one transverse ridge along each segment. Male first pleopods long and slender; basal parts sinuous; each distal part biramous. Second male pleopods short, thin, slightly curved; distal segment with blunt tip.

Abdomen of mature females broad, rounded, with all segments free, segments 1-2 dorsoventrally compressed, one transverse ridge along each segment. Abdomen of immature females triangular (but broader than in males), segments 1-2 dorsoventrally compressed, segments 3-6 fused, transverse ridge along each segment 1-2 plus two along proximal portion of fused segments 3-6.

SPECIES INCLUDED. — *N. contractus* (Rathbun, 1902) and *N. jukesii* (White, 1847).

SEXUAL DIMORPHISM. — As in other palicids, females are considerably larger in size than males. The chelipeds are equal or nearly equal in both sexes. They are slender in females but heavier in males. There is no evidence of differences in the length or shape of the walking legs or the fifth pair of pereopods.

DISCUSSION. — The description of *Neopalicus* by MOOSA & SERÈNE (1981) included the most important characters of this small and relatively homogeneous genus. As in the other Indo-west Pacific genera, however, its description has been expanded to include several new characters, even though no new species are described here.

Neopalicus is morphologically similar to *Palicoides* Moosa & Serène, 1981. The four species included in these two genera are adapted to live in coarse sediments in relatively shallow water in or near coral reefs. Two and even three of the four species in the two genera have been repeatedly collected together from the same stations in the Coral Sea region. There are sharp differences between these four species and the species included in the other palicid genera (see Table 1), most of which are inhabitants of finer sediments in deeper waters. Many of these differences are seemingly the result of morphological and behavioral adaptations to their particular habitats. Unfortunately, nothing is known about the habits of the four species of *Neopalicus* and *Palicoides* but it is assumed that they bury in the sand (that is, they cover themselves with sand without forming burrows) at least during part of the day.

Species of *Neopalicus* and *Palicoides* share a subquadrate carapace, large and low tubercles that do not form bosses, and thick fifth pereopods (Figs 39, 42). They even have a similar color pattern (Figs 61 c-e). *Neopalicus* species are characterized by three rounded tubercles on each eye peduncle, the largest of which is round, high and granular, while there is a very conspicuous, larger, crescent-shaped (thin, rounded, and with pointed tip) process on each peduncle in *Palicoides* species (see Table 1). Another character that is diagnostic in *Neopalicus* is the expansion of the anterior borders of the propodi of the second and third pair of walking legs (P3-4) as a wide and convex enlargement. Such an expansion is absent in the legs of *Palicoides*. Segments 2-3 of the antennae (Fig. 42a) are expanded and provided with long setae in *Palicoides*, whereas they are slender in *Neopalicus* as in most other Indo-west Pacific palicids (Figs 40a-c).

No described species of palicids from outside the Indo-west Pacific region show the subquadrate, flat carapace, and thickened fifth pereopods characteristic of *Neopalicus*.

Key to the species of *NEOPALICUS*

1. Carapace widest at level of first anterolateral tooth, lateral borders convergent posteriorly (Fig. 39a). Basal antennal segment thick, scale-like (Fig. 40a) .... ***N. contractus*** (Rathbun, 1902)

— Carapace widest at level of second anterolateral tooth, lateral borders not convergent posteriorly (Fig. 39b). Basal antennal segment with two thin, nearly equal, wing-like processes (Figs 40b-c) .... ***N. jukesii*** (White, 1847)

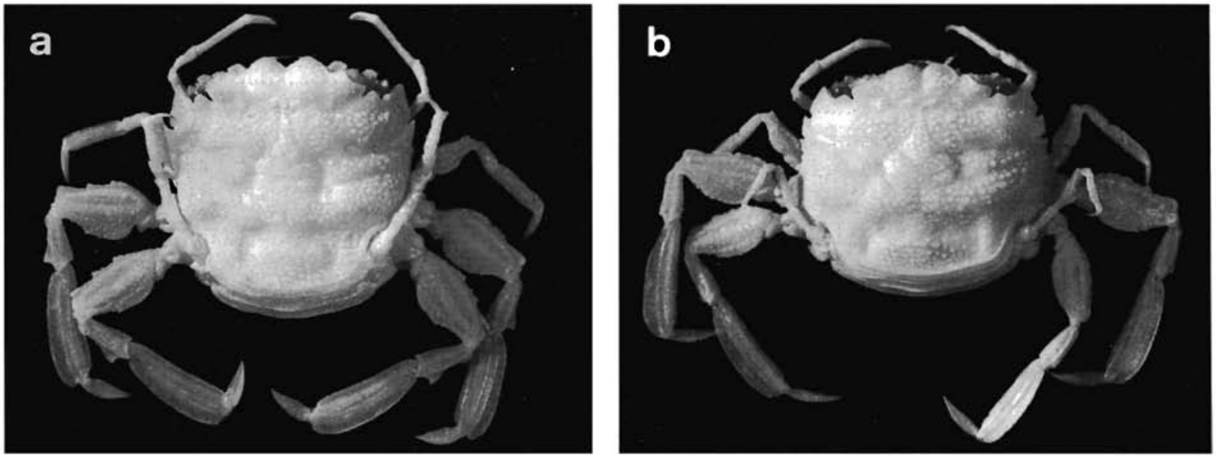

FIG. 39. — **a**, *Neopalicus contractus* (Rathbun, 1902), ♀ 14.2 x 15.7 mm, Chesterfield Islands, CORAIL 2, stn DW 65, 62 m (MNHN-B 26788): dorsal view. — **b**, *Neopalicus jukesii* (White, 1847), ♀ 8.1 x 9.6 mm, east coast of New Caledonia, LAGON, stn 713, 34-35 m (MNHN-B 26996): dorsal view.

Neopalicus contractus (Rathbun, 1902)

Figs 39a, 40a, 41a-b, 49

Palicus contractus Rathbun, 1902: 126, figs 7-8. — SERÈNE, 1968: 96.
Palicus jukesi - LAURIE, 1906: 430, pl. 1, fig. 12 [non *Neopalicus jukesii* (White, 1847)].
Cymopolia robusta Ward, 1942a: 46, pl. 4, figs 3-4; 1942b: 53. — MICHEL, 1964: 33; 1974: 134. — GUINOT, 1967: 280.
Palicus robustus - SERÈNE, 1968: 96.
Neopalicus contractus - MOOSA & SERÈNE, 1981: 44, pl. 2, fig. D.
Palicus jukesi - GARTH *et al.*, 1987: 259 [non *Neopalicus jukesii* (White, 1847)].
non *Palicus contractus* - ZARENKOV, 1968: figs 3Д, E [*P. contractus* in caption and English summary, *P. jukesii* in text; fig. 3Д = *Paliculus kyusyuensis* (Yokoya, 1933), fig. 3E = *N. jukesii* (White, 1847)].

MATERIAL EXAMINED. — **Seychelles**. REVES 2: stn 17, 05°44.8'S, 56°39.1'E, 55 m, coralline algae, 5.09.1980: 1 ♂, 1 ♀ (MNHN-B 27149). — Stn 18, 05°43.2'S, 56°34.0'E, 50 m, shelly sand, 5.09.1980: 1 ♀ (MNHN -B 27147). — Stn 38, 05°03.5'S, 56°50.5'E, 44 m, coralline algae and dead coral, 13.09.1980: 1 ♀ (MNHN-B 27145). — Stn 52, 03°52.8'S, 55°25.3'E, 60 m, sand, 16.09.1980: 1 ♀ (MNHN-B 27144).

Maldives. *Miladummadulu Atoll*. Nallandu Island, 44 m, A. AGASSIZ coll., 18.01.1902: 1 ♂ lectotype of *Palicus contractus* Rathbun, 1902 4.9 x 7.5 mm (MCZ 6699).

South Nilandu Atoll. J.S. GARDINER coll.: 1 ♂, 1 ♀ (UMZ).

Sri Lanka. *Gulf of Manaar*. W.A. HERDMAN coll.: 1 ♂ (BMNH 1934.1.16.164).

Philippine Islands. MUSORSTOM 3: stn DR 137, 12°03'N, 122°06'E, 56 m, 6.06.1985: 3 ♀ (MNHN-B 27143).

Chesterfield Islands - Chesterfield-Bellona Plateau. CHALCAL 1: stn D 43, 20°41.50'S, 158°38.40'E, 78 m, *Halimeda* sand, 07.1984: 1 ♂ (MNHN-B 27151). — Stn D 45, 20°48.93'S, 158°30.21'E, 50 m, 07.1984: 1 ♀ (MNHN-B 27154). — Stn D 52, 21°13.40'S, 158°49.20'E, 69 m, 07.1984: 1 ♂ (MNHN-B 27155). — Stn D 53, 21°19.50'S, 158°05.30'E, 60 m, 07.1984: 3 ♂ (MNHN-B 27148). — Stn D 55, 21°23.90'S, 158°59.60'E, 55 m, *Halimeda* and foraminiferans, 07.1984: 1 ♂ (MNHN-B 27150). — Stn D 56, 21°24.40'S, 159°08.80'E, 60 m, *Halimeda* and foraminiferans, 07.1988: 1 ♂ 10.8 x 12.0 mm (MNHN-B 26789), 1 ♀ (MNHN-B 27139).

CORAIL 2: stn DW 2, 20°55.90'S, 161°40.70'E, 62 m, boulders and *Halimeda*, 28.07.1988, 1 ♀ (MNHN-B 27156). — Stn DW 18, 20°44.08'S, 160°59.92'E, 69 m, 21.07.1988: 1 ♀ (MNHN-B 27142). — Stn DW 61, 19°14.96'S, 158°53.60'E, 54 m, *Halimeda* sand, 24.08.1988: 1 ♀ (MNHN-B 27152). — Stn DW 65, 19°15.00'S, 158°40.64'E, 62 m, *Halimeda* sand, 24.08.1988: 1 ♀ 14.2 x 15.7 mm (MNHN-B 26788). — Stn DW 80, 19°11.98'S, 158°47.01'E, 66 m, *Halimeda* sand, 25.08.1988: 1 ♀ (MNHN- B 27141). — Stn DW 94, 19°06.00'S, 158°50.00'E, 36-53 m, boulders and *Halimeda*, 27.08.1988: 1 ♀ (MNHN-B 27146).

Bellona Reefs. Stn 2 DE, 21°21.5'S, 158°48.0'E, 61-64 m, 19.10.1985: 1 ♀ (MNHN-B 27153). — Stn 7 DE, 21°21.0'S, 158°52.7'E, 56-58 m, 19.10.1985: 2 ♂ (MNHN-B 27140).

New Caledonia. LAGON: stn 392, 22°48.2'S, 167°02.3'E, 80 m, shell debris, foraminiferans, 22.01.1985: 1 ♀ 17.3 x 18.6 mm (MNHN-B 26786).

SMIB 5: stn DW 100, 23°22.9'S, 168°05.2'E, 80-120 m, sand, 14.09.1989: 1 ♂ 12.9 x 14.0 mm (MNHN-B 26787).

Marshall Islands. *Enewetak Atoll*. Stn 423, J.W. KNUDSEN coll., 14.08.1967: 1 ♂ (LACM). — Stn 429, 15.08.1967: 1 ♀ (LACM). — Stn 187: 1 ♀ (LACM).

TYPES. — *Lectotype* of *Palicus contractus* Rathbun, 1902: 1 ♂ 4.9 x 7.5 mm, 1 ♂ paralectotype, Maldives (MCZ 6699).

Holotype of *Cymopolia robusta* Ward, 1942: 1 ♀ CW 16 mm (WARD, 1942), Mauritius. Deposit unknown: Mauritius Institute, Port Louis, Mauritius ?

TYPE LOCALITY. — Nallandu Island, Miladummadulu Atoll, Maldives, 44 m.

DIAGNOSIS. — Carapace (Fig. 39a; RATHBUN, 1902, fig. 7; MOOSA & SERÈNE, 1981, pl. 2, fig. D) subquadrate, with large, low granules; lateral borders wider anteriorly than posteriorly so that widest extension of carapace at level of first and larger of two anterolateral teeth. Supraorbital borders each with one triangular inner lobe, one short outer lobe. Suborbital borders (Fig. 40a) each with two triangular, tooth-like lobes. Each basal antennal segment (Fig. 40a) with thick, dorsoventrally flattened process along outer border, much shorter, elongate process along inner border. Dorsal borders of cheliped propodi with rounded, microscopic tubercles, much more pronounced in thick chelipeds of large males; outer borders with hook-like setae. Dorsal and ventral sides and upper and lower borders of meri of second and third pairs of walking legs (P3-4; Fig. 39a) with conspicuous tubercles; anterior borders of carpi of P3-4 with similar tubercles; anterior borders of propodi with conspicuously wide, convex enlargement. Abdomen of mature males narrow, with all segments distinct; one transverse ridge along each segment. Male first pleopods (Figs 41a-b) with sinuous basal parts; each distal part biramous, with one flattened, anterior tip with four pointed teeth, and long, curved extension with teeth along dorsal border extending immediately above toothed base. Abdomen of mature females with all segments distinct, one transverse ridge along each segment (less pronounced and curved in median portion in segment 6).

DISCUSSION. — This is the first time the male pleopod of *N. contractus* is described and illustrated. The figure of the male pleopod given by ZARENKOV (1968, fig. 3E) is actually that of *N. jukesii*, although it is correctly identified in the text (ZARENKOV, 1968: 765). The ventral view of the anterolateral portion of the carapace that is identified as *N. jukesii* in the text and as *N. contractus* in the caption (ZARENKOV, 1968, fig. 3Д, 765) does not belong to *Neopalicus* but to *Paliculus kyusyuensis* (Yokoya, 1933) instead. To add to the confusion, *N. contractus* and not *N. jukesii*, is listed in the English summary (ZARENKOV, 1968: 766)!

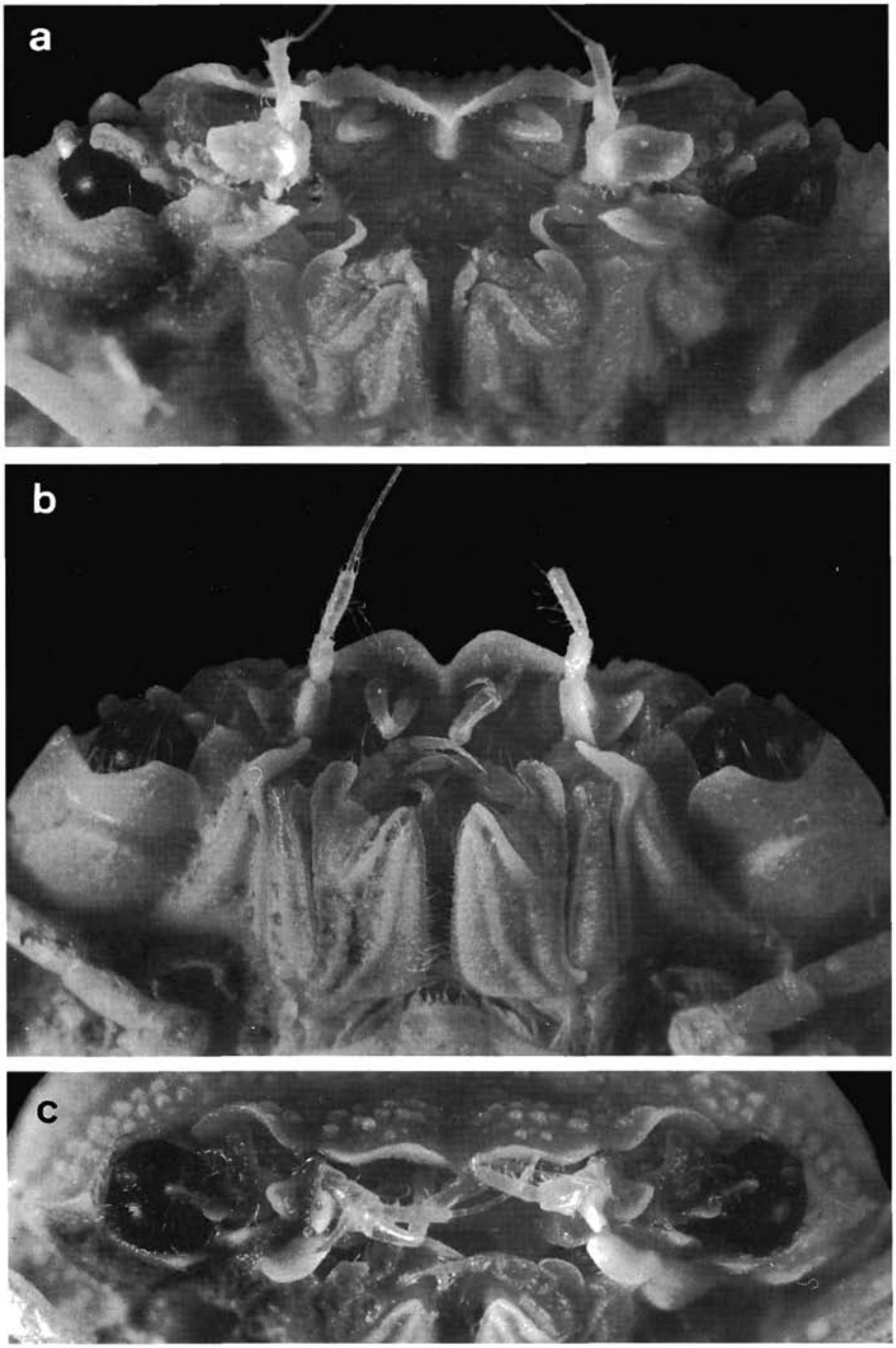

FIG. 40. — **a**, *Neopalicus contractus* (Rathbun, 1902), ♀ 14.2 x 15.7 mm, Chesterfield Islands, CORAIL 2, stn DW 65, 62 m (MNHN-B 26788): ventral view of anterior portion of carapace. — **b-c**, *Neopalicus jukesii* (White, 1847): ♀ 8.1 x 9.6 mm, east coast of New Caledonia, LAGON, stn 713, 34-35 m (MNHN-B 26996): **b**, ventral view of anterior portion of carapace; **c**, anterior view of carapace.

Although the chelipeds are long, slender, and equal in immature males, they become thicker with increasing size. In the largest male examined in this study, a specimen from New Caledonia (12.9 x 14.0 mm; MNHN-B 26787), the right cheliped was greatly enlarged, much more than the chelipeds in the second largest male (10.8 x 12.0 mm; MNHN-B 26789). A large male from the Maldives (UMZ) that was not measured, also had an enlarged right cheliped. The fingers of the enlarged cheliped were short and very thick. The propodus and fingers of the left cheliped were missing but the segments that remain were only slightly smaller than those of the right cheliped. The male first pleopods and other morphological characters of the largest specimens agreed with those of smaller males.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	0.9-1.0	1.5	1.5-1.6	0.8-0.9
Merus length/CL	0.3	0.4	0.4-0.5	0.2-0.3
Dactylus length/Cl	0.2	0.2-0.3	0.5	0.1-0.2

The fifth pair of pereopods (P5; Fig. 39a) is typical of *Neopalicus*, with thick, tuberculate segments (except dactylus), very thick spines along the posterior border of the propodus, and a slightly curved dactylus.

Most specimens of *N. contractus* can be easily distinguished from *N. jukesii*, a close species (see Table 3). Nevertheless, both species can be confused when there is limited material or only small specimens, as demonstrated by repeated mistakes in the literature. The shape of the carapace is a relatively stable character but the shape of the anterolateral teeth tends to overlap, particularly in small specimens and in large females.

The shape of each basal antennal segment is a much more reliable character. It has a conspicuous, thick, scale-like process as well as a smaller, inner process (Fig. 40a) in contrast to the two thin, nearly equal, wing-like processes (Figs 40b-c) in *N. jukesii*. In their key to the species of *Neopalicus*, MOOSA & SERÈNE (1981: 41) characterized the basal antennal segment of *N. jukesii* as having a "subacutely carinate" anterolateral angle in contrast to a "bilobed process" on the anterolateral angle of *N. contractus*. It seems that both characters were reversed since it is difficult to characterize the segment in *N. contractus* as "bilobed" (unless the inner prominence was considered a lobe) and one of the two wing-like expansions in *N. jukesii* was interpreted as a carina.

MOOSA & SERÈNE (1981: 41) also included in the key they used to separate between the two species a difference in the relative length of the dactylus of P4 in relation to the length of the propodus, the dactylus being less than half the propodus length in *N. contractus* but more than half in *N. jukesii*. This was found not to be the case in the many specimens that were examined in this study. The dactylus length to propodus length ratio was found to vary between 1:1.8 to 1:1.9 in both species.

Cymopolia robusta Ward, 1942 can be identified as a subjective junior synonym of *N. contractus* from the photograph that accompanied its description (WARD, 1942a). The holotype, supposedly at the Mauritius Institute, was unavailable for examination. As previously mentioned by MOOSA & SERÈNE (1981: 44), the characters used by WARD (1942a) to separate his species from *N. jukesii* also apply when *N. contractus* is compared with *N. jukesii*.

RATHBUN (1902) based her description of *Palicus contractus* on two specimens without selecting a holotype. One of the two syntypes (♂ 4.9 x 7.5 mm, MCZ 6699) is hereby designated as the lectotype and the second male specimen as a paralectotype.

SIZE. — Maximum size among specimens examined: 17.3 x 18.6 mm (female, MNHN-B 26786); 12.9 x 14.0 mm (male, MNHN-B 26787).

DISTRIBUTION. — Mauritius (WARD, 1942a, 1942b; as *Cymopolia robusta*), Maldives (RATHBUN, 1902), Sri Lanka (LAURIE, 1906, as *Palicus jukesi*), and Ceram and Kai islands, Indonesia (MOOSA & SERÈNE, 1981). It is here recorded for the first time from the Seychelles, Philippine Islands, the Coral Sea (Chesterfield Islands, Bellona Reefs, and New Caledonia), and the Marshall Islands (Fig. 49). It has been repeatedly collected from coarse sand rich in coral, coralline algae, and shell rubble. In the Coral Sea, it has been collected together with *N. contractus* and the two species of *Palicoides*. Depth: known reliably between 44 and 80 m; also collected in trawls between 36-53 m and 80-120 m.

Neopalicus jukesii (White, 1847)

Figs. 39b, 40b-c, 41c, 49, 61c

Cymopolia jukesii White, 1847a: 54 [nomen nudum].
Cymopolia jukesii White, 1847b: 338, pl. 2, fig. 1; 1861: pl. 2. — MIERS, 1874: 3, pl. 3, figs 4, 4a-c; 1886: 335. — HASWELL, 1882: 138. — HENDERSON, 1893: 405.
Cymopolia carinipes Paulson, 1875: 76, pl. 9, figs 4, 4a; 1961: 79, pl. 9, figs 4, 4a.
Palicus jukesii - BOUVIER, 1897: 65. — ALCOCK, 1900: 451. — CALMAN, 1900: 29, pl. 1, figs 9-13. — DE MAN, 1902: 545. — RATHBUN, 1902: 126; 1911: 240, pl. 19, fig. 9. — LAURIE, 1915: 416. — NOBILI, 1906a: 325. — ZARENKOV, 1968: 765, fig. 3E [*P. contractus* in caption and English summary]; 1971: 173.
Palicus jukesi - BORRADAILE, 1903: 433. — SERÈNE, 1968: 96.
Cymopolia jukesi - GUINOT, 1967: 280.
Palicus carinipes - HOLTHUIS, 1977: 181, fig. 2.
Neopalicus jukesi - MOOSA & SERÈNE, 1981: 42, fig. 7, pl. 2, fig. C.
non *Palicus jukesii* - LAURIE, 1906: 430, pl. 1, fig. 12 [= *Neopalicus contractus* (Rathbun, 1902)].
non *Palicus jukesii* - ZARENKOV, 1968: fig. 3Д [*P. contractus* in caption = *Paliculus kyusyuensis* (Yokoya, 1933)].

MATERIAL EXAMINED. — **Gulf of Aden**. *"Meteor"*: stn Me5-236 Ku, 12°21.2'N-12°19.0'N, 43°27.1'E-43°27.8'E, 35-45 m, 6.03.1987: 5 ♂, 19 ♀, 21 juv. (SMF 24709), 3 ♂, 4 ♀ (SMF 24710).

Comoro Islands. *Mayotte*. 50 m, coarse sand, A. CROSNIER coll., 09.1958: 1 ♂ (MNHN-B 27216).

Madagascar. *Northwest coast*: Nosy Iranja. Sand, R. PLANTE coll., 26.08.1965: 1 ♀ (MNHN-B 27217). — Nosy Be. A. CROSNIER coll.: 1 ♂ (MNHN-B 27218).

Saya de Malha Bank. *"Sealark"* EXPEDITION: 101 m, , J.S. GARDINER coll., 6.09.1905: 1 ♀ (UMZ).

Maldives. *"Sealark"* EXPEDITION: *South Nilandu Atoll*, J.S. GARDINER coll.: 3 ♂, 5 ♀ (UMZ), 2 ♀ (UMZ), 1 ♀ (UMZ). — *Kolumadulu Atoll*, J.S. GARDINER coll.: 1 ♀ (UMZ). — *Haddumati Atoll*, J.S. GARDINER coll.: 1 ♀ (UMZ), 1 ♀ (UMZ), 1 ♀ (UMZ), 1 ♀ (UMZ), 1 ♀ (UMZ). — *Suvadiva Atoll*, J.S. GARDINER coll.: 1 ♂, 6 ♀ (UMZ), 2 ♂, 1 ♀ (UMZ), 2 ♀ (UMZ), 1 ♀ (UMZ).

Sri Lanka. Trincomalee, 11 m, K. FRISTEDT coll., 03. 1889: 1 ♂, 1 ♀ (MZUF C.2481).

Malaysia. Tioman Island: Tekek Bay, 26.06.1985: 1 ♀ (ZRC 1989.3765).

Singapore. Senang Island: 1 ♀ (ZRC 1965.8.2.235).

Japan. *Ogasawara Islands*. Muko-jima Island, 27°48.52'N, 142°02.62'E, 98-99 m, T. KOMAI coll., 15.10.1997: 1 ♀ (CBM-ZC 2004).

Philippine Islands. MUSORSTOM 3: stn CP 142, 11°47'S, 123°02'E, 26-27 m, 6.06.1985: 1 ♀ (MNHN-B 27215).

Indonesia. *Celebes Sea*. *"Challenger"*: stn 212, 06°54'N, 122°18'E, 18 m: 1 ♀ (BMNH 1884.31).

Moluccas, Ternate. W. KÜKENTHAL coll., 1894: 3 ♀ (SMF 4713).

Kai Islands. DANISH EXPEDITION TO KAI ISLANDS: stn 26, 05°38'S, 132°55'E, sand, 90 m, 14.04.1922: 1 ♂ (ZMUC).

Papua New Guinea. *Bismark Archipelago*. New Britain Island, Ralum, 24-30 m, S. DAHL coll., 24.11.1897: 1 ♀ (ZMB 18139).

Australia. *Great Barrier Reef*. Sir Charles Hardy Island, 20 m, coarse sand, J.B. JUKES coll., 08.1844: 1 ♀ holotype of *Cymopolia jukesii* White, 1847 9.0 x 10.9 mm (BMNH 46.80).

Torres Strait. Murray Island, A.C. HADDON coll., 1888: 1 ♂ (BMNH 1954.9.14.91).

Chesterfield Islands - Chesterfield-Bellona Plateau. CHALCAL 1: stn D 52, 21°13.40'S, 158°49.20'E, 69 m, 07.1984, 1 ♂ (MNHN-B 27219). — Stn D 55, 21°23.90'S, 158°59.60'E, 55 m, *Halimeda* and foraminiferans, 07.1984: 1 ♀ (MNHN-B 27220).

Stn 4 DE, 21°19.0'S, 158°48.0'E, 66 m, 19.10.1985: 1 ♀ (MNHN-B 27179).

CORAIL 2: stn DW 61, 19°14.96'S, 158°53.60'E, 54 m, *Halimeda* sand, 24.08.1988: 1 ♂, 1 ♀ (MNHN-B 27221). — Stn DW 73, 19°12.11'S, 158°22.57'E, 41 m, coarse sand, 25.08.1988: 1 ♀ (MNHN-B 27222). — Stn DW 76, 19°12.25'S, 158°32.90'E, 41 m, coarse sand and *Halimeda*, 25.08.1988: 1 ♀ (MNHN-B 27226). — Stn DW 87, 19°06.14'S, 158°59.94'E, 31 m, coarse sand and *Halimeda*, 26.08.1988, 1 ♀ (MNHN-B 27223). — Stn CP 98, 19°04.32'S, 158°31.66'E, 44-48 m, corals, 26.08.1988: 1 ♀ (MNHN-B 27224). — Stn DW 135, 19°31.37'S, 158°19.14'E, 46 m, coarse sand, 30.08.1988: 1 ♂, 1 ♀ (MNHN-B 27182). — Stn DW 137, 19°34.00'S, 158°14.60'E, 32 m, coarse sand, 30.08.1988: 1 ♀ (MNHN-B 27225).

New Caledonia. LAGON: stn 517, 19°08.9'S, 163°35.0'E, 42 m, *Halimeda* sand, 5.03.1985: 1 ♀ (MNHN-B 27210). — Stn 528, 19°31.2'S, 163°30.0'E, 47 m, fine sand, 6.03.1985: 1 ♂ (MNHN-B 27195). — Stn 536, 19°08.8'S, 163°22.6'E, 61 m, shelly sand, 6.03.1985: 1 ♀ (MNHN-B 27200). — Stn 541, 19°06.0'S, 163°13.3'E, 48-43 m, foraminiferan sand, 6.03.1985: 1 ♀ (MNHN-B 27211). — Stn 560, 22°43.2'S, 166°56.8'E, 48 m, shelly sand, 16.07.1985: 1 ♂ (MNHN-B 27181). — Stn 598, 22°19.1'S, 167°06.7'E, 73-75 m, shelly sand, 5.09.1986: 1 ♀ (MNHN-B 27227). — Stn 620, 22°02.4'S, 166°56.2'E, 50-52 m, *Halimeda*, 6.08.1986: 1 ♂ (MNHN-B 27228). — Stn 626, 21°57.9'S, 166°52.5'E, 47-48 m, foraminiferan sand, 6.08.1986: 3 ♂, 1 ♀ (MNHN-B 27229). — Stn 627, 21°58.9'S, 166°50.7'E, 45-47 m, *Halimeda* sand, 6.08.1986: 1 ♂ (MNHN-B 27205). — Stn 632, 21°57'3S, 166°49.6'E, 44-45 m, foraminiferan sand, 6.08.1986: 1 ♂ (MNHN-B 27201). — Stn 633, 21°55.6'S, 166°48.2'E, 50 m, foraminiferan sand and *Halimeda*, 6.08.1986: 1 ♂ (MNHN-B 27230). — Stn 641, 21°53.0'S, 166°43.0'E, 50-52 m, *Halimeda*, 7.08.1986: 1 ♂ (MNHN-B 27231). — Stn 682, 21°33.7'S, 166°18.6'E, 36-37 m, foraminiferan sand, 9.08.1986: 1 ♀ (MNHN-B 27190). — Stn 697, 21°27.6'S, 166°10.0'E, 35-36 m, foraminiferan sand, 10.08.1986: 1 ♂, 2 ♀ (MNHN-B 27196), 1 ♂ (MNHN-B 27191). — Stn 702, 21°26.7'S, 166°08.2'E, 37 m, foraminiferan sand, 10.08.1986: 1 ♂ 6.0 x 7.1 mm (MNHN-B 26814). — Stn 708, 21°23.6'S, 166°05.2'E, 34-35 m, foraminiferan sand, 10.08.1986: 1 ♂, 4 ♀ (MNHN-B 27232). — Stn 709, 21°22.2'S, 166°03.5'E, 39-40 m, foraminiferan sand, 10.08.1986: 3 ♂, 4 ♀ (MNHN-B 27233). — Stn 713, 21°22.6'S, 166°00.7'E, 34-35 m, coarse sand, 11.08.1986: 1 ♂, 1 ♀ 8.1 x 9.6 mm (MNHN-B 26996). — Stn 714, 21°21.0'S, 166°01.8'E, 37-38 m, coarse sand, 11.08.1986: 1 ♂ 7.7 x 9.2 mm (MNHN-B 26790). — Stn 724, 21°19.7'S, 165°57.8'E, 36-38 m, foraminiferan sand and *Halimeda*, 12.08.1986: 1 ♀ (MNHN-B 27212). — Stn 725, 21°18.6'S, 165°56.0'E, 41-43 m, coarse sand, 12.09.1986: 1 ♂ (MNHN-B 27206). — Stn 730, 21°17.2'S, 165°54.5'E, 40-43 m, coarse sand, 12.08.1986: 1 ♂, 1 ♀ (MNHN-B 27192). — Stn 747, 21°14.7'S, 165°50.9'E, 31-34 m, foraminiferan sand and *Halimeda*, 6.01.1987: 2 ♂ (MNHN-B 27234). — Stn 753, 21°14.9'S, 165°48.4'E, 53 m, shell debris, 7.01.1987: 1 ♀ (MNHN-B 27213). — Stn 754, 21°13.1'S, 165°49.2'E, 36 m, foraminiferan sand and *Halimeda*, 7.01.1987: 1 ♂, 2 ♀ (MNHN-B 27186). — Stn 761, 21°13.1'S, 165°44.3'E, 41-44 m, fine sand, 7.01.1987: 1 ♂ (MNHN-B 27202). — Stn 772, 21°07.7'S, 165°40.5'E, 30 m, coarse sand, 8.01.1987: 1 ♀ (MNHN-B 27203). — Stn 780, 21°06.0'S, 165°39.2'E, 33 m, coarse sand, 8.01.1987: 2 ♀ (MNHN-B 27193). — Stn 781, 21°04.6'S, 165°37.8'E, 36 m, coarse sand, 8.01.1987: 1 ♂, 1 ♀ (MNHN-B 27235). — Stn 788, 21°01.6'S, 165°34.7'E, 33 m, coarse sand, 9.01.1997: 1 ♀ (MNHN-B 27236). — Stn 794, 21°03.2'S, 165°30.9'E, 51 m, mud, 9.01.1987: 1 ♂, 4 ♀ (MNHN-B 27207). — Stn. 795, 21°01.6'S, 165°32.0'E, 31 m, coarse sand, 9.01.1987: 1 ♂ (MNHN-B 27184). — Stn 796, 20°59.9'S, 165°33.1'E, 38 m, coarse sand, 9.01.1987: 1 ♀ (MNHN-B 27185). — Stn 808, 20°57.4'S, 165°29.6'E, 30 m, coarse sand, 10.01.1987: 1 ♀ (MNHN-B 27237). — Stn 828, 21°50.1'S, 165°19.5'E, 28 m, coarse sand, 10.01.1987: 1 ♂ (MNHN-B 27188). — Stn 856, 20°36.9'S, 165°11.4'E, 30 m, coarse sand, 12.01.1987: 1 ♂ (MNHN-B 27204). — Stn 863, 20°39.4'S, 165°06.5'E, 28 m, coarse sand, 13.01.1987: 1 ♂ (MNHN-B 27241). — Stn 865, 20°38.7'S, 165°04.4'E, 24 m, shelly sand, 13.01.1987: 2 ♂, 1 ♀ (MNHN-B 27214); 1 ♀ (MNHN-B 27240). — Stn 866, 20°37.5'S, 165°02.7'E, 26 m, foraminiferan sand, 13.01.1987: 1 ♂ (MNHN-B 27197). — Stn 892, 20°18.3'S, 164°32.1'E, 26 m, coarse sand and *Halimeda*, 14.01.1987: 1 ♀ (MNHN-B 27238). — Stn 898, 21°13.6'S, 164°27.1'E, 22 m, gray sand, 14.01.1987: 1 ♂ (MNHN-B 27239). — Stn DW 1026, 20°04.6'S, 163°47.6'E, 29 m, foraminiferan sand and *Halimeda*, 3.04.1988: 1 ♀ (MNHN-B 27194). — Stn DW 1075, 19°52.0'S, 163°58.4'E, 28 m, white sand and *Halimeda*, 23.10.1989: 1 ♀ (MNHN-B 27242). — Stn DW 1094, 19°54.4'S, 163°41.2'E, 26 m, foraminiferan sand and *Halimeda*, 20.10.1989: 1 ♀ (MNHN-B 27243). — Stn DW 1097, 19°51.7'S, 163°42.5'E, 34 m, foraminiferan sand, 24.10.1989: 1 ♀ (MNHN-B 27198). — Stn DW 1110, 19°43.6'S, 163°41.8'E, 31 m, fine sand and foraminiferans, 25.10.1989: 1 ♀ (MNHN-B 27208). — Stn DW 1129, 19°29.2'S, 163°48.8'E, 40 m, shelly sand, 26.10.1989: 1 ♂ (MNHN-B 27244). — Stn DW 1134, 19°31.3'S, 163°34.6'E, 40 m, coarse sand and *Halimeda*, 26.10.1989: 1 ♂, 1 ♀ (MNHN-B 27187). — Stn DW 1155, 19°09.3'S, 163°15.9'E, 48 m, coarse sand, 30.10.1989: 1 ♂ (MNHN-B 27199). — Stn DW 1163, 19°11.3'S, 163°21.9'E, 48 m, fine sand, 30.10.1989: 2 ♂ (MNHN-B 27209). — Stn DW 1181, 19°23.9'S, 163°14.7'E, 45 m, coarse sand, 31.10.1989: 1 ♂, 1 ♀ (MNHN-B 27180). — Stn DW 1182, 19°27.3'S, 163°16.2'E, 48 m, coarse sand, 31.10.1989: 6 ♀ (MNHN-B 27183). — Stn DW 1192, 19°35.3'S, 163°24.6'E, 48 m, coarse sand, 1.11.1989: 2 ♂, 1 ♀ (MNHN-B 27189). — Stn DW 1197, 19°35.6'S, 163°22.1'E, 41 m, foraminiferans, 1.11.1989: 1 ♂ (MNHN-B 27245). — Stn DW 1205, 19°41.6'S, 163°25.6'E, 38 m, coarse sand, 2.11.1989: 1 ♀ (MNHN-B 27246). — Stn DW 1217, 19°51.6'S, 163°35.6'E, 30 m, coral debris, 3.11.1989: 1 ♂ (MNHN-B 27247).

TYPES. — *Holotype* of *Cymopolia jukesii* White, 1847: 1 ♀ 9.0 x 10.9 mm, Great Barrier Reef, Australia (BMNH 46.80).

Holotype of *Cymopolia carinipes* Paulson, 1875: 1 ♂ 6 x 7 mm (PAULSON, 1875), Red Sea. Material most probably lost.

TYPE LOCALITY. — Sir Charles Hardy Island, Great Barrier Reef, Australia, coarse sand, 20 m.

DIAGNOSIS. — Carapace (Figs 39b, 61c; CALMAN, 1900, pl. 1, fig. 9; RATHBUN, 1911, pl. 19, fig. 9; MOOSA & SERÈNE, 1981, pl. 2, fig. C) subquadrate, with large, low granules; anterolateral borders slightly curved, with widest extension at level of second and smallest of first two, truncate, anterolateral teeth; 2-3 shorter, smaller teeth may be found posterior to first two (HOLTHUIS, 1977, fig. 2a, as *Palicus carinipes*). Supraorbital borders each with

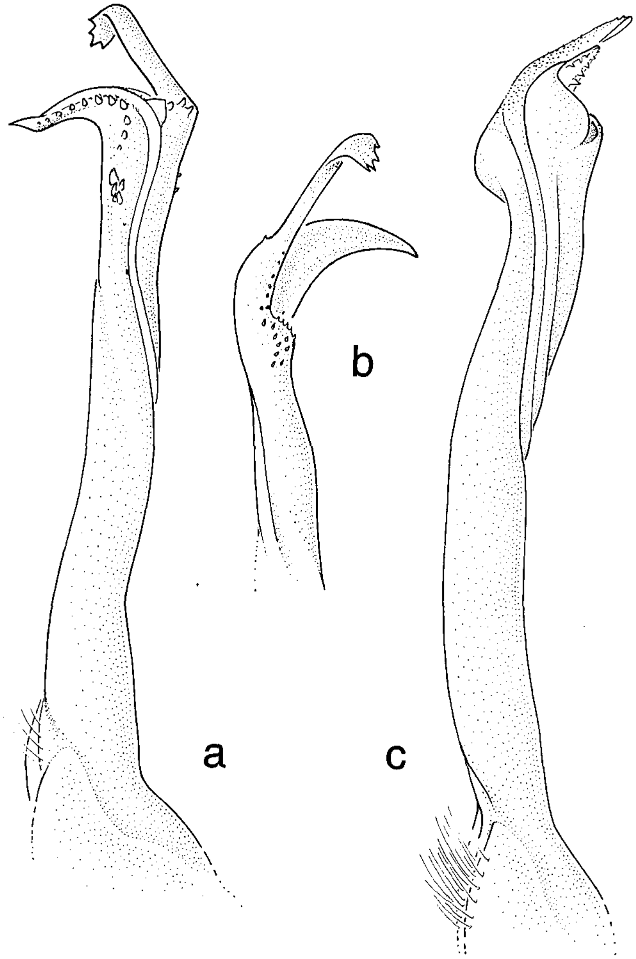

FIG. 41. — **a-b**, *Neopalicus contractus* (Rathbun, 1902): ♂ 10.8 x 12.0 mm, Chesterfield-Bellona Plateau, CHALCAL 1, stn D 56, 50 m (MNHN-B 26789): **a**, left male first pleopod, ventral view; **b**, left male first pleopod, distal part, lateral (outer side) view. — **c**, *Neopalicus jukesii* (White, 1847), ♂ 7.7 x 9.2 mm, east coast of New Caledonia, LAGON, stn 714, 37-38 m (MNHN-B 26790): left male first pleopod, ventral view.

one short, triangular lobe. Suborbital borders (Fig. 40b; CALMAN, 1900, pl. 1, fig. 10; HOLTHUIS, 1977, fig. 2b, as *Palicus carinipes*) each with two triangular, tooth-like lobes. Each basal antennal segment (Figs 40b-c) with two thin, nearly equal, wing-like ventral processes along ventral side (V-shaped in dorsal or ventral view). Dorsal borders of cheliped propodi with irregular, microscopic tubercles, increasing in size to form rows of conspicuous tubercles in large males; outer borders with hook-like setae; dense clusters of plumose setae on inner border of cheliped propodi in males (HOLTHUIS, 1977, fig. 2c, as *Palicus carinipes*). Dorsal and ventral sides and upper and lower borders of meri of second and third pairs of walking legs (P3-4) with rounded tubercles (CALMAN, 1900, pl. 1, fig. 12); anterior borders of carpi of P3-4 with similar tubercles; anterior borders of propodi with wide, convex enlargement. Abdomen of mature males narrow, with all segments distinct; one transverse ridge along each segment (slightly more salient and wider in segment 6). Telson of males and females with low, elongate, and rounded tubercles (CALMAN, 1900, pl 1, fig. 11). Male first pleopods (Fig. 41c; MOOSA & SERÈNE, 1981, fig. 7) with sinuous basal parts; each distal part with two pointed tips (close together in most specimens but separate in larger specimens; ZARENKOV, 1968, fig. 3E; HOLTHUIS, 1977, fig. 2e, as *Palicus carinipes*), dorsal with short teeth and ventral with small, blunt teeth. Abdomen of mature females with all segments distinct, one transverse ridge along each segment (less pronounced and curved in median portion in segment 6).

Color: A specimen from New Caledonia photographed live (Fig. 61c) had a broad orange-red, vertical band through the middle of the carapace, a black patch on each branchial region, and broad, orange-red bands across the walking legs.

DISCUSSION. — *N. jukesii* may be easily confused with *N. contractus*. Differences between the two species are summarized in Table 3. Although the lateral shape of the carapace (particularly by being broader at the level of the second anterolateral tooth in *N. jukesii* but at the level of the first anterolateral tooth in *N. contractus*) can be used as a diagnostic feature in most specimens, variations have been observed. In some specimens the first anterolateral tooth may be more salient than the second (although often on only one side of the carapace) or the broadest width of the carapace is at the level of the teeth posterior to the second anterolateral tooth (see HOLTHUIS, 1977, fig. 2a, as *Palicus carinipes*). The shape of each basal antennal segment (Figs 40b-c), V-shaped in dorsal or ventral view in contrast to a conspicuous, thick, dorsoventrally flattened process in *N. contractus* (Fig. 40a) is a useful diagnostic character.

TABLE 3. — Morphological differences between *Neopalicus contractus* (Rathbun, 1902) and *N. jukesii* (White, 1847).

	Neopalicus contractus (Rathbun, 1902)	***Neopalicus jukesii*** (White, 1847)
Carapace	Widest extension typically at level of first anterolateral tooth; anterlolateral borders straight, narrowing posteriorly; slightly narrower, more quadrate in appearance (CW/CL = 1.1)	Widest extension typically at level of second anterolateral tooth; anterolateral borders slightly curved, widening posteriorly; slightly wider, less quadrate in appearance (CW/CL= 1.2)
Posterolateral border of carapace	Shallow tubercles posterior to two obtuse anterolateral teeth	2-3 very shallow, obtuse teeth posterior to two obtuse anterolateral teeth
Frontal lobes of carapace	Slightly more pronounced (higher in middle), median sulcus wider and deeper	Slightly less pronounced (shallower in middle), median sulcus narrower and shallower
Supraorbital lobes	Two triangular lobes (outer shallow)	One shallow triangular lobe
Postorbital angle	Longer, slender; slightly higher than outer suborbital tooth	Shorter, blunt; as high as outer suborbital tooth
Basal antennal segment	Thick, dorsoventrally flattended, appearing as flat, nearly triangular process in ventral view; much shorter round process on inner border	Two flat, nearly equal processes (outer pointed, inner round), appearing V-shaped in dorsal or ventral view
Meri of P2-3	More pronounded, triangular tubercles along anterior (upper) and posterior (lower) borders	Fewer, less pronounded, round tubercles along anterior (upper) and posterior (lower) borders
Merus of P5	More pronounced tubercles along posterior (lower) border	Fewer, less pronounced tubercles along posterior (lower) border
Chelipeds of males	Inner border without a conspicuous cluster of setae	Inner border with a conspicuous cluster of setae, particularly larger specimens
Telson of males and females	Round, shallow granules	Round, shallow granules and 1-2 short, elongate, carina-like tubercles
First male pleopods	Two very different tips, one short with flatenned tip and second long and curved (Fig. 41a-b)	Two pointed tips that often appear as one (Fig. 40c)

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.0-1.1	1.6-1.8	1.5-1.8	0.7-0.8
Merus length/CL	0.3	0.5	0.4-0.5	0.2
Dactylus length/Cl	0.3-0.4	0.3-0.4	0.3	0.1-0.2

The fifth pair of pereopods (P5) (Fig. 39b; HOLTHUIS, 1977, fig. 2d, as *Palicus carinipes*) has, like in *N. contractus*, thick, tuberculate (except dactylus) segments, very thick spines along the posterior border of the propodus, and a slightly curved dactylus.

HOLTHUIS (1977) identified his Red Sea material as *Palicus carinipes* (Paulson, 1875), which is clearly a subjective junior synonym of *N. jukesii*. His conclusion was based on several differences, most important of which was the presence in his specimens of a curved ridge of tubercles (subhepatic crest) on the pterygostomial (subhepatic) region posterior to the suborbital margin (HOLTHUIS, 1977, fig. 2b). This ridge appears in the figure that accompanies the description of *P. carinipes* (PAULSON, 1875, pl. 9, fig. 4a; 1961, pl. 9, fig. 4a), while there is only a simple tubercle in the figure of *N. jukesii* given by CALMAN (1900, pl. 1, fig. 10) for *N. jukesii*. CALMAN's specimen (BMNH 1954.9.14.91) actually had a curved ridge on its pterygostomial region, even if it was stated that "the tubercle on the underside of the hepatic region ... represented [in *P. carinipes*] by a curved transverse ridge" was absent in the specimen (CALMAN, 1900: 31). A curved ridge of tubercles is present in both

N. jukesii (Fig. 40b) and *N. contractus* (Fig. 40a), a fact already mentioned by RATHBUN (1911: 240). It becomes more conspicuous with growth, however. A specimen (BMNH 1934.1.16.164) incorrectly identified by LAURIE (1906: 430, 431; pl. 1, fig. 12) as *Palicus jukesii* is actually *N. contractus*. LAURIE mentioned the characteristic curved ridge of tubercles but, to complicate matters, his figure shows only a short row.

HOLTHUIS (1977: 182, fig. 2b) mentioned that another difference between his Red Sea specimens and CALMAN's figure of *N. jukesii* (CALMAN, 1900, pl. 1, fig. 10) was an outer suborbital tooth described as "narrowly triangular" and a broader inner lobe in contrast to the opposite situation shown in CALMAN's figure. While most of the specimens examined in this study agreed with CALMAN's specimen, some did show the arrangement described by HOLTHUIS.

HOLTHUIS unfortunately referred to the fifth pereopod (P5) of his specimens as "subchelate" on account of the slightly curved dactylus (HOLTHUIS, 1977: 183). The same characteristic was attributed to *N. jukesii* based on the figure of the type by MIERS (1874, pl. 3, fig. 4) but not to the specimen of the same species as illustrated by CALMAN (1900, pl. 1, fig. 9). The dactylus, although curved, cannot articulate enough to make contact with the posterior border of the propodus and as such cannot be regarded as truly subchelate. As foreseen by HOLTHUIS himself, this and the other differences that were given have proven to be the result of individual differences and incorrect information.

The male first pleopods of *N. jukesii* were described as having a "spiraled shaft" by MOOSA & SERÈNE (1981: 44). The basal part of the pleopods should be described as sinuous, not spiraled (or helicoidal) as in the case of species of *Parapalicus*.

A female specimen from the Ogasawara Islands, Japan (8.0 x 8.8 mm; CBM-ZC 2004) is the first record of *Neopalicus* from Japan. It has slightly higher tubercles on the eye peduncles, two conspicuous rounded tubercles on the carpus of its only cheliped, unusually pointed postorbital angles similar to those of *N. contractus*, and the upper lobe of the meri of the third maxillipeds is larger and rounder that of *N. jukesii*. All other characters agree with *N. jukesii*. The examination of the male first pleopods would confirm if it is *N. jukesii* or if it belongs to a new species.

SIZE. — Maximum size among specimens examined: 13.8 x 15.1 mm (female, UMZ); 7.7 x 9.2 mm (male, MNHN-B 26790).

DISTRIBUTION. — *N. jukesii* is known from many records from a very wide geographic distribution (Fig. 49). It is known from the Red Sea (PAULSON, 1875, as *Cymopolia carinipes*; NOBILI, 1906a; ZARENKOV, 1971; HOLTHUIS, 1977, as *Palicus carinipes*); Amirante Islands and Saya de Malha Bank (RATHBUN, 1911); Maldives (ALCOCK, 1900; RATHBUN, 1902; BORRADAILE, 1903); Sri Lanka and Andaman Islands (ALCOCK, 1900); Myanmar (HENDERSON, 1893); Celebes Sea, Indonesia (MIERS, 1886); Ternate, Indonesia (DE MAN, 1902); Ceram, Kai, and Aru islands, Indonesia (MOOSA & SERÈNE, 1981); Torres Strait (WHITE, 1847b; MIERS, 1874; HASWELL, 1882; CALMAN, 1900); Queensland, Australia (HASWELL, 1882; WARD, 1942a). Its distribution is now extended to include the Gulf of Aden, Comoro Islands, Madagascar, Sri Lanka, Malaysia, Singapore, Japan, Philippine Islands, Bismark Archipelago, and the Coral Sea (Chesterfield Islands, Chesterfield-Bellona Plateau, and New Caledonia). It has been collected from the same Coral Sea stations together with *N. contractus* and the two species of *Palicoides*. Depth: 10 m (MIERS, 1886) to 146 m (RATHBUN, 1911).

Genus ***PALICOIDES*** Moosa & Serène, 1981

Palicoides Moosa & Serène, 1981: 45.

TYPE SPECIES. — *Cymopolia whitei* Miers, 1884 by original designation (MOOSA & SERÈNE, 1981). Gender masculine.

DIAGNOSIS. — Carapace subquadrate; frontal border divided into two large lobes that continue to supraorbital border as sinuous border without distinct notch. Anterolateral borders each with two large truncate teeth. Dorsal surface of carapace with large, low granules and very low bosses. Thick, simple setae throughout carapace and surface of appendages. Eyes spherical; each peduncle with a conspicuous, crescent-shaped process on anterior border and hard, rounded tubercle on ventral side. Supraorbital borders each with 1-2 triangular lobes. Suborbital borders each with one triangular inner lobe, one broad, rectangular outer lobe. Segments 2-3 of antennae very wide and provided with numerous long setae; flagellum relatively short. Each basal antennal segment expanded into thick, flat process. Epistome expanded dorsoventrally, forming broad, semicircular, nearly flat surface; thin carina-like process across median portion with two rounded, tubercle-like central teeth. Chelipeds nearly equal in males and females, slender in females, heavier and very long in males. First three pairs of walking legs (P2-4) with flattened (not filiform) carpi, propodi, and dactyli. First pair (P2) shorter than second and third pairs (P3-4); third pair about as long as second pair. Meri of P2-4 elongate, borders with small, low tubercles except distalmost one. Anterior borders of propodi of P3-4 without wide, convex enlargement; posterior borders of dactyli entire. Fifth pair of pereopods (P5) reduced (0.8-0.9 CL), thick; rows of thick spines along posterior border of propodus. Abdomen of mature males elongate (sides almost parallel to each other), with all segments free or segments 4-6 fused, complete transverse ridge along segments 1-3 (two on fused segments 4-6). Male first pleopods long and slender; basal parts sinuous; each distal part biramous. Abdomen of mature females with segments 3-6 fused, one complete transverse ridge along segments 1-2 (varying number of complete or incomplete ridges on fused segments).

REDESCRIPTION. — Carapace subquadrate, slightly broader than long, with large, low granules and well defined, low bosses. Anterolateral borders straight, each with two truncate teeth followed by granular or tuberculate posterolateral border. Confluence of branchial and mesogastric regions depressed and smooth. Thoracic sternite 7 with reduced process (episternal process) at each outer edge and posterior to insertion of fifth pair of pereopods (P5), almost invisible dorsally. Posterior border of carapace smooth, without protruding tubercles. Thick, simple setae (sometimes dark in color) throughout carapace and appendages.

Frontal border divided into two rounded lobes, each continuing without distinct notch into folded border ending in sharp angle forming V-shaped fissure at supraorbital border. Supraorbital borders each with 1-2 triangular lobes. Postorbital angles long (extending just to anterior border of retracted eyes), pointed. Cornea of eyes spherical, almost as wide as base of peduncle; each peduncle with one conspicuous, thin, crescent-shaped process on anterior border, several soft or granular tubercles, and one hard, rounded tubercle on ventral side. Orbits deep.

Suborbital border with one small, triangular inner lobe, one broad, rectangular outer lobe. Pterygostomial process at each anterolateral angle of buccal frame projects ventrally, triangular or rounded edge.

Antennules short, thick, and transversely folded beneath front; interantennular septum narrow. Each basal antennal segment expanded into thick, dorsoventrally-flattened, scale-like process. Epistome expanded dorsoventrally, forming nearly flat surface between antennular fossae and anterior border of endostome; two rounded, tubercle-like central teeth on low, thin, carina-like process along median portion, flanked at same level by two very short outer lobes that connect with each pterygostomial lobe. Meri of third maxillipeds smaller and narrower than ischia.

Chelipeds equal or nearly equal in males and females, long and slender in females, very long (propodus and merus becoming greatly elongated, chelipeds slightly more unequal with increasing body size), slender in males. Fingers of chelipeds with cutting edge or triangular teeth (broadly rounded teeth in chelipeds of largest males), pollex becoming flatter with increasing size. Numerous simple and plumose setae along inner surfaces of cheliped propodi and fingers of males. First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair slightly shorter than second. First three pairs of walking legs (P2-4) with flattened carpi, propodi, and dactyli. Meri elongate; anterior (dorsal) and posterior (ventral) borders with small, unequal, low tubercles, rows of low tubercles on dorsal and ventral surfaces. Elongate (but not filiform and conspicuously slender) propodi and dactyli; posterior borders entire. Last two pairs of walking legs (P3-4) each with slightly broadened basis-ischia, having slightly flattened, thick-edged anterior and posterior borders. Anterior borders of propodus of P3-4 without conspicuously wide, convex enlargement. Fifth pair of pereopods (P5; Figs 42 a-b) reduced (0.8-0.9 CL), thick; basis-ischia and meri long and tuberculate; propodi with 2-3 rows of very thick spines along posterior border; dactyli thick and slightly curved.

Abdomen of mature males elongate, with both sides almost parallel to each other, with all segments free or segments 4-6 fused, segments 1-2 dorsoventrally compressed, one transverse ridge along each segment (incomplete and very slight in segments 5-6) or only on segments 1-3 (plus two incomplete and very slight ridges along proximal portion of fused segment 4-6). Male first pleopods long and slender; basal parts sinuous; each distal part biramous. Second male pleopods short, thin, slightly curved; distal segment with blunt tip. Abdomen of immature males elongate, with varying number of fused segments.

Abdomen of mature females broad, rounded, with segments 3-6 fused, segments 1-2 dorsoventrally compressed, one complete transverse ridge along each segment 1-2 plus two along proximal portion of fused segment 3-6. Abdomen of immature females triangular (but broader than in males), segments 1-2 dorsoventrally compressed, 3-6 fused, complete transverse ridge along each segment 1-2 and one along proximal portion of fused segment 3-6.

SPECIES INCLUDED. — *P. longimanus* (Miyake, 1936) and *P. whitei* (Miers, 1884).

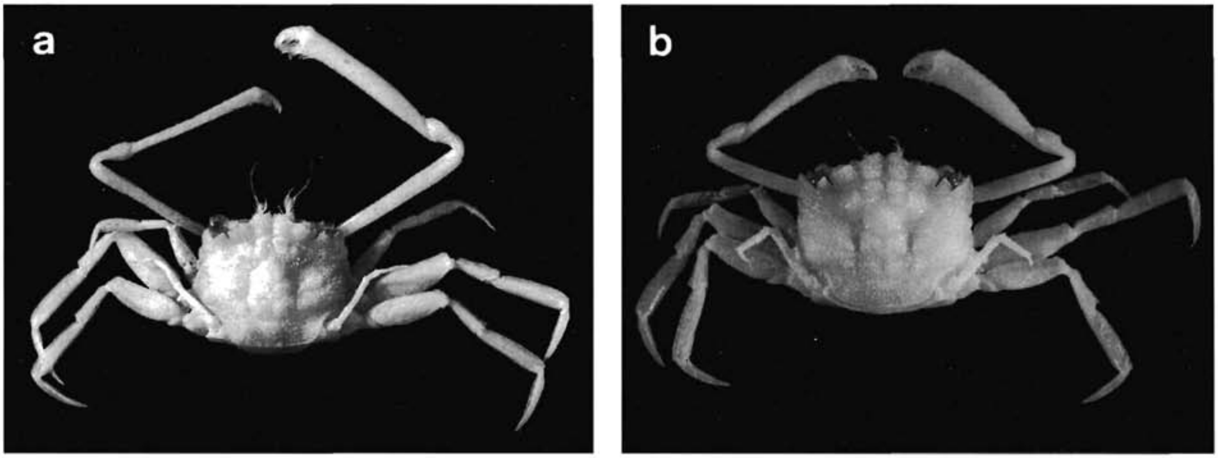

FIG. 42. — **a**, *Palicoides longimanus* (Miyake, 1936), ♂ 9.9 x 11.5 mm, north coast of New Caledonia, LAGON, stn 894, 12 m (MNHN-B 26997): dorsal view. — **b**, *Palicoides whitei* (Miers, 1884), ♂ 8.6 x 9.6 mm, Seychelles, REVES 2, stn 50, 45-50 m (MNHN-B 26798): dorsal view.

SEXUAL DIMORPHISM. — Females are generally larger in size than males. The chelipeds are equal or nearly equal in both sexes but they are much longer in males, increasing in length with body size. The lower surfaces of the cheliped meri and fingers of the males are provided with many long simple and plumose setae. They are particularly abundant and longer along the distal portion of the meri.

DISCUSSION. — Although close to *Neopalicus* in the morphology of the carapace, species of *Palicoides* can be easily differentiated by the conspicuous, crescent-shaped process on each eye peduncle. In contrast, the eye peduncles of *Neopalicus* have several tubercles but never a conspicuous process. There are also significant differences in the morphology of the basal antennal segment (see discussion of *Neopalicus*) and abdomen. Several segments are fused in *Palicoides* (4-6 in males of *P. longimanus*, 3-6 in females of both species), while none are fused in *Neopalicus*. Other differences are listed in Table 1. Another characteristic of *Palicoides* is the decrease in size of the upper borders of the meri of the third maxillipeds. It is reduced to a short, rounded or slightly pointed protuberance.

MOOSA & SERÈNE (1981) mention in the diagnosis of their new genus *Palicoides* that the male abdomen has "distinct segments" (MOOSA & SERÈNE, 1981: 45). Segments 4-6 are fused in *P. longimanus* and in smaller males of *P. whitei*. The fusion of segments in *P. longimanus*, however, is mentioned in their key to the species (MOOSA & SERÈNE, 1981: 46).

No described species of palicids from outside the Indo-west Pacific region resemble *Palicoides* in terms of the quadrate, relatively flat carapace, and thickened fifth pereopods. Since the same applies to *Neopalicus*, it appears that shallow-water, coarse-sediment habitats associated with coral reefs are occupied by palicids only in the Indo-west Pacific region.

Key to the species of the genus *PALICOIDES*

1. Two frontal lobes of carapace small, separated by narrow, shallow notch (Fig. 42a). Supraorbital border with only one triangular lobe .... ***P. longimanus*** (Miyake, 1936)

— Two frontal lobes of carapace broad, separated by wide, deep notch (Fig. 42b). Supraorbital border with one triangular lobe and small, rounded to slightly pointed outer lobe .... ***P. whitei*** (Miers, 1884)

Palicoides longimanus (Miyake, 1936)

Figs 42a, 43a, 50, 61d

Cymopolia longimana Miyake, 1936: 495, fig. 1, pl. 35, figs 3-4. — SAKAI, 1939: 609, fig. 90c; 1956: 52.
Palicus longimanus - SERÈNE, 1968: 96. — SAKAI, 1976: 595, fig. 325c.
Palicoides longimanus - MOOSA & SERÈNE, 1981: 46, fig. 8, pl. 3, fig. A.
Palicus whitei - GARTH *et al.*, 1987: 259 [non *Palicoides whitei* (Miers, 1884)].

MATERIAL EXAMINED. — **Japan**. *Yaeyama Islands.* Iriomote Island, Sonai, Yaeyama Expedition, H. OHSHIMA coll., 08.1934: 1 ♂ holotype of *Cymopolia longimana* Miyake, 1936 9.4 x 10.9 mm (ZLKU 5771).

Indonesia. *Sulawesi.* Bahuluang Island, from beach sand, 10.10.1984: 1 ♂ (RMNH 47901).

Moluccas, Ambon. RUMPHIUS EXPEDITION 1: stn MO-1, 03°32'00"S, 128°12'30"E, KASIJAN coll., 8.01.1973: 1 ♀ (MNHN-B 10006).

RUMPHIUS EXPEDITION 2: seagrass meadow, R. SERÈNE coll. (CB 1261), 26.01.1975: 1 ♂ (MNHN-B 27270).

Chesterfield Islands. CORAIL 2: stn DW 41, 19°21.52'S, 158°31.87'E, 52 m, *Halimeda* sand, 23.07.1988: 1 ♂ (MNHN-B 27271). — Stn DW 59, 19°18.50'S, 158°56.55'E, 50 m, 24.08.1988: 1 ♀ (MNHN-B 27272). — Stn DW 73, 19°11.00'S, 158°22.57'E, 41 m, 25.08.1988: 1 ♀ (MNHN-B 27273). — Stn DW 87, 19°06.14'S, 158°59.94'E, 31 m, coarse sand and *Halimeda*, 28.08.1988: 1 ♀ (MNHN-B 27274). — Stn DW 154, 19°52.04'S, 158°26.5'E, 35 m, *Halimeda*, 1.09.1988: 1 ♀ (MNHN-B 27275). — Stn DW 160, 19°46.00'S, 158°23.00'E, 35-41 m, sand, 1.09.1988: 2 ♀ (MNHN-B 27276).

New Caledonia. LAGON: stn 1, 22°18.0'S, 166°24.6'E, 19 m, fine sand and *Halimeda*, 05.1984: 1 ♀ (MNHN-B 27248). — Stn 7, 22°24.0'S, 166°19.7'E, 14 m, white sand, 05.1984: 1 ♀ (MNHN-B 27249). — Stn 49, 22°18.5'S, 166°13.8'E, 10 m, sargassum, 05.1984: 1 ♀ (MNHN-B 27263). — Stn 50, 22°16.6'S, 166°12.2'E, 12 m, white sand, 05.1984: 2 ♀ (MNHN-B 27277). — Stn 52, 22°14'S, 166°14'E, 13 m, seagrasses, 1984: 1 ♂ (MNHN-B 27258). — Stn 69, 22°22.8'S, 166°31.7'E, 13 m, shelly sand, 08.1984: 1 ♀ 14.7 x 17.0 mm (MNHN-B 26791). — Stn 99, 22°32.6'S, 166°34.6'E, 14 m, corals, 08.1984: 1 ♀ (MNHN-B 27278). — Stn 180, 21°59.6'S, 166°04.5'E, 10 m, mud, 09.1984: 1 ♀ (MNHN-B 27279). — Stn 185, 22°04.8'S, 166°02.2'E, 15 m, coral blocks and *Halimeda*, 19.09.1984: 1 ♂ (MNHN-B 27253). — Stn 187, 22°02.8'S, 166°01.7'E, 13 m, shelly sand, 09.1984: 2 ♀ (MNHN-B 27259). — Stn 192, 22°00.6'S, 166°00.0'E, 18 m, boulders, 09.1984: 1 ♀ (MNHN-B 27264). — Stn 253, 22°22.1'S, 166°22.9'E, 16 m, coarse sand, 10.1984: 1 ♀ (MNHN-B 27280). — Stn 269, 22°18.0'S, 166°18.1'E, 20 m, muddy sand and *Halimeda*, 11.1984: 2 ♀ (MNHN-B 27250). — Stn 284, 22°25.8'S, 166°24.9'E, 6 m, corals, 10.1984: 1 ♀ (MNHN-B 27265). — Stn 455, 18°29.5'S, 163°07.9'E, 40 m, coarse sand, 28.02.1985: 1 ♀ (MNHN-B 27254). — Stn 483, 19°01.0'S, 163°32.2'E, 33 m, boulders and *Halimeda*, 2.03.1985: 1 ♀ (MNHN-B 27281). — Stn 550, 22°54.0'S, 166°57.5'E, 26 m, coral debris, 15.07.1985: 2 ♀ (MNHN-B 27282). — Stn 554, 22°50'S, 166°54'E, 27 m, white sand and shells, 16.07.1985: 1 ♂ (MNHN-B 27255). — Stn 623, 22°01.0'S, 166°50.5'E, 32-40 m, 6.08.1983: 1 ♀ (MNHN-B 27283). — Stn 890, 20°20.3'S, 164°35.6'E, 23 m, coarse sand, 14.01.1987: 1 ♂, 1 ♀ (MNHN-B 27260). — Stn 891, 20°19.8'S, 164°33.5'E, 25 m, mud and shells, 14.01.1987: 1 ♀ (MNHN-B 27284). — Stn 892, 20°18.3'S, 164°32.1'E, 26 m, coarse sand and *Halimeda*, 14.01.1987: 1 ♂, 1 ♀ (MNHN-B 27285). — Stn 894, 20°16.6'S, 164°28.0'E, 12 m, coarse sand and *Halimeda*, 14.01.1987: 1 ♂ 9.9 x 11.5 mm (MNHN-B 26997). — Stn DW 896, 20°15.2'S, 164°29.3'E, 20 m, medium-size sand and mud, 14.01.1987: 1 ♂ (MNHN-B 27251). — Stn 898 20°13.6'S, 164°27.1'E, 22 m, gray sand, 14.01.1987: 1 ♀ (MNHN-B 27267). — Stn 899, 20°14.2'S, 164°25.2'E, 16 m, coarse sand and *Halimeda*, 14.01.1987: 1 ♀ (MNHN-B 27286). — Stn DW 921, 20°51.2'S, 164°26.6'E, 10-11 m, shelly sand, 27.04.1988: 1 ♀ (MNHN-B 27287). — Stn DW 934, 20°43.0'S, 164°16.8'E, 10 m, coarse sand and *Halimeda*, 27.04.1988: 1 ♀ (MNHN-B 27269). — Stn DW 944, 20°35.2'S, 164°11.9'E, 14-15 m, shelly sand, 28.04.1988, 1 ♀ (MNHN-B 27288). — Stn DW 948, 20°32.2'S, 164°08.8'E, 16 m, coarse sand and *Halimeda*, 28.04.1988: 2 ♀ (MNHN-B 27256). — Stn DW 952, 20°30.8'S, 164°07.4'E, 16-17 m, coarse sand, 28.04.1988: 1 ♂ 9.6 x 11.2 mm (MNHN-B 26794). — Stn DW 953, 20°31.8'S, 164°05.8'E, 18-19 m, white sand, 28.04.1988: 1 ♂ (MNHN-B 27261). — Stn DW 954, 20°31.0'S, 164°03.0'E, 15-17 m, coarse sand, 20.04.1988: 1 ♂, 1 ♀ (MNHN-B 27289). — Stn 985, 20°20.3'S, 163°57.9'E, 15-17 m, coarse sand and *Halimeda*, 30.04.1988: 1 ♀ (MNHN-B 27257). — Stn DW 989, 20°18.1'S, 163°57.1'E, 21 m, foraminiferan sand, 30.04.1988: 1 ♀ (MNHN-B 27290). — Stn DW 1008, 20°11.0'S, 163°53.4'E, 27 m, shells and foraminiferans, 2.05.1988: 1 ♀ (MNHN-B 27262). — Stn DW 1046, 20°05.0'S, 164°06.6'E, 6-7 m, boulders and *Halimeda*, 4.05.1988: 1 ♂, 1 ♀ (MNHN-B 27291). — Stn DW 1075, 19°52.0'S, 163°58.4'E, 28 m, white sand and *Halimeda*, 23.10.1989: 1 ♀ (MNHN-B 27268). — Stn DW 1094, 19°54.4'S, 163°41.2'E, 26 m, foraminiferan sand and *Halimeda*, 24.10.1989: 1 ♂ (MNHN-B 27292). — Stn DW 1163, 19°11.3'S, 163°21.9'E, 48 m, fine sand, 30.10.1989: 1 ♀ (MNHN-B 27213). — Stn DW 1168, 19°15.9'S, 163°09.3'E, 50 m, coarse sand, 30.10.1989: 1 ♀ (MNHN-B 27294). — Stn DW 1181, 19°23.9'S, 163°14.7'E, 45 m, coarse sand, 31.10.1989: 1 ♂, 1 ♀ (MNHN-B 27295). — Stn DW 1182, 19°27.3'S, 163°16.2'E, 48 m, coarse sand, 30.10.1989: 1 ♂, 1 ♀ (MNHN-B 27296). — Stn DW 1205, 19°41.6'S, 163°25.6'E, 38 m, coarse sand, 2.11.1989: 1 ♂ 6.2 x 6.8 mm (MNHN-B 26793). — Stn DW 1210, 19°45.5'S, 163°35'E, 31 m, 3.11.1989: 1 ♂ (MNHN-B 27252).

Passe de Boulari: 15 m, 20.03.1988: 1 ♂ 11.4 x 12.5 mm (MNHN-B 26792). — *Îlot Goeland*: 10 m, 16.04.1993: 1 ♂ (MNHN-B 27297). — *Îlot Maître*: 6 m, seagrass meadow, suction pump, P. BOUCHET coll., 24.03.1993: 1 ♀ (MNHN-B 27300). — *Bancs de l'Ouest*: 1 ♂ (MNHN-B 27298). — *Récif Aboré*: 10 m, P. BOUCHET coll., 8.10.1992: 1 ♀ (MNHN-B 27299).

Loyalty Islands. MUSORSTOM 6: stn DW 434, 20°21.21'S, 166°08.64'E, 23 m, 18.02.1989: 1 ♂ (MNHN-B 27266).

Marshall Islands. *Enewetak Atoll*: stn 429, J.W. KNUDSEN coll., 15.08.1967: 1 ♀ (LACM). — Stn 431, 16.08.1967: 2 ♀ (LACM). — Stn 183: 2 ♂, 1 ♀ (LACM). — Stn 184: 1 ♂ (LACM). — Stn 187: 1 juv., ♂, 1 ♀ (LACM). — Stn 189: 1 juv. ♂ (LACM). — Stn 722: 1 ♂ (LACM).

TYPES. — *Holotype* of *Cymopolia longimana* Miyake, 1936: 1 ♂ 9.4 x 10.9 mm, Ryukyu Islands, Japan (ZLKU 5771).

TYPE LOCALITY. — Sonai, Iriomote Island, Yaeyama Islands, Ryukyu Islands, Japan.

DIAGNOSIS. — Carapace (Figs 42a, 61d; MIYAKE, 1936, pl. 35, fig. 3; MOOSA & SERÈNE, 1981, pl. 3, fig. A) subquadrate, with large, low granules. Frontal border with two small lobes separated by narrow, shallow notch. Two truncate anterolateral teeth. Supraorbital borders each with one triangular lobe. Each eye peduncle with rounded, low, soft tubercle at distal end. Postorbital angles triangular, with rounded tips. Suborbital borders each with one rounded to triangular inner lobe and one broad, rounded outer lobe (MIYAKE, 1936, fig 1A). Segments 2-3 of antennae very wide, thick, numerous long setae. Each basal antennal segment expanded into thick, dorsoventrally-flattened process. Chelipeds with long carpi and meri in larger specimens of both sexes but extremely long and increasingly (but slightly) unequal in males (Fig 42a; MIYAKE, 1936, pl. 35, figs 3-4); dorsal borders of propodi with irregular, microscopic tubercles; outer border with hook-like setae; long, simple and plumose setae along lower borders of cheliped propodi and fingers in males. Upper and lower borders of meri and anterior borders of carpi of second and third pairs of walking legs (P3-4) with very small, low tubercles; meri of P2 elongate, equal or longer than half carapace length (0.5-0.6 CL). Abdomen of mature males narrow, with segments 4-6 fused; one complete transverse ridge along segments 1-3, low ridges on proximal portion of fused segment 4-6. Male first pleopods (Fig. 43a; MIYAKE, 1936, figs 1D, F; MOOSA & SERÈNE, 1981, fig. 8) with sinuous basal parts; each distal part spherical, with two pointed ventral teeth and long, toothed dorsal process. Abdomen of mature females with segments 3-6 fused, one transverse ridge along each segment 1-2, two complete ridges along proximal portion of fused segment 3-6.

Color: A male from New Caledonia photographed live (Fig. 61d) had a broad, vertical, red-brown band through the middle of the carapace, irregular black patches along the sides of the carapace, and thin red-brown bands across the walking legs. The chelipeds were red-brown. A female from the same area had a similar color pattern except that the band across the carapace was solid red-brown. Many preserved specimens of both sexes had a dark dot on the median portions of the dactyli of the chelipeds and fifth pereopods (P5).

DISCUSSION. — The single male specimen that was used in the description of *P. longimanus* (MIYAKE, 1936, pl. 35) was characterized by very long and slender chelipeds, hence the name of the species. MOOSA & SERÈNE (1981), who examined only three specimens (one male and two females, all of a relatively large size), concluded that the chelipeds were always very long in both sexes. They used the relative length of the chelipeds to distinguish between *P. longimanus* and the two other species they included in the new genus *Palicoides*, *P. whitei* and *P. ternatensis* Moosa & Serène, 1981, a subjective junior synonym of *P. whitei* (see below).

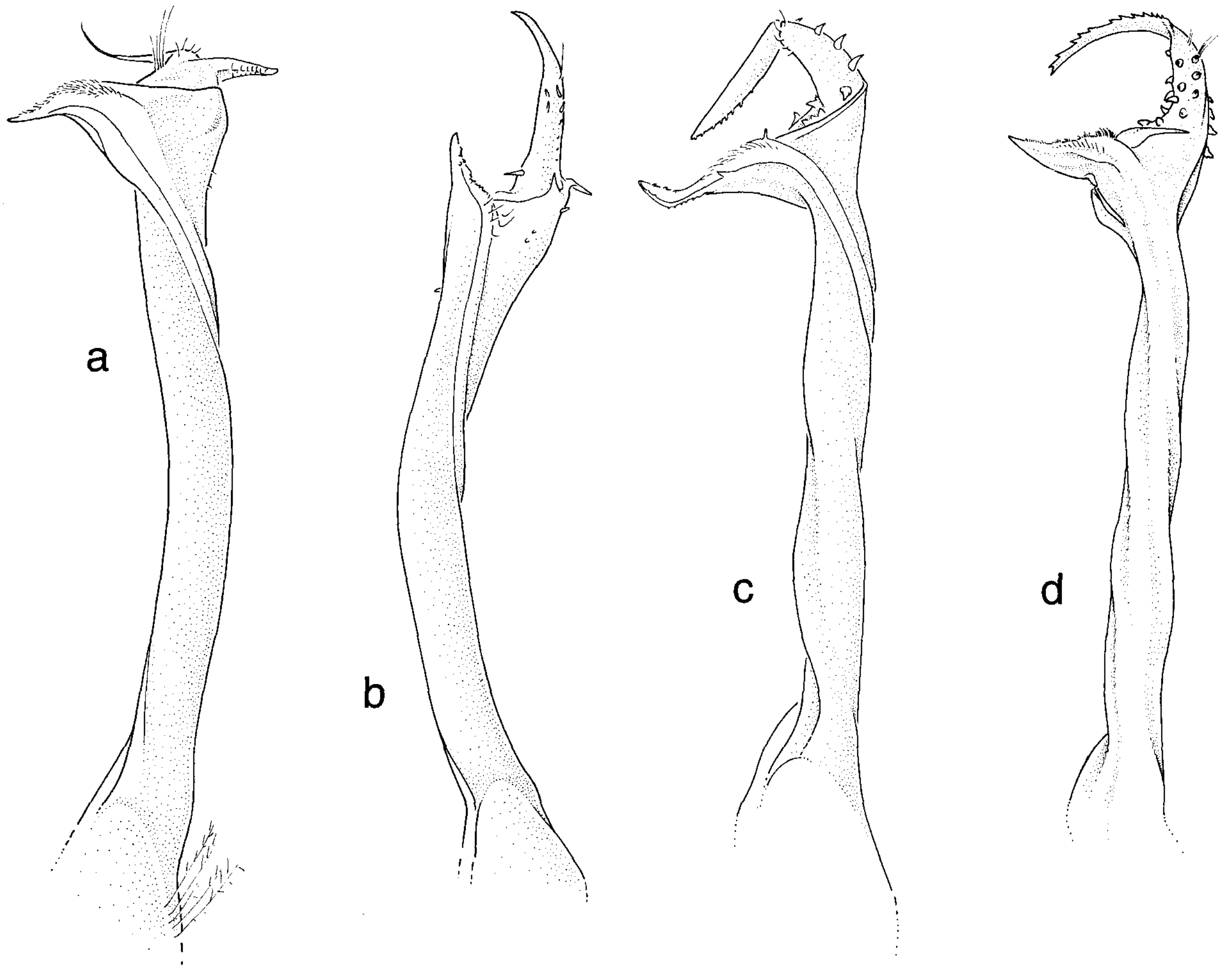

FIG. 43. — **a**, *Palicoides longimanus* (Miyake, 1936), ♂ 11.4 x 12.5 mm, Passe de Boulari, New Caledonia, 15 m (MNHN-B 26792): left male first pleopod, ventral view. — **b-d**, *Palicoides whitei* (Miers, 1884): **b**, ♂ 5.1 x 5.0 mm, LAGON, Grand Récif, New Caledonia, stn 1094, 26 m (MNHN-B 26795): left male first pleopod (ventral view) of immature specimen. — **c**, ♂ 8.2 x 9.7 mm, west coast of New Caledonia, LAGON, stn 815, 32 m (MNHN-B 26800): left male first pleopod (ventral view) of intermediate-size specimen. — **d**, ♂ CL 14.5 mm, LAGON, west coast of New Caledonia, stn 748, 35 m (MNHN-B 26801): left male first pleopod (ventral view) of large-size specimen.

Examination of a large number of specimens of *P. longimanus* and *P. whitei* has shown that very long chelipeds (total length far exceeding carapace length) are found in large individuals of both species (Figs 42a-b, 61e). The relative length of the chelipeds increases with body size in both sexes. A direct relationship between cheliped length and body size is not always observed, however, perhaps the result of some chelipeds being regenerated (Fig. 61d). In *P. longimanus*, male chelipeds become longer than carapace length at a carapace length of approximately 9.0 mm, reaching 2.2 times carapace length (cheliped meri 0.9 times carapace length) in the largest male examined, 11.4 x 12.5 mm (MNHN-B 26792). Female chelipeds reach a length equal to carapace length at a carapace length of approximately 11.0 mm but they never exceeded carapace length in any of the females that were examined. The meri of male chelipeds were never found to be longer than carapace length, as stated in the key of MOOSA & SERÈNE (1981: 45). They also referred to only two fused segments (5-6) in the only *P. longimanus* male they examined (MOOSA & SERÈNE, 1981: 52). Adult males were actually found to have segments 4-6 fused.

The specimens examined in this study agree with the description of the species (MIYAKE, 1936) in most aspects. No mention was made in the description of the crescent-shaped process on the eye peduncles, a diagnostic characteristic of the genus, although it is present in the holotype (ZLKU 5771). The tip of the process on the left peduncle, however, is severed. A small but not crescent-shaped process is shown in two figures (MIYAKE, 1936, figs 1 A-B), one of which is reproduced by SAKAI (1939, fig. 90c; 1987, fig. 325c). The figure of the anterolateral portion of the carapace (MIYAKE, 1936, fig. 1B) does not show the gap between the first anterolateral tooth and the postorbital angles. The gap was found in the holotype and in most but not all of the specimens that were examined. Another diagnostic character present in the holotype but not mentioned in the description or shown in MIYAKE's figures is the presence of long setae along the lower borders of the chelipeds.

MOOSA & SERÈNE (1981: 45) described the male first pleopods as having a "spiraled shaft". It is best described as sinuous, but not spiral (or helicoidal) as in the basal parts of *Parapalicus*. The male first pleopods of the smallest male examined in this study (6.2 x 6.8 mm; MNHN-B 26793) consisted of two flat terminal processes similar to the male first pleopods in small males of *P. whitei* (see below). Unlike *P. whitei*, however, two minute spines were present on opposite sides at the base of the processes.

Some variation was observed in the shape of the basal antennal segment. It was elongate or even biramous in a few specimens but thick and dorsoventrally-flattened in the great majority of specimens that were examined.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.1-1.2	1.7-2.1	1.8-2.0	0.8-0.9
Merus length/CL	0.4	0.5-0.6	0.5-0.6	0.3
Dactylus length/Cl	0.3	0.4-0.5	0.4-0.5	0.1-0.2

P. longimanus may be easily confused with *P. whitei*, its only congener. Differences between species are given in Table 4. In many specimens of *P. longimanus* there is only a very narrow fissure between the first anterolateral teeth and the postorbital angles, whereas it is wider in many specimens of *P. whitei* (MOOSA & SERÈNE, 1981, fig. 10). This, however, is not an absolute character.

TABLE 4. — Morphological differences between *Palicoides longimanus* (Miyake, 1936) and *P. whitei* (Miers, 1884).

	Palicoides longimanus (Miyake, 1936)	***Palicoides whitei*** (Miers, 1884)
Frontal lobes of carapace	Two small lobes separated by narrow and shallow notch	Two broad lobes separated by wider, deeper notch
Distalmost tubercle on eye peduncle	Round, shallow	Pointed, reaching almost same heigth of crescent-shaped process
Supraorbital borders	One triangular lobe	One triangular inner lobe and small, round to sligthly pointed outer lobe
Suborbital borders	Round to triangular inner lobe and broad, round outer lobe	Two rectangular to slightly round lobes
Abdomen of mature males	Segments 4-6 fused	Complete segments
First male pleopods	Two ventral teeth, long toothed dorsal process (Fig. 43a)	Small males: two flatenned processes (Fig. 43b); medium-size males: bent toothed tip (Fig. 43c); larger males: arched process with thick teeth (Fig. 43d)

SIZE. — Maximum size among specimens examined: 14.7 x 17.0 mm (female, MNHN-B 26791); 11.4 x 12.5 mm (male, MNHN-B 26792).

DISTRIBUTION. — Previously known only from the Ryukyu Islands, Japan (MIYAKE, 1936; SAKAI, 1956) and Kai (Banda Sea) and Tanimbar (Arafura Sea) islands, Indonesia (MOOSA & SERÈNE, 1981). It is now also known from Ambon (Indonesia), the Coral Sea (Chesterfield Islands, New Caledonia, and the Loyalty Islands), and the Marshall Islands (Fig. 50). It has been collected from the same Coral Sea stations together with *Neopalicus jukesii* and *P. whitei*. Depth: 6 m to 57 m (MOOSA & SERÈNE, 1981).

Palicoides whitei (Miers, 1884)

Figs 42b, 43b-d, 50, 61e

Cymopolia whitei Miers, 1884: 551, pl. 49, figs C, c. — GUINOT, 1967: 280.
Palicus whitei - BOUVIER, 1897: 65. — ALCOCK, 1900: 453. — CALMAN, 1900: 31, pl. 2, figs 14-19. — RATHBUN, 1911: 240, pl. 19, fig. 10. — LAURIE, 1915: 416, 421, 473. — MCNEILL, 1968: 82. — SERÈNE, 1968: 96.
Palicoides whitei - MOOSA & SERÈNE, 1981: 46, figs 9-10.
Palicoides ternatensis Moosa & Serène, 1981: 50, fig. 11, pl. 3, fig. B.

MATERIAL EXAMINED. — **Socotra**. Stn 146, 12°37.1'N, 54°18.3'E, 20-25 m, sand, under coral *Goniopora stokesii*, M. APEL coll., 2.04.1999: 1 ♂ (SMF 25280).

Seychelles. *"Alert"*: stn 194, 7-22 m, COPPINGER coll., 03.1882: 1 ♂ lectotype of *Cymopolia whitei* Miers, 1884 6.0 x 6.7 mm, 1 ♂ paralectotype 5.8 x 6.5 mm, 2 ♀ paralectotypes 8.4 x 9.4 mm, 7.5 x 8.4 mm (BMNH 1882.24).

REVES 2: stn 41, 04°44.0'S, 56°15.1'E, 50 m, shelly sand and *Halimeda*, 13.09.1980: 1 ♀ (MNHN-B 27303). — Stn 47, 04°03.8'S, 55°59.5'E, 45-55 m, shelly sand, 14.09.1980: 2 ♂ (MNHN-B 27310). — Stn 50, 03°56.1'S, 55°40.5'E, 45-50 m, shelly sand, 15.09.1980: 1 ♂ (MNHN-B 27304), 1 ♂ 8.6 x 9.6 mm (MNHN-B 26798).

Mauritius. Tombeau Bay, stn 38, 73 m, T. MORTENSEN coll., 8.10.1929: 1 ♂ (ZMUC).

Madagascar. *Nosy Be*. A. CROSNIER coll.: 1 ♂ (MNHN-B 27317).

Comoro Islands. *Mayotte*. Lagoon, medium-size sand, 55 m, A. CROSNIER coll., 09.1958: 1 ♀ (MNHN).

Japan. *Ryukyu Islands*. Okinawa, 26°30.4'N, 127°52.6'E, 48.8 m, R.F. BOLLAND coll., 12.06.1984: 1 ♂ (USNM). — 26°30.0'N, 127°50.9'E, 64 m, R.F. BOLLAND coll., 29.06.1984: 1 ♂ (USNM), 1 ♀ (USNM). — Kerama Islands, Amuro-jima Island, *"Toyoshio-maru"*, stn 7, 26°10.00'N, 127°18.90'E, 52 m, T. KOMAI coll., 19.05.1998: 1 ♂ (CBM-ZC 4671).

Indonesia. *Halmahera*. MARIEL KING MEMORIAL EXPEDITION: stn HD I/1, Dodinga Bay, 0°49'N, 127°33'E, 31-42 m, coral (*Acropora*) sediment and mud, 20.05.1970: 1 ♂ holotype of *Palicoides ternatensis* Moosa & Serène, 1981 10.5 x 12.3 mm (RDC CB 2724).

Saparua Island. RUMPHIUS EXPEDITION 1: stn Ip3, 03°30'15"S, 128°41'20"E, KASIJAN coll., 18.01.1973: 1 ♂ (MNHN-B 10005).

Australia. *Torres Strait*. Murray Island, A.C. HADDON coll., 1888: 2 ♀ (BMNH 1954.9.14.89-90).

Queensland. GREAT BARRIER REEF EXPEDITION: stn 16, off Lookout Point, 9.03,1929: 1 ♂, 1 ♀. — Stn 17, off Lookout Point, 9.03.1929: 3 ♀ (BMNH 1950.12.1.24-27).

Chesterfield Islands, Chesterfield-Bellona Plateau. CHALCAL 1: stn DC 34, 19°52.10'S, 158°20.10'E, 33-37 m, *Halimeda* sand, 21.07.1984: 1 ♂ (MNHN-B 27343). — Stn DC 45, 20°48.93'S, 158°30.21'E, 50 m, 23.07.1984: 1 ♂, 2 ♀ (MNHN-B 27346). — Stn CP 14, 21°13.50'S, 158°50.20'E, 66 m, 24.07.1984: 1 ♀ (MNHN-B 27347). — Stn DC 53, 21°19.50'S, 158°55.30'E, 60 m, 24.07.1984: 1 ♀ 20.5 x 23.5 mm (MNHN-B 26799), 1 ♂ (MNHN-B 27351). — Stn DC 55, 21°23.90'S, 158°59.60'E, 55 m, *Halimeda* and foraminiferans, 25.07.1984: 3 ♀ (MNHN-B 27348).

"Vauban": stn 7 DE, 21°21.0'S, 158°52.7'E, 56-58 m, 19.10.1985: 1 ♂, 1 ♀ (MNHN-B 27349). — Stn 14 DE, 21°46.5'S, 159°28.3'E, 42-52 m, 22.10.1985: 1 ♀ (MNHN-B 27350).

CORAIL 2: stn DW 41, 19°21.52'S, 158°31.87'E, 52 m, *Halimeda*, 23.07.1988: 1 juv. (MNHN-B 27352). — Stn DW 59, 19°18.50'S, 158°56.55'E, 50 m, 24.08.1988: 1 ♀ (MNHN-B 27354). — Stn DW 67, 19°14.9'S, 158°36.94'E, 66 m, 24.08.1988: 1 ♀ (MNHN-B 27355). — Stn DW 79, 19°11.55'S, 158°43.40'E, 58 m, *Halimeda* sand, 25.08.1988: 1 ♂, 3 ♀ (MNHN-B 27356). — Stn DW 93, 19°05.92'S, 158°53.00'E, 58-60 m, *Halimeda*, 27.08.1988: 2 ♂, 1 ♀ (MNHN-B 27357). — Stn 94, 19°06.00'S, 158°50.00'E, 36-53 m, boulders and *Halimeda*, 27.08.1988: 1 ♂ (MNHN-B 27358). — Stn 101, 19°08.99'S, 158°26.24'E, 37 m, *Halimeda* sand, 27.08.1988: 1 ♀ (MNHN-B 27359). — Stn DW 110, 19°08'95'S, 158°55.82'E, 48 m, shelly sand, 28.08.1988: 1 ♀ (MNHN-B 27360). — Stn DW 117, 19°25.10'S, 158°31.70'E, 52 m, *Halimeda* sand, 28.08.1988: 1 ♂ 16.2 x 18.9 mm (MNHN-B 26796). — Stn DW 135, 19°31.37'S, 158°19.14'E, 46 m, coarse sand, 30.08.1988: 1 ♀ (MNHN-B 27361). — Stn DW 136, 19°31.20'S, 158°16.00'E, 37 m, sand and boulders, 30.08.1988: 1 ♀ (MNHN-B 27362). — Stn DW 154, 19°52.04'S, 158°26.50'E, 35 m, *Halimeda* sand, 1.09.1988: 1 ♀ (MNHN-B 27363). — Stn DW 155, 19°49.08'S, 158°24.85'E, 42 m, foraminiferan sand, 01.09.1988: 1 ♀ (MNHN-B 27364). — Stn DW 166, 19°41.49'S, 158°25.24'E, 56 m, boulders, 2.09.1988: 1 ♀ (MNHN-B 27365).

New Caledonia. LAGON: stn 100, 22°32.6'S, 166°34.6'E, 15 m, shelly sand, 08.1984: 1 ♀ (MNHN-B 27318). — Stn 239, 22°24.3'S, 166°57.8'E, 43 m, coarse sand, 10.1984: 1 ♀ (MNHN-B 27319). — Stn 313, 22°40.3'S, 166°50.1'E, 30 m, coarse sand and *Halimeda*, 11.1984: 1 ♀ (MNHN-B 27331). — Stn 345, 22°46.4'S, 166°50.4'E, 39 m, white sand and corals, 11.1984: 2 ♀ (MNHN-B 27311). — Stn 353, 22°33.5'S, 167°00.8'E, 70 m, coarse sand and corals, 11.1984: 1 ♀ (MNHN-B 27312). — Stn 474, 18°02.4'S, 163°01.8'E, 52 m, *Halimeda* sand, 1.03.1985: 1 ♀ (MNHN-B 27332). — Stn 477, 18°51.0'S, 163°27.0'E, 50 m, *Halimeda* sand, 2.03.1985: 2 ♀ (MNHN-B 27320). — Stn 540, 19°06.2'S, 163°15.8'E, 35-40 m, *Halimeda* sand, 6.03.1985: 1 ♂ (MNHN-B 27333). — Stn 541, 19°06.0'S, 163°13.3'E, foraminiferan sand, 48-43 m, 6.03.1985: 1 ♀ (MNHN-B 27321). — Stn 601, 22°18.0'S, 167°02.5'E, 47-48 m, shelly sand, 5.08.1986: 1 ♀ (MNHN-B 27305). — Stn 708, 21°23.6'S, 166°05.2'E, 34-35 m, foraminiferan sand, 10.08.1986: 1 ♀ (MNHN-B 27313). — Stn 709, 21°22.2'S, 166°03.5'E, 39-40 m, foraminiferan sand, 10.08.1986: 1 ♀ (MNHN-B 27334). — Stn 710, 21°24.0'S, 166°02.5'E, 30-31 m, foraminiferan sand, 10.08.1986: 1 ♀ (MNHN-B 27335), 1 ♂ (MNHN-B 27306). — Stn 714, 21°21.0'S, 166°01.8'E, 37-38 m, foraminiferan sand, 11.08.1986: 1 ♂ (MNHN-B 27307). — Stn 747, 21°14.7'S, 165°50.9'E, 31-34 m, foraminiferan sand and *Halimeda*, 6.01.1987: 1 ♂ (MNHN-B 27322), 1 ♀ (MNHN- B 27323). — Stn 748, 21°16.9'S, 165°49.9'E, 35 m, coarse sand and *Halimeda*, 6.01.1987: 1 ♂ CL 14.5 mm (MNHN-B 26801), 1 ♂, 4 ♀ (MNHN-B 27324), 1 ♂ 15.5 x 18.1 mm (MNHN-B 26797). — Stn 749, 21°18.4'S, 165°18.4'E, 49 m, mud and shells, 6.01.1987: 1 ♀ (MNHN-B 27308). — Stn 765, 21°13.8'S, 165°41.8'E, 35 m, coarse sand, 8.01.1987: 1 ♀ (MNHN-B 27325). — Stn 780, 21°06.0'S, 165°39.2'E, 33 m, coarse sand, 8.01.1987: 1 ♂ (MNHN-B 27309). — Stn 782, 21°06.1'S, 165°36.7'E, 30 m, coarse sand, 8.01.1987: 1 ♀ (MNHN-B 27326). — Stn 788, 21°01.6'S, 165°34.7'E, 33 m, coarse sand, 9.01.1987: 1 ♀ (MNHN-B 27336). — Stn 794, 21°03.2'S, 165°30.9'E, 51 m, mud, 9.01.1987: 1 ♂, 2 ♀ (MNHN-B 27337). — Stn 795, 21°01.6, 165°32.0'E, 31 m, coarse sand, 9.01.1987: 3 ♂ (MNHN-B 27338). — Stn 801, 21°02.0'S, 165°29.3'E, 29 m, foraminiferan sand, 9.01.1987: 1 ♀ (MNHN-B 27339). — Stn 815, 21°54.1'S, 165°26.9'E, 32 m, coarse sand, 10.01.1987: 1 ♂ 8.2 x 9.7 mm (MNHN-B 26800). — Stn 821, 20°51.9'S, 165°23.2'E, 32 m, coarse sand, 10.01.1987: 2 ♂, 1 ♀ (MNHN-B 27314), 1 ♂ (MNHN-B 27341). — Stn 828, 20°50.1'S, 165°19.5'E, 28 m, coarse sand, 10.01.1987: 2 ♂ (MNHN-B 27327). — Stn 847, 20°37.6'S, 165°13.4'E, 28 m, fine sand, 11.01.1987: 1 ♀ (MNHN-B 27340). — Stn 867, 20°39.0'S, 165°01.3'E, 25 m, shell debris, 13.01.1987: 1 ♀ (MNHN-B 27328). — Stn DW 985, 20°20.3'S, 163°57.9'E, 15-17 m, coarse sand and *Halimeda*, 30.04.1988: 1 ♂ (MNHN-B 27315). — Stn DW 1094, 19°54.4'S, 163°41.2'E, 26 m, foraminiferan sand and *Halimeda*, 20.10.1989: 1 ♂ 5.1 x 5.0 mm (MNHN-B 26795). — Stn DW 1126, 19°33.0'S, 163°46.0'E, 41 m, coarse sand, 26.10.1989: 1 ♂ (MNHN-B 27316). — Stn DW 1139, 19°23.6'S, 163°47.0'E, 39 m, *Halimeda* sand, 27.10.1989: 6 ♀ (MNHN-B 27342).

Passe de Touho. Suction pump, 20 m, 18.09.1993: 1 ♀ (MNHN-B 27345).

Ilôt Maître. 22 m, P. BOUCHET coll., 28.09.1992: 1 ♀ (MNHN-B 27344).

TYPES. — *Lectotype* of *Cymopolia whitei* Miers, 1884: 1 ♂ 6.0 x 6.7 mm; paralectotypes 1 ♂ 5.8 x 6.5 mm, 2 ♀ 8.4 x 9.4 mm; 7.5 x 8.4 mm, *"Alert"*, stn 194 (BMNH 1882.24).

Holotype of *Palicoides ternatensis* Moosa & Serène, 1981: 1 ♂ 10.5 x 12.3 mm, MARIEL KING MEMORIAL EXPEDITION, stn HD I/1 (RDC CB2724).

TYPE LOCALITY. — Seychelles, *"Alert"*, stn 194, exact location unknown, 7-22 m.

DIAGNOSIS. — Carapace (Figs 42b, 61e; MIERS, 1884, pl. 49, fig. C; CALMAN, 1900, pl. 2, fig. 14; RATHBUN, 1911, pl. 19, fig. 10; MOOSA & SERÈNE, 1981, pl. 3, fig. A, as *P. ternatensis*; fig. 10) subquadrate, with large, low granules. Frontal border with two broad lobes separated by wide notch. Two truncate anterolateral teeth. Supraorbital borders each with one triangular inner lobe and smaller, rounded to slightly pointed outer lobe. Each eye peduncle with conspicuous, pointed, soft tubercle at distal end. Postorbital angles elongate, with pointed tips. Suborbital borders each with two rectangular to slightly rounded lobes (CALMAN, 1900, pl. 2, fig. 15). Segments 2-3 of antennae very wide, thick, numerous long setae. Each basal antennal segment expanded into thick, dorsoventrally-flattened process. Chelipeds with long carpi and meri in larger specimens of both sexes but extremely long and increasingly (but slightly) unequal in males (Figs 42b, 61e); dorsal borders of propodi with rounded or pointed tubercles; outer border with hook-like setae; long, simple and plumose setae along lower borders of cheliped propodi and fingers of males. Upper and lower borders of meri and anterior borders of carpi of second and third pairs of walking legs (P3-4) with very small, low tubercles (CALMAN, 1900, pl. 2, fig. 18). Abdomen of mature males narrow, with all segments free; one complete transverse ridge along segments 1-3 (incomplete one in segment 4, very low or absent in segments 5-6). Abdomen of immature males with segments 3-6 or 4-6 fused (MIERS, 1884, pl. 49, fig. c). First pleopods of small males (Fig. 43b; CALMAN, 1900, pl. 2, fig. 19; MOOSA & SERÈNE, 1981, fig. 9) with sinuous basal parts; distal part each with two flattened processes provided with teeth. First pleopods of larger males (Figs 43c-d; MOOSA & SERÈNE, 1981, fig. 11, as *P. ternatensis*) with sinuous basal parts; each distal part with bent, toothed tip becoming enlarged as thick, arched process with thick teeth. Abdomen of mature females with segments 3-6 fused, one complete transverse ridge along each segment 1-2, two complete ridges along proximal portion of fused segment 3-6.

Color: A large male from New Caledonia photographed live (Fig. 61e) had a carapace that was mostly red and orange except a broad, dark-red band bordered by pink and orange blotches on the cardiac and intestinal regions, red chelipeds, and broad, red bands across the walking legs. Smaller males and females from the same region had a similar color pattern except that there was a broad band of red in the form of geometric patterns through the middle of the carapace. Many preserved specimens of both sexes had a dark dot on the median portion of the dactyli of the chelipeds and fifth pereopods (P5).

DISCUSSION. — The male first pleopods of *P. whitei* were illustrated by CALMAN (1900, pl. 2, fig. 19) and MOOSA & SERÈNE (1981, figs 9a-b). Their figures, however, are of the pleopods characteristic of small males, a situation found in those with a carapace length of up to 9.0 mm (5.1 x 5.0 mm; MNHN-B 26795) among the specimens that were examined. CALMAN did not give the size of this specimen; the specimen of MOOSA & SERÈNE had a carapace length of 9.2 mm (MOOSA & SERÈNE, 1981: 50). Such pleopods have sinuous basal parts (although MOOSA & SERÈNE described them as having a flattened shaft) and bifurcated distal parts (Fig. 43b). The ventral terminal process, the longest of the two, has rows of small teeth and its tip is dorsoventrally flattened and bordered by smaller teeth. As body size increases, the basal part of the pleopods becomes more distinctly sinuous, the two terminal processes and their teeth enlarge and the flattened tip of the ventral process bends downward (Fig. 43c). These were features used by MOOSA & SERÈNE (1981, figs 11a-d) to characterize their new species, *P. ternatensis*, here regarded as a subjective junior synonym of *P. whitei*. Nevertheless, there was not much difference between size of the only specimens examined by MOOSA & SERÈNE: one male *P. whitei* (9.2 x 10.6 mm) and one male, the holotype, of *P. ternatensis* (10.5 x 12.3 mm; RDC CB2724). The larger specimen identified as *P. ternatensis*, however, had all abdominal segments free, whereas the small male had "segments 3-5 soldered" (MOOSA & SERÈNE, 1981: 46), a characteristic of immature males (see below). In larger males the terminal processes of the pleopods are further enlarged (Fig. 43d). The ventral process gradually becomes thicker and arched, with thick teeth along its proximal portion and two rows of curved teeth along the outer (ventral) border. Whereas MOOSA & SERÈNE refer to the basal part of the pleopods of *P. whitei* and *P. ternatensis* as having a "flattened shaft", their figure of the pleopod of *P. ternatensis* (MOOSA & SERÈNE, 1981, fig. 11) clearly shows a sinuous basal part.

MOOSA & SERÈNE (1981) also used the relative length of the chelipeds to distinguish between the species of *Palicoides*, stating that it was shorter in *P. whitei* than in *P. longimanus* and intermediate in *P. ternatensis*. They based their conclusion using only a relatively small male of *P. whitei* and a slightly larger male of *P. ternatensis* (see above). Very long chelipeds where total length exceeds carapace length, however, characterize both species (Figs 42a-b). Chelipeds of *P. whitei* were longer than carapace length in all the males and females that were examined in this study except in the small males, where cheliped length was approximately equal to carapace length. The chelipeds of the largest *P. whitei* male examined in this study (16.2 x 18.9 mm; MNHN-B 26796) were 1.3 times longer than carapace length (cheliped meri 0.4 CL) but they were relatively longer in other specimens (15.5 x 18.1 mm [MNHN-B 26797], Fig. 61e; 8.6 x 9.6 mm [MNHN-B 26798], Fig. 42b). Differences in the relative length of chelipeds probably result from their loss and eventual regeneration in some individuals. Female chelipeds were always longer than carapace length but only reached a length slightly longer than carapace length (cheliped meri 0.3 CL) in the largest female examined (20.5 x 23.5 mm; MNHN-B 26799).

The number of abdominal segments also vary with increasing size. Immature males have segments 3-6 fused, but traces of sutures become progressively evident with increasing size until all segments are evident in mature males.

Another characteristic used by MOOSA & SERÈNE (1981: 46) to distinguish between the species of *Palicoides* is the presence in *P. longimanus* of irregular granules (larger on the branchial region) while being "of about the same sizes" in *P. whitei* and its subjective junior synonym *P. ternatensis*. This was found not to be true: larger specimens of both species have slightly larger granules on the branchial region.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

Length relationship of pereopods 2-5 in *Palicoides whitei*

	P2	P3	P4	P5
Total length/CL	1.1-1.2	1.6-1.8	1.5-1.7	0.9
Merus length/CL	0.3-0.4	0.5	0.4-0.5	0.3
Dactylus length/Cl	0.3	0.4	0.4	0.1-0.2

MIERS (1884) based his description of *Cymopolia whitei* on four specimens without selecting a holotype. One of the four syntypes (♂ 6.0 x 6.7 mm, BMNH 1882.24) is hereby designated as the lectotype. A second male and two females from the same collection are paralectotypes.

SIZE. — Maximum size among specimens examined: 20.5 x 23.5 mm (female, MNHN-B 26799); 16.2 x 18.9 mm (male, MNHN-B 26796).

DISTRIBUTION. — Previously known from the Red Sea (LAURIE, 1915), Seychelles (MIERS, 1884; RATHBUN, 1911), Andaman Islands, India (ALCOCK, 1900), Halmahera (Moluccas) and Kai Islands (Banda Sea), Indonesia (MOOSA & SERÈNE, 1981, some records as *P. ternatensis*), Torres Strait (CALMAN, 1900), and Queensland, Australia (MCNEILL, 1968). Its distribution is now extended to Socotra, the Comoro Islands, Madagascar, Mauritius, Japan, and the Coral Sea (Chesterfield Islands, Chesterfield-Bellona Plateau, and New Caledonia) (Fig. 50). It is an inhabitant of coarse-sand sediments (particularly those rich in the coralline alga, *Halimeda*) that is associated with coral reefs. It has been collected from the same Coral Sea stations together with *P. longimanus* and the two species of *Neopalicus*. Depth: 7 m (MIERS, 1884) to 70 m.

Subfamily CROSSOTONOTINAE Moosa & Serène, 1981

Crossotonotinae Moosa & Serène, 1981: 52.

TYPE GENUS. — *Crossotonotus* A. Milne Edwards, 1873.

DIAGNOSIS. — Fifth pair of pereopods (P5) reduced in size but similar in shape to anterior walking legs (P2-4); articulation to carapace at same level as walking legs. All borders of carapace with teeth or rounded to pointed tubercles. Dorsal surface of carapace relatively flat or slightly convex except regions with high bosses or tubercles. No episternal process overhanging each posterolateral border of carapace posterior to fifth pair of pereopods. Epistome very narrow, not expanded dorsoventrally (vertically inclined). Abdomen of mature males and females with all segments free, segments 1-2 wide (not dorsoventrally compressed); transverse ridges complete, incomplete, or absent.

GENERA INCLUDED. — *Crossotonotus* A. Milne Edwards, 1873 and *Pleurophricus* A. Milne Edwards, 1873.

DISCUSSION. — The subfamily was established by MOOSA & SERÈNE (1981) to include *Crossotonotus* A. Milne Edwards, 1873, *Pleurophricus* A. Milne Edwards, 1873, and *Manella* Rathbun, 1906. *Manella* is here synonymized with *Crossotonotus* (see below). *Parapleurophrycoides* Nobili, 1906, sometimes included in the Palicidae but "discarded" by MOOSA & SERÈNE (1981: 52) since the description of its only species was based on a juvenile specimen, does not belong to the Palicidae at all (see below). The two genera that remain in the subfamily share, among several characters, a fifth pair of pereopods (P5) that is not greatly reduced in size, is similar in morphology to the anterior walking legs (P2-4), and is located at the same level as that of the remaining walking legs, that is, not dorsal to them as in the Palicinae. Other significant differences include the morphologies of the outline of the carapace and in the abdomen of both sexes.

Parapleurophrycoides Nobili, 1906 was described for *P. roseus* from French Polynesia (see also NOBILI, 1907; FOREST & GUINOT, 1962). It was questionably included, as *Pleurophrycoides* [*sic*], in the Palicidae by SERÈNE, (1968: 97) but "discarded" by MOOSA & SERÈNE (1981: 52) since the description of its only species "was a juvenile which can not be used for the definition of the genus". The very small male holotype (1.3 x 1.5 mm; MNHN-B 13091) is a xanthoid (P.K.L. NG, personal communication) and possibly, as stated by NOBILI (1907: 402), BALSS (1957: 1662), and TAKEDA & SHIMAZAKI (1974: 75), a pilumnid. A very small male specimen from the Gulf of Thailand identified as *P. roseus* (1.2 x 1.4 mm; ZMUC) by RATHBUN (1910: 358; also see NAIYANETR, 1980: 43; 1998: 119, as *Pleurophrycoides* [*sic*] *roseus*) is very close if not identical to NOBILI's species and therefore not a palicid either.

The shape and placement of the P5 in *Crossotonotus* and *Pleurophricus* in contrast with the rest of the palicids led to their placement in other groups of brachyurans. *Crossotonotus* was placed between "Ocypodidae and Plagusiinae" by A. MILNE EDWARDS (1873a: 258) and DE MAN (1888: 344) included his new species, *P. spinipes* (a junior subjective synonym of *Crossotonotus compressipes* A. Milne Edwards, 1873) among the Corystidae. A. MILNE EDWARDS (1873a: 260) placed *Pleurophricus* among the Oxystomata close to the Ocypodidae, while MIERS (1879: 660) included it among the Oxyrhyncha.

All members of the subfamily appear to be restricted to hard substrates in relatively shallow water. No species are known from outside the Indo-west Pacific region.

Key to the genera of the subfamily CROSSOTONOTINAE

1. Carapace subquadrate, with low bosses on dorsal surface and many small (10 to more than 20), rounded or pointed tubercles along posterior border .... ***CROSSOTONOTUS*** A. Milne Edwards, 1873

— Carapace subcircular, with two very conspicuous, high bosses on metagastric region and few (5-6) larger, salient tubercles along posterior border .... ***PLEUROPHRICUS*** A. Milne Edwards, 1873

Genus *CROSSOTONOTUS* A. Milne Edwards, 1873

Crossotonotus A. Milne Edwards, 1873a: 258 [82]. — A. MILNE EDWARDS, 1873b: 282. — SAKAI, 1965: 186; 1976: 595. — TAKEDA & SHIMAZAKI, 1974: 75. — HOLTHUIS, 1977: 187. — MOOSA & SERÈNE, 1981: 58.
Crossonotus - HASWELL, 1882: 95.
Manella Rathbun, 1906: 837. — MOOSA & SERÈNE, 1981: 53.

TYPE SPECIES. — *Crossotonotus compressipes* A. Milne Edwards, 1873 by monotypy. Gender: masculine. Type species of *Manella* Rathbun, 1906: *Pleurophricus spinipes* De Man, 1888 by monotypy.

DIAGNOSIS. — Frontal border of carapace divided into 2-4 lobes (innermost lobes sometimes secondarily notched). Anterolateral borders each with pointed teeth. Dorsal surface of carapace with small granules and high granular bosses. Eyes spherical; peduncles with soft tubercles. Supraorbital borders each with two lobes. Suborbital borders each with two lobes. Each basal antennal segment rectangular but outer side can be slightly expanded. Epistome very narrow, with conspicuous, triangular median teeth. Chelipeds unequal in males and females. Walking legs (P2-5) with flattened carpi, propodi, and dactyli. First (P2) and fourth (P5) pairs shorter than second and third pairs (P3-4). Borders of meri of P2-5 with equal or nearly equal tubercles; carpi, propodi, and dactyli with teeth along anterior and posterior borders. P5 reduced (0.9-1.0 CL), thick and flattened. Abdomen of mature males elongate (sides parallel to each other), with all segments free. Male first pleopods long and slender; basal parts sinuous; each distal part uniramous (secondary, proximal tip may be present), tip with minute teeth. Abdomen of mature females with all segments free.

REDESCRIPTION. — Carapace subquadrate, slightly broader than long, with low, granular bosses. Anterolateral borders each with a continuous row of teeth; posterolateral borders with tubercles, straight or slightly rounded, with marked junction with convex posterior border. Confluence of branchial and mesogastric regions depressed and smooth; no conspicuous sulcus between hepatic and branchial regions. Posterior border with many rounded or pointed tubercles. Thoracic sternite 7 without episternal process visible dorsally.

Frontal border divided into 2-4 pointed or rounded lobes (if four, inner pair more advanced anteriorly than outer pair, may be secondarily lobed). Supraorbital borders each with two triangular or rounded lobes. Postorbital angles conspicuous, with long and pointed tips. Cornea of eyes spherical, slightly wider than base of eye peduncle; peduncle with granular tubercles at least on distal border. Orbits deep.

Suborbital border with two broad, rounded lobes usually bordered by long teeth or pointed tips. Pterygostomial lobe at each anterolateral angle of buccal frame broad, bordered by long teeth or slightly pointed.

Each basal antennal segment rectangular, with or without small, outward expansion. Epistome very narrow, not expanded dorsoventrally, vertically inclined. Border of epistome with two triangular, pointed median teeth (plus two triangular, pointed outer processes) connecting distally with each pterygostomial lobe. Meri of third maxillipeds smaller and narrower than ischia.

Chelipeds unequal in males and females. First (P2) and fourth (P5) pairs of walking legs shorter than second and third pairs (P3-4). Walking legs (P2-5) with flattened carpi, propodi, and dactyli; anterior (dorsal) and posterior (ventral) borders of meri with pointed teeth and rows of tubercles on dorsal and ventral surfaces; anterior and posterior borders of carpi, propodi, and dactyli with teeth. Second and third pairs of walking legs (P3-4) each with broad coxae, having flattened, thin-edged anterior and posterior borders.

Abdomen of mature males elongate, with both sides almost parallel to each other, with all segments free, and no transverse ridges; first segment broad and long. Male first pleopods long and slender; basal parts sinuous; each distal part uniramous (secondary, proximal tip may be present), tip bordered by minute teeth. Second male pleopods short, slightly thick, slightly curved; distal segment with blunt tip.

Abdomen of mature females broad, rounded, with all segments free and no transverse ridges; first segment broad and long. Abdomen of immature females triangular (but broader than in males), with all segments free.

SPECIES INCLUDED. — *C. compressipes* A. Milne Edwards, 1873, *C. spinipes* (De Man, 1888), *C. ceramensis* (Moosa & Serène, 1981), and *C. lophocheir* sp. nov.

SEXUAL DIMORPHISM. — The largest specimen known for *C. spinipes* is a male, the only case among Indo-west Pacific palicids. The chelipeds are unequal in both sexes in *C. spinipes* but a conspicuous, dense cluster of plumose setae is found only on the inner surface of the propodi and fingers of male chelipeds. The lower margin of the large cheliped of males has a series of sinuous ridges, presumably a stridulating surface (RATHBUN, 1911).

DISCUSSION. — *Crossotonotus* was established by A. MILNE EDWARDS (1873a) for a new species, *C. compressipes*, which was described using specimens from Samoa. The genus was considered not to belong to any known family of the Catometopa and was placed "between Ocypodidae and Plagusiinae" (A. MILNE EDWARDS, 1873a: 258).

A second species, *Pleurophricus spinipes*, was described from Ambon, Indonesia by DE MAN (1888), who placed it in *Pleurophricus* A. Milne Edwards, 1873. RATHBUN (1906) identified *P. spinipes* from the Hawaiian Islands but created *Manella* (with *P. spinipes* De Man as the type species) to recognize the position of the species as a palicid based on the relative size of its walking legs: "I have separated generically DE MAN's species from the type of *Pleurophricus* on account chiefly of the legs" (RATHBUN, 1906: 837). The legs of RATHBUN's species (*Manella spinipes* Rathbun, 1906) were found to be similar to those of other palicids (that is, first and fourth walking legs smaller than the second and third) whereas the legs of *Pleurophricus cristatipes* A. Milne Edwards, 1873, originally the only species in the genus, were more similar in size and therefore not considered palicid-like (RATHBUN, 1906). RATHBUN (1911), WARD (1933), MONOD (1938), SAKAI (1939), EDMONDSON (1933, 1946, 1962) and ZARENKOV (1968) followed RATHBUN (1906) and placed *C. compressipes* and *P. spinipes* under *Manella*. Three additional species were eventually added: *M. gardineri* Rathbun, 1911, *M. brevimana* Ward, 1933, and *M. ceramensis* Moosa & Serène, 1981. SAKAI (1965, 1974, 1976), however, regarded *Manella* as a synonym of *Crossotonotus*, a view followed by SERÈNE (1968), HOLTHUIS (1977) and MCNEILL (1968). MOOSA & SERÈNE (1981: 60) examined the type material of *C. compressipes* and mistakenly concluded that it was different from *Manella*, although they stated that the genera "are close one from another and perhaps identical". They restricted *Crossotonotus* to the type material of *C. compressipes* that was examined (MNHN-B 3078) plus three additional specimens examined by WARD (1933).

The figure that was published following the description of *C. compressipes* (A. MILNE EDWARDS, 1873b: pl. 13, fig. 1) shows a rounded carapace that lacks a noticeable junction between the posterolateral borders and a convex posterior border. This character was unfortunately used by MOOSA & SERÈNE (1981) to separate *Crossotonotus* from *Manella*. In the type material of *C. compressipes* (MNHN-B 3078), the posterior edge of the carapace is slightly convex and there are noticeable junctions with each posterolateral border.

Key to the species of *CROSSOTONOTUS*

1. Carapace subquadrate, depressed; pointed or broad, straight-edged anterolateral teeth **2**
— Carapace subcircular, dorsally convex; rounded anterolateral teeth ....***C. compressipes*** A. Milne Edwards, 1873

2. Dorsal border of propodus of cheliped with two rows of short tubercles **3**
— Dorsal border of propodus of cheliped with one large, rounded tubercle ....***C. lophocheir*** sp. nov.

3. Frontal lobes broad with tips bent upward or rounded (in smaller individuals). Inner surface of cheliped propodi (distal portions) and fingers (proximal borders) of males with dense clusters of plumose setae .... ***C. spinipes*** (De Man, 1888)
— Frontal lobes broadly rounded and only slightly protuberant. Inner surface of cheliped propodi of males without clusters of setae ..... ***C. ceramensis*** (Moosa & Serène, 1981)

Crossotonotus compressipes A. Milne Edwards, 1873

Figs 44, 51

Crossotonotus compressipes A. Milne Edwards, 1873a: 259 [83]. — A. MILNE EDWARDS, 1873b: 283, pl. 13, figs 1, 1a-f. — WARD, 1933: 389. — SAKAI, 1965: 186. — MCNEILL, 1968: 81. — SERÈNE, 1968: 96. — MOOSA & SERÈNE, 1981: 60. — FRANSEN *et al.*, 1997: 152. — MURAOKA, 1998: 49.
Crossonotus [*sic*] *compressipes* - HASWELL, 1882: 96.
Crossotonotus taketomiensis Sakai, 1974: 94; 1976: 596, fig. 326.
Crosstonotus [*sic*] *taketomiensis* - NAGAI & NOMURA, 1988: 197, color photograph.

MATERIAL EXAMINED. — **Japan**. *Ishigaki Islands, Taketomi Island.* Taketomi Island, Ishigaki Islands, Ryukyu Islands, T. SAKAI coll., 25.10.1973: 1 juv. ♂ holotype of *Crossotonotus taketomiensis* Sakai, 1974, 5.7 x 6.1 mm (SMF 24716).

No locality. 1 ♂ (SMF 24717).

Indonesia. *Moluccas*. RUMPHIUS EXPEDITION I: stn Li-1, Ambon, 03°36'06"S, 128°14'58"E, KASIJAN coll., 15.01.1973: 1 ♀ (MNHN-B 10014).

Papua New Guinea. *Bismark Archipelago*. New Britain Island, Ralum, coral reef, S. DAHL coll., 4.09.1986: 1 ♀ (ZMB 18167).

Australia. *Queensland*. Hope Islands. 12°28'S, 145°15'E, A.R. MCCULLOCH coll., 1905: 1 ♂ (AM P3740).

Low Isles. GREAT BARRIER REEF EXPEDITION: 1 ♀ 9.5 x 10.5 mm (BMNH 1950.12.1.28).

New Caledonia. Nouméa, baie des Citrons, under rock, 1 m, G. PAULAY coll., 18.05.1999: 1 ♀ (MNHN-B 27138).

Unknown locations. M. BALANSA coll.: 1 ♀ 7.0 x 7.3 mm (MNHN-B 26272). — BOUGRIN ? coll., 1903: 1 ♀ (MNHN-B 13251).

Samoa. *Upolu*. 1 ♀ lectotype 8.4 x 9.5 mm, 1 ♀ paralectotype 6.4 x 7.4 mm (MNHN-B 3078). — 2 ♀ 6.7 x 8.0 mm, 7.3 x 8.7 mm (SMF 1747). — 2 ♀ 6.7 x 7.1 mm, 7.0 x 7.4 mm (ZMUC CRU-3623).

TYPES. — *Lectotype*: 1 ♀ 8.4 x 9.5 mm, Samoa (MNHN-B 3078).

Paralectotypes: 1 ♀ 6.4 x 7.4 mm, Samoa (MNHN-B 3078).

Holotype of *Crossotonotus taketomiensis* Sakai, 1974: 1 ♂ 5.7 x 6.1 mm, Taketomi Island, Ishigaki Islands, Ryukyu Islands, T. SAKAI coll., 25.10.1973 (SMF 24716).

TYPE LOCALITY. — Upolu, Samoa, unknown depth.

DIAGNOSIS. — Carapace (Fig. 44a) subcircular, dorsoventrally convex, with large, low bosses. Five to six broad, rounded anterolateral teeth on each side of carapace, followed by 3-4 slightly smaller, rounded tubercles along each posterolateral border; 9-14 rounded tubercles along convex posterior border separated from posterolateral border by clear junction. Supraorbital borders each with two short, slightly rounded lobes. Four rounded to slightly pointed lobes along anterior border; median lobes slightly broader and longer than outer lobe. Suborbital borders (Fig. 44b) each with two pointed lobes, proximal bifurcated. Dorsal borders of cheliped propodi each with two rows of rounded tubercles; lower border of propodus of largest cheliped straight. Dactyli of P2-4 with teeth along anterior and posterior borders (two on posterior borders of P4); dactyli of P5 (Fig. 44c) with 3-4 spines along posterior borders. Abdomen of mature males and females with all segments free (A. MILNE EDWARDS, 1873b, pl. 13, figs 1e, 1f). Male first pleopods (Figs 44d-e) with sinuous basal parts; each distal part straight, one simple tip bordered by conspicuous teeth.

Color: A color photograph in NAGAI and NOMURA (1988: 197) identified as *C. taketomiensis*, a junior synonym of *C. compressipes*, shows an individual partially camouflaged against a hard substrate in an Okinawa coral reef. The carapace of the specimen is pinkish brown, with a bright yellow spot on the cardiac region flanked on each side by a greenish spot. The legs and clumps of setae across the dorsal surface of the carapace are gray.

DISCUSSION. — *C. compressipes* was actually described twice by A. MILNE EDWARDS (1873a, 1873b), with both publications appearing in the same year. Unfortunately, it has not been possible to obtain information on which of the two was first published. The descriptions are identical except that in one of the two (A. MILNE EDWARDS, 1873b: 284) there is information on additional material from New Caledonia, which leads to belief that it was written after the intended description (A. MILNE EDWARDS, 1873a).

Two dry female specimens from Samoa that were originally deposited at the Godeffroy Museum, Hamburg and the source of specimens used in the description, were designated by MOOSA & SERÈNE (1981) as the "holotype" and "paratype" of *C. compressipes*. Since A. MILNE EDWARDS had not selected a holotype, the two specimens were actually syntypes. The selection of a "holotype" and a "paratype" among the syntypes by MOOSA & SERÈNE was incorrect and therefore the two selected specimens are a lectotype and a paralectotype respectively, not a holotype (International Code of Nomenclature, fourth edition, 1999, Article 74.1). Both specimens are small (lectotype 8.4 x 9.5 mm, paralectotype 6.4 x 7.4 mm; MNHN-B 3078). A photograph of one of the specimens of the type material, perhaps the lectotype, is probably shown in a photograph in MOOSA & SERÈNE (1981, pl. 3, fig. D). They are similar to the measurements given by A. MILNE EDWARDS (1873a: 259 [83]) in his description (8 x 9 mm). The number of lateral teeth given in the description (10-12) agree with the number observed in the lectotype and paralectotype but not in the case of the posterior teeth: 12 in the specimen against 6-8 in the description. Some of the posterior teeth are rounded and broad, while others are small and pointed and perhaps they were not taken into account. The posterior border of the paralectotype is damaged. The carapace of a third dry specimen from New Caledonia presumably examined by A. MILNE EDWARDS (MNHN-B 26272) is in poor condition. The figure given by A. MILNE EDWARDS (1873b, pl. 13, fig. 1) shows a rounded carapace bordered by similar rounded teeth, of which 12 may be interpreted as lateral. The number of posterior teeth cannot be determined.

Two alcohol-preserved females from Samoa (6.8 x 7.3 mm, 8.0 x 8.7 mm; SMF 1747), originally at the Godeffroy Museum as the type material, have eight lateral teeth on the left side and nine on the right. The largest specimen has 14 uneven posterior teeth and the smallest 12, also uneven. Two other alcohol-preserved females from Samoa that had also been deposited at the Godeffroy Museum (6.7 x 7.1 mm, 7.0 x 7.4 mm; ZMUC CRU-3623). The other specimens examined are similar to the type material and the remaining Godeffroy Museum specimens. A small female from New Caledonia (6.9 x 7.2 mm; MNHN-B 13251) had 10 lateral and nine posterior teeth and tubercles, all rounded. A female specimen from the Great Barrier Reef (9.5 x 10.5 mm; BMNH 1950.12.1.28) had similarly shaped teeth and tubercles (nine lateral, 12 posterior).

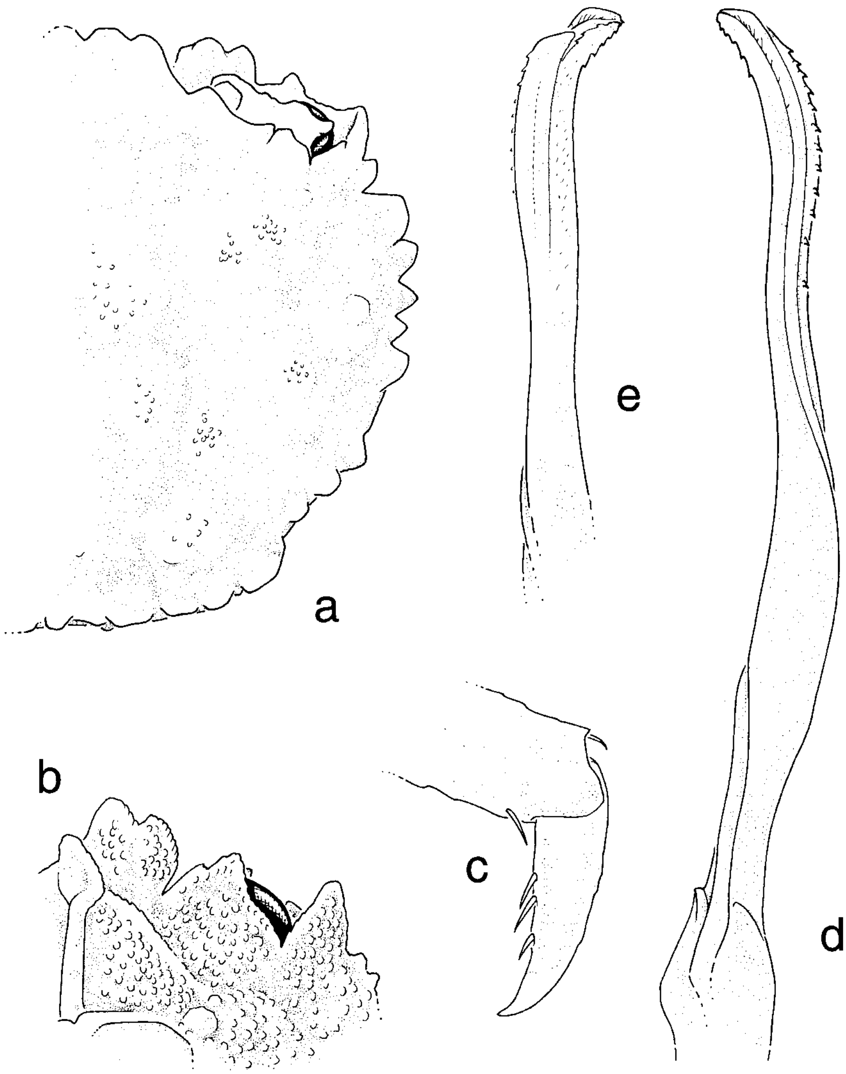

FIG. 44. — *Crossotonotus compressipes* A. Milne Edwards, 1873: **a-c**, ♀ 7.3 x 8.7 mm, Upolu, Samoa (SMF 1747): **a**, carapace, dorsal view; **b**, suborbital border; **c**, dactylus, right fifth pereopod, dorsal view. — **d-e**, ♂ 9.9 x 10.9 mm, Hope Islands, Queensland, Australia (AM P3740): **d**, left male first pleopod, lateral view (outer side) view; **e**, left male first pleopod, distal end (inner side).

According to L.B. HOLTHUIS (*in litt.*), the Godeffroy Museum offered specimens of *C. compressipes* for sale (Museum Godeffroy, *Catalog V*, 1874, p. 75). Subsequent issues of their catalogues (*VI-IX, 1877-1884*) did not list any specimens so specimens were probably sold, which explains their presence in Frankfort (SMF 1747), Copenhagen (ZMUC CRU-3623), and Berlin (ZMB 4463, lost).

C. taketomiensis was described by SAKAI (1974) from two small specimens collected in the southern Ryukyu Islands. The species was distinguished from *C. compressipes* mostly by the shape of the teeth along the carapace borders. The holotype of *C. taketomiensis* (male, 5.7 x 6.1 mm; SMF 24716), however, is almost identical to the lectotype of *C. compressipes*. SAKAI (1974: 95; 1976: 597) stated that the teeth on the anterior border of

C. taketomiensis were rounded, in contrast to those of *C. compressipes*. A. MILNE EDWARDS, however, described them as rounded and they are shown as such in the figure that accompanied the description (A. MILNE EDWARDS, 1873b, pl. 13, fig. 1). Although the number of teeth along the rest of the carapace borders were found to be similar in both species, SAKAI (1974: 95; 1976: 597) characterized them as "variable in size and their tips obtusely pointed" in contrast to the rounded, similar teeth shown in A. MILNE EDWARDS' figure. SAKAI, nevertheless, mistakenly used the shape of the first anterolateral tooth ("very prominent and acuminate") to contrast between the two species. It is the second tooth, however, that is the largest of the three anterolateral teeth in the holotype of *C. taketomiensis* and the lectotype of *C. compressipes*. The serration of the anterior borders of the meri of the walking legs is a characteristic of the species found in both type specimens, although SAKAI noted to be entire in *C. compressipes*, obviously based only on A. MILNE EDWARDS' figure. SAKAI (1974: 95; 1976: 597) also used the presence of plumose setae on the chelipeds of *C. compressipes* (in contrast to their absence in *C. taketomiensis*). Although A. MILNE EDWARDS (1873b: 284) mentions that setae were present on the inner surface of the small chelipeds ("poils sur sa face interne"), no dense clusters of setae were observed in specimens of *C. compressipes*, as is the case of the male of *C. spinipes*.

SIZE. — Maximum size among specimens examined: 9.5 x 10.5 mm (female, BMNH 1950.12.1.28); 9.9 x 10.9 mm (male, AM P3740).

DISTRIBUTION. — Known from Japan (SAKAI, 1974, 1976, both as *C. taketomiensis*), Solomon Islands (WARD, 1933), Queensland, Australia (HASWELL, 1882; MCNEILL, 1968), New Caledonia (A. MILNE EDWARDS, 1873b), and Samoa (A. MILNE EDWARDS, 1873a, 1873b). Its range is now extended to Ambon (Indonesia) and the Bismark Archipelago (Papua New Guinea) (Fig. 51). It appears to have been collected only in shallow water: "reef flat at low tide" (MCNEILL, 1968: 81) and "coral reef" (SAKAI, 1974: 95).

Crossotonotus spinipes (De Man, 1888)

Figs 45, 46, 51, 61f

Pleurophricus spinipes De Man, 1888: 344, pl. 15, figs 1, 1a-c.
Manella spinipes - RATHBUN, 1906: 837, fig. 3, pl. 7, fig. 6. — EDMONDSON, 1933: 268, fig. 158b; 1946: 310, fig. 184b; 1962: 12, figs 2e, 4f. — WARD, 1933: 389. — MONOD, 1938: 153, figs 26D-E, 29 (as "?*Manella spinipes*"). — SAKAI, 1939: 610, pl. 103, fig. 3; 1956: 52. — GUINOT, 1967: 280. — ZARENKOV, 1968: 762. — YANG, 1979: 34.
Manella gardineri Rathbun, 1911: 240, pl. 20, fig. 9. — WARD, 1933: 389. — GUINOT, 1967: 280.
Manella brevimana Ward, 1933: 387, pl. 21, figs 7-8. — MOOSA & SERÈNE, 1981: 54, figs 12 a-b, 13 a.
Crossotonotus spinipes - SAKAI, 1965: 187, fig. 25, pl. 89, fig. 4; 1976: 596, pl. 206, fig. 1. — CHEN, 1975: 167, fig. 9, pl. 2, fig. 3. — HOLTHUIS, 1977: 187. — DAI *et al.*, 1986: 414, fig. 229 A. — DAI & YANG, 1991: 450, fig. 229A. — WADA, 1995: 418, pl. 118, fig. 11.
Crossotonotus gardineri - SERÈNE, 1968: 97.
Crossotonotus brevimanus - SERÈNE, 1968: 97.
Crossotonotus sp. - TAKEDA & SHIMAZAKI, 1974: 75, pl. 2, fig. B.

MATERIAL EXAMINED. — **Red Sea.** *Al Sayad.* Stn 23, R. DOLLFUS coll., 30.12.1928: 1 ♀ (MNHN-B 13255).
Port Sudan. Wingate Reef, stn SAN-166, V. NEUMANN coll., 5 m, on dead corals, 21.09.1992: 2 ♀ (SMF 24541). — Sanganeb Atoll, stn SAN-120, V. NEUMANN coll., 6-10 m, on dead corals, 3.10.1992: 1 ♀ (SMF 24542).
Seychelles. REVES 2: stn 47, 04°03.8'S, 55°59.5'E, 45-55 m, shelly sand, 14.09.1980: 1 ♂ (MNHN-B 27131).
Amirante Islands. *"Sealark"*: stn E21, 55 m, 17.10.1905: 1 juv. ♂ 8.7 x 10.0 mm, 1 ♂ 10.1 x 12.1 mm, holotype of *Manella gardineri* Rathbun, 1911 (USNM 41364).
La Réunion. M. PEYROT-CLAUSADE coll.: 1 juv. (MNHN-B 26275).
Sri Lanka. *Trincomalee*, south side of first bay north of harbor, 26 m, C. KOENIG coll., 5.04.1970: 1 ♀ (USNM).
Japan. *Boso Peninsula.* Katsuura. Rocky shore intertidal, A. ASAKURA coll., 23.08.1995: 1 ♂ (CBM-ZC 1931).
Miura Peninsula. Washed up at Nahama beach, H. IKEDA coll., 05.1995: 1 ♀ (HSM).
Shimoda ?: 1 ♀ (SMF 24711).
Wagu. 2 ♀ (SMF 24712). — From lobster nets, 10-15 m, H. IKEDA coll., 04.1980: 1 ♂ (HSM).
Kii Nagashima. YAMAMOTO coll., 12.1963: 1 ♂ (SMF 24713).

Ryukyu Islands. Okinawa, off Horseshoe Cliffs, 26°30.0'N, 127°50.9'E, 57.9 m, R.F. BOLLAND coll., 18.04.1981: 1 ♀ (USNM).

Miyako Islands. Irabujima Island, 12 m, in cave, S. NAKATANI coll., 17.07.1999: 1 ♀ 31.5 x 35.8 mm (MNHN-B 26802).

Ishigaki Islands. Ohama, 27.08.1977: 1 ♂ (SMF 24714).

No locality. 1 juv. ♀ (SMF 24715).

Taiwan. *Lan Yu (= Orchid) Island*. Night diving, 5 m, S.-H. WU coll., 8.07.1997: 1 juv. ♀ 26.6 x 30.0 mm (NTOU).

Viet Nam. Nhatrang, R. SERÈNE coll., 13.08.1964: 1 ♂ (MNHN-B 9765).

Singapore. Sultan Shoal, 18-24 m, 12.1933: 1 ♀ (ZRC 1965.8.2.234).

Indonesia. *Timor*. SIBOGA EXPEDITION: stn 303, Samau Island, 10°27.9'S, 123°28.7'E, 36 m, *Lithothamnion*, 2-5.02.1900: 1 ♀ (ZMA De 203890).

Papua New Guinea. *Hansa Bay*. Laing Island lagoon, 4°11.62'S, 144°51.46'E, 5 m, in *Pocillopora damicornis* colony, S. DE GRAVE coll., 25.10.1993: 1 juv. ♀ (MNHN-B 27031).

Capricorn Group. North West Island, 23°18'S, 151°22'E, under large spreading coral in pool, outer edge of reef, M. WARD coll., 12.1929: 1 ♂ holotype of *Manella brevimana* Ward, 1933 14.1 x 16.5 mm (AM P10636).

Chesterfield Islands - Chesterfield-Bellona Plateau. CHALCAL 1: stn D 51, 21°13.21'S, 158°42.50'E, 55 m, 07.1984: 1 ♂ juv. (MNHN-B 27129).

CORAIL 2: stn DW 104, 19°08.95'S, 158°35.67'E, 49 m, boulders, 27.08.1988: 1 ♂ (MNHN-B 27098). — Stn CP 127, 19°27.73'S, 158°27.30'E, 44-45 m, boulders and corals, 29.08.1988: 1 ♀ (MNHN-B 27119).

New Caledonia. LAGON: stn 427, 22°41.9'S, 167°18.0'E, 60 m, boulders and corals, 25.01.1985: 1 ♂ (MNHN-B 27127). — Stn 428, 22°40.7'S, 167°16.4'E, 56 m, *Halimeda* sand, 25.01.1985: 1 juv. ♀ (MNHN-B 27094). — Stn 477, 18°51.0'S, 163°27.0'E, 50 m, *Halimeda* sand and boulders, 2.03.1985: 1 ♀ (MNHN-B 27128). — Stn 606, 22°12.8'S, 167°00.5'E, 46-48 m, corals, 5.08.1986: 1 ♂, 1 ♀ (MNHN-B 27122). — Stn 625, 21°59.2'S, 166°53.6'E, 34-40 m, *Halimeda* sand and corals, 6.08.1986: 1 ♂ (MNHN-B 27096). — Stn 635, 21°57.7'S, 166°44.5'E, 52-45 m, boulders and corals, 6.08.1986: 1 juv. ♀ (MNHN-B 27095). — Stn 640, 21°54.8'S, 166°45.8'E, 50-80 m, *Halimeda* sand, 7.08.1986: 1 ♀ (MNHN-B 27130). — Stn 650, 21°49.3'S, 166°37.7'E, 50 m, boulders and *Halimeda*, 7.06.1986: 1 ♀ (MNHN-B 27123). — Stn 657, 21°48.2'S, 166°33.7'E, 40-42 m, *Halimeda* sand, 8.08.1986: 1 ♀ (MNHN-B 27100). — Stn 659, 21°45.3'S, 166°33.4'E, 46-48 m, boulders and corals, 8.08.1986: 1 ♂ (MNHN-B 27120). — Stn 662, 21°44.0'S, 166°32.0'E, 50 m, boulders and corals, 8.08.1986: 1 ♂ 10.6 x 12.8 mm (MNHN-B 26810), 1 ♂ (MNHN-B 26215). — Stn 668, 21°40.5'S, 166°29.1'E, 40 m, boulders and corals, 8.08.1986: 1 ♂ (MNHN-B 27097). — Stn 769, 21°12.0'S, 165°40.2'E, 39 m, coarse sand, 8.01.1987: 1 ♂ (MNHN-B 27099).

EXPÉDITION MONTROUZIER: Touho, 09.1993: 1 juv. ♂ (MNHN-B 27125).

Récif Mbere. 22°19.9'S, 166°13.2'E, outer reef slope, 25-30 m, P. BOUCHET coll., 5.05.1993: 1 juv. ♀ (MNHN-B 27121). — 7.01.1993: 1 ♂, 1 juv. ♂, 1 juv. ♀ (MNHN-B 27126).

Passe de Dumbéa. Outer reef, under coral ridge, night diving, 12 m, 8.01.1999: 1 ♂ 36.9 x 43.3 mm (MNHN-B 26803).

Norfolk Ridge. SMIB 5: stn DW 100, 23°22.90'S, 168°05.20'E, 80-120 m, sand, 14.09.1989: 1 ♂ (MNHN-B 27124).

Unknown location. — Night diving, 20 m, P. LABOUTE coll., 19.11.1988: 1 ♀ (MNHN-B 26811).

Fiji. Great Astrolabe Reef, off north tip of Dravuni Island, stn WE 83-27, poison station, 10-15 m, 29.03.1983: 1 ♂ (USNM).

TYPES. — *Holotype* of *Pleurophricus spinipes* De Man, 1888: 1 juv. ♂ 7.0 x 8.5 mm (DE MAN, 1888), J. BROCK coll., Ambon, Indonesia. Deposit unknown (material lost ?).

Holotype of *Manella gardineri* Rathbun, 1911: Amirante Islands, western Indian Ocean, *"Sealark"*, stn E21, 55 m, 17.10.1905: 1 ♂ 10.1 x 12.1 mm (USNM 41364).

Holotype of *Manella brevimana* Ward, 1933: 1 ♂ 14.1 x 16.5 mm, North West Island, Capricorn Group, Queensland, Australia, 23°18'S, 151°22'E, under large spreading coral in pool, outer edge of reef, M. WARD coll., 12.1929 (AM P10636).

TYPE LOCALITY. — Ambon, Moluccas, Indonesia, unknown depth.

DIAGNOSIS. — Carapace (Figs 45a, 46, 61f) subquadrate, depressed, with large, slightly swollen areas with low bosses topped by rounded tubercles. Three broad, pointed anterolateral teeth (second typically bifurcated) on each side of carapace, followed by 3-4 large, pointed or blunt tubercles along each lateral border, 4-6 similar but slightly smaller, pointed tubercles along each posterolateral border; 17-24 pointed or blunt tubercles along convex posterior border separated from posterolateral border by clear junction. Supraorbital borders each with two triangular lobes (sometimes bifurcated). Four lobes along anterior border; tips bent upward, median lobes broader and notched with increasing carapace size (lobes rounded, median lobes slightly longer than outer lobes, and with entire borders in very small specimens). Suborbital borders (Fig. 45b) each with two broad, rectangular lobes bordered by long, narrow teeth. Dorsal borders of cheliped propodi each with two high and conspicuous rows of pointed to rounded tubercles; cluster of abundant plumose setae on inner, distal surface of propodi and proximal border of fingers in males (less abundant, shorter setae in largest females); propodus of largest cheliped very high, with lower border expanded to form J-shaped proximal edge. Dactyli of P2-4 with teeth along anterior and posterior borders (three on posterior borders of P4); dactyli of P5 (Fig. 45c) with 2-3 spines along posterior borders. Abdomen of mature males (Fig. 45d) with all segments free (all fused in juveniles). Male first pleopods (Fig. 45e; MOOSA & SERÈNE, 1981, figs 12a-b) with sinuous basal parts; each distal part straight, one simple tip bordered by minute teeth.

Color: Orange carapace and legs (Fig. 61f). A light spot on the cardiac region was observed in two specimens from New Caledonia. Red spots flanked the yellow spot of one.

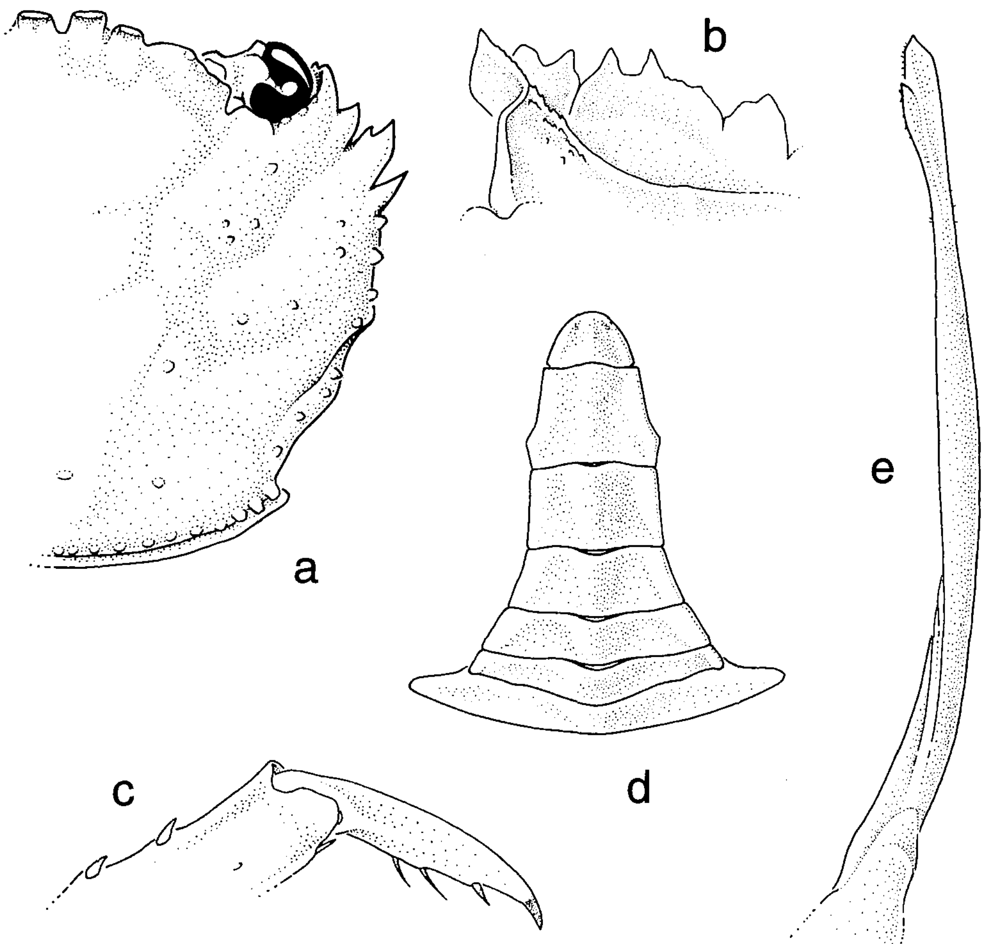

FIG. 45. — *Crossotonotus spinipes* (De Man, 1888), ♂ 10.6 x 12.8 mm, east coast of New Caledonia, LAGON, stn 662, 50 m (MNHN-B 26810): **a**, carapace, dorsal view; **b**, suborbital border; **c**, dactylus, right fifth pereopod, dorsal view; **d**, abdomen; **e**, left male first pleopod, lateral (inner side) view.

DISCUSSION. — The chelipeds of *C. spinipes* are very unequal in both sexes, the largest having a much thicker and higher propodus. Each finger of the largest cheliped has one cutting edge plus broad teeth in the largest specimens. The fingers of the smaller cheliped has spoon-shaped tips and short, rounded teeth along the distal half. In males there is a dense cluster of plumose setae at the distal end of the propodus and proximal portion of the finger on the inner surface of both chelipeds. Shorter and less dense setae, however, are found in the largest females.

The lower border of the propodus of the largest cheliped has low undulating ridges that were referred to as "stridulating lines" by RATHBUN (1911: 241). Their function remains unknown. Males do not seem to have a specialized plectrum, the structure rubbed by the cheliped to emit sound. Two possibilities for the plectrum are the teeth along the dorsal border of the second walking leg or the tubercles on the dorsal border of the small cheliped. Both of these structures are nevertheless also found in females.

The fourth pair of walking legs (P5) is identical in shape to the other walking legs, in sharp contrast to the members of the subfamily Palicinae where the segments are much more slender. The P5 of *C. spinipes* have the same relative width and spinulation of the remaining three pairs of walking legs. Nevertheless, they are slightly shorter than the first pair (P2) and their relative length (0.9 CL) is the same or similar as in many other species of the subfamily Palicinae. It appears that the widening of the P5 is an adaptation to crawling on hard substrates. Nevertheless, at least one species of the subfamily Palicinae (*Exopalicus maculatus*) has a similar habitat but it shares slender P5 with the other members of the subfamily.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.0-1.1	1.4-1.7	1.4-1.6	0.9
Merus length/CL	0.3-0.4	0.4-0.5	0.4-0.5	0.2-0.3
Dactylus length/Cl	0.2	0.3	0.3	0.2-0.3

The maximum size of juvenile females varies widely so that size alone does seem to determine when maturity is reached. A female as large as 26.6 x 30.0 mm (NTOU) had the narrow abdomen characteristic of juvenile females.

FIG. 46. — *Crossotonotus spinipes* (De Man, 1988): ♀ 31.5 x 35.8 mm, Ryukyu Islands, Japan, 12 m, S. NIKATANI coll. (MNHN-B 26802): dorsal view.

DE MAN (1888) described *Pleurophricus spinipes* from Ambon, Indonesia. The holotype, a "juvenile male" that was collected by J. BROCK and deposited at the Göttingen Zoological Museum under registration number 761, is apparently lost. It is not in Frankfurt (SMF), where the collection of the Göttingen Zoological Museum is now deposited, nor in either Amsterdam (ZMA) or Leiden (RMNH), where some of BROCK's material studied by DE MAN was deposited (FRANSEN *et al.*, 1997: 218).

The abundant material examined agrees with the detailed description and the illustration given of the holotype given by DE MAN (1888). The anterolateral teeth of the holotype, however, appear much too thin and pointed but only on the left side of the carapace (DE MAN, 1888, pl. 15, fig. 1); the anterior border of the carapace has two dissimilar lobes (DE MAN, 1888, pl. 15, figs 1-1a).

Manella gardineri, described by RATHBUN (1911) from five specimens collected from the western Indian Ocean (male holotype from the Amirante Islands, 10.1 x 12.1 mm; USNM 41364), is a junior subjective synonym of *C. spinipes*. RATHBUN (1911: 241) distinguished *M. gardineri* from *C. spinipes* by citing four characters: "carapace wider, surface less hairy, projections less spinous, presence of a distinct stridulating mechanism". RATHBUN obviously based at least part of the comparison on DE MAN's illustration, which shows abnormally thin anterolateral teeth but only on the left side of the carapace (see above). The "stridulating lines", the thin, sinuous ridges observed by RATHBUN, are also evident in *C. spinipes*. One difference in the holotype is that its lateral and posterolateral tubercles are thicker and rounder than usual. This feature, however, has been found in specimens of *C. spinipes* from other Indo-west Pacific locations.

Manella brevimana was described by WARD (1933) from a relatively large male (14.1 x 16.5 mm; AM P10636) from Queensland, Australia. The specimen unquestionably belongs to *C. spinipes*. WARD compared his new species with *M. gardineri* Rathbun and *P. spinipes* (as *M. spinipes*) but the differences noted were clearly the result of individual variation, such as the relative length and shape of the teeth, spines, and granules of the carapace, and the length and ornamentation of the chelipeds. The species was named "brevimana" because the chela was "not as long as the carapace", whereas that of *M. gardineri* was longer, "about 1 1/2 times as long as carapace" (RATHBUN, 1911: 241). The total length of the propodus and dactylus of the largest cheliped of the holotype of *M. brevimana* is the same (0.6 CL) as in the holotype of *M. gardineri* (USNM 41364); the total length of the cheliped (merus, carpus, propodus, and dactylus) is 1.0 CL in the holotype of *M. brevimana* against 1.3 CL in the holotype of *M. gardineri*. RATHBUN's "length of the chela" measurement certainly referred to cheliped length, which was misinterpreted by WARD.

The abdomen of the male holotype of *M. brevimana* was described as having fused segments, but the presence of separate segments is clearly visible in the fragment still extant as well as in WARD's figure (WARD, 1933: 389, pl. 21, fig. 8). One significant difference is that there is no evidence of "stridulating ridges" in the large cheliped of the holotype, as mentioned in the description. Such a structure was also reported as absent in three males from Palau (= Belau) (TAKEDA & SHIMAZAKI, 1974: 79).

A small (5.6 x 6.3 mm) male from Ceram, Indonesia, most probably a juvenile since segments 3-6 of the abdomen were fused, was identified by MOOSA & SERÈNE as *M. brevimana*. It could not be examined but it almost certainly represents *C. spinipes* on account of the illustrations, particularly of the male first pleopod (MOOSA & SERÈNE, 1981: 54, figs 12 a-b).

SIZE. — Maximum size among specimens examined: 31.5 x 35.8 mm (female, MNHN-B 26802); 36.9 x 43.3 mm (male, MNHN-B 26803).

DISTRIBUTION. — A very wide distribution throughout the Indo-west Pacific region, the widest known so far in a palicid: Red Sea (MONOD, 1938; ZARENKOV, 1968); Seychelles, Amirante Islands, and Saya de Malha Bank (RATHBUN, 1911, as *M. gardineri*); Japan (SAKAI, 1939, 1956, 1965, 1976); South China Sea (CHEN, 1975; DAI *at al.*, 1986; DAI & YANG, 1991); Ceram (MOOSA & SERÈNE, 1981, as *M. brevimana*) and Ambon (DE MAN, 1888), Indonesia; Queensland, Australia (WARD, 1933, as *M. brevimana*); Palau (= Belau) (TAKEDA & SHIMAZAKI, 1974); Samoa (A. MILNE EDWARDS, 1873a, 1873b); Hawaiian Islands (RATHBUN, 1906; EDMONDSON, 1933, 1946, 1962). Its range is now extended to La Réunion, Sri Lanka, Cocos (Keeling) Islands, Western Australia, Viet Nam, Singapore, Timor, Papua New Guinea, the Coral Sea (New Caledonia, Chesterfield Islands, and the Chesterfield-Bellona Plateau), and Fiji (Fig. 51). It seems to be restricted to hard substrates. Of the New Caledonia stations where the type of substrate was recorded, 13 of the 17 stations where the species was collected consisted at least in part of hard bottoms such as boulders and coral. Depth: "intertidal" (SAKAI, 1974: 94) and "reef flat at low tide" (MCNEILL, 1968: 81) to 146 m (RATHBUN, 1911).

Crossotonotus ceramensis (Moosa & Serène, 1981)

Manella ceramensis Moosa & Serène, 1981: 54, figs 12 c-d, 13 b, pl. 3, fig. C.

MATERIAL EXAMINED. — **Indonesia**. *Ceram*. MARIEL KING MEMORIAL EXPEDITION: stn CP 1/8-14, Piru Bay, 03°15'S, 128°8'E, coarse sand and rubble, 26-48 m, 2.06.1970: 1 ♂ holotype 5.7 x 6.5 mm (RDC CB2735).

TYPES. — *Holotype* of *Manella ceramensis* Moosa & Serène, 1981: 1 ♂ 5.7 x 6.5 mm, MARIEL KING MEMORIAL EXPEDITION, stn CP 1/8-14 (RDC CB2735).

Paratype: 1 ♀ 7.7 x 8.5 mm (MOOSA & SERÈNE, 1981), Piru Bay, Ceram, 3°15'S, 128°8'E, coarse sand and rubble, 26-48 m, MARIEL KING MEMORIAL EXPEDITION, stn CP 1/8-14, 2.06.1970 (RDC CB2737).

TYPE LOCALITY. — Piru Bay, Ceram, Indonesia, 3°15'S, 128°8'E, coarse sand and rubble, 26-48 m.

DIAGNOSIS. — Carapace (MOOSA & SERÈNE, 1981, fig. 13a, pl. 3, fig. b) subquadrate, depressed, with large, slightly swollen areas with low bosses topped by rounded tubercles. Three very broad, straight-edged anterolateral teeth (second divided into separate portions) on each side of carapace, followed by three slightly pointed tubercles along each lateral border, 2-3 smaller, blunt tubercles along each posterolateral border; 15-17 rounded tubercles along convex posterior border separated from posterolateral border by clear junction. Supraorbital borders each with two broad, rectangular lobes with irregular borders. Four lobes along anterior border; lobes broadly round, nearly equal in size, and entire borders. Suborbital borders each with two broad, rectangular lobes bordered by long, narrow teeth. Dorsal borders of cheliped propodi each with two high and conspicuous rows of pointed to rounded tubercles; distal, inner surface of propodi and proximal border of fingers smooth in male holotype; propodus of largest cheliped very high, with lower border expanded to form J-shaped proximal edge. Dactyli of P2-4 with teeth along anterior and posterior borders; dactyli of P5 with 2-3 spines along posterior borders. Abdomen of mature males with all segments free. Male first pleopods (MOOSA & SERÈNE, 1981, figs 12c-d) with sinuous basal parts; each distal part straight, one simple tip bordered by minute spinules. Abdomen of mature females with all segments free.

DISCUSSION. — *Manella ceramensis* was described by MOOSA & SERÈNE (1981) from a small male and a slightly larger female from Ceram, Indonesia. It was differentiated from *M. spinipes* and *M. brevimana* (a junior subjective synonym of *Crossotonotus spinipes*) by several differences: the presence of a frontal border that is "entire, and with obscure or very shallow median notch", wider anterolateral teeth, rounder anterolateral border, straight posterior border with a smaller number of rounded tubercles ("teeth or lobes"), abdomen of male with distinct segments, and a different morphology of the male first pleopod (MOOSA & SERÈNE, 1981: 57). The frontal lobes are broad and rounded in the holotype (5.7 x 6.5 mm; RDC CB2735), not short and almost straight, and the posterior border is slightly convex with protuberant tubercles, not almost straight, as shown in the figure of MOOSA & SERÈNE (1981, fig. 13b). A slightly convex border is nevertheless shown in the photograph of the holotype (MOOSA & SERÈNE, 1981, pl. 3, fig. C). The use of the presence of distinct segments in the male abdomen as a difference rose from the mistaken belief that the abdomen of *M. brevimana* had fused segments (see discussion of *C. spinipes*). The differences in the male first abdomen (tip entire, small pointed "spinules" instead of distinctive spines; see MOOSA & SERÈNE, 1981, figs 12 c-d), may be the result of the small size of the holotype. Although drawn as having a single pointed tip, there is a small but distinctive second lobe as in other species of *Crossotonotus*. One difference is that in the male holotype the inner surface of the propodi and fingers of the chelipeds only have a few thick setae instead of the thick cluster of plumose setae in the males of *C. spinipes*. This may also be a consequence of size.

The unique frontal and anterolateral borders of the holotype are distinctive enough to support considering *C. ceramensis* as different from *C. compressipes* and *C. spinipes*. Nevertheless, the presumed parallel occurrence of these characters in a female collected from the same location (the female paratype, which could not be examined) and their absence in the many other specimens of *C. spinipes* that were examined in this study does not support the possibility of individual variation. The examination of the paratype as well as of additional material may provide additional evidence.

SIZE. — Size of the only two specimens known: 5.7 x 6.5 mm (male holotype, RDC CB2735), 7.7 x 8.5 mm (female paratype, MOOSA & SERÈNE, 1981).

DISTRIBUTION. — Known only from Ceram, Indonesia (MOOSA & SERÈNE, 1981). Depth: 26-48 m.

Crossotonotus lophocheir sp. nov.

Figs 47

MATERIAL EXAMINED. — **New Caledonia.** LAGON: stn 692, 21°32.0'S, 166°12.3'E, boulders and corals, 44-48 m, 9.08.1986: 1 ♀ paratype 6.0 x 6.8 mm (MNHN-B 26736).

EXPÉDITION MONTROUZIER: Touho Bank, 20°44.6'S, 165°13.7'E, suction pump, hard substrate, 15 m, 31.08.1993: 1 ♂ holotype 4.2 x 5.1 mm (MNHN-B 26733). — Koé Reef, 20°47.7'S, 165°15.7'E, diving, 10 m, 8.09.1993: 1 juv. ♀ paratype 5.4 x 6.1 mm (MNHN-B 26734), 1 ♀ paratype 5.5 x 6.2 mm (MNHN-B 26735).

TYPES. — *Holotype*: 1 ♂ 4.2 x 5.1 mm, EXPÉDITION MONTROUZIER (MNHN-B 26733).
Paratypes: 1 ♀ 6.0 x 6.8 mm, LAGON, stn 692 (MNHN-B 26736); 1 juv. ♀ 5.4 x 6.1 mm, EXPÉDITION MONTROUZIER (MNHN-B 26734); 1 ♀ 5.5 x 6.2 mm, EXPÉDITION MONTROUZIER (MNHN-B 26735).

TYPE LOCALITY. — Touho Bank, New Caledonia, 20°44.6'S, 165°13.7'E, 15 m, hard substrate.

DIAGNOSIS. — Carapace (Fig. 47a) subquadrate, depressed, with large, slightly swollen areas with low bosses. Three broad, rounded or pointed anterolateral teeth on each side of carapace, 3-4 small, blunt tubercles along each lateral border, 1-3 similar but slightly smaller tubercles along each posterolateral border; convex posterior border separated from posterolateral border by clear junction, with 10-14 small, blunt or slightly pointed tubercles. Four lobes along anterior border, inner pointed, outer lobed. Supraorbital borders each with two slightly pointed lobes. Suborbital borders (Fig. 47b) each with two lobes bifurcated into pointed tips. Dorsal borders of cheliped propodi each with one conspicuous, rounded tubercle. Dactyli of P2-5 with teeth or spines along anterior and posterior borders (2-4 on posterior borders of each P4 and P5; Fig. 47c). Abdomen of mature males with all segments free. Male first pleopods (Figs 47d-e) with sinuous basal parts; each distal part straight, two unequal tips bordered by spines. Abdomen of mature females with all segments free.

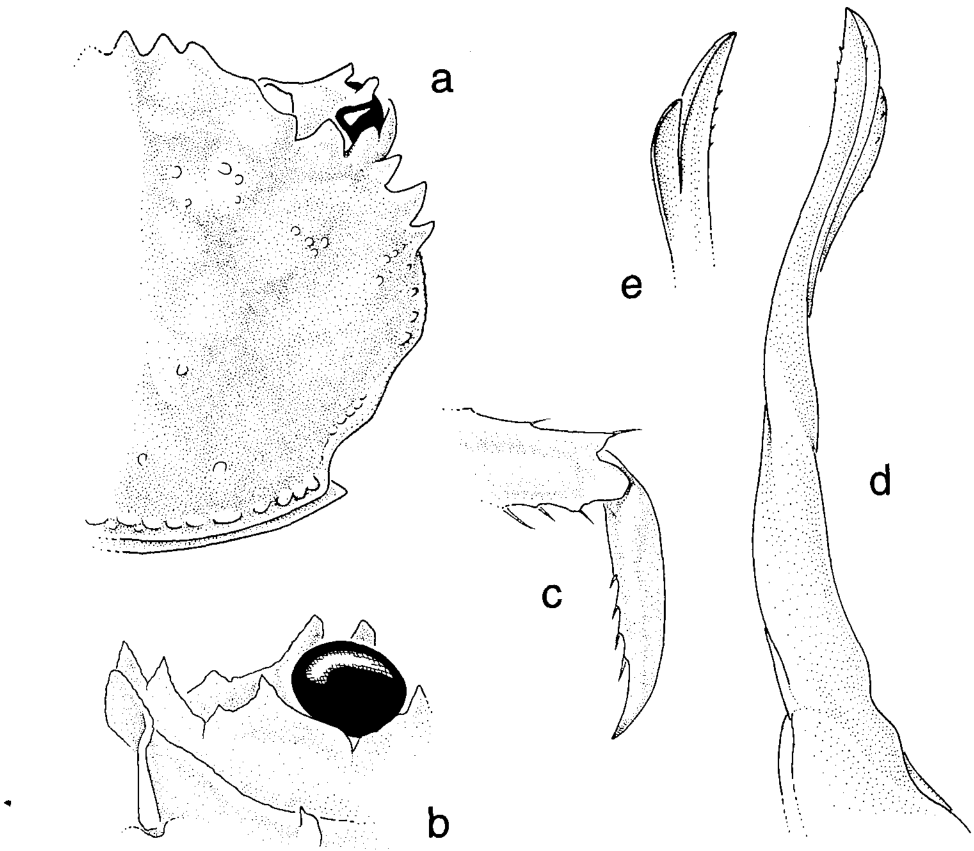

FIG. 47. — *Crossotonotus lophocheir* sp. nov., ♂ holotype, 4.2 x 5.1 mm, Touho Bank, northeast coast of New Caledonia, EXPEDITION MONTROUZIER, 15 m (MNHN-B 26733): **a**, carapace, dorsal view; **b**, suborbital border; **c**, dactylus, right fifth pereopod, dorsal view; **d**, left male first pleopod, lateral (outer side) view; **e**, left male first pleopod, apex, dorsal view.

DESCRIPTION. — Carapace (Fig. 47a) subquadrate, slightly wider than long (CW/CL = 1.1-1.2); dorsal surface depressed, covered with small granules, large, slightly swollen areas with low bosses. Confluence of branchial and mesogastric regions depressed, granular. Anterolateral borders of carapace each with three pointed or slightly rounded anterolateral teeth, first rising from base of postorbital angle. Lateral borders each with 3-4 (number increases with carapace size) small, blunt tubercles; posterolateral borders each with 1-3 similar but slightly smaller tubercles. Posterior border separated from posterolateral border by clear junction, with 10-14 blunt or slightly pointed tubercles, conspicuous plumose setae.

Frontal border of carapace divided into four lobes, inner lobes longer and more pointed. Borders between frontal lobes and supraorbital borders slightly folded upward medially, ending in sharp angle forming V- shaped fissure before supraorbital border. Supraorbital borders each with two slightly pointed lobes. Postorbital angles long (extend to slightly beyond dorsal border of retracted eye) and pointed inward. Cornea of eyes spherical, wider than base of long eye peduncle; each peduncle with two conspicuously long, granular tubercles on distal border.

Suborbital borders (Fig. 47b) each with one triangular inner lobe topped by two pointed teeth (innermost longest), one broad, rounded outer lobe topped by two teeth (innermost blunt, outermost pointed and longest). Pterygostomial lobes project slightly ventrally, slightly pointed.

Each basal antennal segment slender and rectangular; flagellum long, with very long, simple setae. Epistome very narrow, vertically inclined, with two short, pointed median teeth, each flanked by short outer process and thin, rounded margin before pterygostomial lobe. Inner border of ischia of third maxillipeds straight; surface granular, upper borders round. Meri much narrower than ischia; very small, rounded upper borders.

Dorsal borders of cheliped propodi each with one conspicuous, rounded tubercle bordered by minute teeth and 1-2 small, pointed tubercles. Fingers of largest cheliped with rounded teeth, similar teeth or cutting edge in smallest cheliped. Carpus short, each outer border with one conspicuous, rounded tubercle and several small, pointed tubercles; meri slender, outer borders with rounded and pointed tubercles.

Walking legs (P2-5) slender but without filiform propodi and dactyli. Upper and lower borders of meri with pointed tubercles of different sizes; distalmost tubercle on each anterior border much wider at base, much higher, slender, pointed, directed distally (decrease in size from P2 to P5). Anterior borders of carpi of all walking legs with small tubercles (smaller in P5); anterior and posterior borders of propodi with short teeth (thin spines along anterior borders of P5); posterior borders of dactyli with teeth, each topped with spine (two on P2, 2-3 on P3-4, three on P5), anterior borders with short teeth (3-4 long, curved spines along anterior border of dorsal side of each P5; Fig. 47c). Each P2-4 with one dorsal, carina each on carpus and propodus; each P5 with one dorsal carina on propodus. Meri, carpi, and propodi of all walking legs with plumose setae; dorsal surfaces of propodi of P3-4 each with one row of conspicuous plumose setae along anterior and posterior borders, dactyli with one similar row along each anterior border.

First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair slightly shorter than second. Fifth pair of walking legs (P5) short (0.9-1.0 CL), flattened but more slender than the anterior walking legs (P2-4).

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.2-1.3	1.7-2.0	1.5-1.9	0.9-1.0
Merus length/CL	0.4-0.5	0.5-0.6	0.4-0.6	0.2
Dactylus length/Cl	0.2-0.3	0.4-0.5	0.3-0.4	0.2-0.3

Abdomen of mature males with all segments free. Male first pleopods (Figs 47d-e) with sinuous basal parts; each distal part straight, one pointed tip divided into two unequal parts both bordered by minute teeth. Abdomen of mature females with all segments free.

DISCUSSION. — This species is being described from only one male and three females, all of small size. The smallest female is a juvenile; the remaining two (the smallest, 5.5 x 6.2 mm) are ovigerous. It seems to be restricted, like *C. spinipes*, to hard substrates.

Other than the size difference (*C. spinipes* attains a much larger size and females become ovigerous at a much larger size), diagnostic characteristic for *C. lophocheir* are the presence of a large, rounded tubercle on the dorsal border of each cheliped propodus (two rows of relatively shorter tubercles in *C. compressipes* and *C. spinipes*), relatively longer walking legs (P3 1.7-2.0 CL in contrast to 1.4-1.7 CL in *C. spinipes*), the large cheliped of the male lacks the sinuous ridges, or presumed stridulating surface of *C. spinipes*, and the inner border of the propodi of the male chelipeds lack a dense cluster of setae.

SIZE. — Maximum size among specimens examined: 6.0 x 6.8 mm (female); 4.2 x 5.1 mm (male holotype).

ETYMOLOGY. — From *lophos*, Greek for crest or ridge, and *cheir*, Greek for hand, in reference to the characteristic crest-like tubercles on the dorsal border or the cheliped propodi and carpi.

DISTRIBUTION. — Known only from New Caledonia. Depth: 10-44 m.

Genus ***PLEUROPHRICUS*** A. Milne Edwards, 1873

Pleurophricus A. Milne Edwards, 1873a: 84. — MOOSA & SERÈNE, 1981: 53 (in key).

TYPE SPECIES. — *Pleurophricus cristatipes* A. Milne Edwards, 1873.

DIAGNOSIS. — Carapace subcircular; frontal border divided into 2-4 lobes. Anterolateral borders with pointed or rounded teeth. Dorsal surface of carapace with small granules and high, granular bosses, including two very high bosses on metagastric region. Eyes spherical, peduncles with soft tubercles. Supraorbital borders each with two lobes. Suborbital borders each with two lobes. Each basal antennal segment rectangular. Epistome very narrow. Chelipeds equal. Walking legs (P2-5) similar in shape; meri may be inflated, dactyli hook-like. Abdomen of mature males elongate (sides parallel to each other), with all segments free. Male first pleopods long, slender with basal parts straight; each distal part uniramous, tip with minute teeth. Abdomen of adult females with all segments free.

REDESCRIPTION. — Carapace subcircular, dorsal surface with granular bosses, including two very high bosses on metagastric region. Anterolateral borders each with three pointed or three secondarily bifurcated, slightly pointed teeth; posterolateral borders with slightly rounded tubercles, with marked junction with convex posterior border. Confluence of branchial and mesogastric regions depressed and smooth; no conspicuous sulcus between hepatic and branchial regions. Posterior border with 5-6 salient, rounded tubercles. Thoracic sternite 7 without episternal process visible dorsally.

Frontal border divided into 2-4 pointed or rounded lobes (if four, inner pair more advanced anteriorly than outer pair). Supraorbital borders each with two rounded lobes. Postorbital angles short, with slightly pointed tips. Cornea of eyes spherical, slightly wider than base of eye peduncle; peduncle with granular tubercles at least on distal border. Orbits deep.

Suborbital border with two broad, rounded lobes. Pterygostomial lobe at each anterolateral angle of buccal frame broad and pointed.

Each basal antennal segment rectangular. Epistome very narrow, not expanded dorsoventrally, vertically inclined. Meri of third maxillipeds smaller and narrower than ischia.

Chelipeds equal in males. Walking legs (P2-5) about same size. Meri may be inflated and dactyli hook-like.

Abdomen of mature males elongate, with both sides almost parallel to each other, with all segments free, no transverse ridges; first segment broad and long. Male first pleopods long and slender; basal part straight; distal part uniramous, with tip bordered by minute teeth. Abdomen of adult females with all segments free, no transverse ridges.

SPECIES INCLUDED. — *P. cristatipes* A. Milne Edwards, 1873 and *P. longirostris* (Moosa & Serène, 1981).

SEXUAL DIMORPHISM. — Unknown.

DISCUSSION. — *Pleurophricus* was described for *P. cristatipes* A. Milne Edwards, 1873, which until now had been known from only one specimen collected in Australia ("Nouvelle Hollande"). The genus was placed by A. MILNE EDWARDS (1873a: 260) among the Oxystomata *à côté des Orithya* (Ocypodidae). MIERS (1879: 660) included the genus (but with some doubt) in the Oxyrhyncha and HASWELL (1882: 23) listed it among the crabs of Australia under the family Maiidae. The structure of the orbits, eyes, peduncles, and carapace leave no question of its inclusion in the Palicidae, even if only two incomplete specimens have been examined.

The morphologies of the abdomen and of the male first pleopods, both absent in the holotype of *P. cristatipes*, are very close to those of *Crossotonotus spinipes*, which would support the inclusion of *Pleurophricus* in *Crossotonotus* A. Milne Edwards, 1873. Both genera were actually described in the same publication but placed among different groups of brachyuran crabs. Their descriptions, however, did not include any characters that could be used to actually differentiate between the two. The similarities were so close that the second species of *Pleurophricus* that was described (*P. spinipes* De Man, 1888) is actually a species of *Crossotonotus* (see above). Nevertheless, NOBILI (1907: 402) stated that *P. cristatipes* and *C. spinipes* (as *Pleurophricus spinipes*) did not belong to the same genus. Significant differences in the shape of the carapace (subcircular in shape, fewer and larger, salient tubercles along posterior border, two very high and conspicuous bosses on metagastric region, in contrast to the subquadrate carapace with very low bosses and many, very small tubercles along the posterior border in *Crossotonotus*) and walking legs (presumably shorter and more equal in length than in *Crossotonotus*), however, support the separation of the two genera within the Crossotonotinae.

Key to the species of *PLEUROPHRICUS*

1. Narrow, pointed anterolateral teeth; posterior border with five tubercles (Fig. 48a). Walking legs with narrow meri (A. MILNE EDWARDS, 1873a, pl. 1, fig. 6) .... ***P. cristatipes*** A. Milne Edwards, 1876

— Flattened, wider anterolateral teeth; posterior border with six tubercles (MOOSA & SERÈNE, 1981, fig. 14). Walking legs with inflated, nearly rounded meri .... ***P. longirostris*** (Moosa & Serène, 1981)

Pleurophricus cristatipes A. Milne Edwards, 1873

Figs 48

Pleurophricus cristatipes A. Milne Edwards, 1873a: 260 [84], pl. 1, figs 6, 6b, 6c. — HASWELL, 1882: 23. — RATHBUN, 1906: 837. — SERÈNE, 1968: 97. — MOOSA & SERÈNE, 1981: 60.

MATERIAL EXAMINED. — **Indonesia.** *Kai Islands. "Alpha Helix"*: stn M-99, 05°31.6'S, 132°17.8'E, 6-18 m, 7.07.1979: 1 ♂ (USNM).

Australia. 1 ♂ holotype 9.0 x 9.0 mm (ZMUH K-347).

TYPES. — *Holotype*: 1 ♂ 9.0 x 9.0 mm, originally at Godeffroy Museum, Hamburg, no. 6044 (ZMUH K-347).

TYPE LOCALITY. — Australia, unknown depth.

DIAGNOSIS. — Carapace (Fig. 48a) subcircular, with several elevated areas topped by conspicuous granular bosses (two very conspicuous bosses on metagastric region). Three pointed anterolateral teeth (first rising from base of postorbital angle) on each side of carapace, one large, pointed tubercle along each lateral border, 1-2 slightly smaller, pointed tubercles along each posterolateral border; straight posterior border separated from posterolateral border by clear junction, with five blunt, salient tubercles. Four lobes along anterior border; rounded median lobes slightly longer than rounded outer lobes. Supraorbital borders each with two rounded lobes. Suborbital borders (Fig. 48b) each with two slightly pointed lobes, inner fused to pterygostomial lobe. Dorsal borders of cheliped propodi each with two rounded tubercles (A. MILNE EDWARDS, 1873a, pl. 1, fig. 6). First three walking legs nearly equal in size (A. MILNE EDWARDS, 1873a, pl. 1, fig. 6). Abdomen of mature males with all segments free. Male first pleopods with straight basal parts; each distal part straight, with simple tip. Females unknown.

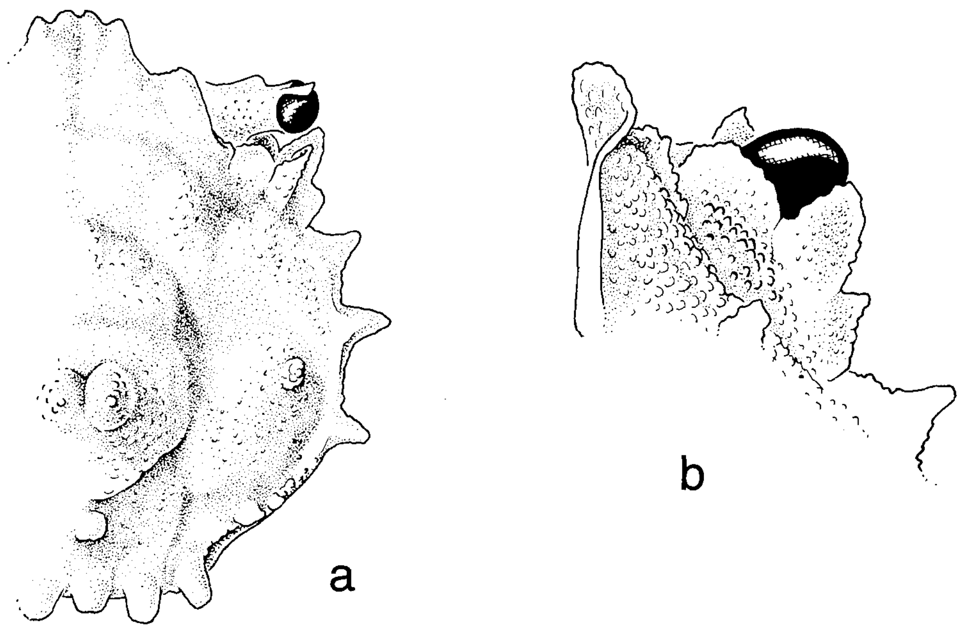

FIG. 48. — *Pleurophricus cristatipes* A. Milne Edwards, 1873, ♂ holotype, 9.0 x 9.0 mm, Australia, unknown depth (ZMUH K-347): **a**, carapace, dorsal view; **b**, suborbital border.

DISCUSSION. — The type material of *P. cristatipes*, a male (9.0 x 9.0 mm; ZMUH K-347), is unfortunately incomplete. While the dorsal surface and the anterior portion of the ventral surface of the carapace are complete (Figs 48a-b), the remaining portions of the ventral surface survive as two large pieces, and the walking legs and chelipeds are missing. The figure given in the description (A. MILNE EDWARDS, 1873a, pl. 1, fig. 6) showed that the first pair of walking legs is not reduced and that the last pair is only slightly reduced in size in comparison to the other legs. The walking legs were described as having an "unequal crest" (*crête inégale*). The chelipeds were shown as nearly identical (raising some doubts on the accuracy of the figure). Both were heavy, with two large tubercles on the dorsal surface of each propodus.

One very small, soft, and incomplete (no appendages) male from the Kai Islands (Banda Sea) Indonesia (2.4 x 2.4 mm; USNM) proved to be identical to the holotype of *P. cristatipes* as far as the shape of the carapace is concerned (number, shape, and position of teeth and tubercles, morphology of the anterior, posterior, and supraorbital borders). The coxae of the fourth walking legs, as in *P. cristatipes*, were aligned with the coxae of the anterior walking legs. The abdomen of the Banda Sea specimen had all segments free. The male first pleopods (soft in the specimen) appeared to have a straight basal part. The distal part was straight, with a simple tip very much as in *C. spinipes* and *C. lophocheir*. The presence of abdominal segments that were all free strongly suggests that the male was mature.

SIZE. — Maximum size among the two specimens examined: 9.0 x 9.0 mm (male holotype; ZMUH K-347).

DISTRIBUTION. — Known only from Australia ("Nouvelle Hollande"; A. MILNE EDWARDS, 1873a) and the Kai Islands, Banda Sea, Indonesia. Depth: 6-18 m.

Pleurophricus longirostris (Moosa & Serène, 1981)

Manella longirostris Moosa & Serène, 1981: 58, fig. 14.

MATERIAL EXAMINED. — **Indonesia**. *Sunda Strait*. Off Panjang Island, 16.03.1963: 1 ♀ 4.6 x 4.6 mm (RDC CB2712).

TYPES. — *Holotype*: 1 ♀ 4.6 x 4.6 mm, 16.03.1963 (RDC CB2712).

TYPE LOCALITY. — Off Panjang Island, Sunda Strait (between Sumatra and Java), Indonesia.

DIAGNOSIS. — Carapace (MOOSA & SERÈNE, 1981, fig. 14) hexagonal, depressed, with swollen areas with bosses topped by rounded tubercles. Four broad, slightly pointed anterolateral teeth on each side carapace, two large, pointed teeth along each lateral border; slightly convex posterior border separated from posterolateral border by clear junction, six rounded, low tubercles. Two narrow, squarish lobes along anterior border. Supraorbital borders each with two very short, rounded lobes. Suborbital borders each with two lobes, one with triangular, pointed tip, second obliquely directed with irregular border. Dorsal border of cheliped propodi with cusp of pointed tubercles. Meri of walking legs inflated, laterally flattened, almost circular. Dorsal borders of meri and carpi with thin, rounded tubercles. Dactyli short, hook-like, one spine on each posterior border. Males unknown. Abdomen of mature females with distinct segments.

DISCUSSION. — The species was described from one small ovigerous female collected in the Sunda Strait, Indonesia (MOOSA & SERÈNE, 1981). It was included in *Manella*, a junior subjective synonym of *Crossotonotus* (see above). It is tentatively placed in *Pleurophricus* since its carapace is very similar in shape to that of *P. cristatipes* (Fig. 48a). There are differences between the species, however. The most obvious is in the presence in the walking legs of *P. longirostris* of inflated, almost circular meri bordered by thin, rounded tubercles in contrast to the thin meri of *C. cristatipes* (A. MILNE EDWARDS, 1873a, pl. 1, fig. 6). They were described as "very inflated which give the impression of a tree leaf" (MOOSA & SERÈNE, 1981: 58). The flattened meri, hook-like dactyli, and the very long plumose setae on the meri, carpi, and particularly on the propodi suggest that the species may be cryptic and perhaps associated with the surface of algae or another organism.

Other differences are in the shape of the anterolateral teeth. They are flattened, secondarily divided, and less pointed (very much as in *C. spinipes*) in *P. longirostris*, while they are narrower and more pointed in *P. cristatipes* (Fig. 48a). There are six rounded tubercles along the posterior border of *P. longirostris* but five pointed tubercles in *P. cristatipes* (Fig. 48a).

The relative length and shape of the fifth pair of walking legs (P5) are unknown. They articulate to the carapace at the same level as the other walking legs as in other members of the Crossotonotinae.

SIZE. — Size of female holotype: 4.6 x 4.6 mm.

DISTRIBUTION. — Only known from Panjang Island, Sunda Strait, Indonesia. Depth: unknown.

ECOLOGY AND OTHER ASPECTS OF THE BIOLOGY OF THE INDO-WEST PACIFIC PALICIDS

HABITAT. — Most species of palicids appear to be restricted to mud, sand, and other soft sediments at moderate depths. This is the case of species of *Pseudopalicus*, *Parapalicus*, *Miropalicus*, *Paliculus*, and *Rectopalicus* in the Indo-west Pacific and of *Palicus* in the Mediterranean, Atlantic, and eastern Pacific. Species of *Neopalicus* and *Palicoides* are known only from coarse, biogenous sediments in shallow water around Indo-west Pacific coral reefs. Species of *Exopalicus*, *Crossotonotus*, and apparently *Pleurophricus*, are inhabitants of hard bottoms in shallow water.

Species of *Parapalicus* and *Miropalicus* (plus *Pseudopalicus macromeles* and *Paliculus kyusyuensis*) have long, slender legs that seem to be adapted to slide over muddy sediments. At least this is what has been observed in freshly collected live specimens of *Parapalicus* (B. RICHER DE FORGES, personal communication). There is no information on the microhabitats and habits of the other palicids that live on soft sediments but that have flattened walking legs (species of *Pseudopalicus* and *Rectopalicus*) other that the legs appear to be adaptations for occasional swimming. This possibility is supported by observations of live *P. amadaibai* using its second and third pairs of walking legs for active swimming off the sandy bottom of an aquarium (T. KOMAI, personal communication).

The high bosses and tubercles on the carapace of most palicids do not support the possibility that any of the species inhabiting soft sediments are long-term borrowers in the sediment itself. This, however, may not be the case of species of *Neopalicus* and *Palicoides*, inhabitants of coarse sediments in coral reefs. Their carapaces are relatively smooth, being devoid of high bosses. Their habits, however, remain unknown.

There is no detailed information on the microhabitats and habits of palicids living on hard substrates. Many of the few records of *Exopalicus maculatus* have been from collections during night diving, a suggestion that they hide in coral and other hard substrates during daytime.

Most of the species inhabiting soft sediments have been collected from moderate depths in the subtidal and bathyal zones (Table 5): *Pseudopalicus* (30-430 m), *Parapalicus* (55-778 m), *Miropalicus* (245-575 m), *Paliculus* (50-487 m), and *Rectopalicus* (105-430 m). Exceptions are the species inhabiting coarse sediments in coral reefs: *Neopalicus* (10-146 m) and *Palicoides* (6-73 m). Inhabitants of hard substrates are also restricted to shallow water: *Exopalicus* ("shallow water" to 18 m) and *Crossotonotus* ("intertidal" to 146 m). Nothing is known about the habitat of the two little-known species of *Pleurophricus* but they appear to be inhabitants of hard bottoms in shallow water (only record for *P. cristatipes*, 6-18 m).

BIOGEOGRAPHY. — Information on the geographic distribution of Indo-west Pacific palicids is limited and incomplete. The majority are deep-water, cryptic, or nocturnal species that are rarely collected or seen. Most of the information (as well as most of the new species described here) are from the Coral Sea and southwestern Pacific, where recent collecting effort has been more intense (Table 6). Conversely, little is known about the distribution of palicids through most of the Indian Ocean and the central Pacific.

There is no evidence of the occurrence of any palicids in the Indian or Pacific oceans outside the tropical Indo-west Pacific region proper. Species of *Palicus*, however are found in subtropical or temperate waters outside the tropics in the Mediterranean and off the northwestern coast of Africa [*P. caronii* (Roux, 1830)], the eastern coast of North America north of northern Florida and/or the eastern coast of South America south of Rio de Janeiro [*P. alternatus* (Rathbun, 1897), *P. cursor* (A. Milne Edwards, 1880), *P. dentatus* (A. Milne Edwards, 1880), *P. faxoni* Rathbun, 1897, *P. gracilis* (Smith, 1883), *P. obesus* (A. Milne Edwards, 1880)], and the Gulf of California [*P. cortezi* (Crane, 1937), *P. fragilis* (Rathbun, 1893), *P. lucasii* Rathbun, 1898 and *P. zonatus* (Rathbun, 1893)]. Most of these species, however, are also found in tropical regions (see RATHBUN, 1918; MELO, 1996).

The most widely distributed species that show a wide Indo-west Pacific distribution are inhabitants of shallow water: *Neopalicus contractus* and *N. jukesii* (Fig. 49), *Palicoides longimanus* and *P. whitei* (Fig. 50), *Crossotonotus spinipes* (Fig. 51), and *Exopalicus maculatus* (Fig. 56). Although shallow-water species are the easiest to collect, some inhabitants of deeper water also show a wide Indo-west Pacific distribution. This is the case of *Pseudopalicus investigatoris*, *P. serripes* (Fig. 52), and *Paliculus kyusyuensis* (Fig. 56). None of the Indo-west Pacific species is known to cross the East Pacific barrier. The six species of palicids found in the eastern Pacific appear to be endemics to the region.

Most species of *Pseudopalicus* (Figs 52-55), *Parapalicus* (Figs 57-58), *Miropalicus* (Fig. 59), and *Rectopalicus* (Fig. 53) show a more restricted geographic distribution, mostly along the western Pacific Ocean. This is perhaps best explained as a result of collection that has been mostly limited to these areas. Restriction to particular substrates or differences in the length of larval development or the behavior of the free-living larvae, however, may effect the geographic distribution of these species.

TABLE 5. — Depth distribution (reliable ranges only) of Indo-west Pacific palicids.

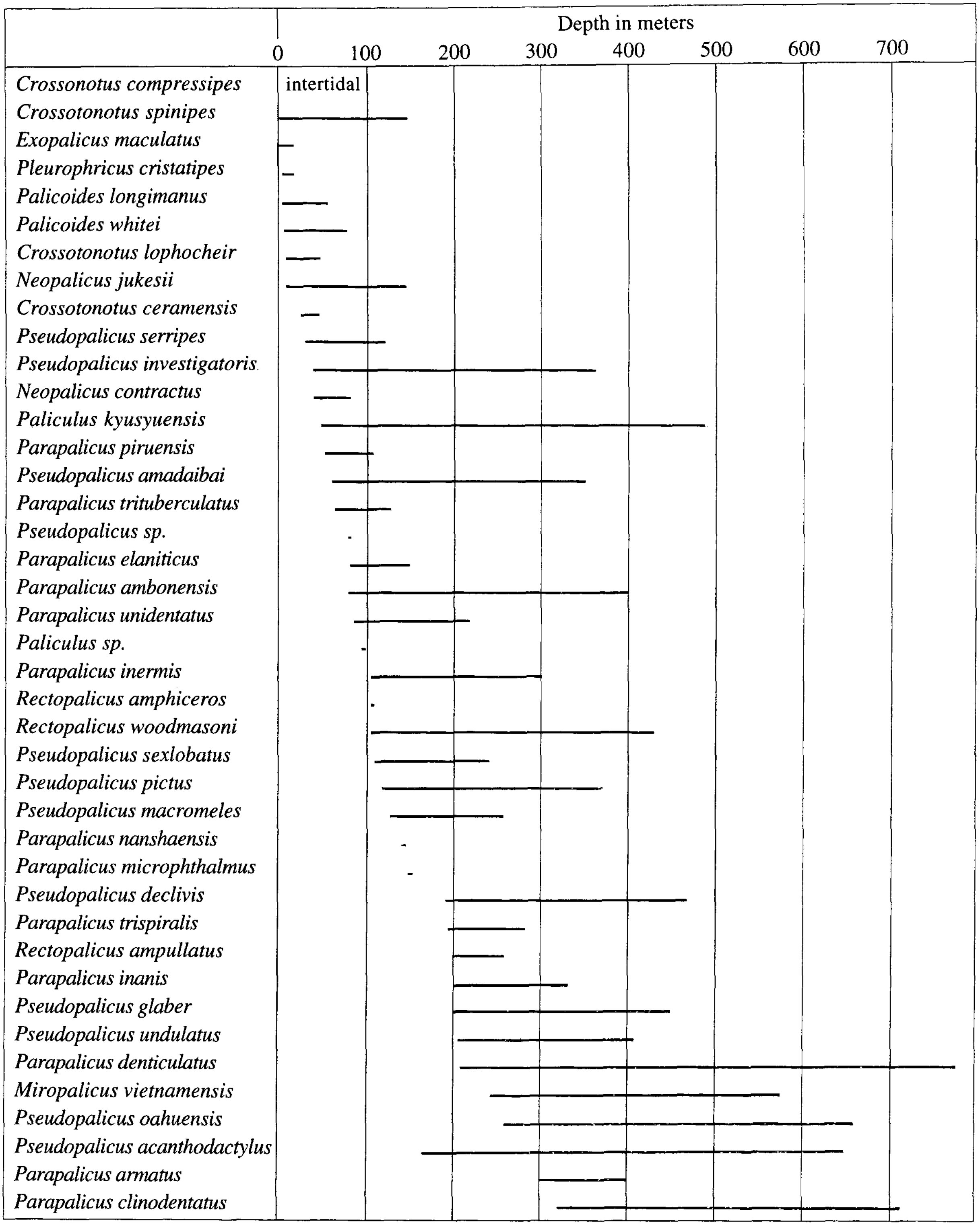

TABLE 6. — Geographic distribution of Indo-west Pacific palicids.

	Red Sea	Seychelles	SW Indian Ocean	Maldives	NE Indian Ocean	W Australia	South China Sea	Japan	Philippines Is	Indonesia	Papua New Guinea	NE Australia	SE Coral Sea (1)	Fiji	Wallis and Futuna Is	Samoa	Marshall Is	Hawaiian Is	French Polynesia
Crossotonotus ceramensis										●									
Crossotonotus compressipes								●		●	●	●	●			●			
Crossotonotus lophocheir													●						
Crossotonotus spinipes	●	●	●		●		●	●		●	●	●	●	●				●	
Exopalicus maculatus			●															●	
Miropalicus vietnamensis							●			●			●						
Neopalicus contractus		●	●	●	●				●				●				●		
Neopalicus jukesii	●		●	●	●		●		●	●	●	●	●						
Palicoides longimanus								●		●			●				●		
Palicoides whitei	●	●	●		●			●		●		●	●						
Paliculus foliatus													●						
Paliculus kyusyuensis			●					●		●			●		●				
Paliculus sp									●										
Parapalicus ambonensis					●					●			●		●				
Parapalicus armatus													●						
Parapalicus clinodentatus													●	●					
Parapalicus denticulatus													●						
Parapalicus elaniticus	●		●																
Parapalicus inanis													●						
Parapalicus inermis														●					
Parapalicus microphthalmus			●																
Parapalicus nanshaensis							●												
Parapalicus piruensis									●	●			●	●					
Parapalicus trispiralis									●				●						
Parapalicus trituberculatus							●			●									
Parapalicus unidentatus							●			●									
Pleurophricus cristatipes										●		●							
Pleurophricus longirostris										●									
Pseudopalicus acanthodactylus													●						
Pseudopalicus amadaibai								●	●	●			●	●					
Pseudopalicus declivis									●	●			●						
Pseudopalicus glaber													●						
Pseudopalicus investigatoris			●		●	●	●	●	●				●	●				●	
Pseudopalicus macromeles						●													
Pseudopalicus oahuensis										●		●	●					●	●
Pseudopalicus pictus													●						●
Pseudopalicus serripes		●			●			●		●		●	●		●				
Pseudopalicus sexlobatus			●																
Pseudopalicus sp.								●											
Pseudopalicus undulatus								●	●	●			●	●					
Rectopalicus amphiceros													●						
Rectopalicus ampullatus													●		●				
Rectopalicus woodmasoni					●		●	●		●			●						
Total number of species	4	4	10	2	8	2	8	11	9	20	3	7	29	7	4	1	2	4	2

(1) SE Coral Sea includes New Caledonia, Loyalty Is, Chesterfield Is, Vanuatu.

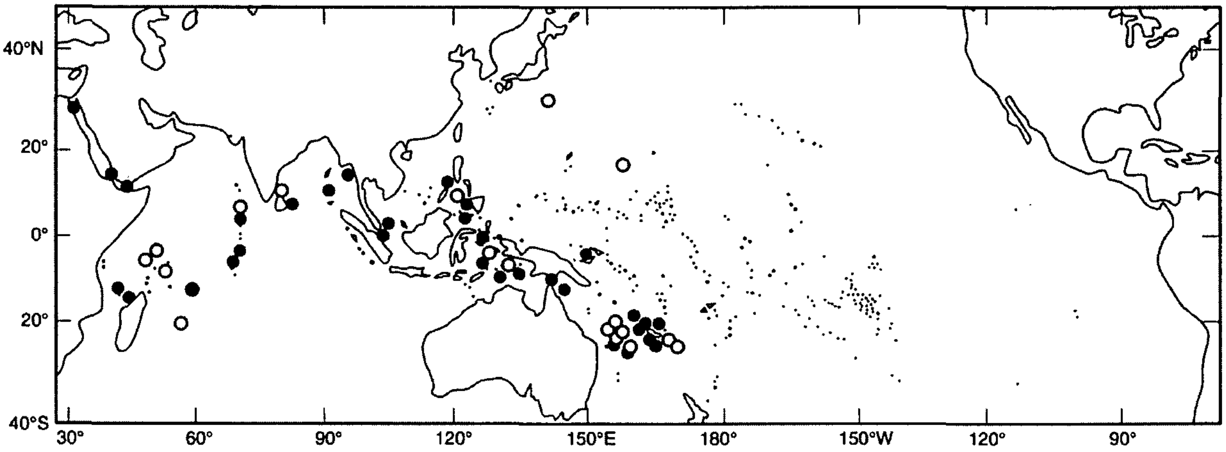

FIG. 49. — Geographic distribution of (○) *Neopalicus contractus* (Rathbun, 1902) and (●) *N. jukesii* (White, 1857).

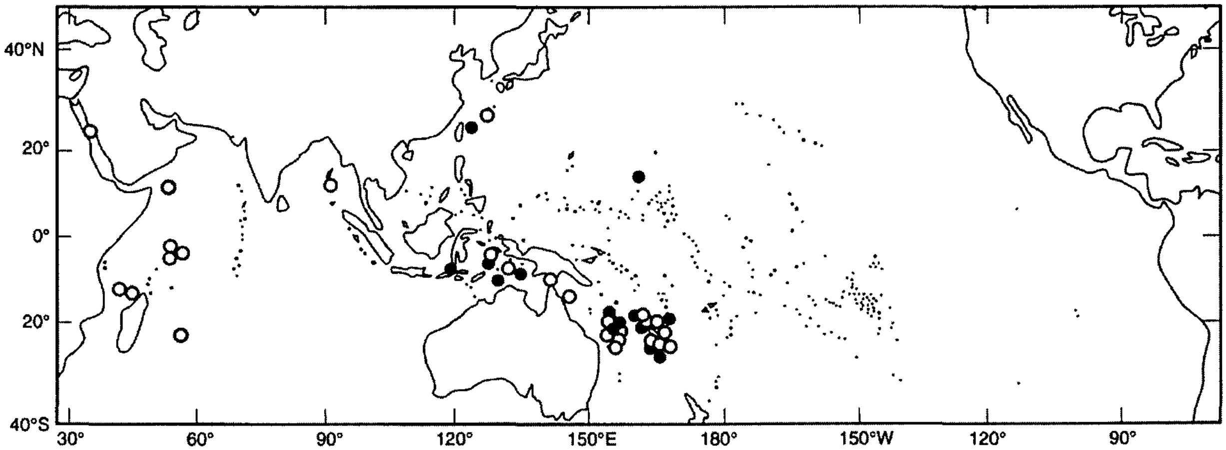

FIG. 50. — Geographic distribution of (●) *Palicoides longimanus* (Miyake, 1936) and (○) *P. whitei* (Miers, 1884).

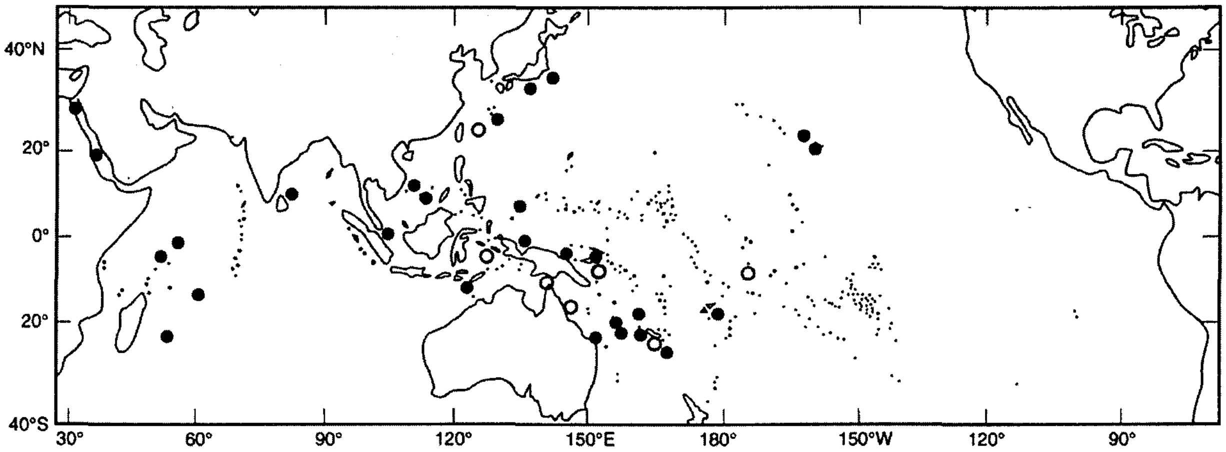

FIG. 51. — Geographic distribution of (●) *Crossotonotus spinipes* (De Man, 1888) and (○) *C. compressipes* A. Milne Edwards, 1873.

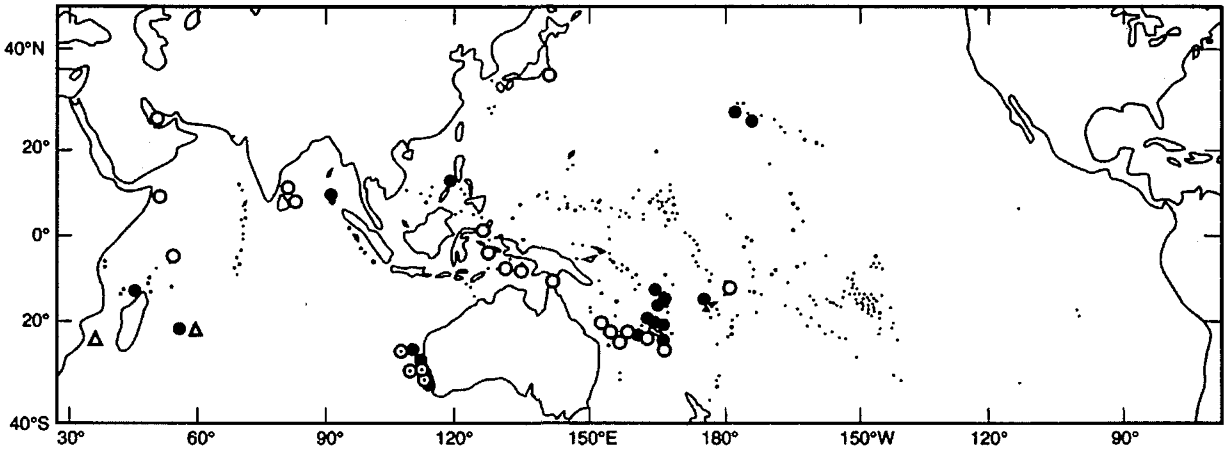

FIG. 52. — Geographic distribution of (●) *Pseudopalicus investigatoris* (Alcock, 1900), (⊙) *P. macromeles* sp. nov., (○) *P. serripes* (Alcock & Anderson, 1895), and (△) *P. sexlobatus* (Kensley, 1969).

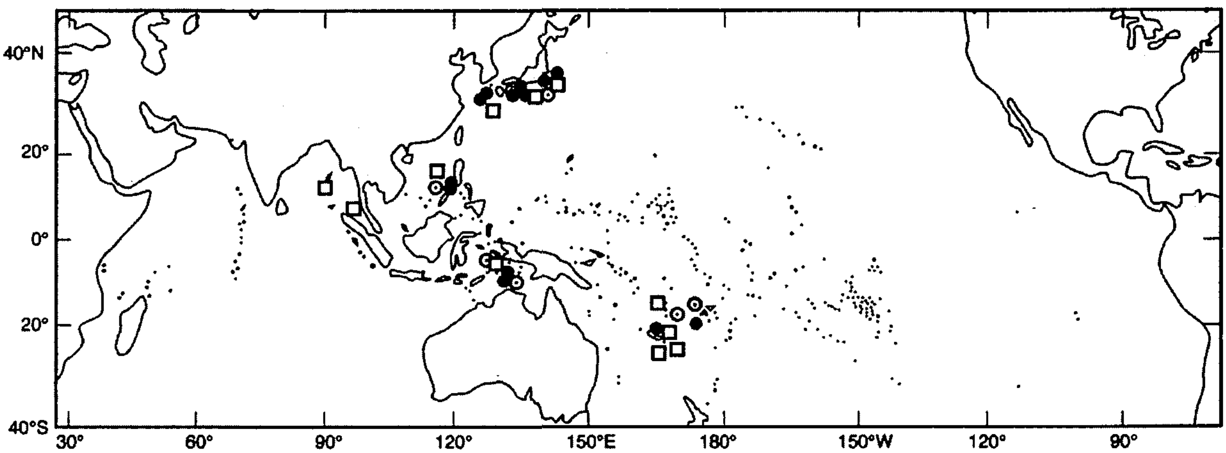

FIG. 53. — Geographic distribution of (●) *Pseudopalicus amadaibai* (Sakai, 1963), (⊙) *P. undulatus* sp. nov., and (□) *Rectopalicus woodmasoni* (Alcock, 1900).

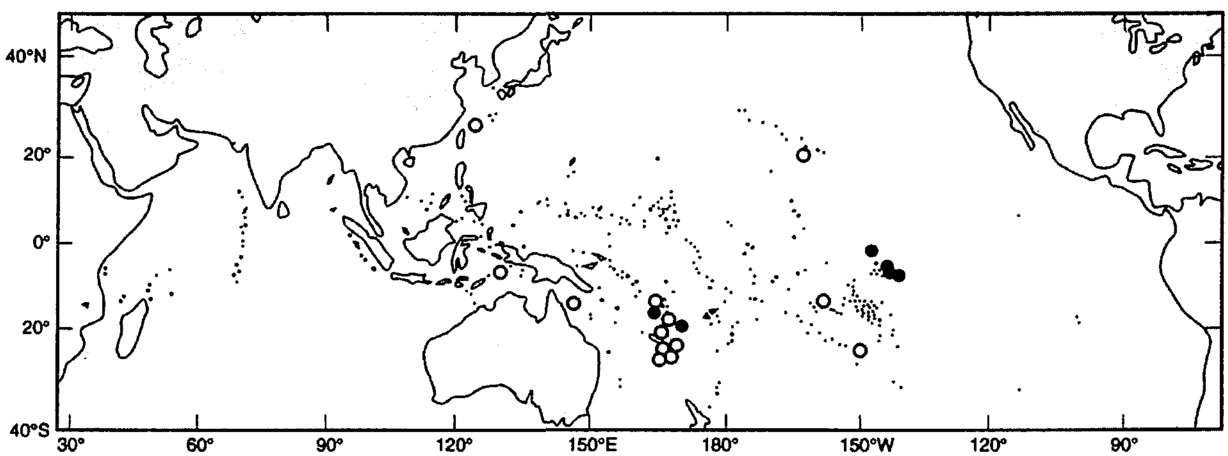

FIG. 54. — Geographic distribution of (○) *Pseudopalicus oahuensis* (Rathbun, 1906) and (●) *P. pictus* sp. nov.

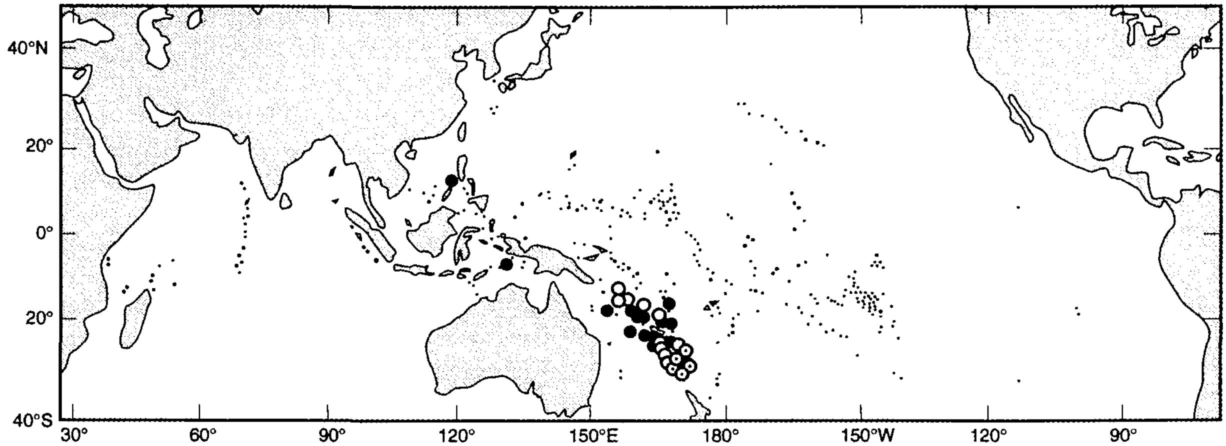

FIG. 55. — Geographic distribution of (⊙) *Pseudopalicus acanthodactylus* sp. nov., (●) *P. declivis* sp. nov., and (○) *P. glaber* sp. nov.

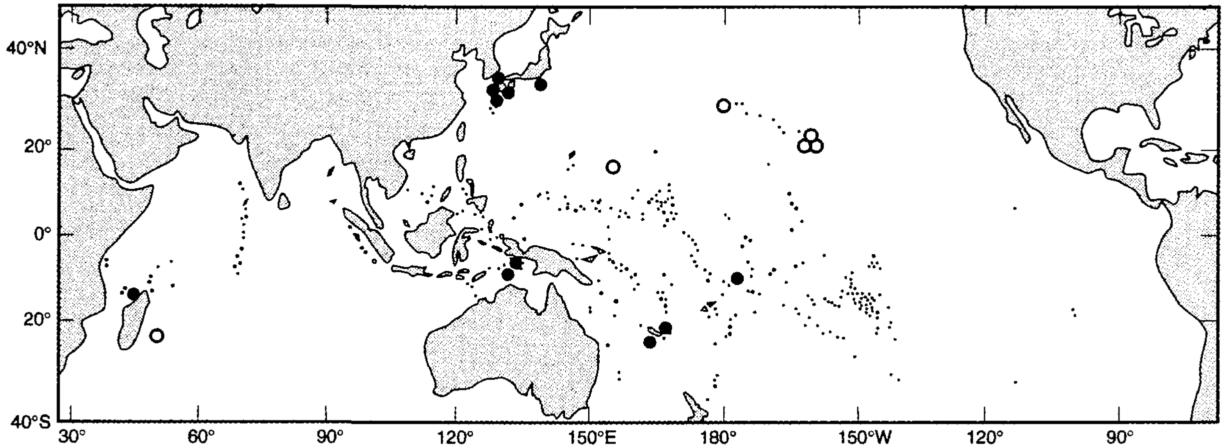

FIG. 56. — Geographic distribution of (●) *Paliculus kyusyuensis* (Yokoya, 1933) and (○) *Exopalicus maculatus* (Edmondson, 1930).

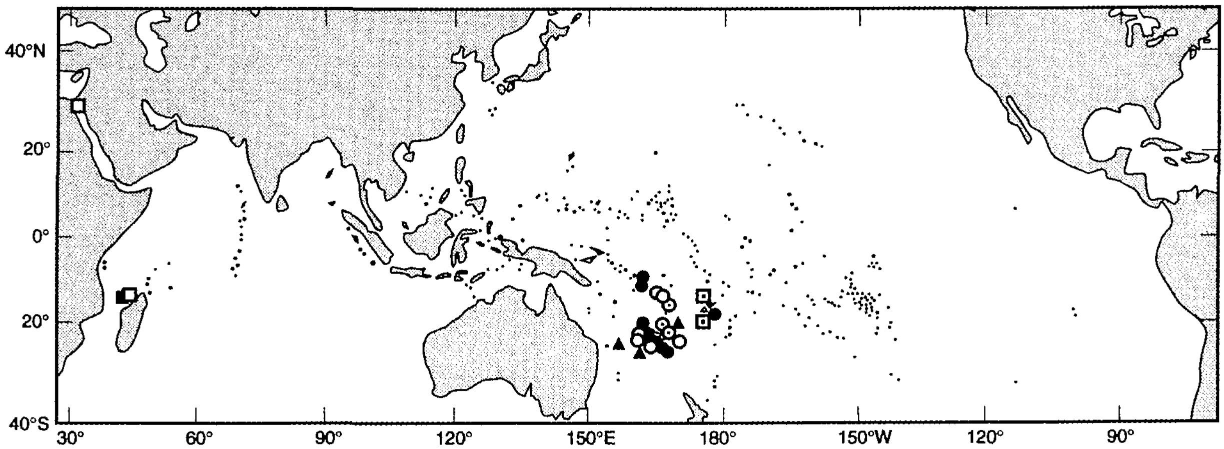

FIG. 57. — Geographic distribution of (⊙) *Parapalicus armatus* sp. nov., (●) *P. clinodentatus* sp. nov., (○) *P. denticulatus* sp. nov., (□) *P. elaniticus* (Holthuis, 1977), (▲) *P. inanis* sp. nov., (□) *P. inermis* sp. nov., and (■) *P. microphthalmus* sp. nov.

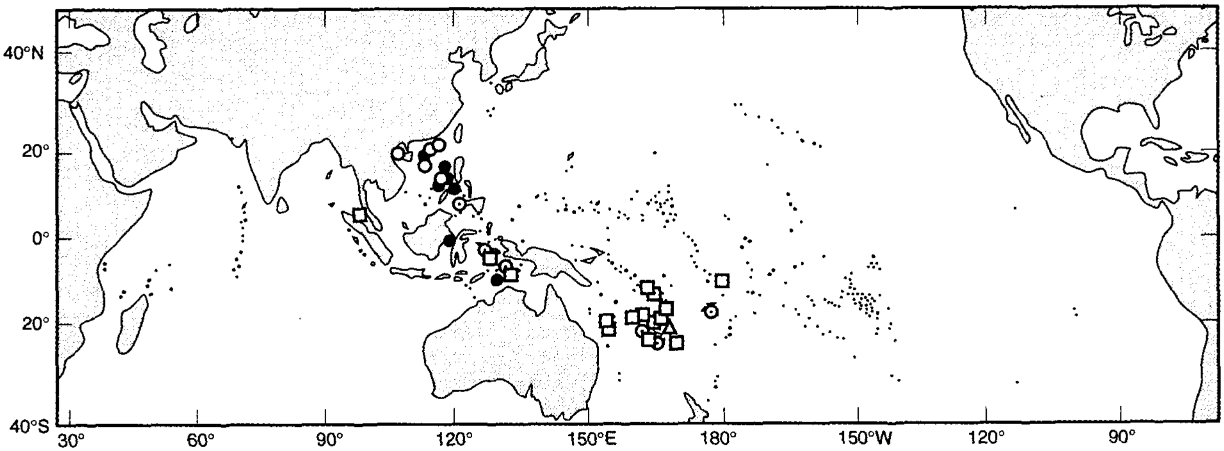

FIG. 58. — Geographic distribution of (□) *Parapalicus ambonensis* sp. nov., (⊙) *P. piruensis* Moosa & Serène, 1981, (△) *P. trispiralis* sp. nov., (○) *P. trituberculatus* (Chen, 1981), and (●) *P. unidentatus* (Zarenkov, 1968).

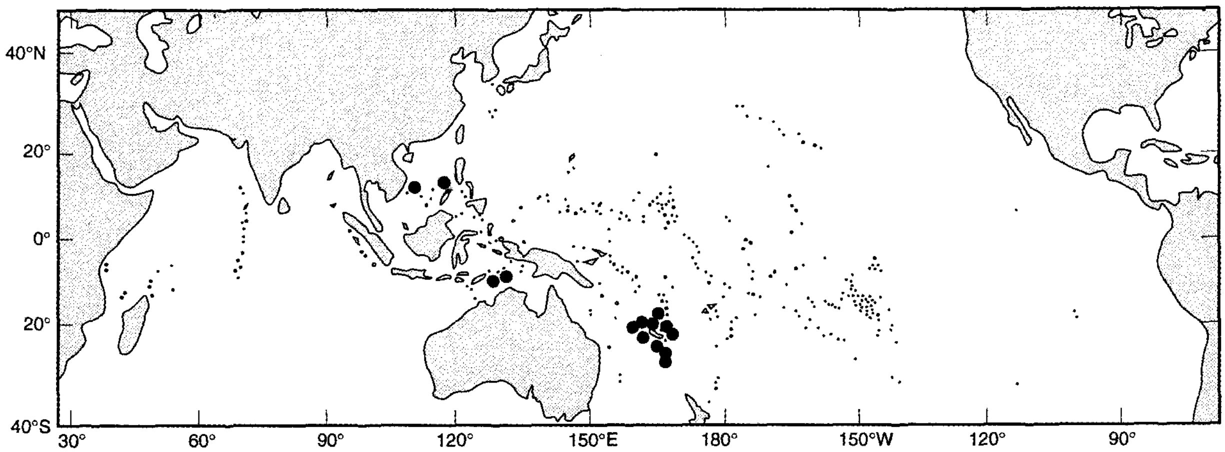

FIG. 59. — Geographic distribution of (●) *Miropalicus vietnamensis* (Zarenkov, 1968).

DIET. — Casual analyses of stomach and intestinal contents showed that palicids ingest sediment and digest particulate organic matter in it. This applies to inhabitants of soft sediments as well as those assumed to live on hard substrates such as *Exopalicus maculatus* and *Crossotonotus spinipes*.

SEXUAL DIMORPHISM AND MATING BEHAVIOR. — The presence of more unequal and much thicker or longer chelipeds in the males of many species plus the conspicuous presence of setae on the inner, distal surface of male chelipeds in six Indo-west Pacific species (*Pseudopalicus serripes*, *Exopalicus maculatus*, *Neopalicus jukesii*, *Palicoides longimanus*, *P. whitei*, and *C. spinipes*) suggests the role of chelipeds in mating behavior. The sinuous ridges found along the ventral border of the largest cheliped in the males of *C. spinipes* were suggested to serve as a stridulating structure by RATHBUN (1911: 241).

ROLE OF THE FIFTH PAIR OF PEREOPODS. — The biological significance of the reduced and slender fifth pair of pereopods characteristic of members of the subfamily Palicinae remains a mystery. The structure of the reproductive system of palicids is one characteristic of the less primitive families of Brachyura so that reduced P5 should not be considered a primitive, less specialized character.

No observations have been made of the behavior of the P5 in live palicids. There are no differences in the morphology or size of the fifth pair of pereopods between males and females so they do not appear to be involved in mating behavior. It can be hypothesized that they may be involved in cleaning the carapace and/or other appendages. The joints of the P5 are unusually mobile, and the shortening of the articles certainly increases the overall flexibility of the appendage. The movement of the various joints alternates between the dorsoventral and antero-posterior planes beginning with the dorsoventral plane of movement of the sternal-coxal articulation. The total length of the P5 is surprisingly similar in most of the species that were examined, varying between 0.7-0.9 CL with very few exceptions. This length would be just enough to reach the orbits and clean them of debris. The same relative length of the P5, however, also applies to members of the subfamily Crossotonotinae, where the P5 are broad and appear to be locomotory in function. The dactyli of P5 among members of the subfamily Palicinae are variously provided with short teeth and/or setae, typically of the simple type. Only the rows of thick, bristle-like spines that are present along the posterior border of the propodi in *Neopalicus* and *Palicoides* offer a potentially efficient cleaning surface.

WICKSTEN (1986: 365) suggested that the reduced P5 of palicids, retroplumids, and pinnotherids may be involved in climbing in burrows or in cleaning the carapace. There is no evidence that palicids are borrowers, although this remains a possibility. Nevertheless, the suggested involvement of the P5 in the cleaning of the carapace is not supported by the frequent presence of sediment or polychaete tubes on the carapace and even around the eye (Fig. 12e).

The absence of chelate or subchelate dactyli does not preclude their use in actively carrying another organism or object. Carrying behavior in many brachyurans, however, involves modified appendages unlike those of palicids (see GUINOT *et al*, 1995). There is unfortunately no evidence of carrying behavior among palicids with reduced P5. It is possible, however, that individuals carry shells or fragments of shells that are lost during collection.

Although still reduced in size, the P5 of members of the subfamily Crossotonotinae have the same morphology and insertion to the carapace as the anterior walking legs. All members of the subfamily (species of *Crossotonotus* and *Pleurophricus*) appear to be restricted to hard substrates so in these species the P5 are adapted, possibly secondarily, to an ambulatory function. Nevertheless, the P5 of *Exopalicus*, which also appears to be restricted to hard substrates, remain slender as in the inhabitants of soft substrates.

Another possible explanation for the reduction in the size of the P5 is that they have no specific function. They may thus represent vestigial structures, at least in the Palicinae. An analogous reduction in the size of the P5 is observed among brachyuran crabs of the families Hexapodidae and Retroplumidae. The affinities between palicids and these two families remain unknown.

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FIGURE 60

a, *Pseudopalicus acanthodactylus* sp. nov., ♂ holotype, 8.9 x 10.5 mm, Norfolk Ridge, south of New Caledonia, SMIB 8, stn DW 146, 514-522 m (MNHN-B 26672): dorsal view. Photo by J.-L. MENOU, IRD.

b, *Pseudopalicus glaber* sp. nov., ♀ 8.4 x 10.6 mm, off southeast coast of New Caledonia, SMIB 4, stn DW 57, 260 m (MNHN-B 26812): dorsal view. Photo by P. LABOUTE, IRD.

c, *Pseudopalicus oahuensis* (Rathbun, 1906), juvenile ♀ 8.2 x 10.7 mm, Norfolk Ridge, south of New Caledonia, CHALCAL 2, stn DW 75, 600 m (MNHN-B 26813): dorsal view. Photo by P. LABOUTE, IRD.

d, *Pseudopalicus investigatoris* (Alcock, 1900), ♀ 11.7 x 14.5 mm, Vanuatu, MUSORSTOM 8, stn CP 1077, 180-210 m (MNHN-B 26746): dorsal view. Photo by J.-L. MENOU, IRD.

e, *Pseudopalicus pictus* sp. nov., ♂ holotype, 8.6 x 10.4 mm, Vanuatu, MUSORSTOM 8, stn DW 1042, 200-265 m (MNHN-B 26690): dorsal view. Photo by J.-L. MENOU, IRD.

f, *Miropalicus vietnamensis* (Zarenkov, 1968), Loyalty Islands, MUSORSTOM 6, stn SW 410, 490 m (lost specimen): dorsal view. Photo by P. LABOUTE, IRD.